

**TACKLING BODY
ANXIETY DURING
PREGNANCY
THROUGH FLEXIBLE
AND SUSTAINABLE
GARMENT DESIGN**

TACKLING BODY ANXIETY DURING PREGNANCY THROUGH FLEXIBLE AND SUSTAINABLE GARMENT DESIGN

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Design for the fashion System

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Maria Antonieta Sandoval

ABSTRACT

Beauty, as understood by Plato was immaterial (i.e., spiritual), eternal. However, it appears that nowadays it is the opposite. Beauty has moved from the world of ideas to the “physical world.” This shift has had an impact in the concept of human beauty, and in many contexts, it has negatively affected the overall well-being of people. Actors such as the media and the fashion industry have shaped “beautiful bodies” to almost unattainable standards by the majority of the population. What’s more, standards such as extreme slenderness have been imposed on women, who undergo processes such as diets and cosmetic surgeries to fit into these standards and mitigate the anxieties produced by their bodies.

In this thesis, we set out to investigate how these body anxieties (“body dissatisfaction”) affect a particular portion of women, pregnant women, and propose a solution to tackle this issue from the perspective of flexible and sustainable garment design. We conducted our research via several instruments: literature review, consultation with experts and user-centered research. The results lead us to a proposal that aims to convey the message to value one’s body for what it is capable of doing, rather than its aesthetics.

The final proposal is named Nawale, based on a mythological creature from meso-american folk that is capable of shapeshifting. Specifically, Nawale is a product-service system that allows pregnant women to customize garments based on their style and particular body shape. Two dresses and a support belt were designed. All the garments are adaptable to fit all the stages of pregnancy and even after giving birth. The garments are aimed to be produced sustainably and the service allows the user to choose if the product is produced and shipped by the brand, or to independently produce the garment from technical drawings provided through the service, making use of locally available materials and facilities.

Finally, we performed a final survey to understand how the proposed solution would work on pregnant women and received an overall positive response along with valuable feedback for future improvements of the project.

ABSTRACT

La bellezza, come intesa da Platone, era immateriale (spirituale), eterna. Tuttavia, sembra che oggi sia il contrario. La bellezza si è spostata dal mondo delle idee al "mondo fisico". Questo cambiamento ha avuto un impatto sul concetto di bellezza umana e, in molti contesti, ha influito negativamente sul benessere generale delle persone. Attori come i media e l'industria della moda hanno plasmato "bei corpi" secondo standard quasi irraggiungibili dalla maggior parte della popolazione. Inoltre, standard come l'estrema snellezza sono stati imposti alle donne, che si sottopongono a processi come diete e interventi di chirurgia estetica per adattarsi a questi standard e mitigare le ansie prodotte dai loro corpi.

In questa tesi, ci proponiamo di indagare su come queste ansie corporee ("insoddisfazione corporea") colpiscono una parte particolare delle donne, donne in gravidanza, e proponiamo una soluzione per affrontare questo problema dalla prospettiva di un design di abbigliamento flessibile e sostenibile. Abbiamo condotto la nostra ricerca attraverso diversi strumenti: revisione della letteratura, consultazione con esperti e ricerca incentrata sull'utente. I risultati ci portano a una proposta che mira a veicolare il messaggio di valorizzare il proprio corpo per ciò che è capace di fare, piuttosto che per la sua estetica.

La proposta finale si chiama Nawale, basata su una creatura mitologica del popolo mesoamericano capace di mutare forma. Nello specifico, Nawale è un sistema prodotto-servizio che permette alle donne in gravidanza di personalizzare i capi in base al loro stile e alla particolare forma del corpo. Sono stati progettati due abiti e una cintura di sostegno. Tutti i capi sono adattabili a tutte le fasi della gravidanza e anche dopo il parto. I capi mirano ad essere prodotti in modo sostenibile e il servizio consente all'utente di scegliere se il prodotto è prodotto e spedito dal marchio, oppure di produrre autonomamente il capo da disegni tecnici forniti attraverso il servizio, avvalendosi di materiali e strutture disponibili localmente.

Infine, abbiamo eseguito un sondaggio finale per capire come la soluzione proposta avrebbe funzionato sulle donne in gravidanza e abbiamo ricevuto una risposta complessivamente positiva insieme a un prezioso feedback per futuri miglioramenti del progetto.

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CHAPTER ONE INTRODUCTION AND THESIS PURPOSE

1



INTRODUCTION
THESIS PURPOSE

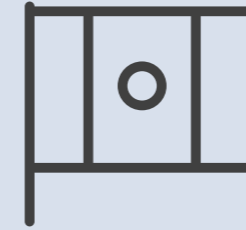
The concept of body image has changed throughout history. Depending on the culture and globalization taste, the idea of beauty is altered. Currently, there exists the idea that the body needs to be perfect and extremely thin. These characteristics are denoted with good adjectives and as qualities, and anyone who does not follow these standards is considered a failure and out of control. The standardization of beauty promoted by the media and the fashion system has brought serious consequences for women's mental and physical health. This thesis aims to develop a solution from the point of view of fashion to reduce the anxiety problems promoted by the current production system. In the following chapters, the importance of the subject will be explained, as well as the methodology that has been followed to develop the solution and the objectives that are intended to be achieved with the design idea.

1.1

IMPORTANCE OF THE TOPIC

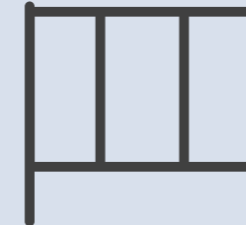
Plato believed that when a person refers to the human body as beautiful, people refer to the incarnation, an invocation to the surface of its being, and not only the body. However, today the opposite happens. **The concept of beauty currently looks weak and disfigured.** It is a constant repetition developed for reproducibility on the market. Alberto Abruzzese (2012) argues that the concept of beauty is a pale memory of what philosophers previously proclaimed. Now it is expressed as something **abundant with a lack of meaning. The concept of beauty is reduced to an image.** This classification also alludes to positive and negative qualities that people adopt as a norm and can cause physiological and physical problems such as **bulimia, anorexia, and low self-esteem (figure 1).**

Body image is a person's perceptions, thoughts, and feelings about his or her body (Grogan, 2016). The problem is born when people do not feel good



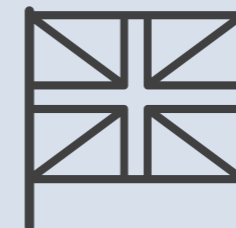
In Mexico, there are 22 thousand annual cases of eating disorders. They affect women more than men, in a ratio of nine to one (Camara de diputados LXV legislatura, 2019).

In the last 20 years, anorexia and bulimia problems in girls, adolescents, and women have increased 300 percent in Mexico (Camara de diputados LXV legislatura, 2019).



The incidence of anorexia nervosa is estimated for women in at least 8 new cases per 100,000 people in a year in Italy (Ministero della Salute, 2017).

The incidence of bulimia nervosa is estimated at least 12 new cases per 100,000 people, in one year for women in Italy (Ministero della Salute, 2017).



One in five adults (20%) felt shame, just over one-third (34%) felt down or low, and 19% felt disgusted because of their body image in the last year in the UK (Mental Health Foundation, 2019).

Just over one-third of adults said they had ever felt anxious (34%) or depressed (35%) because of their body image in the UK (Mental Health Foundation, 2019).

Just over one in five adults (21%) said images used in advertising had caused them to worry about their body image in the UK (Mental Health Foundation, 2019).

Just over one in five adults (22%) and 40% of teenagers said images on social media caused them to worry about their body image in the UK (Mental Health Foundation, 2019).

Figure 1: Mental and physical health problems caused by body dissatisfaction on Mexico, Italy and UK

about their appearance. **Body dissatisfaction** is a person's negative thoughts and feelings about his or her body (Grogan, 2016). It refers to the perceptions people have of their physical appearance and the emotions caused by these perceptions. Body dissatisfaction happens by the tendency to promote a beauty standardization that is unattainable by most of the population. The media and society promote the idealization of slenderness and beauty portrait and stipulate that everything that manages to look like those beauty standards is good. On the contrary, everything that does not adhere to these standards is linked to laziness, lack of willpower, and being out of control (Grogan, 2016).

Women are the most affected by this problem. In their research, Marion Kostanski et al. (1998) found that **women showed lower self-esteem than men caused by bad feelings about their bodies**. The article also points out that **women perceive themselves as sizes larger than their ideal figure** in contrast with men. Nickie Charles and Marion Kerr (1986) carried out a series of 200 interviews with women about their attitudes and experiences of dieting and satisfaction with their current bodies. All women presented dissatisfaction with their bodies because all of them had an idealized beauty benchmark that they wanted to achieve. In another interview, a study made by Sarah Grogan et al. between 1994 and 1996 shows that women have more difficulty describing good things about their bodies than expressing their discontent with body parts that they do not like.

The objectification theory suggests that body dissatisfaction in women happens because women's bodies are socially construct-

ed as objects to be watched and evaluated (Grogan, 2016). Women's bodies are used to promote and humanize products. This is very evident in all the advertising and the media around the world. Additionally, women's bodies tend to be represented by a tubular and thin shape. Media advertising promotes the idea that body shape and size are adaptable, and that achieving being thin is easy (Monro & Huon, 2005). **There exists a specific correlation between the frequency in which women watch media portrayed and read diet articles and the desire that they have to change their weight and shape** (Monro & Huon, 2005). Ferguson (1985) argued that this kind of advertising changes women's perception of themselves by teaching them socially acceptable ways in which they should behave.

Body dissatisfaction affects women during all their lives, including pregnancy. Even in the process of pregnancy, women face social comparisons and media messages that make them feel bad about their looks. The loss of confidence in pregnancy is generated by a strong social comparison created by the media and the friends and family nucleus. Yummy Mummy is a popular trend that generates stress for women to come back to their pre-pregnancy bodies after the birth of a baby. The trend relates the figure and size of the body with being good versus a bad mother (Malatzky, 2017). This trend claims that the postpartum body must be the same or better than before (O'Brien, 2011). The Yummy Mummy standardization is unachievable for most women because it requires an investment of money, time, and energy, which are difficult to have during pregnancy and when raising a child. The social nucleus of pregnant women also has a strong influence on

the generation of body dissatisfaction. The "Fat talk" is the dialogue between family and friends where the body is despised. Engaging in Fat talk can produce depression, eating disorders, and other anxieties. These can have serious and negative consequences for the health and well-being of the mother as well as for the newborn. Rachel Dryer et al. (2020) in their study found that pregnant women are not exempted from this type of conversation. Women continue to experience the sociocultural pressure for thinness and perfection even when they cannot control the changes in their bodies.

Fashion and brands have contributed to the generation of body dissatisfaction. **Women express that they feel pressure to change their figure and be slim because the fashion industry only makes clothes for small sizes, so if they want to look fashionable and chic, they need to be thin** (Grogan, 2016). In the fashion industry, the **size variation of clothes has a strong impact on the perception of the body for consumers**, because even when people know that these sizes are not reliable and well-proportioned for different kinds of bodies, they still use them as a mark for weight gain. This makes them feel extremely unhappy when the clothes do not fit well (Grogan, 2016). On pregnancy, clothes can represent a way in which pregnant women can practice control about their own body. However, the standardization of the sizes in the fashion industry makes pregnant women have problems finding the right clothes. Ogle et al. (2013) in their study found that fashion maternity clothes were considered expensive, ugly, and unattractive. **This caused anxiety in women because, the clothes in the market symbolized someone that they did not want to**

be associated with. Moreover, expressed on the study that it was very hard to find maternity clothes that fit well to their bodies in every stage of the pregnancy. They had to accept what the market offered to their bodies. This caused them a big unhappiness related to their appearance because they felt that they lost control over their bodies.

This thesis presents the process of a project generated to reduce body dissatisfaction in women during pregnancy. The objective was to be able to develop a product service system that can eliminate the standardization of sizes and reduce body dissatisfaction caused by clothes anxieties. The aim is to create a more inclusive service in which users can feel integrated and where the body can be revalued for what it can do and not so much for its appearance. The system wants to promote the creation of products that can be adjusted to the different stages of pregnancy, as well as the customization of the garment, so that women are in control. Once exposed the previous information and taking into account that in 2020 there were 140 million of births in the world (Global change Our world in data, 2021), and that during 2018 85% of women and 79% of girls skip important activities due to body dissatisfaction (Directory, 2021), and that most of the half of 97 women, who were pregnant and participated in the project internal survey for this thesis, indicated that they suffer body dissatisfaction. It can be concluded that this problem is present in our society, and that it is important to generate solutions that help to reduce it. In the next section the different steps (research, experiments, design proposal development) that were carried out to generate the design proposal will be explained.

1.2

THESIS METHODOLOGY

The development of the thesis contains different stages from which important information was obtained for the creation of the Nawale project. Each stage was divided into **nine chapters that goes from the literature review, to the testing and validation of the proposal.** In Chapter 2 **“Standardization of Beauty, body image”** a literature review on books, magazines, articles, web pages, among other materials was conducted on the topic of **beauty, body image, body positivity, and body dissatisfaction**. It was discovered that body dissatisfaction is a problem that affects women from the age of eight throughout their entire life. Throughout history, the implementation of stereotypes of beauty have pigeonholed a woman’s body as an object. This brings several problems related to mental health, which can generate anxiety and health problems. Women seek to achieve a stereotype of beauty imposed by society and advertising, because the concept of beauty is related to good adjectives and anyone who does not meet these standards is considered lazy and a failure. It was investigated also how fashion and the media have encouraged the propagation of this problem and how this has affected the clothes and accessory production by the standardization of sizes. Research has focused primarily on pregnant women, because even during pregnancy when they have a health reason to not fulfill the beauty stereotypes, they are judged and pressured to return to their previous body as soon as possible to ensure to be a good mother. Furthermore, during the literature review, the different techniques and theories applied by experts to solve the problem were investigated. It was found that body functionality is a good theory to solve the problem of body dissatisfaction in women. This theory focuses the attention of the women on what their bodies can do rather than their appearance. This theory works well during pregnancy because women can relate the changes in their bodies to the health of the baby.

The next step, Chapter 3, **“User-centered research.”** The research was focused on collecting the experiences of mothers about their process with body image during their pregnancy and after pregnancy. Also, it was important to know what methods they used to build confidence in their body, as well as their experience with maternity products offered by the current market. This section as well had the objective of knowing the methods that experts use to generate a positive image in women during this stage. What kind of techniques and materials are used and how when they apply them. **The investigation was composed of three materials and their results.** The first material included the results of two interviews with two perinatal psychologists. The second material was a survey made to **97 pregnant women** and mothers. And the third material is a survey made to clarify the results obtained from the first and second material with two body experts. The results obtained were that most women experience body dissatisfaction during pregnancy, however, less than half of the interviewed women went to the psychologist to treat these problems. What mothers usually do is physical activity, such as yoga and exercise, and look for support groups with people who are going through the same situation. In the **interviews with experts**, it was found that the best techniques to treat body dissatisfaction during pregnancy are functionality and feminist theory. Therapists apply exercises that make women’s bodies feel good, such as massages and activities such as yoga and generate a speech that empowers women and a space where women can trust and not be judged. To know how these exercises work a third survey was developed. The results showed which body part women suffer more pain, what types of massages and exer-

cise to do to relieve the pain, and the importance of exploring their bodies to produce positive feelings.

The following step, Chapter 4, **“Tech solutions and fashion transformation,”** shows a summary of relevant elements of the **state of the art**. The aim was to **discover what type of movements, technologies, and design proposal have been developed today that can help to solve the problem of body dissatisfaction during pregnancy.** In this stage of the project, the body positivity movement and how it has influenced the fashion industry to be more inclusive were examined. Furthermore, some examples of wearables projects were researched as to investigate how fashion and wellbeing could be associated. Study cases related with maternity products, body perception, and body dissatisfaction were collected. In this phase of the thesis, it was discovered that designers are starting to change the rules. With the help of the new technologies and the introduction of new values and ideologies, they are searching innovative ways to increase diversity in fashion. Social media opened the door to explore a varied body portrait. This brought the introduction of different physical attributes on several channels that break with the idealization of the perfect body. It also, brought the introduction of new technologies and new exploration to change the manufacturing processes. Those changes are generating a creative approach to vindication of the body. This means that the designers are establishing processes to take care of the bodies, treat them with respect and generate a diversification on the industry.

Having a broader view of what is currently happening in the market, the design in-

dustry, and the results of the user-centered research, in Chapter 5, **“Nawale, a transformable co-designed dress collection for changeable bodies”** is introduced. The thesis project proposes the design of a product service system. Which could offer adaptable products to women during pregnancy and after pregnancy. The aim is to make tailor-made products that can offer freedom of movement, comfort, and personalized style. The project intends to introduce these products through a digital customization system, which across a platform it will give users options to select their preferences, include their size and view their custom items in a virtual fitting room with their personalized avatar. In this stage the components of the proposals were explained. It was showed how these elements work and why they were selected. The presentation of the components started with the introduction of the importance to create an inclusive and sustainable system. In this part it was shown the environmental consequences of the fashion industry and the advantages of applying a **circular fashion system**. Then it was presented each element. The system is composed:

- **Zero waste concept and the Make/Use tool**, that create zero waste pattern design and permit garment personalization.
- **Virtual prototyping and Clo3D software are also used**, which allow to see the prototype, test and modified it in a quick and easy way.
- **Auxetic figures**, that make clothes more flexible and comfortable by expanding the figures.
- **Adaptable design and lacing as adjustable method**, which allow the garment to adapt to the body during the different stages of pregnancy and postpartum.

- **Distributed production and participatory design (connectors and Fablabs)**, methods that allow clothing to be assembled without the need for a sewing machine and that allow the garment to be produced around the world through a network of laboratories.
- **Laser cut technology**, which allows to produce the garment in a faster, more efficient way, tailored and with less waste.
- **Recycled materials**, materials that reduce CO2 emissions and that can be recycled constantly.
- And digital **fashion retailing (web 3.0 technologies)** tools that allow the creation of a more inclusive digital platform, which can generate customizable and tailor-made products.

Auxetic figures and connectors are elements that need further research to understand their behavior in recycled materials and laser cut machine. The next step of the thesis Chapter 6, **“Experiments on auxetic cuts and connectors” experiments and samples** on three different fabrics were made. The objective was to select the best ones to be applied on Nawale products. In this stage it was showed the process and result of the samples development. The **aim was to study their viability for the type of garment and accessories in which they are going to be applied**. Per auxetic figure five properties were studied: expandability and flexibility, aesthetic, texture, manufacturing faculty and digital behavior. These properties also were scored to find the figures that fulfill the requirements of the products and project. From eleven auxetic figures only ten structures were selected to be applied on Nawale products. On the connector side the same happened. They were tested on three different materials and four

properties were studied and scored, stretch resistance, aesthetic, manufacturing difficulty and assembly difficulty. Only eleven of nineteen connectors were selected. During the process of comparison and analysis of the two elements (auxetic figures and connectors), it was concluded that connectors have more requirements, which limit the design and product proposal to the use of specific materials with particular properties and to patterns with straight silhouettes. However, our user, pregnant women, search for more alternatives that permit them express themselves to redefine their personality and for the creation of rounded patterns to generate more space in the abdominal area. For these reasons, it was decided to offer women the two alternatives. Products made with connectors and auxetics figures, which they can produce at home, and products produced on the conventional way (at the brand workshop). These products will be designed with auxetic figures but not with connectors.

The next stage ,Chapter 7, **“Product service system design process” the product service system design process was described**. In this step it was presented the Nawale project development: product, service-platform, and branding designs. The aim was to explain the **entire process from the creation of the products to the design of the platform using the components selected on step four and the experiments results of step five**. On the design process 3 products were designed: two dresses and one belt accessory. The two dresses were born from the idea to give people the alternative to choose between the two ways of production, through a **traditional manufacture or through a networking manufacture using connectors**. The belt was born

from the idea to provide and additament to women to relief lower back pain. The accessory was thought to be produced in the two manufacturing proposals. Furthermore, the **Nawale identity** and branding was also developed. It went from understanding the user requirements and bring an unexpected and less traditional view of what it is be mother. The project intends to break the stereotype that women during pregnancy should be cute, wear pastel colors, that they should be perfect. The branding implements feminist values to help women to feel better with themselves in a funny and interactive visualization and performance. In this section, the service was also designed and the beginning of a **digital platform from which the user will have access to the products is presented**. On this platform it was contemplated the user experience design and the implementation of web technologies 3.0. The objective is to offer a democratic, inclusive, and comfortable service that help women to feel good and feel confidence on the products that they are buying.

Once the design process was developed, it arrives Chapter 8, **“Testing and validation.”** It was built a survey to **know the opinion and feedback of the user about Nawale project**. The questionnaire was sent to mothers and pregnant women. The aim of the survey was to know women’s opinions about Nawale’s service and products. To **identify what are the faults and weaknesses of the project, and base on this improve the design proposal in the future**. They were asked question about the dresses and belt design and service characteristics. These questions were complemented with images and a video. With the testing and validation steps it was possible to identify that the design of the western

dress must be rethought. Women perceived it as basic, heavy, and stiff. For the connectors it could be the best to produce a line collection based on garments that require structure as coats, jackets, blazer, or suits. The project must also explore more the strings and slots connectors and give the user the option of also personalize the interlocking systems. The project needs to offer other alternatives of color palette for the products and create a special area for materials characteristics and Fablab contact laboratories. It also needs to offer fabric as a customization property to personalize the garment and create a kit samples fabrics to send it to clients.

The steps before mentioned were the thesis methodology applied to produce Nawale project. It was important to follow each of the research sections because they give important background of the problem, other solutions that have been implemented, and technologies that can help to improve or polish the existing solutions. The product and service development steps were also important because they helped justify the project well and indicate why the implementation of these elements can help reduce body dissatisfaction in pregnant women. Finally, being able to validate the design proposal with the user helped to see the perception of women towards the product service system and to improve the proposal. In the next section the aims of the thesis and the intention of create a product service system that could help to reduce body dissatisfaction on women during pregnancy will be explained.



Figure 2: Thesis methodology

1.3

AIMS AND RESEARCH SCOPES

The aim of the project is to generate a product service system that can help to reduce body dissatisfaction and anxiety caused by fashion and clothes standardization on pregnant women. A sub-aim is to create this product service system with circular fashion approach to promote sustainable maternity products.

The thesis project proposes the design of a product service system. Which could offer adaptable products to woman during pregnancy and after pregnancy. The goal is to make tailor-made products that can offer freedom of movement, comfort, and personalized style. The project intends to introduce these products through a digital customization system, which across a platform it will give users options to select their preferences, include their size and view their custom items in a virtual fitting room with their personalized avatar. To be able to fulfill the objectives of the project different methodologies, technologies and design processes were involved.

The project includes:

- Zero waste concept and Make/Use tool, which create zero waste pattern design and permit garment personalization.
- Virtual prototyping and Clo3D software, which allow to see the prototype, test, and modified it in a quick and easy way.
- Auxetic figures, that make clothes more flexible and comfortable by expanding the figures as the body does.
- Adaptable design and lacing as adjustable method, which allow the garment to adapt to the body during the different stages of pregnancy and postpartum.
- Distributed production and participatory design (connec-

tors and Fablabs), methods that allow clothing to be assembled without the need for a sewing machine and that allow the garment to be produced around the world through a network of laboratories.

- Laser cut technology, which allows to produce the garment in a faster, more efficient way, tailored and with less waste.
- Recycled materials, fabrics that reduce CO2 emissions and that can be recycled constantly.
- And digital fashion retailing (web 3.0 technologies) tools that allow the creation of a more inclusive digital platform, which can generate customizable and tailor-made products.

The scope of the research reached the **completion of the first design proposal**. Which was subjected to a process of **testing and validation**. The results of this last stage showed that the women are enthusiastic about the product service system proposal, but some modifications will have to be made in the future.

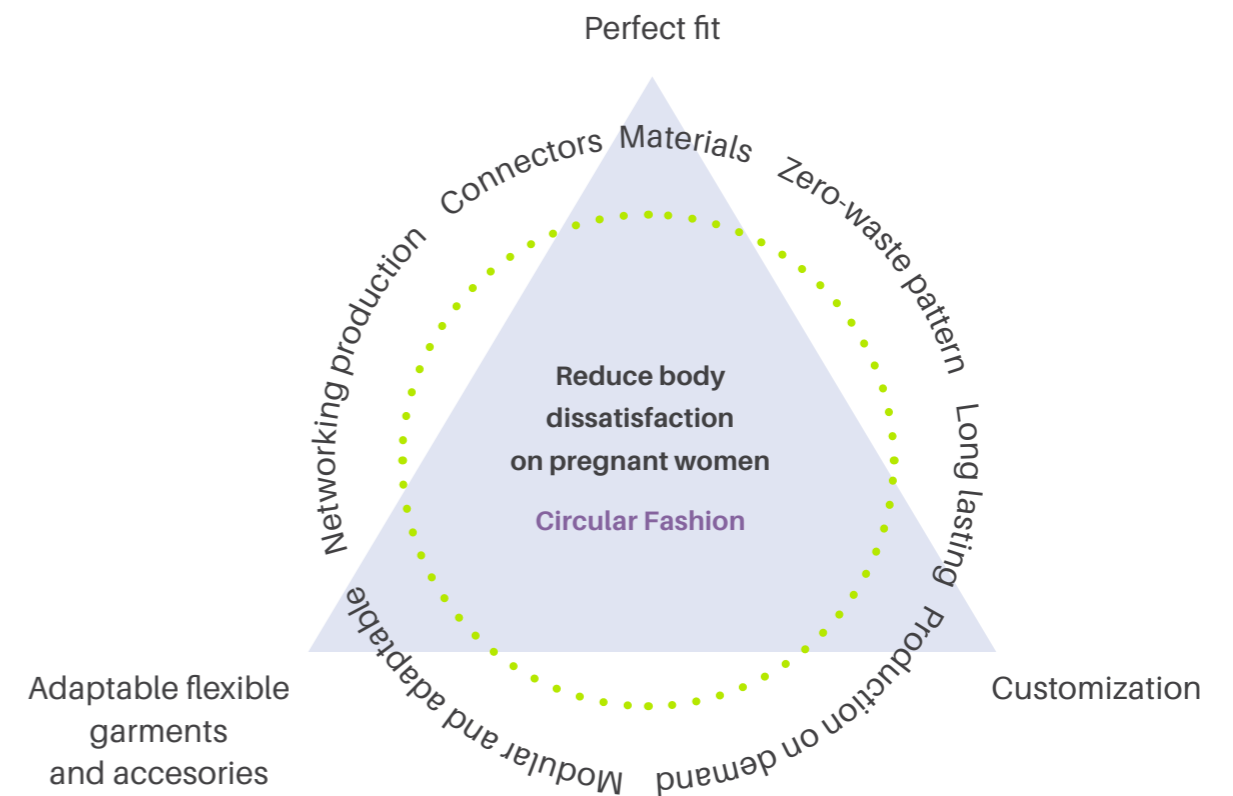


Figure 2: Aims research

CHAPTER TWO STANDARDIZATION OF BEAUTY, BODY IMAGE

2



LITERATURE REVIEW

The concept of beauty formerly known as the interiority of being, its soul, is currently reduced to an image. This image has been transformed into the physical state of the body. Society has given to the body standard characteristics of shape, weight, color, among others, that are considered perfect. These beauty standards are unreachable for most people, causing psychological and physical health problems. The person's perceptions, thoughts, and feelings about his or her body can create positive or negative emotions that can be transcribed in body positivity or body dissatisfaction. These two phenomena have been studied by psychologists to explain the behavior that people adopt when they do not reach the beauty standardization in society.

This chapter explains how these phenomena arise, the problems that they cause, how the media and fashion have influenced its appearance, and some solutions that experts have investigated to help people to reduce this problem. It is important to express that the research work is focused mainly on women, more specifically on pregnant women and new mothers. Women have more body dissatisfaction than men (Kostanski & Gullone, 1998). Specialists have found that since the age of eight years old women feel insecure about their bodies and that this feeling lasts throughout all their life (Grogan, 2016). Even during pregnancy when they have a health reason to not fulfill the beauty stereotypes, they are judged and pressured to return to their previous body as soon as possible to ensure to be a good mother (Malatzky, 2017).

Our world in Data website (Our world in data, 2021), Oxford Program on Global development informs that in 2020 there were **140 million births in the world**. This means that at least 140 million women were mothers. If it is taken into account that during 2018 in the world **85% of women and 79% of girls skip important activities due to body dissatisfaction** (Beauty schools directory, 2021). We can conclude that this problem is present in our society, and that is important to generate projects that help reduce it. Furthermore, while doing this thesis, a survey on 97 women who had experienced pregnancy indicated that more than half of them had suffered body dissatisfaction. The research can also help to create and use the same final proposed solution to be applied to people going through the liminal stage, people that go across the process of define a new personality (Noble & Walker, 1997). It also can be implemented for people with difficulty to accept their bodies, and people with special body considerations that could not find an available solution in the market.

2.1

BEAUTY

People recognize beauty in objects and abstract ideas, in nature, in art, animals, people, and actions. They use metaphors as ways to describe something that is not contained in reality but to create by their own associated potential. These metaphors are important not for the property that they express but for the experience that they are reflecting. Plato and Plotinus described **beauty like the ultimate value**. Something that people pursue for their own sake and for the pursuit of which no further reason needs be given (Scruton, 2011). For Plato and Plotinus beautiful value justify people's inclinations, beliefs, and desires. So, to find the meaning of beauty it is necessary to study the sentiments and experiences of people rather than the physical environment.

People assign the word beautiful to things that they enjoy or find attractive. However, a person cannot judge something to be enjoyable if other person tells him that it is enjoyable, they need to live it or experience it. This means that the judgements of beauty are related with the individual taste and maybe this taste has not a rational foundation. Since the taste depends on each person and this could differ for one to another, how can people say that something is superior to another when comparative judgements merely reflect the taste of the ones that are making them. As a result, anything assigned with the word beau-

ty can be rejected without contradiction. Furthermore, it should be considered that the judgements of value tend to be comparative. When people judge something based on the word beauty, they frequently are offering a rank. The highest form. People can choose between different degrees of a single quality. However, they will always be attracted to what they consider the most beautiful. The judgement of beauty is not only a statement of preferences, but it also requires an act of attention. When the interest of the people is entirely adsorbed by a thing, they began to speak of its beauty.

Pointing something as beautiful is almost always related to people's desire to possess it. It is not a desire to do something with it or select an object for its functionality. People call something beautiful when they gain pleasure only by contemplating it, for its own sake and its presented form. Plato believed that beauty in a person inspires desire. He presents the sexual desire like a common form that involves a wish to possess what is mortal and transient. Sexual desire enslaves people and reduces their soul. The love to the meaning of beauty is a signal that people is being freed of the sensory attachment and that they begin the ascent towards the world of eternal ideas. He claimed that when a per-

son refers to the human body as beautiful, people refer to the incarnation, an invocation to the surface of its being, and not only the body. However, today the opposite happens.

The concept of beauty currently looks weak and disfigured. It is a constant repetition developed for the reproducibility on the market. Alberto Abruzzese (2012) argues that the concept of beauty is a pale memory of what philosophers previously proclaimed. **Now it is expressed as something abundant with a lack of meaning.** He claims that this happened for the philosophical invention of the aesthetic, a concept born for the public opinion and the necessity to control it. The beauty of people becomes an internal and external agreement of themselves. People started to live above the threshold of their own appearance, and they examine their bodies under the eye of society. Individuals, based on the media, build a mass culture industry that establishes the concept of beauty like a universal symbol of domination. People follow this, adopting behaviors and phrases like "it is beautiful, I like it" that bring and suggest power associations.

Moreover, the appearance of human diversity has been classified within an aesthetic order from beautiful to ugly and it is applied by the gaze of people. **The concept of beauty is reduced to an image.** This classification also alludes to positive and negative qualities. Suggesting that what is beautiful is the truth, correct and, good. Furthermore, beauty controls people's happiness. The closer beauty is to people's desire and necessities, the happier they are. To Alberto Abruzzese (2012) beauty is a fiction, a social construction, a power instrument that depends on people to exist. The beauty civilization de-

pends on the slaves that perceive physical ugliness and general inequality. These slaves can be anyone that does not fulfill the occidental canons that have perpetuated the industrial development. Such as people with physical malformations, overweight people, or pregnant women. However, Alberto Abruzzese also expresses that today with the help of new technologies a mentality change is happening, because people is exercising the corporeality of pleasure. **They are creating new virtual worlds in which the collective beauty image is losing power.**

People are creating virtual characters that do not necessary represent the standard body. This means that they have different age, personality, sex, and they are not necessarily a human figure (animals or monsters). The image still domains the human mind but now people can manipulate it to their taste. This could be a start point for a philosophical paradigm shift of beauty in our time. However, like Abruzzese mentions, the meaning of beauty is still a manipulation of people that have several consequences in the social perception of what is the correct body. This affects the quality of life of people in a huge proportion causing several disorders and anxieties. The following text explains how the modern conception of beauty affects people. How this phenomenon is studied, how it has been imposed on society, who it affects the most, and how the problems that it causes can be alleviated.

PHILOSOPHERS

Beauty = Eternal ideas , soul, ultimate value.

"When a person refers to the human body as beautiful, people refer to the incarnation, an invocation to the surface of its being, and not only the body." Plato.

TODAY

Beauty = Weak, disfigured, abundant and lack of meaning.

Aesthetic, symbol of domination

" People started to live above the threshold of their own appearance and they examine their bodies under the eye of the society" Alberto Abruzzese.

THE CHANGE

Beauty = Corporeality, creation of virtual worlds, virtual characters

New technologies + mentality change

" Collective beauty image is losing power" Alberto Abruzzese.

Figure 3: Beauty, its concept is changing

2.2

BODY IMAGE

Sarah Grogan in her book defines **body image as a person's perceptions, thoughts, and feelings about his or her body** (2016). It is how people see their bodies and feel about them. The term was originated in the work of Paul Schilder in the 1920's. He started to consider the psychological and sociological impacts that the perceptions and experiences have on the body. Before him, body image only was related with mental illness.

In the 1980's, body image psychological research was focused only on women. It was based on the clinical psychology and psychiatric work oriented on eating disorders (Grogan, 2016). However, in the mid and late 80's the concept of body image started to change bringing into consideration a broader meaning and subject of study, not only women and weight, but also shape problems.

In the 1990's the sociology of the body was established with the work of Bryan Turner that contained the term "somatic society" that tried to highlight the value of the body in the contemporary society (Turner, 1992). Body image has become a very important subject of investigation, because from it, behaviors and values that society has adopted to indicate that the body has a positive or negative way of being emanate, giving it specific characteristics in how to develop in society.

More recent studies are focused on the fat embodiment and obesity of the body, but also in the critiques of the media for the use of skinny stereotypes, fomenting the culture to be slender that produces disorders on people. Based on this body image research, several projects also started to focus on constructing a positive acceptance of the appearance promoting appreciation, and a broader conceptualization of beauty.

Sarah Grogan (2016) in her book establishes that there exist four components to measure body dissatisfaction:

- Global subjective satisfaction, referent to the evaluation of the body.
- Affect, the feelings associated with the body.
- Cognitions, the investments in appearance and belief about the body.
- And behaviors, avoidance of situations where the body could be exposed.

These four measurements can be contained in two main branches: satisfaction or **body positive image, that is when people feel comfortable and confident with the shape, proportions, and style of their bodies, and body dissatisfaction, when people do not feel good with their appearance body**. This last term is discussed in depth in the next section.

2.3

BODY DISSATISFACTION

Body dissatisfaction is a person's negative thoughts and feelings about his or her body (Grogan, 2016). It refers to the perceptions that people have of their physical appearance and the feelings caused from these perceptions. It involves discrepancy between a person's evaluations of his, her body and his or her ideal body. Body dissatisfaction is an important psychological and social problem. **It is associated with anxiety symptoms like generalized anxieties disorder, panic disorder, social anxieties disorder, and separation disorder** (Vannucci & McCauley Ohannessian, 2018). Furthermore, this syndrome is closely related to self-esteem, and it can become the individual's self-definition of people (Tiggemann, 2005).

To understand body dissatisfaction, it must be assumed that body image is a psychological phenomenon that is significantly affected by social factors (Grogan, 2016). That means that it needs to be studied from the perception of the people with their bodies and the context in which people live. Socio-cultural perspectives propose that society has a standard body that is catalogued like good and is transmitted between people and media (Grogan, 2016). In their paper, Anna Vannucci et al. (2018) point that people suffer body dissatisfaction because they feel pressure from family, friends, and media to fulfill a standardization of a body that frequently is impossible to achieve. People internalize these ideas like their personal standard and focus their self-worth on this objective. This idealization of the perfect body in society brings social comparisons and evaluation between people and promote the vigilance of the body. Moreover, the sociocultural mechanisms can worsen the symptoms of depression, poor self-esteem, and other anxieties (Vannucci & McCauley Ohannessian, 2018).

Like the text has mentioned before, society has established and standardization of beauty. People measure themselves based on these images and develop behaviors that help them to reach this desired perfection. In the following section, some of the established control behaviors will be discussed.

BODY IMAGE

Body image: person's perceptions, thoughts, and feelings about his or her body.

BODY POSITIVE IMAGE

Satisfaction or body positive image, is when people feel comfortable and confident with the shape, proportions, and style of their bodies.

BODY DISSATISFACTION

Body dissatisfaction is a person's negative thoughts and feelings about his or her body.

Figure 4: Derived from body image concept

2.4

THE IDEALIZATION OF SLENDERNESS AND BEAUTY

People have the tendency to link physical attractiveness with positive personal qualities (Grogan, 2016) **"what is beautiful is good."** This promotes that people that fit in the beauty standards can also be perceived with a higher social competence. This encourages the birth of erroneous beliefs about weight and body proportions. **The culture of the slenderness is based on the capability of people to have their bodies under control.** On one hand, being slim in the western culture is associated with good adjectives like happiness, success, youthfulness, and social acceptance. On the other hand, being fat is linked to laziness, lack of willpower and being out of control (Grogan, 2016).

Women's body have the tendency to be represented with a tubular and thin shape. Media advertising promotes the idea that body shape and size are adaptable, and that achieving being thin is easy (Monro & Huon, 2005). Some of the mechanisms in how the thin ideal is promoting are based on dieting culture. **Dieting culture** is a way of body control that have been instituted in society. There exists a strong industry that designs plans to lose weight that frequently are dangerous. This culture of dieting is a behavioral indicator of body dissatisfaction, and it is a way to try to change the body. Dieting is very popular among western women. About 95% of women in America and British countries have dieted at least once in their life (Grogan, 2016). Many of these women are in dieting cycles, which means that they lose weight by dieting for a period of two or six weeks approximately but then they regain the weight when they begin to eat normally. Diet cycles pose a risk to the physical and psychological health of the body. Many women feel guilty for not following their diets and therefore they are not satisfied with the way they look. In addition to this, **diets can represent an important damage for the body since some of them promote the bulimic-type behavior** (Ogden, C., & De La Rey, 2011).

In the culture of slenderness and beauty the concept **“toned body” can be found**, which is associated with solid and muscular idealization. This suggests that not being thin is acceptable only if the body is worked and firm (Grogan, 2016). Body tone is also promoted in the media, and it is reflected on important figures such as Jennifer Lopez, Kim Kardashian, and Beyonce. These artists are accepted by society because they invest on their bodies, and they constantly work on them. To have a strong body rather than a thin one is starting to be accepted by society. However, this message is also charged with negative and stigmatizing comments about the weight and shape of women’s bodies. The main motivation to exercise for women is to lose weight and improve muscle tone, however, many of these women abandon their exercise routine, because they are predisposed to comparing themselves with their gym mates (Pridgeon & Grogan, 2012). This is problematic because although the media promotes bodies unachievable for normal people, it is proven that exercise is beneficial to increase satisfaction with the body and better self-esteem.

The relationship between being slim and being healthy is also a form of body control. Being thin means better health. This is an argument that many biologists and doctors state as fact. However, it has been proven that many methods that are used to determine the health risk posed by overweight are not accurate or a 100% reliable (Grogan, 2016). Based on this, some authors claim that moderate overweight does not represent a significant health risk and that the concern with overweight is based on cultural prejudice. The previously stated suggests that social pressure to be slim is based more on cultural aesthetic preferences than on health concerns.

In a society that does not allow imperfections and where being young is synonymous of charm, **cosmetic surgery** aims to be a tool to fulfil unrealistic societal standards of beauty. People are turning to cosmetic surgery as a way to change the shape of their bodies. This is other way of body control. People, especially women, see cosmetic surgery as an option of measure, when exercise and diet are not enough, or only to fulfill their desirable look. It is also seen like a method to stop time and reduce aging (Slevec & Tiggemann, 2010). Cosmetic surgeries have reduced the range of bodies and types of faces considered beautiful and accepted by society. **There is a tendency to point out that the body is defective by nature, and that it needs technological reconstruction** (Grogan, 2016). Women can take this as fact, some of them argued that they want to be subjected to this process because they want to be “normal” (Davis K., 1995). The media encourage this kind of methods by showing the latest of surgical processes as well as the advertisement of the important figures that have been subjected to this type of operations. TV

shows like extreme makeover convey how easy and simple it can be to undergo this type of procedure. However, it can have severe consequences, especially if people are engaged with a low-cost surgery without the knowledge and necessary medical conditions.

The ideal body in society is the one that is under control, toned and contained, the industry says that this could be achieved through dieting, extreme exercise, and cosmetic surgery. These routines are taken by people, especially women, that want to fit in society’s appearance standards. People that follow the before mentioned tend to value appearance over any other attribute (Monro & Huon, 2005). They will do whatever it takes to be seen like active members of society, with good qualities, as not to feel rejected. Such focus on appearance results in increased body shame, low self-esteem, and appearance anxiety, especially in conditions where the body is subjected to scrutiny.

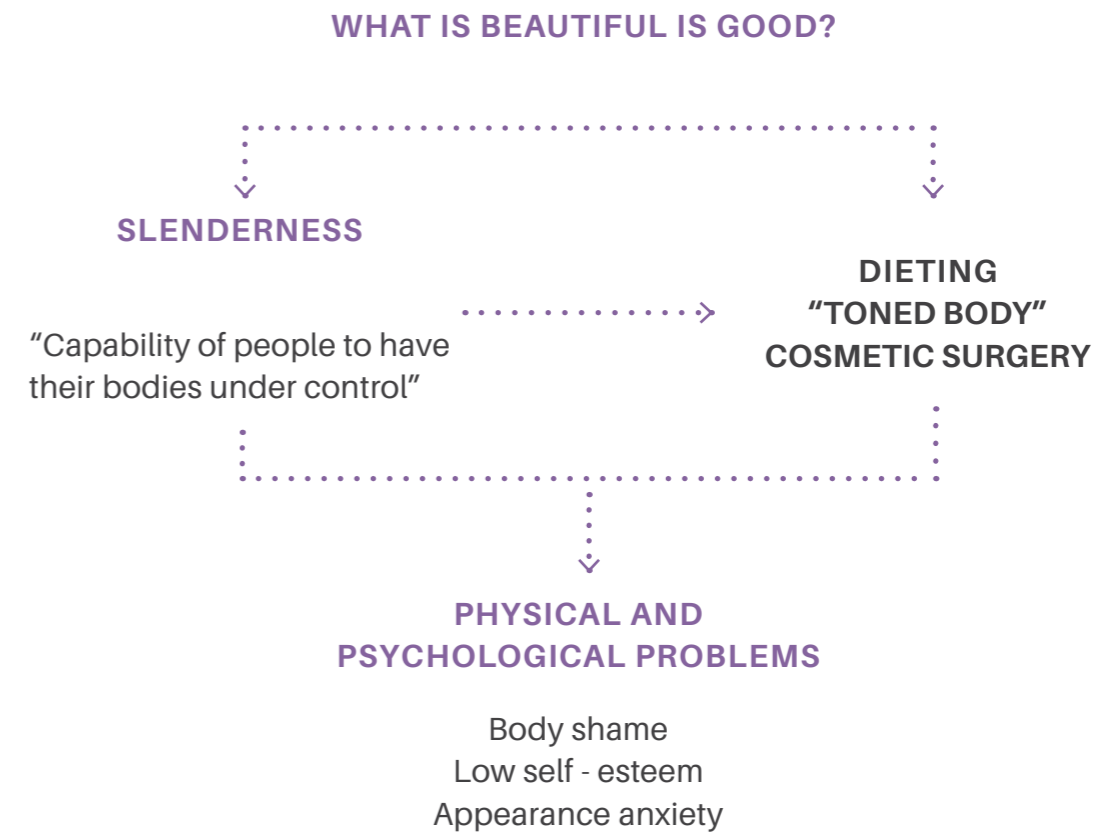


Figure 5: The idealization of slenderness and beauty

2.5

MEDIA AND BODY DISSATISFACTION

Media plays a big role in society to produce changes in the ways that the body is experienced and evaluated. (Grogan, 2016). Mass media is an influential source of messages about the idealized body. There exists a specific correlation between the frequency in which people, especially women, watch media portrayed and read diet articles and the desire that they have to change their weight and shape (Monro & Huon, 2005). Ferguson (1985) argued that this kind of advertising changes women's perception of themselves by teaching them socially acceptable ways in which they should behave.

Through time the social standards of beauty have been reflected in advertising. **The constant standard since the 20s is to represent the body of women as slim.** There exists the concept of **"thinspiration"**. The thinspiration is usually defined as the media content with words and images that show a slender appearance. This content usually promotes weight loss and exacerbates eating disorders (Laia, 2021). More recently people can also find the concept of **"fitspiration"** other kind of media designed to inspire people to attain fitness goals. **88% of thinspiration and 80% of fitspiration content contain guilt-inducing messages regarding weight of the body, fat stigmatization, presence of objectifying phrases and dieting messages** (Cohen, Irwin, Newton-John, & Slater, 2019).

The frequency of images of thin people in advertising is so huge that even in countries and regions in which slimness and body perfection was not a problem, media started to modify this feeling especially in countries that have had greater contact with western culture (Grogan, 2016). Furthermore, **media shows the body in a sexualized way with a tendency to show it as an object of desire** (Ghaznavi & Taylor, 2015). This tendency to represent women's bodies, as a sexual, thin white, and with moderate breasts (barbie doll image) can be seen around the world and it is a big influence in society's cultural be-

liefs, this standardization is associated with the grow of bad feelings about the body that produce shame and anxieties on people.

Media argued that these stereotypes are the only ones that sell products. **However, it has been found that it is attractiveness, rather than size of model what attracts people to consume products** (Halliwell, 2012), and that having average sizes can promote body positivity and secure customers with the product (Diedrichs & Lee, 2011). This is a new trend that the media is shifting to. Companies' strategies are moving to change traditional media conception of the body image, showing more image portraying diversity (Chapter 4). This will have a positive impact in society, especially in women. However, this movement is starting, and it is still limited, without mentioning that currently people are sharing more negative messages about the body in social networks.

2.6

SOCIAL MEDIA AND BODY IMAGE

Media figures, fashion models, actors, actresses etc. provide body image role models for people. This is based in a social comparison phenomenon that exists on the society. **People use the image projected by the media as standard for comparison.** However, media models are a less important standard than the peers and family if the media figure does not have similar qualities with the person (Grogan, 2016). **This means that the person must see reflected certain characteristics of him or her in the person with whom he or she is being compared to.**

The evolution of the media through the internet has transformed the way in

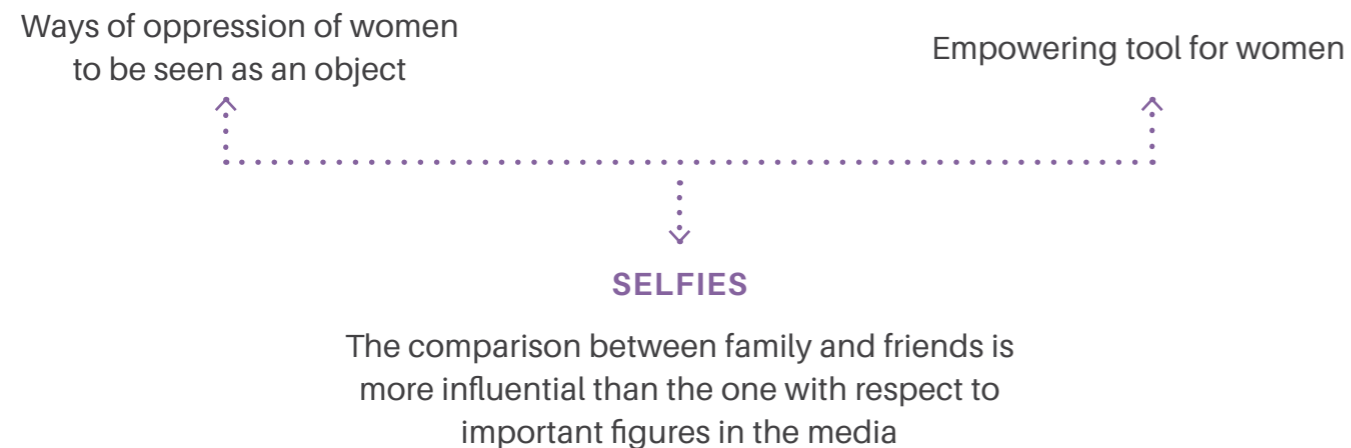


Figure 6: Two types of selfies

how body image is appreciated. It has been demonstrated that the comparison between family and friends is more influential than the one with respect to important figures in the media (Grogan, 2016). When people use social media, they are exposed to two kinds of pressure: the social, friends and family, and media advertising. This brings several bad consequences for people, especially adolescents, because it has been demonstrated that people reflect more insecurities about their bodies when they consult social networks than common media such as television (Tiggemann & Slater, 2013).

Other important thing about social media and body image are selfies. In some cases, researchers claim that selfies are other way of oppression of women to be seen as an object, as well as the distortion of the body image as a result of the filters that are made based on unrealistic beauty proportions (Tremblay, Tremblay, & Poirier, 2020). In other cases, **selfies are seen like an empowering tool for women tool because they generate diversity and give image control to real females** (Chua & Chang, 2016). In the work of Grogan

et al. (2018) about posting selfies and body image in young adult women, people expressed that “likes” on their posts increased their confidence. However, they feel pressure to post nice and coquettish images, some of them even limited themselves to put this type of content to avoid social criticism.

The culture of getting “likes” has become a peer influence or social reinforcement. This means that “likes” are comments of significant agents (media and peers) that reinforce particular attitudes and behaviors (Tiggemann, Hayden, Brown, & Veldhuis, 2018). **“Likes” are a marker of peer status and popularity.** It has been demonstrated that a big number of “likes” are related to idealized, thin and culturally attractive images. So, **“likes” are also an accepted numerical indicator of consensually determined physical beauty** (Chua & Chang, 2016). But sometimes these images reinforce the wrong standards of attractiveness. This can be very dangerous because people, in particular women, perceived the number of “likes” that they receive as direct evaluative feedback about their beauty and their self-worth.

2.7

FASHION AND MEDIA CONSTRUCTION OF THE WOMEN BODY IMAGE

The slenderness of the body of women is viewed as a product of a historical evolution, where the world of fashion and media has had great influence. In the **middle age** the **rounded stomach, big hips and breast** were considered fashionable and erotic. These characteristics were associated with fertility and health.

The slim figures were not attractive until the twentieth century approximately in the **1920s** when the fashion marketing industry started to promote a standardization of beauty through fashion magazines, and the industries introduced the standardization of sizes (Sizolution team, 2021). After the first world war **flapper** fashion appeared, showing a flat-chested figure, and dressed in a low waisted dress. Women started to hide their breasts to flat their silhouettes. Silverstein et al. (1986) in its article points that woman practiced diets and exercises to keep their bodies with adolescent’s appearance (breastless).

In the 1930s and 1940s women’s bodies

move to a more curve well-proportioned shape. The **“sweater girls”** were born and breasts became acceptable and clothes to highlight this part of the body started to appear. In the 1950s the curved body remained, and the Hollywood industry started to promote large breasts, tiny waists, and slim legs. The most obvious example of this beauty stereotype was Marilyn Monroe symbol of sexuality and empowerment of the time.

Also, in the 1950s an inclination to the slender body started to appear. It started to associate the thin figure with **sophistication** rather than sensuality. Artists like Audrey Hepburn became role models of upper classes for young women. In the 1960s the trend for slimness took root with the appearance of the fashion model Twiggy. Showing narrow hips, small breasts, and low weight. The thin ideal became symbol of youthfulness.

From the 1960s to the 1980s models became thinner. But this trend became stronger in the 1990s with the arrival of **“waif style”** that referred to models with no bust, minimal make-

up, no muscle tone, and very thin bodies (Anderson, 2021). The designers and magazine editors chose to use this extremely thin models such as Kate Moss to promote their products. This also brought the concept of "heroin chic," women who look like drug addicts. Slim with pointed body features, black eye make-up, blue lips, messy hair, was the standard of beauty that these models represented. This also was a mirror of context of the society and the fashion world in which heroin use was present (Benavent, 2021). Models like Emma Balfour and Zoe Fleischauer denounced that the world of fashion encouraged models to take stimulants to look thin and look weak.

"The skinnier and more fucked up you look, the more everybody thinks you are fabulous" (Furek, 2008).

This approach to the stylization of the body caused concern about the psychological and physical problems that could cause on the young generation. However, the slenderness stereotype was maintained in the 2000s. In the **2000s** the virtual age became stronger, with the appearance of new and accessible technology the alteration of fashion images begun. **Media started to show unrealistic bodies without any imperfection;** thin, polished bodies with smooth skin.

Currently, the pressure to show slim models without any imperfection is still evident in the mass media. However, the new cultural trend is to show models with a perfect body obtained through exercise rather than diet and harmful substances. Nevertheless, a change is also visible. There are positive initiatives that began to promote different kinds of sizes and show more diversity in beauty (Chapter 4). The Dove Movement for self-esteem campaign in 2010, and the brand Universal Standard are some examples. These initiatives try to improve the confidence of women about their own bodies and try to change the perception created by the fashion industry and

media of an idealized thin, perfect body.

It is important to mention all these previous facts to understand the context in which the body image has been constructed in society and how the alteration of the body and beauty has been present in culture throughout the stimulus of fashion and media. Even though a different perception of beauty is being built, the stereotypes of perfection and slimness are still present in the behavior of society, and they are factors that frequently cause body dissatisfaction and anxieties on people.

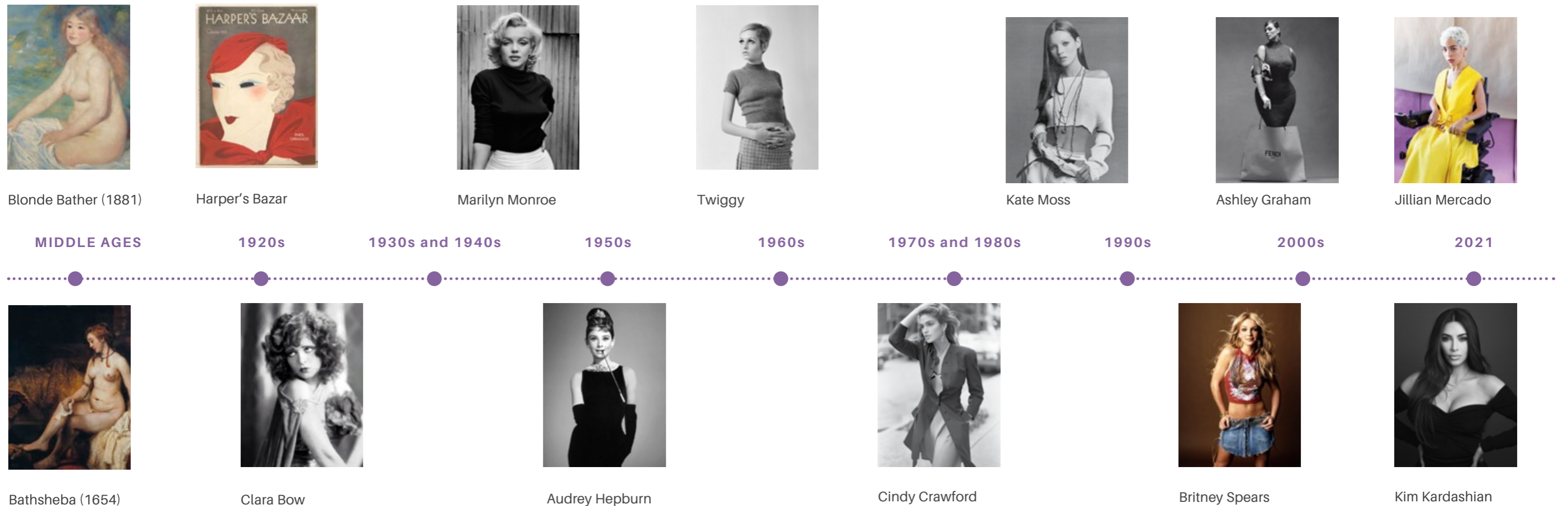


Figure 7: Portrayal of the female body

2.8

WOMEN AND BODY IMAGE

Women have been always encouraged to change their shape and weight to conform the trends through time (Grogan, 2016), because of this body dissatisfaction affects women more than men. Marion Kostanski et al. (1998) in their research found that **women showed lower self-esteem than men caused by bad feelings about their bodies.** The article also points, that women perceive themselves more sizes larger than their ideal figure in contrast with men. Methods like the self-report questionnaires and interview studies have ensured that women have a persisting body dissatisfaction from very young to very old age.

Nickie Charles and Marion Kerr (1986) carried out a series of 200 interviews with women about their attitudes and experiences of dieting and the satisfaction with their current body. All women presented dissatisfaction with their bodies, because all of them had an idealized beauty benchmark that they wanted to reach. This study also showed that women have concerns for specific parts of their bodies like the breasts (too small or too large) legs (too fat or too thin) abdomen (not flat enough) and buttocks, (too soft or too skinny), and that most of them wanted to have a slim body, not for health but for beauty.

Another interview study made by Sarah Grogan et al. between 1994 and 1996 shows that **women have more difficulty to describe good things about their body than to express their discontent with the body parts that they do not like.** The interviewed women also showed preference for a slim body and diet processes to achieve this state. They affirmed that they would feel more confident if they could lose weight. This suggested that there is a **connection between feeling confident and feeling slender in women.** These women ensure that their perfect body is **“skinny but shapely”** and that their major influences to determine their body images were actors and models. These studies have shown that women have unrealistic images of their bodies. They are in a **constant war between their body and the thoughts that are generated by social acceptance.** Even idealized perfect women present problems with their appearance. It seems that women are never satisfied, and never secure of their looks (Brownmiller, 1984).

But why has this happened? **The objectification theory suggests that women’s bodies are socially constructed as objects to be watched and evaluated** (Grogan, 2016). This means that women are taught to be commodities. People live in a consumer soci-

ety where **women’s bodies are used to promote and humanize products.** This is very evident in all the advertising and media around the world. These images also show stereotypes impossible to achieve for most of the people. Sandra Bartky (1990) in her book mentions that the fashion- beauty industry objectifies every aspect of women’s bodies. For that reason, women never feel satisfied with their image. She states that this industry creates false needs, through persuasion and psychological manipulation, and that this sector controls the conditions in how these needs must be satisfied.

This objectification of the body causes that women compare between them, and that society judges them for not fulfilling the stereotypes created by the industry; the female body is obedient to cultural demands. Women are especially susceptible to the beauty system pressure because these standards are associated with positive cultural meanings (Bordo, 2003). The objectification follows women during all their lives, even during pregnancy, where the body has a good reason for not meeting beauty standards; their bodies suffer stigmatization, causing anxieties that can be dangerous to the health of women and their newborns.

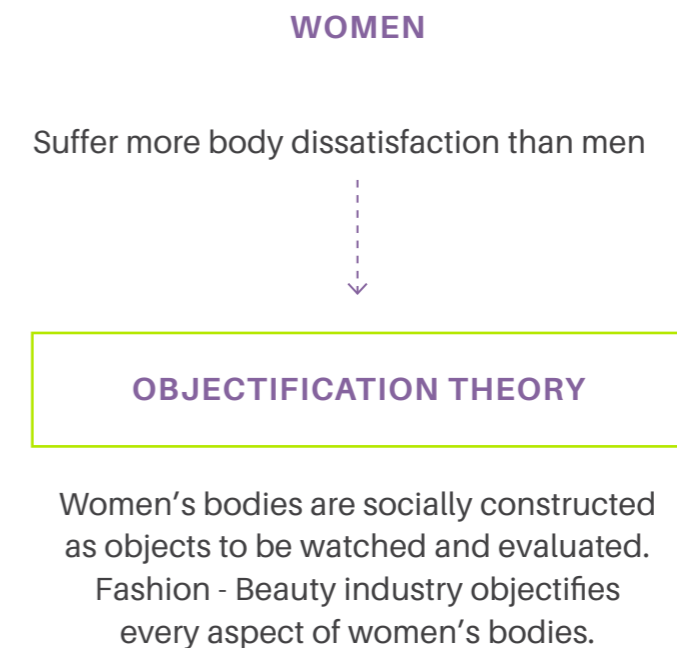


Figure 8: Women and Objectification theory

2.9

WOMEN AND BODY IMAGE DURING PREGNANCY

During pregnancy, women are vulnerable to mood and anxiety disorders due to the significant physical and emotional changes that occur during this period. Pregnancy-related anxiety is associated to the fears and worries centered around pregnancy (Bayrampour, et al., 2016). Women feel concerned about the process and health of the unborn baby. Within this disorder women can experience **poor psychological adjustment and self-care, low self-esteem, increased weight gain and nausea, and negative views of motherhood**. This also greatly influences the appearance of a postnatal depression (Westerneng, et al., 2017) and reduce the intention to breastfeed (Nagl, Jepsen, Linde, & Kersting, 2019).

One of the factors that contribute to the generation of this anxiety is body dissatisfaction. As mentioned in the previous section, women face sociocultural pressures for thinness and body perfection. Even in the process of pregnancy they face social comparison and media messages that make them feel bad about their looks. Pregnant women that continue to define their appearance based on pre-pregnancy body shape and weight have several discomforts with their bodies. This also causes that they want to come back to their old figure as soon as possible (Johnson, Burrows, & Williamson, 2004).

Sarah Earle (2003) in her study found that women indicate three main concerns in relation with their bodies. The first one is how they would look when their pregnancy began to show, where the changes in their bodies would occur and how easy would it be return to their old shape. Furthermore, women indicate that they feel more concerns about their bodies during the last trimester as compared to the onset of pregnancy and pre-pregnant phase, and that the main areas where they feel ashamed of were the breast and the stomach (Breda, Lehmann, & Arshad, 2015). But also, there exist other alterations like the stretch marks, acne, skin pigmentation and varicose veins that

cause serious problems of confidence on women when they interact with people. This loss of confidence is generated by a strong social comparison created by the media and the friends and family nucleus. **Yummy Mummy is a popular trend, that generates stress on women to come back to their pre-pregnancy bodies after the birth of a baby**. The trend relates the figure and size of the body with being a good versus a bad mother (Malatzky, 2017).

Yummy Mummy was born like a tag to describe motherhood with feminist values like female right to choose, self-sufficiency, autonomy, among others. However, media distorted the meaning and it started to associate it with post-partum thinness and body shape recovery. **This trend claims that the post-partum body must be the same or better than before** (O'Brien, 2011). The concept of **being a good mother is related with women that take care of their bodies, slim, toned, and sexy. In contrast, being a bad mother is related with personal failure, lack of self-discipline and self-control** (Malatzky, 2017). This way of thinking is created by media which limits women's views, their bodies, and identities as mothers.

The Yummy Mummy standardization is unachievable for most of women because it requires investment of money, time, and energy, which are difficult to have during pregnancy and when raising a child. Even when the mothers manage to make time to do excessive exercise they are seen like bad mothers because society points that they do not spend enough time with the newborn (Malatzky, 2017). Media representation of the perfect mother plays a powerful role in creating stereotypes in society that reinforce new expectations of the maternal body, but also expresses the idealization of the perfect mom that has everything under control.

The social nucleus of pregnant women also has a strong influence in the generation of body dissatisfaction. **The "Fat talk" is the dialogue between family and friends, especially women, where the body is despised. An example of Fat talk is: "I'm so fat", and "No, you're not, I am!"** (Nichter, 2000). Fat talk is a way of social validation that is related with the emotional discomfort that is generated by the body and associated with guilt caused by eating high-calorie content foods. **To engage in a Fat talk can produce depression, eating disorder and other anxieties**.

Rachel Dryer et al. (2020) in their study found that pregnant women are not exemption from this type of conversation. Women continue to experience the sociocultural pressure for thinness and perfection even when they cannot control the changes on their bodies. In an interview carried out by Brittany Watson et al. (2016) pregnant women assured that people feel free of com-

menting about their pregnancy bodies even though their comments could be perceived like unacceptable and hurtful.

It is interesting how people feel that they can comment... "oh your hips look a bit bigger this week", it is funny how people feel they can say something.

Fat talk contributes to greater levels of pregnancy-related anxiety, depression and eating disorder symptomatology. These can have serious and negative consequences for the health and well-being of the mother as well as for the newborn. D. Lynn O'Brien (O'Brien, 2011) in her article expresses that society is living a new era of definition of the role of women in motherhood. She mentions that **women are defined as good mothers if they have children, devote all their physical and emotional characteristics to them, but also, they must develop a professional career and have an excellent physical presentation.**



Figure 9: Body image during pregnancy

2.10

CLOTHING AND BODY PERCEPTION

Dress is defined as "an assembly of modifications of the body and /or supplements to the body" (Johnson, Lennon, & Rudd, 2014). Body modifications are exercise, make-up usage, dieting between others and body supplements are clothing and accessories. The social psychology of dress is concerned about how the way people dress affects their personality behavior as well as the behavior of others towards themselves. (Lennon, Johnson, & Rudd, 2017).

Clothes are considered a way to satisfy the individual, social and physical human needs, as well as the cultural representations and art forms (Kaiser, 1997). Thus, when people wear clothes, they are reflecting their identity, and telling society their gender, class, status, and consumer attitudes. Clothes are directly related to the image of the body. **They are linked to the way people look and how they feel about their image** (Tiggemann & Lacey, 2009). However, clothing is different from other aspects of body image, it can be controlled by the user. It is an intentional behavior; people choose what they want to wear every day. People select the clothes, but these clothes also affect their mood.

There exists the term "**enclothed cognition**" established by Adam and Galinsky (2012), which **describes the influence that clothes have on people.** This term includes two factors, the **symbolic meaning of clothes and the physical experience of wearing them.** This term refers to how people's style and clothes reflect and affect their mood and confidence. A large portion of women are likely to make emphasis on clothes and fashion to appear in public. It is a way to invest in their appearance and presentation, as well as to enhance their feelings about themselves. Clothes are important for them for all the ages. (Tiggemann & Lacey, 2009). However, women have difficulties to find appropriate clothes that make them feel confident.

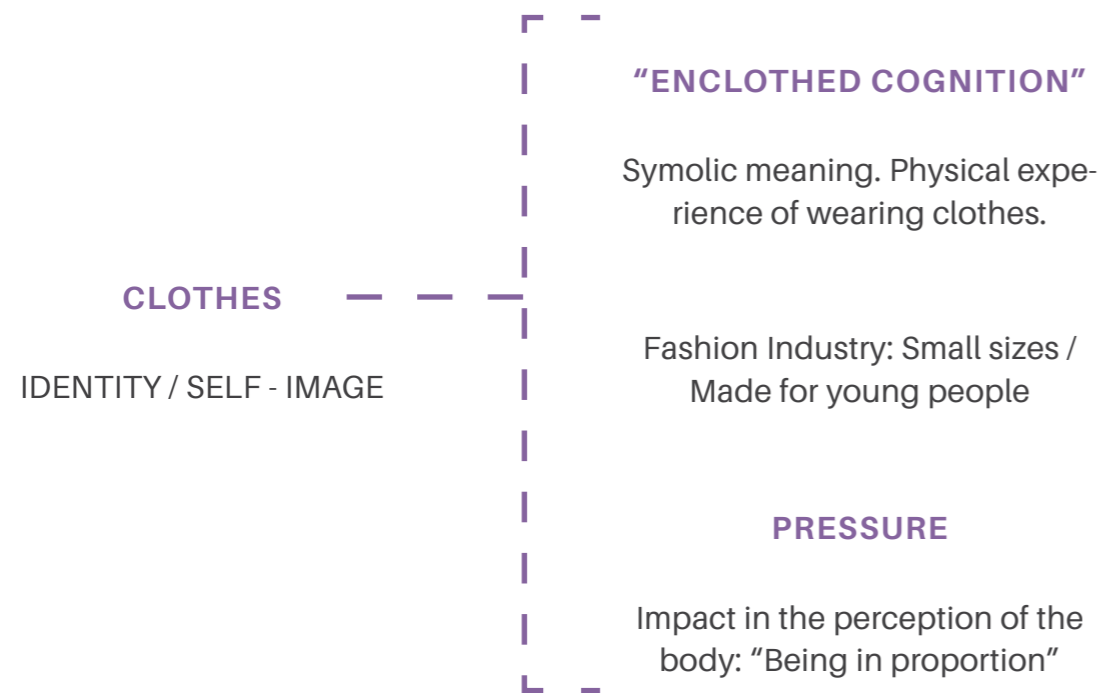


Figure 10: Clothing and body perception

Women express that they feel pressure to change their figure and be slim because the fashion industry only makes clothes for small sizes, so if they want to look fashionable and chic, they need to be thin (Grogan, 2016). On a study made by Sarah Grogan et al. in 2013 suggested that women search clothes that make them feel slim and that show a figure with curves, creating the image of **being "in proportion"**. In contrast, women indicated that they wear loose clothing when feeling fat. Women that consider themselves fat select clothes that can camouflage their bodies. They frequently forget about their individuality and personality in the moment in which they select them. This creates discomfort not only for their appearance but also because they leave aside their self-expression (Tiggemann & Lacey, 2009).

In the fashion industry, **the size variation of clothes has a strong impact in the perception of the body for consumers, because even when people know that these sizes are not reliable and well-proportioned for different kinds of bodies, they still use them like a mark for weight gain.** This makes them feel extremely unhappy when the clothes do not fit well (Grogan, 2016). This results in a motivation to reduce size. Thus, the fact that clothes fit nicely their body encourages people to feel more comfortable and this helps them to gain confidence. Furthermore, in a study made by Reddy and Otieno (2013), women expressed that they had bought clothes that they never wore,

because they do not reflect their self-image. This suggests that even when the clothes are comfortable, they will not use them if they do not reflect their personality and do not make them feel self-confidence. In this same study women claimed that fashion clothes are made for younger people, so women are pressured to stay younger looking. Most of the fashionable clothes for old women are more expensive than those for the younger ones. This is also a motivation for persuading the slim and youthful figure (Tiggemann & Lacey, 2009).

On the study of Reddy and Otieno (2013) women also expressed that their clothing style is influenced by the reaction received from others. **Clothes function is not only transmitting people's personality, but also it is an intention to convey the desired aspect of the others** (Johnson, Burrows, & Williamson, 2004). This is a big pressure for trying to fit in the actual trends that are designed for only stylized bodies. Clothing preference for women are therefore the product of how they feel about their body size, image and, the influence of society standards of beauty (Reddy & Otieno, 2013). A way to improve the body image in women is by encouraging the idea that they can wear clothes that fit them perfectly, that these clothes could reflect their personality, and that they can make them to feel confident and accepted by society no matter the size and figure of the body.

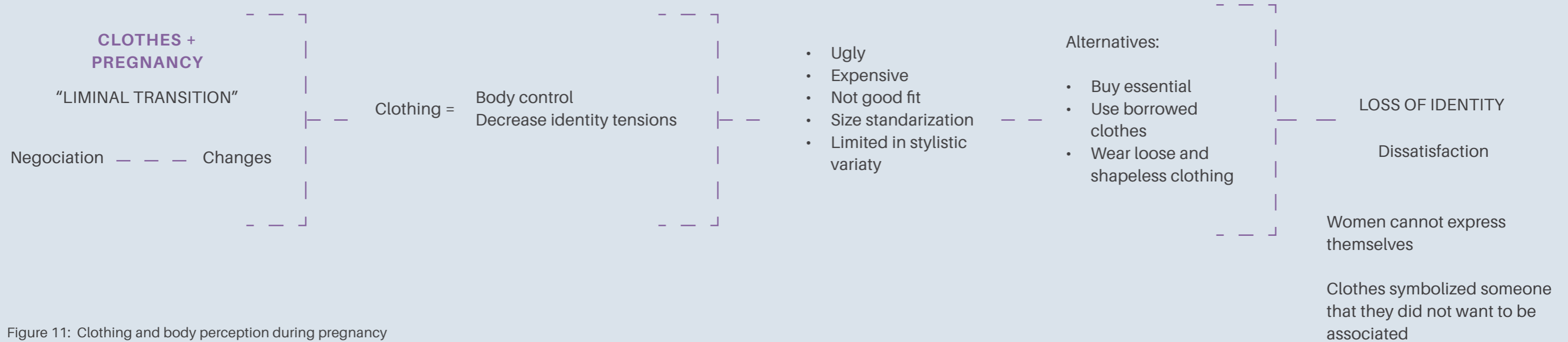


Figure 11: Clothing and body perception during pregnancy

2.11

CLOTHING AND BODY PERCEPTION ON PREGNANT WOMEN

Pregnant women experiment a period of psychological and physical changes. Some researchers classify this period like **"liminal transitions"** which refers to the instability and ambiguity of people that occur during

the lifespan on periods of transitions where the identity is suspended (Noble & Walker, 1997). For women, pregnancy is a period in which some aspects of themselves are re-defined and negotiated as the body undergoes

dramatic changes and the woman moves into the new role of being a mother. In this period women debate aspects of their appearance, specifically their clothing selection and use through symbolic consumption (Ogle, Tyner, & Shofield-Tomschin, 2013).

During pregnancy, maternity clothing can represent a medium for which pregnant women can practice control about their own body, this could decrease certain identity tensions. However, the actual fashion industry could not help to develop this feeling. **The standardization of the sizes on the fashion industry makes pregnant women have problems to find the right clothes.** They are pressured to wear loose and shapeless clothing. When pregnant women are not happy with the clothes, they frequently limit their outdoor activities. This limits their physical movement and for that

reason some of them can experiment overweight during pregnancy (Breda, Lehmann, & Arshad, 2015).

Ogle et al. (2013) in their study found that fashion maternity clothes were considered **expensive** by women, and since they are only used for a short period of time, it is better to limit their expenses and buy the essential. Some of these women even found alternative strategies such as **using borrowed clothes** (oversized, or from their husbands) or buy inexpensive maternity dresses from cheaper retailers like supermarkets. However, these actions also represented for them a **loss of identity and dissatisfaction with their bodies.** They argued that they **do not feel free to express themselves through the use of their favorite clothes.** Furthermore, women expressed that they cannot update their style and personality during pregnancy and

post-pregnancy for the limited number of maternity garments that they possessed. Thus, pregnant women do not have the option to create diverse looks or versions of their personality, which affects their attitudes and self-development. They also stated that even when they decided to buy fewer quality clothes, to diversify their wardrobe, they felt unsatisfied because they were dishonoring their personal aesthetic standards for appearance.

In this same study women expressed that the clothes available on the market were **ugly and unattractive**. They said that **maternity clothes are limited in stylistic variety**. They did not understand why maternity clothes had to be related with a cute image. They stated that good **clothes for work were almost impossible to find**. This caused them anxiety because, the **clothes in the market symbolized someone that they did not want to be associated** with, like adorable and flourish women. In this study most of the women feel that it was very **hard to find maternity clothes that fit well to their bodies in every stage of the pregnancy**. They had to accept what the market offered to their bodies. This caused them a big unhappiness related to their appearance because they felt that they lose control over their bodies. Nevertheless, some of these women also expressed that they were **proud of their belly**, and that they would prefer clothes that enhance this part of the body. In terms of styles, they indicated that when they wore maternity clothes, **they wanted to feel young and professional, to show authority, especially those women who worked**.

These results, which Ogle's et al. (2013) work produced, can also be reaffirmed in an-

other study carried out by Watson and his team (2016) in which they discovered that pregnancy clothes act as reminder of the gain of weight during pregnancy and in the post-partum stage for women, which causes a huge body dissatisfaction. For that reason, women attempt to use their pre-pregnancy clothes for as long as possible. Added to this also women believe that maternity clothes are ugly, and some of them prefer not to buy them (Watson, Broadbent, Skouteris, & Fuller-Tyszkiewicz, 2016).

Other study made by Sohn et al. (2015) explores the function of maternity clothes and body image. They found that maternity clothing was worn primarily for comfort and assurance and not for camouflage. They also expose that woman tend to have positive image because they focus on improving their appearance with better looking maternity clothes. In their study it was found that currently women want to wear fitted or tight garments that expose their belly and to wear styles similar to what they wore before pregnancy. Body positive appearance relates to wearing current trend clothing. Clothes can help women to reduce the pregnancy-anxiety and body dissatisfaction. **The industry must find a balance between functionality and visual design that can adapt to different types of bodies in different stages of the pregnancy and that gives freedom of creativity** to women to combine and create new style with a limited wardrobe.

2.12

THEORIES OF BODY DISSATISFACTION

People internalize body ideals through sociocultural messages. This causes negative feelings that are related with self-confidence. People can be resistant to the negative effects of these feelings by changing the way of how they interpret incoming social information (Grogan, 2016). **Psychoeducational interventions known as media literacy** programs teach people to reject media as appropriate targets for comparison. This kind of programs educate people about the problems related with the negative body image including causes and consequences (Alleva, Sheeran, Webb, Martjin, & Miles, 2015). However, these programs only train people to be skeptical about the media images and most of the time are not successful in reducing body dissatisfaction.

Another approach to challenge unrealistic cultural messages and to rethink unrealistic body standards is **cognitive-behavioral therapy (CBT)**. This therapy aims to help individuals to modify dysfunctional thoughts, feelings, and behaviors that contribute to negative body image (Alleva, Sheeran, Webb, Martjin, & Miles, 2015). CBT hypothesizes that people's emotions and behaviors are influenced by their perceptions of events. Feelings are determined by the way in which they interpret situations than the situations per se (Fenn & Byrne, 2013). To achieve these improvements, a variety of cognitive and behavioral change techniques are used such as self-monitoring, cognitive restructuring, and exposure exercises (Alleva, Sheeran, Webb, Martjin, & Miles, 2015). CBT is extremely effective in promoting positive body image because it explores the links between thoughts, emotions, and behavior (Grogan, 2016).

Body shame is also a result of the objectification of the body. **Incorporating feminist values** on programs designed to prevent body dissatisfaction helps people to have a better self-esteem and confidence. Rachel Peterson et al. (2006) in their study found that exposure to feminist perspectives increases

women's body satisfaction through growing feminist identity. They explain that women with traditional views have more danger to internalize sociocultural beauty standards than women with more free thinking about the stereotypes. Feminist theory can work as a filter in which cultural messages about beauty are challenged rather than passively accepted. It could be an alternative to interpret the media messages in a positive way to promote empowerment and positive body image.

Physical self-efficacy can improve body satisfaction (Grogan, 2016). The feminist discourse of "taking control" lead to enhance body image. Strategies like sports, identified goals and learning to value individuality are seen as a way of taking some control over the thin and beauty discourse that the media promotes (Huon, 1994). Moderate exercise that focuses on self-efficacy rather than aesthetics can improve body image as well as other positive impacts on mental and physical health (Grogan, 2016). Exercising can also be related with the body appreciation, which allows people to love the uniqueness and functionality of their bodies highlighting body assets and minimizing imperfections (Tylka, 2012).

Body functionality interventions like exercise, teach people to enjoy their bodies. It helps them to praise their bodies for what they are able to do rather than how they look. Furthermore, focusing on aspects like health, physical capacities, senses, and creative activities, rather than viewing the body as an object can promote body appreciation and reduce body dissatisfaction (Grogan, 2016). This last theory will be explored in greater detail in the next section as studies have indicated that it has a greater chance of helping pregnant women to reduce dissatisfaction with their body.

2.13

BODY FUNCTIONALITY

Jessica M. Alleva et al. (2015) define **body functionality as an aspect of body image that refers to everything that the body can do. It encompasses body functions related with physical capabilities**, (e.g., stamina) health and internal processes (e.g., digestion), as well as senses (e.g., sight), creative endeavors (e.g., dancing), self-care (e.g., showering), and communication with others (e.g., via body language). It can be seen as the body process or what is the body capable of do.

Body functionality can help people to positively reframe the way people think about their bodies. While body dissatisfaction focuses on perceived imperfections with negative orientation, a **functional approach concentrates on what the body can do in an optimistic way, generating good feelings about it**. It needs to be clear that the body functionality does not focus only on a specific type of people. Individuals with physical limitations due to illness, pregnancy, ageing, or structural differences have a functional body. They can do pretty much anything but in a different way. This means that there are several other functions within the domain of physical capacities and internal processes that the body is able of do (Alleva & Tylka, 2020).

In addition, body functionality increases body appreciation that **encourages unconditional approval and respect for the body** (Avalos & Tylka, 2006). In an interview carried out by Wood Barcalow et al. (2010) it was found that women appreciate their body for the physical activity that they can do with it. They emphasized the appreciation of their bodies when they went to do hiking and biking. **This theory proposes that centering in corporal functionality rather than appearance can help to explain the improvements related to exercising and to achieve body satisfaction**. Doing exercise is not always focused on beauty and weight control, but also with health and higher levels of body appreciation. In this case, body appreciation can be translated to functionality appreciation, which appreciates and honors the body for what is capable of doing, extending beyond mere awareness of body functionality. People not only know that their bodies perform a function, like digesting food, but they also are grateful that their bodies do it (Alleva & Tylka, 2020). Moreover, body functionality decreases self-objectification, because it encourages people to think of their bodies as active, dynamic, and instrumental, that therefore prevents them from seeing their bodies like passive, static and aesthetic (Alleva, Martijn, Van Breukelen, Jasen, & Karos, 2015).

2.14

BODY FUNCTIONALITY DURING PREGNANCY

The functionality of the body becomes important during the pregnancy. It **increases and takes part of women's attention compared to aesthetics**. Women worry about their appearance, however, during the pregnancy period **they can negotiate the changes to their bodies as they recognize the functionality of the body** in the context where the body grows for the baby's health and development (Watson, Broadbent, Skouteris, & Fuller-Tyszkiewicz, 2016).

Some women during pregnancy and after the partum expressed that there exists a connection between their bodies and the needs of the baby. During this period, **they develop curiosity and excitement for the increase of their belly that let them to forget their appearance** (Alleva & Tylka, 2020). This also happens with breastfeeding, which may direct awareness for the various and complex functions that the body can or cannot do. However, it has been seen that this appreciation of the body functionalities weakens after childbirth. The appreciation for the body functionalities during pregnancy is good not

only for the baby and woman's wellbeing, but also **can contribute to the emotional bond between mother and child**.

Elizabeth Kirk et al. (Kirk & Preston, 2019) claims that women bodily sensations and perceptions are what help them to connect with the baby, and that women who accept and embrace the physical changes of pregnancy should have a greater tendency to engage emotionally with their child. Thus, women that feel overwhelmed with the changes of their bodies and with their physical limitations during pregnancy tend to feel less emotional attachment with their babies. They found that higher levels of trust in the body and the perception of it as a safe space are strongly associated with lower levels of weight concerns, and appearance of dissatisfaction.

It is important to mention that body functionality may cause concern when women are not able to get pregnant, have miscarriages or have difficulty when breastfeeding. This can create feelings about body betrayal and

shame about how the body is working (Alleva & Tylka, 2020). Furthermore, pregnancy related functionality appreciation may have a limited time span. Women often report that functionality related with the baby is no longer protective in the postpartum. This is important, because it means that there is a lack of instruments that help women to overcome the anxiety of the body not only during pregnancy but also after having the baby when the body dissatisfaction feeling is stronger.

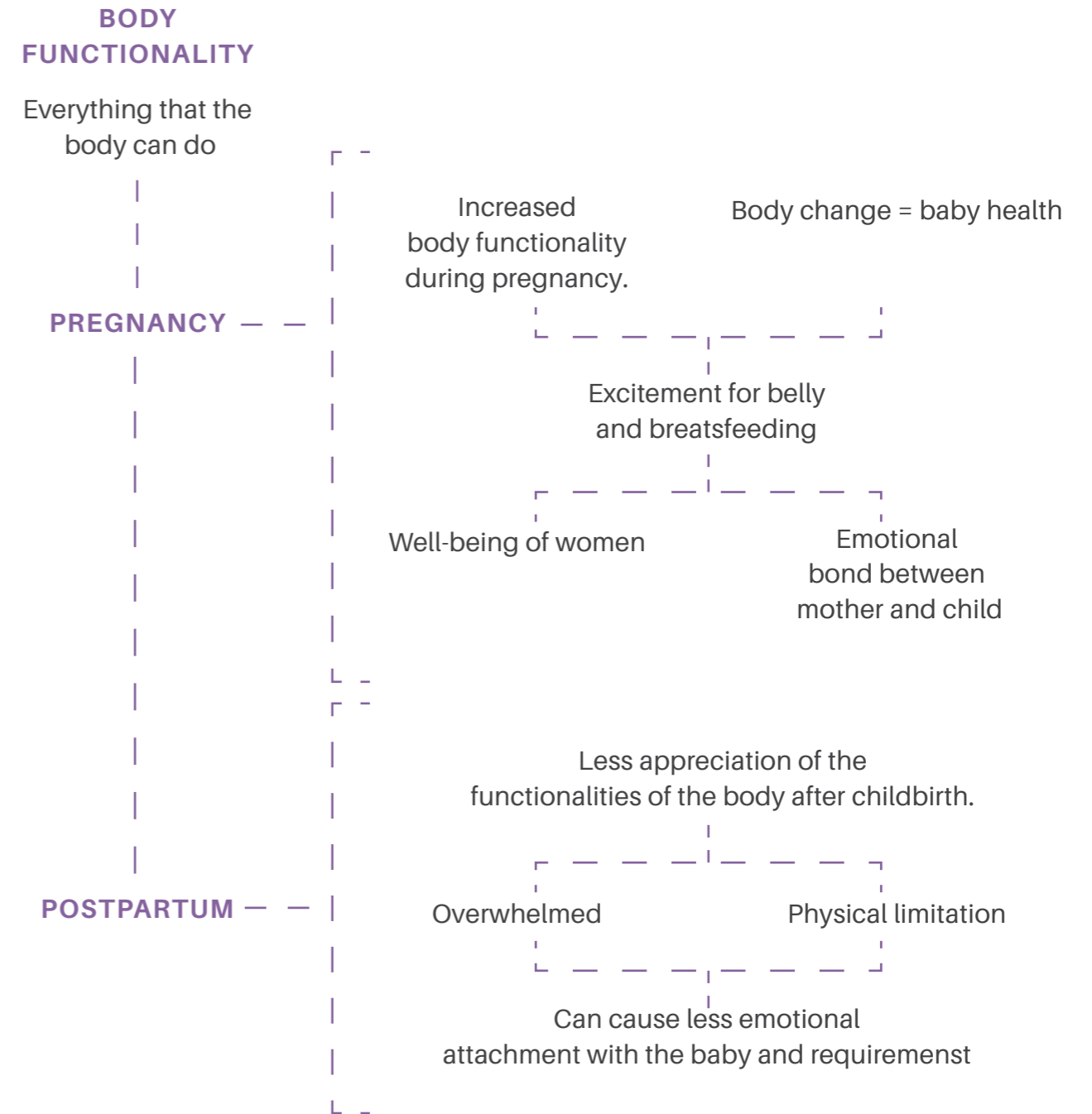


Figure 12: Body functionality during pregnancy

2.15

CONCLUSION

The concept of **beauty has been reduced to an image**. This image is charged with positive adjectives of superiority and accepted by the society like the correct norm. However, this affirmation punishing anyone who does not meet these beauty requirements (most of the world's population). This phenomenon creates body dissatisfaction a psychological and social problem that can attract serious consequences to those who suffer it.

Fashion and media have been key pieces throughout history to address this problem in society, especially in the female sex. Worldwide fashion and media have imposed the skinny and weak portrait of women like the objective to fulfilled. Women are represented in a tubular and thin shape that does not look like reality. Each body is different. However, women undergo different treatments like diet and plastic surgery to achieve this idealized beauty standards. These standards are charged with good adjectives by society. Anyone who does not follow these disciplines is careless, lazy, and unsuitable for the world. This is one of the main reasons why people are afraid of leaving the standardized system.

Body dissatisfaction can cause depression, poor self-esteem, and other anxieties on people. Media advertising promotes the idea that body shape and size are adaptable, and that achieving being thin is easy, but this is not the norm. Furthermore, **media shows women's body in a sexualized way with a tendency to show it as an object of desire.** Media argued that these stereotypes are the only ones that sell products. However, it has been proved that this is not true. Social media has also changed the way in how people is pressure to be perfect. It encourages the comparison between family, friends, and famous people in a more direct and constant way.

This ideology of the perfect body is not only influenced by the women portrait reflected on the media but also by the manufacturing of fashion products. Clothes are directly related to the image of the body. They are linked to the

way people look and how they feel about their image. By making products with **standardized sizes**, they are promoting that only one body type is correct. This leaves out anyone who does not fulfill these specific measurements causing them problems of body dissatisfaction.

Due to this persistent pressure most women have an unreal image of their bodies. They are in a perpetual battle between their bodies and the thoughts that are generated by social acceptance. The problem is so serious that even women with "perfect bodies" feel unsatisfied and insecure of their appearance. Society judges them for not fulfilling the stereotypes created by the industry. This pressure is also visible on **pregnant women**, although their body changes for health reasons and to host the baby. They **suffer stigmatization**. There exist trends such as Yummy Mummy exclusive to pressuring pregnant women to come back to their pre-pregnancy bodies after the birth of a baby. This trend relates the figure and size of the body with being a good versus a bad mother. Pregnant women also receive social pressure from their family/friend nucleus. They engage in what is known as "Fat talk" dialogues between family and friends, where the body is despised.

In terms of fashion, they also **suffer rejection since they are part of the group that does not meet the standards of perfect measurements**. Being not able to find clothes that satisfy their styles and that fit them well on the market causes them unhappiness related to their appearance. They feel that they **lose control over their bodies**. Pregnancy is a liminal transition in which women define a new personality. **Clothes during pregnancy can be a medium to decrease tension and relax their anxieties**, caused by this transition of emotions, but the industry is not currently helping them.

Psychologists have established numerous methods to help people foster a positive image of their bodies. It has found methods such as cognitive-behavioral therapy, feminist therapy, self-efficacy method, functionality therapy etc. It has been proven that the cognitive-behavioral therapy is extremely effective in promoting positive body image because it explores the links between thoughts, emotions, and behavior. **This research and project are focused on analyzing and using functionality theory**, which uses interventions like exercise. It teaches people to enjoy their bodies. It helps them to praise their bodies for what they are able to do rather than how they look. This theory has been chosen because **experts on the field have found that this type of therapy may have greater acceptance in pregnant women, since women experience excitement because they host life**. This is related to the function of their body.

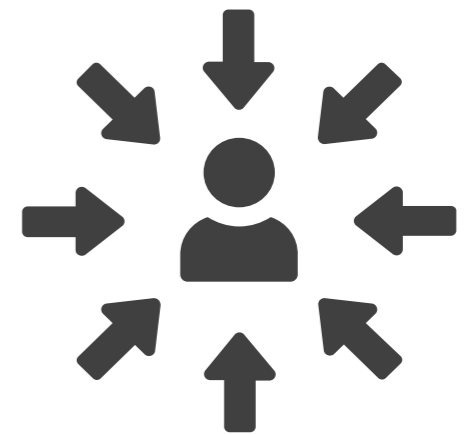
This chapter helps to understand the seriousness of body dissatisfaction in women in a society that hurts them directly and affects their development from a very young age. How the media and fashion industry continue to exhibit these unattainable stereotypes. How this problem can be treated with possible psychological theories, but above all, it puts in perspective how important it is to create projects that help to solve this problem. To rethink the system that is affecting millions of women in their daily lives.

This project is specifically targeted at pregnant women, because they are part of a group that is rejected by the established beauty scheme. Society has imposed standards of rejection of a natural process over which women have no control and by which they should not be judged. Besides that, the market is limited for this sector because it is not offering what the sector is requesting. The fashion system has a responsibility to reverse the problems that it has caused for years. It is necessary to create projects that are more inclusive and stop the standardization of the market, and include a more customized approach, because there is no perfect body. Each person is original and valuable.

To find a design solution that helps to reduce body dissatisfaction during pregnancy and post-partum, it is necessary to reaffirm the above information, in addition to finding out what are the solution that women are using to generate a positive body image. It is essential to understand if the theory of functionality works to reduce the dissatisfaction of women during pregnancy. How the experts apply these theories with their patients. Also, it is important to know how women perceive the current market, know their experiences, and identify their needs. Solving these questions will help the project to have a better overview of the current situation of the problem to generate a viable solution that could be accepted for the target. The next chapter is related to answering these questions. It will present the results of two interviews performed to perinatal psychologists. The two interviews performed to body experts and the result of a survey applied to 97 women who have had the experience of being pregnant

CHAPTER THREE USER-CENTERED RESEARCH

3



USER-CENTERED RESEARCH

Pregnancy and postpartum represent a critical risk period for the development and exacerbation of anxieties caused by body dissatisfaction. To find a solution viable to this problem is important to understand and analyze the experience of the users. **This chapter focuses on collecting the experiences of mothers: (i) about their relationship with body image during and after pregnancy; (ii) about the methods they use to build confidence in their body; (iii) about their relationship with maternity products offered by the current market.** This chapter as well has the objective of knowing the methods that experts use to generate a positive image in women during this stage. What kind of techniques and materials they use and how and when they apply them.

To find these answers, the research has been conducted through **2 interviews made to two perinatal psychologists** (see Appendix A.1 to consult the questionnaire). The interviews had a structure of a questionnaire of fourteen qualitative questions. The interviews were conducted online, lasting approximately an hour and a half each. The main focus was to discover more about the techniques and methods that psychologists on the field use to treat cases of body dissatisfaction during pregnancy and post pregnancy. Moreover, a **survey to 97 women that are or have been pregnant** were made (see Appendix A.2 to consult the questionnaire). The aim was to verify with women if they suffered body dissatisfaction during pregnancy and postpartum, find if they were conscious about these feelings and discover what they did/do to control and reduce these thoughts. The survey had a total of 28 quantitative and qualitative questions, distributed in three sections. The surveys were circulated online in three languages, Spanish, Italian and English. To corroborate the effectiveness and the implementation of some techniques that had a greater predominance in the previous two materials, a **survey to 2 body experts was made** (see Appendix A.3 for consult the questionnaire). A structure of seven questions was established to verify the efficiency of physical activity as yoga and messages during pregnancy, discover what type of exercises are applied during these practices, and how the user can apply them. The interviews were conducted online, lasting approximately half an hour each.

3.1

INTERVIEW: EXPERTS

3.1.1 INTRODUCTION

Two interviews to perinatal psychologists were developed. The main objective was to discover more about the techniques and methods that psychologists on the field use to treat cases of body dissatisfaction during pregnancy and post pregnancy. A structure of fourteen qualitative question was built. The information contact of the interviewees was taken from the European Institute of Perinatal Mental Health. The experts have taken courses in this institute and are people certified on the field. It was informed to the interviewees that the information collected will be used for academic purposes, and that data would be used in an aggregated format. The interviews were conducted online, lasting approximately an hour and a half each.

3.1.2 PEOPLE

Two perinatal psychologists of Mexican nationality were contacted, certified by the European Institute of Perinatal Mental Health. Tania Romero expert on perinatal psychology with a feminist theory approach, Tania have also taken courses about support to gestational and perinatal grief, and Victoria Rocha certified perinatal mental health psychologist, Mexico Perinatal Mental Health project founder, creator, and administrator of the support group "What do I do with my baby?" focused on guiding mothers and fathers in the perinatal period.

3.1.3 MATERIAL

For the interview structure a questionnaire of fourteen qualitative questions was developed (see Appendix A.1 for consult the questionnaire), focused on knowing more about the techniques and methods that psychologists in the field use to treat cases of body dissatisfaction during pregnancy and post pregnancy. The qualitative descriptive material has as objective the exploration of complex situations to reach a deeper understanding of the life experiences of patients suffering body dissatisfaction.

3.1.4 STRUCTURED INTERVIEW QUESTIONS

To understand the dissatisfaction of pregnant women, the questionnaire asked information about the perception of body image during pregnancy and postpartum, deepening on the reasons of why pregnant women suffer this issue, the frequency of cases, and the solutions that they use to solve this problem. Furthermore, it was asked their opinion about different therapies before mentioned on the thesis (Chapter two) and their advice about which characteristics fashion could offer to generate positive body image during pregnancy.

3.1.5 RESULTS

The experts argued that women at least in Spain and Latin America from where they have more patients, are not accepting the changes in their body during the pregnancy and post pregnancy. The lack of knowledge and the missing of full awareness of what it means to have a baby, make women to feel insecure. Some of them suffer body dissatisfaction because it was not in

their plans to have a child. Even when they plan it, they do not understand, or they are not prepared for the experience that is coming. So, based on their body schema, **women manifest rejection**, they do not appreciate their bodies. The psychologists say that women refer to this stage like **“body deformation.”** Frequently women are not aware of what they are doing (judging their body), they only are manifesting what is happening in their psyche. The experts explain that it is important to understand that sometimes this body dissatisfaction does not have to be entirely related with the pregnancy, this means that the problem is not to host the baby. In some cases, **women feel that they are missing the liberty that they had before the pregnancy and the birth of the child. So, they channel this in anger into their bodies for the limitations that they present.**

The experts suggest that it is possible that women understand the body change cognitively, “I am pregnant, so it is logical that I have these changes” but they do not understand it in a psycho-emotional status. They accepted it because it is the condition in where they are but not in their mentality, on their emotions.

The perinatal psychologists explain that the cognitive-behavioral therapy works in establishing a discipline dynamic. These techniques help women to institute rules and put order to their activities. Help them to form their new habits. However, it does not have a big impact in accepting body modification. It stays at a superficial level.

One of the experts mentioned that she prefers to implement **exercises related to the functionality theory**. She divides her process in **two levels**. The first step is to help women to be in **contact with their emotions**, help them to understand their reality, situation, and condition. Women first must reconcile with their being. This step is to make people aware about the tools that they have to be happy, because they consciously or unconsciously decided to have a baby. Criticism needs to be avoided; it has to be a space where women feel free to express their emotions. In this phase it is not required any material, only the human contact. Women must feel supported and identified with the person that is helping them. Once women are conscious of their situation and they are not angry or feel guilty (frequent feelings) is when the body becomes present.

The second step is related to the body. This expert works and uses different body activities. She recommends psychoprophylaxis exercises to prepare women for childbirth. **The exercises help to eliminate pain that occurs during pregnancy and relax muscles in preparation for childbirth.** Also,

breathing and **relaxation techniques** are learned to control the pain of contractions. She explains that everybody is different and what works for one person may not work for another, but in general **she highly recommends exercise**, if the condition of the pregnancy allows it, and relaxation exercises such as **meditation or yoga**. During her routines with her patients, she uses different tools such as the **rebozo** (long flat garment, very similar to a shawl, worn mostly by women in Mexico) to apply pressure, heat, cold etc. This type of exercises also will depend on the pregnancy stage, because she comments that pregnancy is a stage of a lot of sensitivity for women. In her sessions, each of her patients find the exercises that help them to improve their condition and feel better about her body.

She believes that the functionality theory can be good applied on pregnancy and post pregnancy because these are related to the body. A body that is demanding different positions, different temperatures, different pressures, the body is asking for a massage due to all the changes that occur in it. This expert also mentioned that although all bodies are different, usually in the last trimester the weight of the abdomen and breasts along with the hip opening becomes a complicated situation, women feel **pain and discomfort on the lumbar and sacral area**. Also, in the abdomen and breasts they present pain, itching, and heat. She believes that desingning something with support points on these areas could help women to feel fine with their bodies.

Other thing that the expert commented was that pregnant women make a lot of **contact with their belly**, they focus all their attention on this area, so she does not recommend redirecting the attention of pregnant women to other parts of their bodies. At least not in the pregnancy. When the expert works stimulation and uterus, she works with the touch, sound, vision, and sense of balance, she made all the exercises on the abdomen, with these kinds of exercises, she promotes the maternal bond. If the mother's attention is moved to another area, she does not believe that it could be possible to create this bond. She believes that there would be problems to generate this reconciliation with the pregnancy that is attempted in the first step of therapy.

The bond between mother and child is important because it can be a tool to generate body positivity in the postpartum, to be happy and proud of the body. The expert expressed that it is important that once the baby is born, he/she spends most of the time in contact with the mother. The attachment comes from the body. Skin-to-skin contact, the

aroma, the sounds of the mother's body, the sound of the voice, are vital for the development of the baby, but this can also help the mother to build affection towards her.

The perinatal **psychologist with a feminist approach** suggested that the pregnancy is not a behavior problem, so for her there is nothing to be modified. With this argument she discards the cognitive-behavioral therapy like a solution to solve image dissatisfaction problems on pregnancy and post pregnancy. She claims that the main reason for the existence of this problem is the **patriarchal society in which women live and the objectification of women in the media**.

She uses feminist therapy, which invites people to question gender roles and the portrayed construction of the perfect body. In her therapies she invites women to question how their body image has been constructed and why they are in a hurry to return to their previous body. She helps them to identify what factors in their environment make them feel unhappy. She also **uses narrative therapies, exercises, especially writing, to put the patient's expectations and problem into visible words**.

She expressed that what women miss the most is their **independence and the freedom** that they had before they were pregnant, and the baby was born. **The movement is important for them**. Some of women feel bad because the baby becomes the center of attention of everything. In other words, now they have to think about her/his well-being all the time. What limits them or causes them to change their previous habits and routines. Women do not like being at home. What the psychologist recommended them is to go out of the house even if they need to carry the baby (if the conditions of both are good). From a psychological point of view, spending more than seven hours with a baby alone becomes a high-risk factor because it is very demanding and stressful. During the three first months the babies do not sleep longer than three hours, the mothers must provide them with food, change the diaper etc. This situation impacts women in their moods, even if they feel very happy with their baby. So, **she teaches them routines to go for a walk and take their minds off things**.

She believes that what women need more are **tools that help them to feel free, that allow them to move**. Once the baby was born, she recommends women to carry their babies with them. The baby must be in contact with the mother. Even when the babies have been gestating for

nine months, at birth they are still considered immature. There exists the ex-terogestation a period of eighteen months where babies expect an “external womb” this helps babies to learn how to self-regulate. The parents need to train the baby’s system. For this reason, she recommended to take courses about “porteo” (baby carrying). Knowing how to carry babies helps women to know how to move with them, without the necessity of a stroller. This brings liberty to women. Light and extensible tools such as the fulars and rebozos are used in these courses. Moreover, the expert claims that it is important to build confidence in women, make them feel that they are free, autonomous and to feel comfortable with the transition from that old being to a new one.

3.1.6 DISCUSSION

The objective of these interviews was to discover more about the techniques and methods that psychologists in the field use to treat cases of body dissatisfaction during pregnancy and post pregnancy. **Findings indicated that pregnant women and new mothers frequently present body dissatisfaction.** One of the triggers, is that they are not prepared for pregnancy. Not being prepared, the lack of movement caused by pregnancy, coupled with the messages from society, make them feel bad about their bodies. The experts indicated that **women accept this stage in a superficial and practical layer, however they do not do it on their mentality and emotions.** It can be confirmed what Bayrampour (2016) et al. claimed about women being vulnerable to mood and anxiety disorders due the significant physical and emotional changes. The experts reveal that women refer to this stage as a **“body deformation.”** In their inquires they also observe the debate that women have about their old personality and the new one that is forming.

Furthermore, it can be established by the answers on the survey that cognitive-behavioral therapy does not work hundred percent to treat cases of body dissatisfaction during pregnancy. This kind of therapy stays in a superficial level. However, the experts use other kinds of strategies. One of them mentioned that the use of the **functionality theory treatment help women to feel fine with their bodies.** Teaching people to see what they can do with

their situation and body possibilities helps women to feel confident. Make exercising and taking courses about learning to relax reduce the women’s anxieties and help them to appreciate their bodies for what they can do and not for their appearance. **This proves that the body functionality theory suggested to reduce body dissatisfaction can work.** Although, the other expert did not mention directly that she uses functionality theory she explained that what is most **important to women is to feel freedom.**

Other therapies that the experts use to use are the **feminist therapy and the narrative therapies.** Both help women to question why they feel bad, and how their environment affects them. The most important in these therapies is the human contact. Women must feel free to express their emotions in a safe place. It was also mentioned that the last trimester is the most complicated for women. **Most of them present problems in their spine. Doing exercises, giving massages on this area became vital for women to feel better with their physiques.** The bond between the child and the mother is also important to generate body positivity. Doing activities to be in in contact with the baby before and after the childbirth helps women to feel empowered and appreciate their bodies for being able to give life. This can help to reduce the embarrassment of scars when pregnancy is over.

The objective of these interviews was achieved. It was possible to discover some techniques that experts use to generate body positivity. It was also possible to identify that functional theory could work to promote good feelings, and that most of the time this theory is applied by exercises that help the body to relax and make women to take their minds off things.

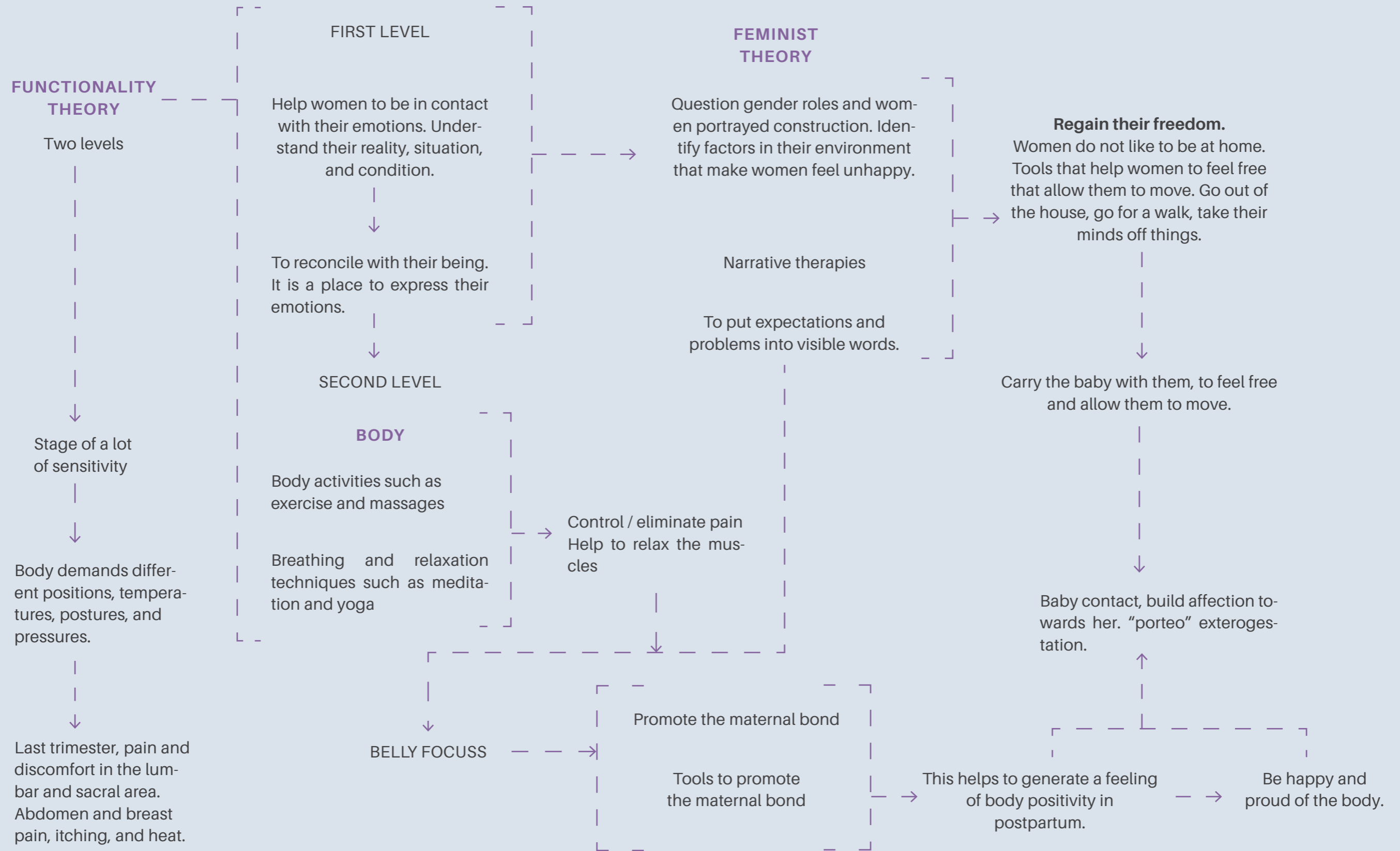


Figure 13: Results interview experts

3.2

SURVEY: USER

3.2.1 INTRODUCTION

A survey was developed to know the women's experience during their pregnancy and post pregnancy period. The aim was to verify with women if they suffer body dissatisfaction during pregnancy and postpartum, find if they are conscious about these feelings and discover what they do to control and reduce these thoughts to create a body positivity image. Furthermore, questions were asked related to their experience with maternity clothes to know their necessities and essential functional requirements that clothes and accessories for maternity must include. The survey was completely confidential, the name was not required. It was notified to the participants that the material would be used for academic purposes and that data would be used in an aggregated format.

3.2.2 PEOPLE

97 online surveys were conducted with pregnant women and mothers. Answers from the following countries were received: 78 from Mexico (80%), 15 Italy (15%), 1 Brazil (1%), 2 Venezuela (2%), 1 Colombia (1%), and 1 Norway (1%). The ages of the interviewees range from 25 to 45 years old. The results showed that 11 women were pregnant, and 86 were mothers at the time of answering the survey.

3.2.3 MATERIAL

The survey has a total of 28 quantitative and qualitative questions, distributed in three sections (see Appendix A.2 for consult the questionnaire). The first section is dedicated to the insecurities of the body during pregnancy. The second section dedicated to knowing what activities women carry out or did to reduce the insecurities of their body during pregnancy and postpartum and the third section is related to knowing more about their experience with maternity clothes. The surveys were distributed in three languages, Spanish, Italian and English. The highest number of responses obtained were from Spanish-speaking women.

3.2.4 STRUCTURED SURVEY QUESTIONS

To understand the dissatisfaction of pregnant women, the questionnaire asked information about the perception of body image during pregnancy and postpartum, deepening on the feelings that women experiment about their bodies and the activities that they do and did to feel better with their appearance. Furthermore, it was asked their opinion about pregnancy products on the market, how they use them and what did they do with them once their children were born.

3.2.5 RESULTS

I. Insecurities of the body during pregnancy and post pregnancy

60% of the interviewees admitted to have suffered insecurity about their appearance during pregnancy and postpartum. **Most of the women admitted to have experienced negative feelings.** They felt insecure and sad due to weight gain and fear of not being able to return to their previous size. Likewise,

they showed concern for their appearance. The interviewees reported to have felt ugly and fat when they looked at themselves in the mirror. Some women rated their appearance with quite strong adjectives such as **disgust, rejection, and repugnance**, *“I hate my body.”* Other women claimed to have perceived rejection by their family and friends, this made them feel insecure with people *“people didn’t like me” “My husband was ashamed of going out with me.”*

Moreover, the interviewees felt confused and frustrated by the limitation of their body and for not being able to find clothes that fitted them well, they referred to **pregnancy as a stage of “deformation”** where they felt uncomfortable, strange, and resigned. In addition to the fear of their physical appearance, many of them assured that they also felt anxiety of medical procedures, such as cesarean and high-risk pregnancies. Some women also, felt unconfident of not being able to take care of the baby. However, thirty percent of the women also expressed to have felt joy of being mothers and being able to generate life inside of them, this aspect made them feel beautiful.

Abdomen, chest, and waist are the areas of the body that produce most embarrassment to the women, followed by legs, face, and arms. This shame was controlled during the pregnancy because eighty-five percent of the interviewees considered that the changes in their body were fine because they related them to their baby’s health and theirs, but this feeling decreased dramatically in the postpartum.

II. Decrease the insecurities of body during pregnancy and postpartum

Despite the high percentage of bad qualifying adjectives towards their bodies during pregnancy and postpartum, **most women have never considered necessary to take therapy to treat these feelings.** Only 8% of the respondents have done it. However, it can be observed that some of them have some interest on receiving this help. 8% have considered it but do not have time to take the therapy, and 15% of them have not done it, but would be willing to try it.

The results showed that **most of the women surveyed remain active and perform physical activity to reduce the dissatisfaction of their body and relax during pregnancy and post pregnancy.** Among the most mentioned activities are walking followed by yoga and stretching. Some women commented that they focused on stretching the hip area. Likewise, some of them took massages and physiotherapies. Going to the gym or taking classes related to physical exercises was also recurrent, swim classes, aerobic exercise classes, Pilates, and dancing were some of those mentioned.

Other activities less related to physical activity mentioned were meditation, talking with family and friends *“laughing helped me a lot”*, listening to music, taking hot showers, having a good diet and eat well, buying nice clothes and getting ready also helped them to feel good about their physical appearance.

Almost all have admired their bodies at least once in their lives. Most of the women surveyed indicated that breathing is the way in which they become more aware of what their body is able to do. Feeling their breath during physical activity or during meditation helps them greatly to appreciate its functions

and to relax. Likewise, many women indicated that **pregnancy is an essential reason to admire their bodies.** Being able to host life, create it, and nurturing it during this process makes them feel good, *“when my baby was just born, I felt empowered and proud that I made that being.”*

Other answers indicate that some women appreciate **the movement of their bodies, the elasticity, the energy that the body produce to make their activities and to resist fatigue.** Other women indicate that the touch made them feel alive. To touch their bodies and feel the touch of other people makes them feel affection and relaxation. In addition to this also to feel the nature and its surroundings make women to feel happy *“I admire my body because I can feel the fresh air.”* However, a third of the interviewees said they never have admired their bodies. Others indicated that they noticed it just when they started to be pregnant, but not before, and some that they only notice or think about it when something serious happens, for example illnesses or breaking a leg, *“after I suffered COVID I realized that it is super important to take care of your body by doing physical activity.”*

More than a third of the women indicated that they have not **hidden the imperfections caused by pregnancy.** Some women never suffered or did not have any imperfection. Other women do not hide them because they are proud of them. Nevertheless, the remaining two thirds of the women revealed that they hide them, especially the part of the abdomen, the belly and the **“extra fat”** as they refer to it. Most women use clothes to hide them, tight clothes, or very large clothes, this makes them feel sad. They think that the

clothes are horrible, but comfortable. Some women also use a girdle or take care of their body posture. **They sit or behave in such a way that their bodies do not reflect any deformation or fat accumulation in the abdomen.** Likewise, most have **stopped wearing bikinis or clothing that implies showing the skin as necklines.** *“You don’t want to show anything again, I hide the additional skin with tight clothes, my belly with a girdle, I don’t wear bikinis.”* The breast is also a complicated area, many women hate the stretch marks caused by breastfeeding. Especially they hate that one of their breasts looks smaller than the other. Women who suffer this look for especial bras or underwear, with rods or special padding, that help them to level the volume of both breasts. With regard to the spots on the skin, women mentioned that they use creams and makeup to hide them. *“I treated the dark spots of my face with lightening creams. I have tried to make the skin on the chest more elastic, but with bad results.”*

More than half of the respondents indicated that the use of a girdle is one of the most frequent suggestions given by family and friends. The girdle for the vast majority implied **limitation of movement and made them feel uncomfortable, especially since they felt overwhelmed with the excess of tasks they had to do and the lack of freedom that they felt.** For other women, the girdle represented a support and they used it for beauty and health *“to correct”* their body as they claim. Another of the most suggested methods was the use of oils and creams before and after pregnancy to avoid stretch marks. Most of the interviewees took this point as positive, however several of them argued that this had not worked and that stretch marks appeared anyway.

Both activities made women feel insecure about their bodies. One of them commented *“people suggested me to wear a belly rap to recover my figure more quickly (as though looking the way I did after giving birth wasn’t right). Also rubbing almond oil all over my body to prevent stretch marks (this in particular made me feel bad as I already had a few stretch marks to begin with and the idea of preventing the appearance of more conveyed the idea that my body was already damage and could get worse).”* Likewise, some women felt laziness and weakness in carrying out these tasks, they felt more concerned about taking care of their baby than about worrying about their appearance, however, people’s comments made them feel that they were not taking enough care of themselves.

Women also expressed having **received advice based on superstitions and on unhelpful methods that they consider unnecessary, hurtful, and sometimes dangerous.** *“Putting on hot aloe leaves to avoid stretch marks was horrible, or drinking beer to generate more milk, how disgusting!” “Using fat-reducing creams,” “drinking herbal drinks,” “they suggested me not to stop putting on makeup because my husband was going to go with someone else.”* However, some women expressed that some suggestions **were very helpful, such as do exercise, eat well, take hot herbal baths, postpartum massages, physical therapy** (hip closure). This helped women to relax appreciate their bodies. *“These helped my body to heal.”*

Among the things that helped the most postpartum women to feel better about their body was the support of their family and friends. Many said that talking and receiving compliments from the people around made them

feel beautiful and special. *“That everyone around (even strangers) told me all the time that I was getting prettier made me feel good.”* For some, feeling her husband close and hearing her husband **say nice things about their appearance made them feel protected and relaxed.** Likewise, they looked for that type of support by doing activities such as meeting with friends or going to classes with women who were facing the same situation, such as meetings with new mothers, classes for yoga with babies, swimming with babies. The women also expressed that they returned to exercising, especially to strengthen their muscles. Along with exercise, some of them began to regulate their food by eating healthier.

Many women argued that after the child is born there is not much time to do extra activities, especially working women. However, **returning to work and recover their normal life helped them to feel good and happy.** Likewise, several women stated that walking and going out of their routine inside the house helped them a lot. Women who had time indicated that activities such as **meditation, massages, physical therapy, hypopressive exercises, freshening up had helped them a lot to love their new body.** Many of them considered that wearing comfortable and beautiful clothes as well as wearing again their clothes that used to wear before pregnancy helped to feel security of their bodies. Some women claimed that seeing their child growing up also helped them, *“although my body was not the same as before, I had something more important in my life.”*

In the survey, some women felt that they have not love their bodies yet. For them it is still difficult to observe themselves, they

avoid doing it. It has been difficult for them to overcome this stage and they feel resigned. *“I lost weight during pregnancy; I have not felt so beautiful in years” “I still feel insecure and resigned.”*

III. Experience with maternity clothes

Women are aware that **maternity clothes change their perception of the body**, some argued that maternity clothes did not affect them in a negative way since they understood that it was necessary to wear them. They found comfortable clothes that fitted them well, this made them feel safe. They also found stylish clothes that they liked. The style was important because this makes them feel secure about their appearance. They expressed that showing their tummy made them feel proud and happy about their futures babies. However, a large part of the women indicated that **they did not like maternity clothes.** They had never tried to wear them because they made them **feel sad, ugly, and old.** *“In general, I have always found ugly maternity clothes, it is as if they want to make one feel bad.”* Some argued that maternity clothes look similar without distinction, there is no customization. Most women choose to continue wearing normal clothing. **They buy larger sizes or clothing that could stretch such as leggings and lycra dresses.** *“Lack of unique designs, all pregnant women look the same, I chose to buy one or two sizes larger since I didn’t like maternity clothes.”* Many women accepted to wear maternity clothes in the last trimester, but this upset them. They considered the **clothes ugly and expensive for only to be wear for few months.** *“Maternity clothes are ugly, and they seem to be made for more mature women. They seem to prioritize comfort, which is good, but they for-*

get about style. Also, I could only wear maternity clothes for my last trimester which meant I had to buy a bigger size of regular clothes for my first and second trimester (for someone who does not like to go shopping it can be a nightmare).” Other women signaled that even when they buy maternity **clothes these do not works for the post pregnancy, because they need other special conditions.** These made them feel upset, because some of them had to adjust their garment to their new bodies or buy more clothes *“maternity clothes must be different than usual and often we try to adapt things that we already have, to not spend too much money on this temporary stage. What is good in pregnancy is not always good in breastfeeding.”*

The favorite garment of **women during pregnancy were dresses**, not pre-mama, but normal dresses. They wore long and short dresses to the knee. Dresses that could adapt to their body, some signaled having worn wrap dresses or with elastic fabrics. **The dresses made them feel comfortable and free.** Another garment that they used to wear was the maternity pants, or wide pants. Some indicated wearing fashionable pants such as jeans, tracksuit pants, sweatpants and especially leggings. For the upper part, most of the interviewees indicated that they usually wore loose t-shirts and shirts, taking care that they fit their tummy. They also mentioned wearing oversized sweaters. Some women tended toward sportswear because it was comfortable and stretchable. Other women indicated that during summer they wore skirts or clothes with thin and fresh fabric. The women indicated that they looked for clothes that formed their silhouette and that helped them to look less fat than they felt.

58% of the surveyed women considered that maternity **clothes are expensive**. This is a little more than half of the women surveyed. Moreover, 42% bought their clothes on specialized department stores. Some of them commented that they acquired their garments through online websites. The next most selected option was normal store followed by **secondhand or borrowed clothes**. Very few people pointed having bought their clothes in supermarkets or fast-fashion maternity stores, and only seven people expressed that they have made their own clothes or modified the ones they already had.

Women indicated that they bought in these establishments especially due to the price. Because pregnancy is a short stage, they did not want to invest a lot of money. Some were looking for sales or stores that offered quality and price. Brands with affordable price. Some women who also wanted to save money bought second-hand clothes or wore clothes that were given to them by friends or relatives who had already passed through this same experience. They also tailored their own clothes. Another motivation for buying on these businesses was the variety of products that they offered and their seasonal designs in line with trends. Women indicated that they had bought in fast-fashion stores because these brands offered beautiful and affordable clothes. Other women, especially women living in small towns, mentioned that **most of their purchases were made online because they found more variety and better price**. Others commented that they bought in normal stores because they did not like to wear maternity clothes, but that they also looked for a fair price, and the viability of using these garments after pregnancy. Some women also signaled to have bought

in these stores because it was easier to buy and for their proximity. Some of them did not like to go to try on clothes in stores because they felt uncomfortable.

Women also expressed having used her **husband's clothes especially at home**. They borrowed pants, t-shirts, pajamas or in general large clothes to sleep. Some of them argued that men's clothes are more comfortable than women's, and for sleeping they were a good option because they also could feel the husband's protection. Furthermore, 69% of the respondents answered having bought essential clothes during pregnancy, therefore more than half of the **women responded that they could not express themselves because their wardrobe was limited**. All women perceived that pregnancy clothes are comfortable. Nevertheless, there exist different opinions about the style. Thirty people describe the maternity clothes like pretty but most of the people think that the **clothes are not very attractive, with old design, ugly and disposable**.

The survey collected data about the essential needs that maternity clothes should cover. Women expressed that the clothes must be **comfortable** and offer different styles following the trends of the moment, with youthful designs avoiding baby themes. Clothes also must permit the free movement and have the possibility to adapt to the different stages of pregnancy body, but adapt to the post pregnancy too, to extend the clothes life. Women suggested that the clothes must use fabrics with nice texture soft to the touch, because pregnancy is a state where women are very sensitive. They suggested fresh natural fibers and expandable materials. Another suggestion **was not to design tight clothing and**

design clothes that could help them to contain and carry the weight of the belly, since some had presented back problems such as pain and even herniated disc problems. Finally, women expressed that the clothes should be easy to put on and cheap.

For the post-partum, women mentioned that one of the main necessities is that the clothes **allow to feed the baby**. The clothes must be good to permit breastfeeding and take the milk. Some of them suggested applying a cushioning in this area to avoid that the breast milk could stain the clothes. The freedom of movement is also important. **Clothing should not be stiff, or tight**. Some women whose babies were born by cesarean, indicated that clothes must be comfortable in the lower abdomen. *"Good for breast feeding is a must, comfortable in the lower abdomen (I had a c-section), permit movement and soft fabric to prevent irritations (again, because of my c-section this was a struggle)."* They also indicate to use natural fibers or fabrics with soft touch to avoid hurting baby's skin.

70% of the people bought or adapted their clothes during the different stages of pregnancy. Women that adapted their clothes added more fabric to the sides, put elastics on their pants (on the waist area), and added more buttonholes to go through the button as the abdomen grew. **After pregnancy, more than half of the women interviewed did not wear their pregnancy clothes again**. Most of the women donated them and gave them away to friends. Fifteen people kept them in their closet and only three threw them away. At the end of the questionnaire, as an optional question, the respondents were asked to leave their email address to be contacted for the design evaluation, there were six positive responses.

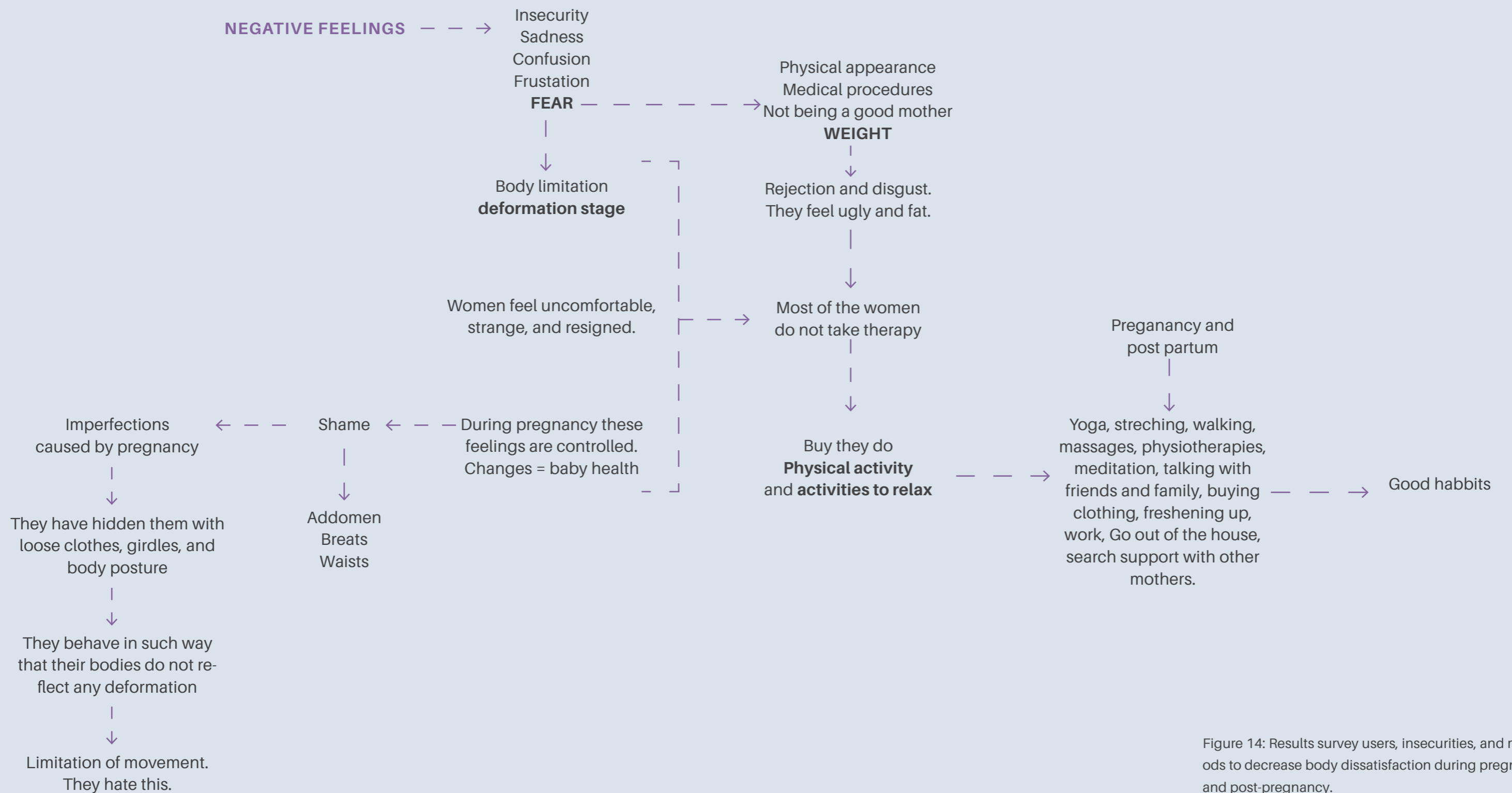


Figure 14: Results survey users, insecurities, and methods to decrease body dissatisfaction during pregnancy and post-pregnancy.

3.2.6 DISCUSSION:

The objective of this survey was to discover how women feel about their bodies during pregnancy and postpartum, learn about how they experience body dissatisfaction and what they did and do to feel good with their bodies. Furthermore, the survey was planned to know their experience with maternity clothes, to understand if they feel comfortable and happy with the offer of products that exist in the market right now.

Findings indicated that pregnant women and new mothers have high levels of body dissatisfaction. The fact that they describe themselves with negative adjectives and that they feel insecure within their family nucleus, confirm what was exposed about body dissatisfaction on pregnant women on the last chapter. Pregnancy represents a liminal stage on women life in which the social family and the social individual are transformed. This is related with the loss of identity on the motherhood. Women are transformed into a different kind of person, a **“new mother”** (Upton & Han, 2003). **The survey indicate that women have difficulties in accept their new bodies their new identities.** They describe pregnancy like a period of “deformation” where their bodies and how to treat them is a key piece to regulate their insecurities.

Although most of the women presented problems with their body image, few of them seek help from a professional to improve their self-esteem. They believe that it is not necessary. **This reflects that people still live in a society in where women must be strong and endure everything, more with the processes of pregnancy because it is a “natural.” However, women search for other kind of activities to regulate their dissatisfaction most of them related with physical activities.** Walking, yoga and stretching were the most mentioned. Also touch their bodies give massages and take physiotherapies help them to appreciate their bodies and relax them. **This confirm that body functionality method can help women during this period.** Body functionality can help women to positively reframe the way they think about their bodies, by make them concentrate on what their bodies can do in an optimistic way to generate good feelings about it (Alleva, Martijn, Van Breukelen, Jasen, & Karos, 2015). Related with this it was asked to the women if they have appreciated their bodies for what they can do with it. Women indicated

have admired their bodies for being able to do physical activity and feel their breathing. They also indicate that to touch their bodies and touch others make them consciences about what their bodies can feel. Being able of host life was also a reference of pride and body appreciation. This confirms what Watson (2016) et al. claimed about how pregnancy women can negotiate the changes to their bodies as they recognize the functionality of the body in the context where the body grows for the baby’s health and development. **These answers on the survey ensure that body functionality can be a good tool to be applied on projects to help women to appreciate their bodies during pregnancy.**

The survey reveal that **women try to hide the imperfection caused by pregnancy.** For them, the abdomen became a shame area. Most women use clothes and modify their behavior to hide their imperfections. These answers validate what Upton (2003) et al. exposed on their paper about women on the postpartum. **After the birthchild women experiment the loss of her pregnancy identity. Bringing another period of instability.** In this period women search to return to their previous personality. Women express that they want **“get the body back”**. However, this expression does not refer only to the physical stage of the body it also expresses that they have the rush to recover their identity and their being. To be appreciated beyond the conception of being a mother.

In the intent to come back to the previous body women surveyed admitted to having changed their behavior, many of them avoid showing their body by covering it with clothes or elements that style their figure. Others modify their posture, they stand, walk, and sit in a way where their bodies do not reflect any **“deformation.”** These believe about the deformation of their bodies is often reinforced by society. A large part of the women surveyed admitted having received advice on how to treat their body after pregnancy. These “suggestion” given by families and friends make them feel bad, especially because they feel overwhelmed with these activities and their new babies. Some of these suggestions such as the use of a girdle, and the use of creams and oils, limited women’s mobility and make them feel that their bodies were imperfect even before they were pregnant. With the results can be concluded that many of these **suggestions given by people do not help the women to improve their feelings about their appearance.** They generate more anxiety for women during this process, so many of them should not be used to generate a positive image in women and people must limited their opinions because sometime these ideas can be dangerous.

The support of their families and their friends helps women to feel good with their bodies after the baby was born. In the survey the women indicated that be in **contact with their family, feel the support of their husband and meet with friends help them to improve their mood.** They also search this kind of support by searching activities where they can share their experience with people who have gone through the same journey. It can be concluded with these answers that women search groups where they can feel identified. They explore a new way of rebuilding their personality and balance their new activities. Upton (2003) et al. explain that women have the necessity of search clothes, foods and adopt behaviors that help them to be part of a new self, and that help them to define their personality. **Going out of their routine inside of the house helped women to generate a better attitude on the postpartum. Activities like walking, yoga, massages, and physical therapy also help them to reconned with their new body and "close the cycle"** like some of them refer to this stage. Body functionality method also can help women to recover in of this stage, it can be a way of discover their new bodies and identities, because the theory does not focus only on physical activities but also in find new ways of body appreciation as well senses, creative endeavors, and communication with others (Alleva, Martijn, Van Breukelen, Jasen, & Karos, 2015).

The survey included a section dedicated to maternity clothes. In this section **women answered that maternity clothes change their perception about their body.** Some of them worn them with joy, but most of the women indicate that maternity clothes made them feel bad. **They indicated that the offer existed in the market do not fulfill their necessities.** They referred to the maternity clothes like ugly, old, and expensive. Even when these garments are comfortable, women believe that this is not enough. **They prefer to buy normal clothes during these periods because to wear maternity clothes makes them feel unattractive.** They think that maternity clothes are expensive because it can be used only for short time. They also argued that these clothes do not follow the trends, and that it is **impossible to find clothes that help them to define their style, there does not exist customization.**

During pregnancy maternity clothing can represent a medium for which pregnant women can practice control about their own body, this could decrease certain identity tensions (Breda, Lehmann, & Arshad, 2015). For that reason, clothes became a key element to control body dissatisfaction. Women on the survey revealed that they select clothes that can adjust to their bodies. Dresses, especially those with system to

adapt, were their favorite garment to use. **In general, they search for clothes that makes them feel comfortable, free, and trendy with an accessible price.** Some of them adapt their own garments adding more fabric or implemented mechanism to create more space. Others bought secondhand clothes or use borrowed clothes for friends and husband. They ensure that men garments are more comfortable.

Women also answered that the main necessities that **maternity clothes must cover are to be comfortable, offer different styles, permit free movement, be adaptable for the different stages of the pregnancy and adaptable for the post pregnancy period, and be easy to wear.** They also suggest the use of soft, expandable, and natural materials. For the structure they indicate the necessity of something that help them to carry the belly. **For the post-partum women mentioned that be able to feed the baby** in an easy way was one of the main necessities in the clothes, following by permit the free movement and be comfortable.

The objective of the survey was achieved. Results indicate information about necessities and problems that pregnancy women suffer. The material will help to identify opportunities where design can be applied to generate an industry more inclusive that could help women to reduce their body dissatisfaction.

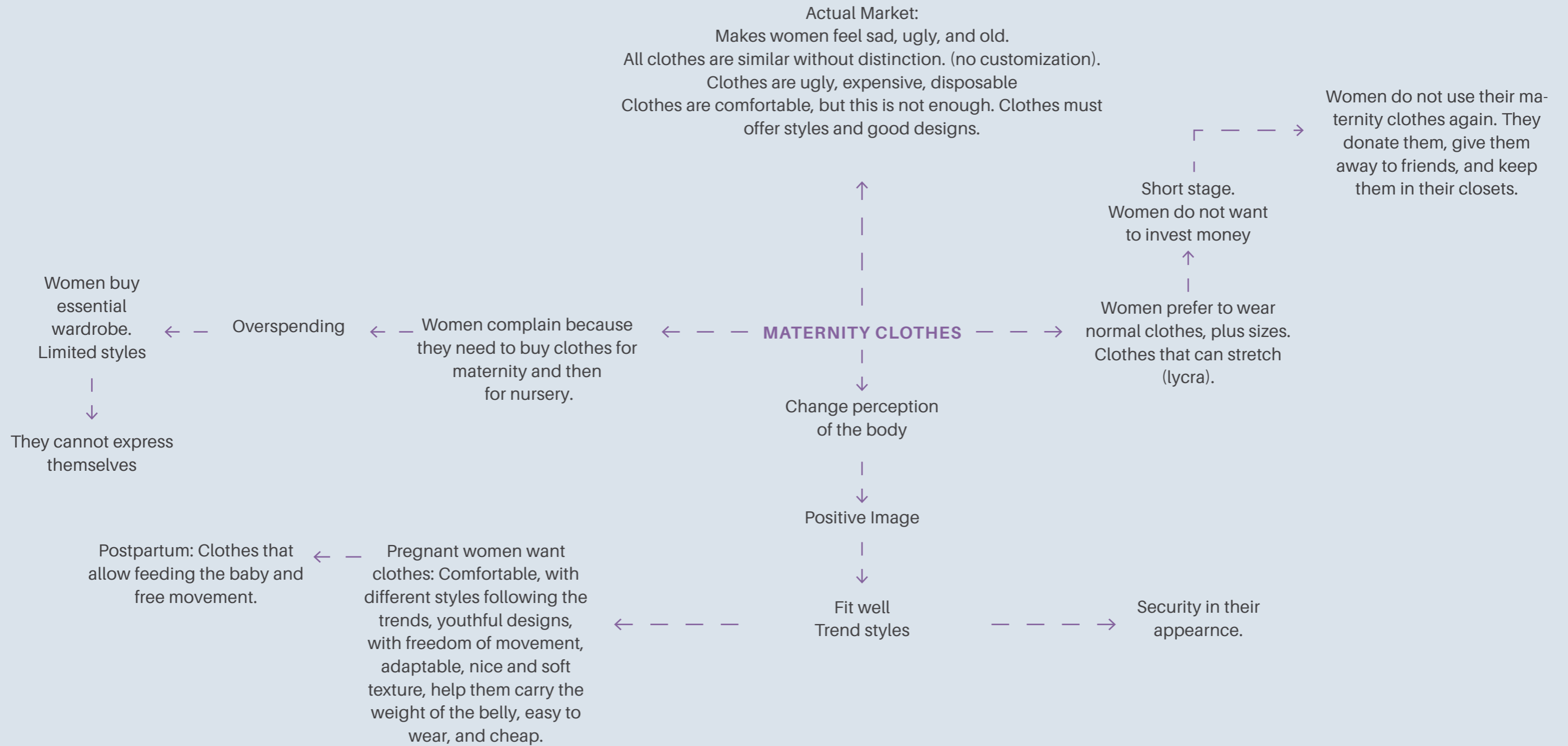


Figure 15: Results survey users, maternity clothes.

3.3

INTERVIEW: EXPERTS FOCUS ON BODY

Body functionality approaches

Avalos et al. (2005) identified the “respect of the body by attending to its needs and engaging in healthy behaviors” as one of the main components of positive body image. So, body functionality should be encouraged to promote a healthier relationship with the body. Psychologists have found that people engaged on following healthier behaviors, such as participation on sports or eating healthy meals, present a better body positivity image (Wood-Barcalow, Tylka, & Augustus-Horvath, 2010).

Moreover, it has been discovered that physical activity and yoga-based fitness can help people to focus more on the functionality of their bodies and to focus less on their appearance (Martin & Lichtenberger, 2002). Yoga teaches people to focus on how the body feels internally. The exercises in yoga classes are based on observing internal sensations rather than on monitoring appearance, and mirrors are usually absent. The experts claim that this focus does not finish when the class ends, they argue that people conserve this philosophy in their life (Boudette, 2006). People that practice Yoga have lower levels of self-objectification. They exercise for health and fitness reasons (Prichard & Tiggemann, 2008). They also experience greater levels of body satisfaction (Daubenmier, 2005).

Massages have also been validated as a way to focus on body functionality and increase body satisfaction. In an experiment made by Dunigan et al. (2011) discovered that massages may improve body image, since they offer participants the opportunity to experience their bodies as a “vehicle for the experience of pleasure,” where the focus is on how the body feels, rather than on how the body looks.

3.3.1 INTRODUCTION

Due to the constant responses of both, experts and users, to use physical activity and methods to relax the body such as massages and yoga to generate a positive image during pregnancy and postpartum, and the above information mentioned about the verification of these methods as a way to generate positive body image two interviews to body experts were carried out (see Appendix A.3 to consult the questionnaire). The main objective was to verify the efficiency of these methods during pregnancy, discover what type of exercises are applied during these practices, and how the user can apply them. The experts selected were a nurse (yoga instructor) and a massage therapist, both with experience working with pregnant women. A structure of seven qualitative questions was built. The interviewees were informed that the information collected will be used for academic purposes, and that data would be used in an aggregated format. The interviews were conducted online, lasting approximately half an hour each.

3.3.2 PEOPLE

Two body experts were contacted, Maria Lemus Hinojosa nurse and yoga instructor, and Silvia Elena Moreno Vázquez massage therapist. Both with experience working with pregnant women.

3.3.3 MATERIAL

For the interview structure a questionnaire of seven qualitative questions was developed (see Appendix A.3 to consult the questionnaire), focused on verifying the efficiency of physical activity such as yoga and massages during pregnancy, discovering what type of exercises are applied during these practices, and how the user can apply them. The qualitative descriptive material has as objective the exploration of complex situations to reach a deeper understanding of the life’s experiences of participant with pregnant women clients.

3.3.4 STRUCTURED SURVEY QUESTIONS

To understand how activities such as massages and yoga help women to reduce their body dissatisfaction during pregnancy and postpartum, the questionnaire asked information about how these methods work. Deepening on how women can apply them and the benefits that they could receive.

3.3.5 RESULTS

Based on their experience the two interviewers commented that **yoga helps pregnant women to feel better with their bodies**, because women work with their mind and physique. They establish a connection with their interior being. Through the **meditation and the conscious relaxation**, they start to know their possibilities, the areas where they need to work more (pain, stressed areas), and know their breathing (how to control it to provide calm). It helps to understand that **having a healthy, flexible, and strong body** is much more satisfying than having a beautiful body.

The **massages allow women to recognize their body limits**, to know the different sensations that they could have if they touch different points of their bodies. They start to recognize how their body regions are connected, what are the different reactions that they could feel. **The massages can bring emotions to people, their objective is to sedate the nervous system**; therefore, the feeling of anxiety decreases with its practice. The self-massage is good for pregnancy because it generates Oxytocin, also related with the **masturbation**, that help women during the childbirth.

The interviewees expressed that pregnant women must **do exercises that help them to relax the musculature of the hips, the sacroiliac joint, the pubis, the groin, the lumbar and sacral areas** (activities that help them align the column). Do exercises that help blood circulation in the legs and feet, exercises that tone the pelvic floor and breathing exercises. After the childbirth they must do more tasks focused on **strengthen the pelvic floor, but in general tasks to relax and strengthen the whole body**. After the labor the

back and hips zones are the more tired. Furthermore, women must practice their flexibility, and apply massages in all their body, they only need to be very subtle touching their feet, ankles, and the upper edge of the trapezius in its central part (point 21 of the gallbladder in acupuncture), since they are areas that trigger contractions. The experts also recommend self-massage in the vulva with almond oil. The massages also, can be an activity that can help people to connect between the family members. These can be applied for the husband and can be focused on the belly. For the **post-partum the women can massage their feet, ankles, hips, sacral and lumbar area, nipples and breasts, abdomen**. In general, the massages must be applied in the direction of the heart, this means from the extremities towards the central torso, since the blood is mobilized towards that organ.

Lastly the experts recommend like another body exploration to brush the nipples in pregnancy with a natural bristle brush to prepare them for breastfeeding, and practice the physical exercise that women prefer, but without getting tired because they will need all their strength for the moment of delivery. They also recommend like an external activity the exploration of the voice because speaking organs are closely related to the reproductive organs.

3.3.6 DISCUSSION

The objective of these interviews was to know more about the efficiency of the physical activity and massages to improve the well-being of the body during pregnancy, to discover what are the areas and points in which people can proportionate pleasure and relief pain, and to know more about how these techniques can be applied to proportionate flexibility to the body.

Findings indicated that **massages and yoga are good tools to help women to feel better with their body**. These are methods help to sedate the nervous system so people's anxiety decrease. Thus, it makes women relax and enjoy their pregnancy more. This can happen with any physical activity that women do; however, women should be careful with the types of exercises so as not to reduce their energy before delivery.

It can observe that the **sacral, lumbar, and hips are areas where women need support to relief pain**. The experts use exercises to improve the flexibility of these areas. Also, feet and legs exercises are important to prevent inflammation and allow blood circulation. The massages can be applied by

the woman herself, by her husband or external people, always in the direction of the heart.

It can be concluded with this material that the physical activity such as yoga the methods to relax like the massages help people to feel better with their bodies especially pregnant women, because yoga and massages help them to relax and dissolve their anxieties. These activities are related with the wellbeing and to promote the body respect, these findings confirming what Avalos et al. (2005) propose in their article *"respect of the body by attending to its needs and engaging in healthy behaviors"*. So, the final proposal of this project should promote a healthier relationship with the body.

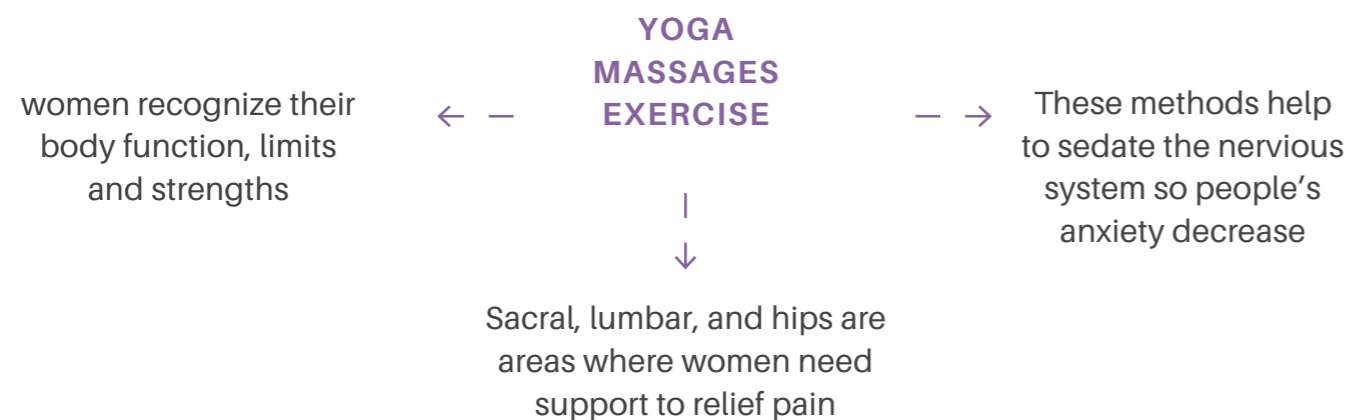


Figure 16: Results survey body experts

3.4

CONCLUSION

Conducting this user research helps the project to understand which are the feelings and needs on pregnancy that women generate in relation with their body. For the user survey and the interview expert material can be conclude that women during pregnancy have low body positivity image. Both materials showed that women refer to this stage like a **"body deformation"** period in which their bodies are changing but also their personality. They feel insecure and confused. These feelings generate fear towards the unknown and frustration for the irremediable changes, such as Upton et al. (2003) explained it *"mothers struggle with the lived experience of what it means to attempt to recapture a "lost" identity, forge a new one, and be responsible for a new kind of body and self."*

It can be concluded that both, **psychologists and women during pregnancy and postpartum, use the theory of functionality to create good habits that enhance the creation of a positive body image.** The application of this theory is based on two phases the emotional, where women feel in a secure space to express their feelings, and the body phase, where they do physical and relaxation activities. Although, most of the women did not go to the to the psychologist, they follow the second phase to make their

body feel good. This kind of theory application aim to **help the body to feel better and relax, as well as help women to improve their movement and regain the feeling of freedom and independence.** It can be established for the results that all kind of exercise, good applied, can help women to feel better with their bodies; However, the experts recommend activities in which women can be conscience of their body's characteristics in a physical and metal level. **Walking, stretching, yoga and massages** where the activities more mentioned in all consultation materials.

In the three materials presented (user survey, experts' interview, and expert body interview) it can be perceived that the pregnancy body demand different conditions related with positions, temperatures, and pressures during the three stages of pregnancy. Also, it can be observed that the three materials points that the **hips, the sacroiliac joint, the lumbar and sacral areas are zones in which women suffer discomfort**, and that the exercises applied are the ones that help the body to relax the musculature of these regions make them more flexibles.

The word **movement** was essential in all the studies carried out. Psychologists said that staying active is vital for a woman to feel

happy. Likewise, the women indicated that one of the main reasons for feeling happy and appreciate their bodies is to move. **Using elements of accessories that limit their movement make them feel bad.** Interviewees and surveyed showed also that the bond between mother and son is good to generate body positivity image. To make women to feel happy and proud of their bodies. Most of the woman indicated that although they feel bad for their appearance, they were happy to be mothers, and this helped them to love their new bodies. The experts indicate that they also perform bond exercises in their sessions through focus women attention on the belly. After childbirth they also suggest “por-teo” exercises. Furthermore, women and experts indicated that the feeling of being sup-

ported by family/ friends or feeling identified with other women (community), help new mothers to define their new personality and feel good with their bodies. Women need a space free of prejudices, where they can express their feelings freely. In this case they need a space of support with human contact.

In general, women indicated that **maternity clothing in the market lacks design.** Especially since **many brands focus on comfort but not on other aspects, such as style, the life of the product, and the price.** Women do not like to buy this kind of goods and most of them prefer to use normal garments and adapt their clothes until the state of their pregnancy no longer allows it. Even when some of them buy maternity clothes for the

last trimester, they do it with disgust. Some of them choose to buy second-hand clothes or wear clothes given away from friends or borrowed from their male partners. It can be concluded from all the information recollected, that to generate a body positivity image on pregnant women fashion products must take in account requirements and keywords presented on the figure 17.

These requirements will help the project to create designs that could be relevant for the user and that could be pleasurable to use. Specially to design things that help to reduce body dissatisfaction on pregnancy and new mothers. Fashion must be aimed to change the current system. Becoming more inclusive and bringing innovation in extending value in

resources through design for longevity, and change and improve the service, to create a respectful industry to every human being and with the planet. Those are elements that the same consumer is asking. They are trying to change the system; the body positive movement is one example of how people are fed up with the current situation which stigmatizes people who do not fit into the perfect body stereotype. In the next chapter we will introduce how people are changing the system and how these movements are bringing a new way of thinking and producing focusing on universal bodies.

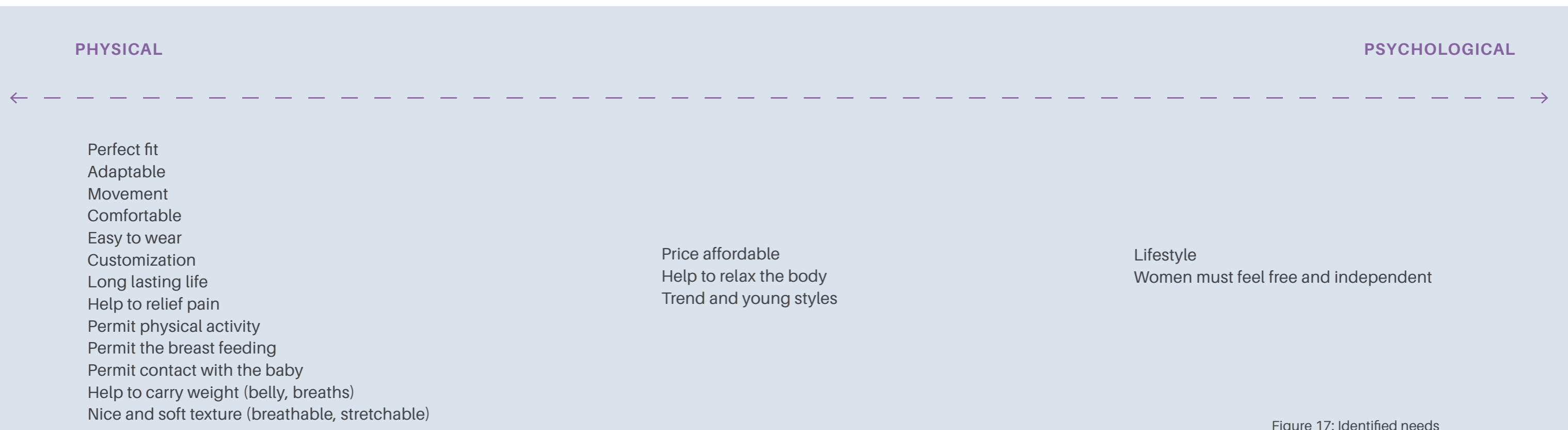
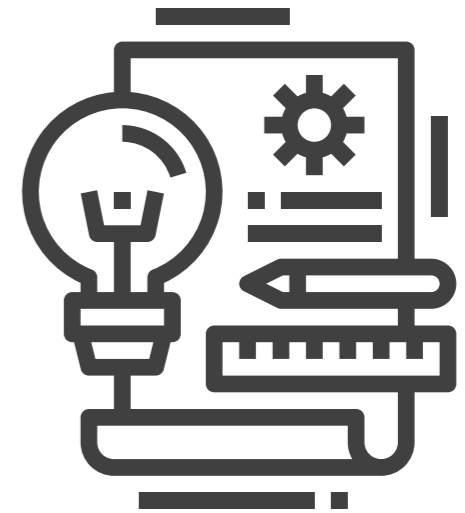


Figure 17: Identified needs

CHAPTER FOUR TECH SOLUTIONS AND FASHION TRANSFORMATION

4



STATE OF THE ART

The designers are starting to change the rules. With the help of the new technologies and the introduction of new values and ideologies they are searching innovative ways to increase diversity on fashion. Social media opened the door to explore a varied body portrait. This brought the introduction of different physical attributes on several channels that break with the idealization of the perfect body. It also, brought the introduction of new technologies and new exploration to change the manufacturing processes. Those changes are generating a creative approach to vindication of the body. This means that the designers are establish processes to take care of the bodies, treat them with respect and generate a diversification on the industry.

This chapter will explore how the new ideologies born, what are the changes that the industry is implementing, and how the new technologies are making this possible. Furthermore, it will present a series of case studies that will work as inspiration to generate the final solution of the project.

4.1

BODY POSITIVITY MOVEMENT

In the last decade, the body image concept has begun to extend beyond a primary focus on body image disturbances and examine the construct of positive body image. This new perspective is knowledge like “body positivity” or “body positivity movement.” This movement **reject the narrowly defined and inaccessible body ideals in favor of a more inclusive and positive conceptualization of body image** (Cohen, Irwin, Newton-John, & Slater, 2019).

This movement emerged from the 1960s feminist-grounded fat acceptance movement that appeared in reaction to the rise in anti-fat discourse in Canada and the United States. The fat acceptance movement aimed to encourage a

debate about societal beliefs of body image and protest against fat people discrimination (Afful & Ricciardelli, 2015). Likewise, body positivity movement has like **objective to challenge the thin and beauty societal and media ideals and grow acceptance and appreciation of bodies of all shapes, sizes, and appearances** (Cwynar, 2016).

Cohen et al. (2019) in their article claim that body positivity is based on six core components, **body appreciation** (gratitude for the function, health and unique features of the body), **body acceptance and love** (accepting aspects of the body that are inconsistent with idealized media images), **conceptualizing beauty broadly** (perceiving beauty based on a variety of appearances and internal characteristics), **adaptive investment in body care** (tending to the body’s needs through exercise, sleep, hydration etc.), **inner positivity** (feeling beautiful on the inside which may radiate to the external appearance and behavior, e.g., kindness, mindfulness), and **protective filtering of information** (rejecting negative body-related information while accepting positive information.)

This movement has been **driven by social media**. Social media platforms offer a more democratic approach to content generation than traditional media. This has allowed the visibility of more diverse portrayals of beauty (Lazuka, Wick, Keel, & Harriger, 2020). In 2012 plus sized model and feminist Tess Holliday, founded the @effyourbeautystandards, Instagram account which launched a campaign in response to messages across media which proclaimed that women were not beautiful if they were above a size 10. Tess Holliday has become one of the main figures of body positivity movement. She became in 2015 the first model over a size 20 that appeared on People magazine 2015 and that signed with Milk Management leading model agency of Europe. Holliday started the inclusion and representation of fat bodies on the fashion industry (Cwynar, 2016).

Since Tess Holliday appearance, the popularity of online communities dedicated to body positivity has grown, especially on **Instagram**. **This platform offers to the body positivity supporters a global platform to reframe the prevailing discourse on body image, beauty, and health in the media to be more inclusive** (Cohen, Irwin, Newton-John, & Slater, 2019). Only in January 2020 over 11 million of post were tagged with #bodypositive hashtag (Cohen, Newton, & Slater, 2020). These posts include images of diverse body sizes, fitness, and yoga practices of fat women (that looks to argue against the think that fat women are not athletics), and even post that try to challenge social believes around beauty and femininity, such as norms around shaving and menstruation (Cwynar, 2016).

With the growing popularity of the body positive movement on social media beauty and fashion industry started to include and capitalize on the movement to gain popularity with activist women. Brands started to include more diverse models that represent what the average women appears as (Chait, 2021). Some of the brands that started and continue to follow the philosophy of body positivity are Dove and Aerie. In 2004 Dove cosmetic brand owner by Unilever, launched their campaign Real Beauty that claims that women’s unique differences should be celebrated. This campaign has lasted more than a decade with an indispensable success. It has been credited with being “on the natural beauty train long before many were even thinking about it” (McCall, 2020). In 2014 Aerie, a lingerie and undergarment retailer owned by American Eagle Outfitters Corporation, launched “Aerie Real” campaign that use real women images without retouching. The campaign received positive acceptance by their consumer and the media (Chait, 2021). These companies were a direct influence on other brands that have been trying to promote inclusivity in different ways such as Nike. This brand promotes women empowerment and female inclusivity in sports. Its promotional material showcases individuals of various backgrounds, skin color and gender identities. Even their mannequins, which now include a plus-size variant, push their message of diversity (Rebekah, 2021).

Despite of the ostensible benefits of body positive movement, some experts argue that the movement continues to reinforce, rather than nullify, society’s preoccupation with appearance over other attributes (Webb, Vinoski, Bonar, Davies, & Etzel, 2017). Others claims that the movement has become politicized and commoditized by corporations (Cwynar, 2016). Body positive influencers may be approached to promote alteration of the movement values as long as they are paying to promote certain products (Lazuka, Wick, Keel, & Harriger, 2020). Furthermore, brands tend to apply this movement with an erroneous perspective, because some of their “real women images” still represent an idealized stereotype. They frequently are white and do not have any imperfection like scars, stretch marks, etc. (Luck, 2016). Brands also tend to exclude marginalized groups, such as people with disabilities or individuals from racial or ethnic minorities (Lazuka, Wick, Keel, & Harriger, 2020).

Some brands have taken notice of these mistakes, and have begun to expand their inclusivity, for example in February 2020 the model Jillian Mercado, actress and American fashion model with muscular dystrophy, was invited to participate on The Blonds runway during New York fashion week. (Drohan, 2021). Other example is the brand Gucci beauty. In January 2020, the brand launched Gucci L’Obscur Mascara campaign starring by Ellie Goldstein, model with Down’s syndrome (Crowther, 2021).

What is clear is that the **body positive movement has begun to change the rules of the fashion industry with inclusive advertising campaigns and expanding the variety of sizes on the market.** Brands like universal standard, ModCloth and Asos provide clothing from straight through plus sizing. They search to provide the same level of style, quality, and respect to every different body. But also, this movement has started to redefine the fashion system process. Brands and new entrepreneurs are trying to find new forms of production that could fulfill the necessities of each body and that can improve the purchasing experience. These new approaches also, bring other kind of values related with sustainability and consumption, because being a brand that promotes body positivity should not only be having a greater variety of sizes but also finding the best way to adapt clothes to different bodies with the most responsible manufacture process.

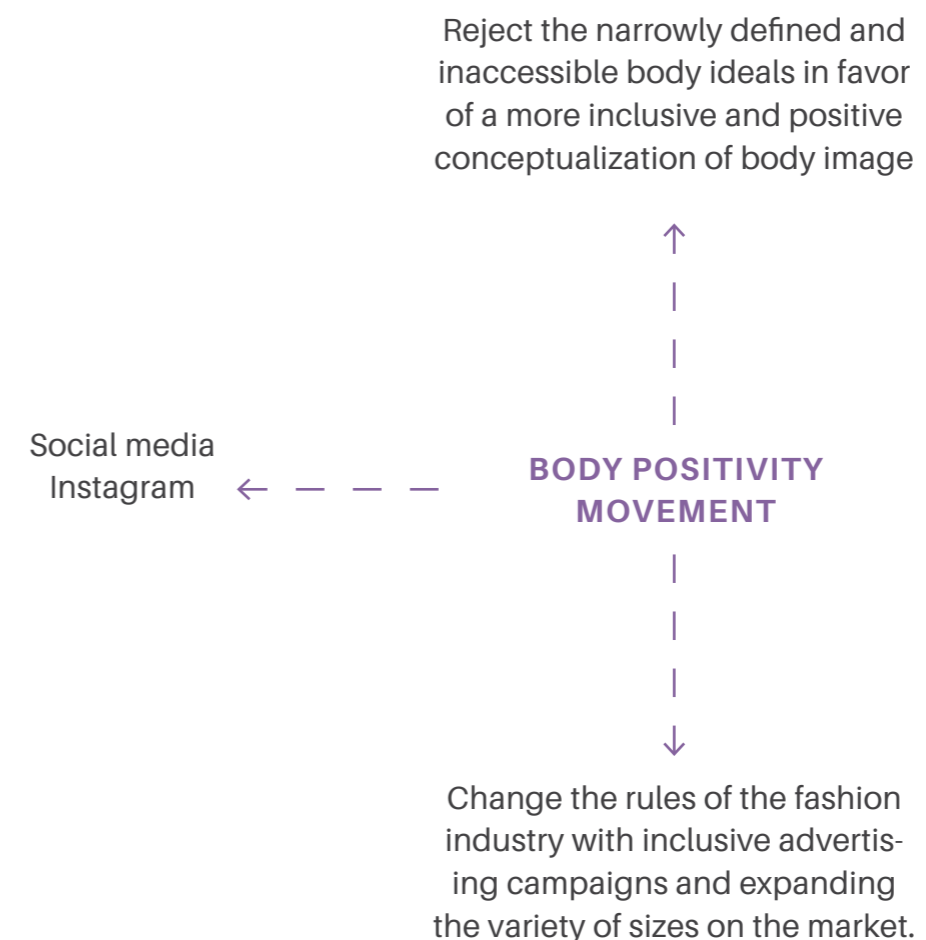


Figure 18: Body positivity movement

4.2

TECHNOLOGY-DRIVEN REDEFINITION OF BODY STANDARDS IN THE FASHION INDUSTRY

Fashion is no longer merely aesthetic. It is a statement that affects the world around it (Rebekah, 2021). **The fashion industry is becoming more and more body positive as time goes on.** Like the thesis had mentioned before brand and retailers are pushing out more collections with more sizes. However, the change in the fashion industry its deeper, the fashion system has been questioned.

Body positivity has begun to be part of larger concepts such as **fashion activism, and slow fashion.** **These concepts are characterized for promote social innovation and sustainability and to be linked with social and political change.** Designers can use these elements to promote fair representation and have greater inclusivity of people with diverse characteristics. These concepts are new ways of how fashion can approach and treat its users (Rebekah, 2021).

Fuad-Luke (2009) define design activism like a “design thinking imagination and practice applied knowingly or unknowingly to create a counter-narrative aimed at generating and balancing positive social, institutional, environmental and/or economic change.” So, designers can be considered activists if they use their skills to improve and change current situation for social and/or environmental betterment. Design activism gives designers the opportunity to invite the users to work with their products and customize them to fulfil their own personal needs. Coupled with this, the slow fashion concept encourages a change

in the system of manufacture and distribution towards slower production cycles and reduced material quantity. It benefits from local craftsmanship, high quality and locally produced garments (Fletcher & Grose, 2012).

In addition to this mentality change **new technologies are emerging.** **The technologies are helping to generate the change from mass production to a more personalized manufacture where the specific needs of everyone are included.** The **3D body scan** is one of these technologies. The scan process can be used for the generation of virtual and physical clothes, it uses essential landmarks and anthropometric data to guide the design and sizing of garments. The two most important advantages of this technology are its accurate information to produce perfect fitting garments, and its rapid scanning time (Fan, Yu, & Hunter, 2004). It also delivers the output in a digital format which can be integrated automatically into apparel CAD systems like Gerber and Lectra (3D representation of clothing products, based on a personalized avatar). This technology permits the brands to offer custom products. The tailor has at his disposal any measure of the client at any time, and in for the future consumers can reproduce clothes that fit well to them once their scan is done (Mazharul, 2021).

The industrial designer Leonie Tenthof van Noorden, used 3D body scan to generate a range of leather dresses in her “This Fits ME” collection. Her collection is based on a basic dress design which can be easily scale to the exact proportions of the consumer. Her process is simple *“The customer gets a body scan, so you get a 3D model of the body in the computer... I scale the dress accordingly and then project a generative line pattern on top of that digital dress.”* The generative pattern enables customers to customize the dress around the curves of their bodies. Then the design is translated from digital to physical (Hobson, 2021). This is one example of how 3D scan is changing the way is how to produce the clothes more centered on the user physiognomy.

3D body scan has evolved, today we can find different kind of scanners. For example, CALA app, which offers everything needed to run e-commerce operations. This app use 3D body scan technology. It asks their clients to take a photo. Then with the use of sensor technology they match these images with the scans of different people that they did previously, this gives an accuracy of millimeters (Perez, 2021). This app has been used for small entrepreneurs like the brand Redthread. This startup through its website asks to their customers to fill out a “fit quiz” and capture a series of full-body photos with their phone. Redthread pulls 3D measurement data from those photos and combined with a customer’s fit preferences, creates a made to order item (Pardes, 2021). This is an example of how currently small brands are trying to implement 3D body scan in their merchandising to offer a better service and approach with their clients.

Traditionally, alteration of garment patterns is an essential step in producing attractive and accurately fitting clothing from patterns which already exist. However, this task became difficult when people does not fit the standard size on the market. **Computer - aided design (CAD)** programs can process the measure information and perform the functions more rapidly, accurately, and consistently than the most experienced patter maker (Istook C. L., 2002). So, these programs offer customization through automatic alteration of patterns based on individual measurements. The programs construct a parametric human body which represents the user or customer as close as possible, a digital twin (Jellema, Bie, Zhou, & Huysmans, 2020).

CAD alteration systems enable the creation of garments, customized for fit, very quickly and accurately. These customized garments can be inserted into normal production line as an additional "size" and produced like every other garment of the same style (Fan, Yu, & Hunter, 2004). This kind of software can bring several advantages to the production line. They can reduce the length of the design process, the prototype can be implemented quickly, they can reduce the cost and time of the production, and people can evaluate the virtual clothes in every moment this ensure that the design is in line with the needs, comfort, and fit of the consumer (Wang & Liu, 2020).

Most apparel CAD systems such as Gerber Technologies, Lectra Systems, Investronica, Assyst, PAD, Optitex and Clo3D have several preparatory activities in common that can ensure the comfort and fit of the clothes. For example, on Clo3D is visible the range of pressure distribution and the contact point, if the garment it is very tight the designer can have the possibility of see it and modified it following the necessities of the consumer. Furthermore, in this kind of software is also possible to see the behavior of the garment on the body and the details and comfort of the fabrics (Wang & Liu, 2020). The virtual clothing display is very close to the reality, so it can be presented to the clients to know their ideas and opinions, and these can be directly communicated to the designer, so the designer can improve the clothes based on the feedback.

Brands like Dressarte Paris (2022) custom-made, include this technology in its service. Dressarte Paris is a sustainable online atelier that produces custom and made-to-measure casual and bridal clothes from upcycled and eco-friendly fabrics. The brand encourages women to express their style, identity, and self-confidence by allowing them to modify the design of clothes and adapt them to their body measurements. The brand works side by side with clients to ensure that they only produce what is needed. Its personalization process starts in its website where the customer can select a package or fill a quiz. In this quiz they indicate their preferences of style and design and leave their measurements.

Then they receive a call to complete the design brief and check the first design and fabric option. Once the customer is satisfied the brand create a 3D avatar of the client according with her measurements, so the clients can see how exactly their clothes will fit in their bodies. Once the design is approved the clothes is produced. All this process is done online, anyone around the world can tailor their clothes and be sure that they will fit perfectly on their body.

Digital fitting technology based on digital human model is a good solution for online shopping, for this reason brands are starting to use it on **virtual fitting rooms**. This technology improves shopping value and satisfaction, because like the text has mentioned before the customers can see how the selected garment looks and fits. This technology helps to reduce the return products caused for buying the wrong size (Jellema, Bie, Zhou, & Huysmans, 2020). Retail companies like Style.me, 3dlook, even Amazon are investing in this technology. They create plugin for websites that allows customers to create online avatars to try on clothes for them (Berjikian, 2021).

As can be perceived, these technologies are aimed to improve the traditional fitting rooms leading them into the virtual age. Normal apparel fit problem is a constant for the clients which cannot find proper size for them, and for the retailers for the lost sales, brand dissatisfaction, and time wasted on the fitting room. Furthermore, the market is moving to design an offer a personalized experience, to satisfy the consumer's desire for more individuality. Brand and internet retailers are started to implement **virtual fit technologies on their website**. They are using infrastructure tools that allow e-consumers to see 360°, touch and feel a product through rotating, zooming, and interacting with the images by let them personalize the products (Wang & Liu, 2020). The brand Isabella Wren offers a customization product not only by collecting the measurements of the clients but also let then them to customize the design by their platform. The customers have the option of select pockets, necklines, sleeves etc. while they observe instantly the change on the clothes in the screen.

These companies frequently use the 3D body scan and the digital avatar twin technologies together along with a questionnaire to accuracy the fitting personalization. One example is the brand Unspun, a robotics and digital apparel company building custom jeans for each consumer, on demand. This company use algorithms to digitally design and fit jeans automatically to customers avatars. People choose their jeans style, fabric, thread color, rise height, and hem length. Next, they take a quick body scan to get an accurate character of them. This method helps the brand to eliminates the need for inventory and reduce the waste created by conventional production while it creates a customer experience.

The future of these technologies is not only improving them but create spaces where **people could be able to wear digital garments**, Amber Jae Slooten one of the founders of the brand “The Fabricant”, dedicated to digital garments, expressed that the brand is searching to make a platform where people can be able to scan themselves and create their own digital identity and express themselves using any collection that the brand could have in the platform (Station F, 2021). In terms of production Designers such as Danit Peleg, founder of the brand with the same name, believe that in the future people could download the clothes and fabricate them at home by using other technologies like 3D printing and laser cut (Pardes, 2021). Since 2017 Peleg sells custom-made 3D-printed bomber jacket on her website where allows to people to order and personalize the jacket, and in 2020 she started to offer digital files of 3D printed garments that can be downloaded and then printed at the customer’s nearest 3D printer. Other example of this approach is Martijn van Strien founder of **The Post-Couture Collective** which in 2015 launched its “One |Off” collection. Each of the items could be personalized to the buyer’s measurements and then downloaded to be produced on local laser cut makerspace or delivered as a kit. The garments can be assembled using an innovative construction technique, which does not require the use of a sewing machine. This makes the designs modular, so parts can easily be adjusted and replaced, without having to throw away the entire garment. This characteristic also reduces the cost of production (Tucker, 2021).

These technologies and virtual apparel exposures support body positivity movement. **They broke the standardization of sizes and lead the market to a more customs experience in which each person can be represented.** Furthermore, these technologies offer a fair same level of style, quality, and respect to every different body.

4.3

FASHION AND WELLBEING DETECTION THROUGH E-TEXTILE AND SMART WEARABLE TECHNOLOGIES

One of the main components of positive body image is the respect of the body by attending to its needs and engaging in healthy behaviors (Avalos, Tylka, & Wood-Barcalow, 2005). Thus, it is necessary to indicate that given the results found in the reviewed literature as well as the results showed on the user-centered research. **To generate a body positive image on pregnant women is also important contemplate the wellbeing of the body.** That means helping it to relax, release pain, to generate flexibility and to feel comfortable with the changes. Fashion is starting to introduce this kind of service through smart textile wearables.

Smart wearables can be defined as electronic devices located near to the body to provide intelligent services that are part of a larger smart system with the help of communications interfaces (Fernández-Caramés & Fraga-Lamas, 2018). Charlotte Kerner et al. (2019) in their research discovered that wearables could help people to improve their satisfaction with their bodies. They studied how the wearable “Fitbit” could work like motivation to do physical activity on people. Although they found that this gadget does not provoke enthusiasm to do exercise, they found that wearing the “Fitbit” led people to appreciate and

value their body for physical movement and functional capabilities. The device helped people to place less value and emphasis on aesthetic qualities.

Clothing is starting to be perceived, not only as a tool to keep people warm as it was considered before, but also as a **tool with new functionalities**. For the proximity with the body, and their comfort of use, textiles have become an alternative for the integration of technological systems. **E-textiles or wearable textiles are smart textiles that sense and react to environmental conditions or stimuli according to thermal, electrical, magnetic, or other bases**. This means they react after the interpretation of data generated by conditions/stimuli on the nature (Ismar, Kursun, Kalaoglu, & Koncar, 2020). These textiles can be divided on two categories active and passive smart textiles. Passive smart textiles can change their stage according to environmental stimuli, while active smart textiles are equipped with sensors and actuators that can detect several signals from the environment and then give a response (Ismar, Kursun, Kalaoglu, & Koncar, 2020).

The e-textiles can be segmented on three areas, textiles-smart clothing, electrical engineering-wearable electronics, and information science-wearable computer (Singha, Kumar, & Pandit, 2019). Smart clothing is a type of wearable device that can express various functions while maintaining the emotional and functional properties inherent in clothing. Experts predict that smart clothing growth will be the highest among smart devices in the future (Ju & Lee, 2021). There exist three areas in which this technology is growing fastest health, entertainment, and education (Kan & Lam, 2021). In the field of health, smart clothes were originally designed for use in clinical settings. However, thanks to miniaturization and mobile technology, their use has recently proliferated in the general population as a tool for health and wellbeing (Pérez & Gaeta, 2015).

The interest of designing for wearables is in part driven by technology's ongoing shifts towards social awareness, aesthetic viability, and fashionability (Tomico, Hallnas, Liang, & Wensveen, 2017). In recent years set-up fashion houses and new designers of the industry have been specializing on wearable technology garments. An example is CuteCircuit brand who designs interactive haute couture as well as ready-to-wear collections. Soundshirt, is one its products. This t-shirt allows deaf and hearing audience members to experience music and virtual reality enhanced by real-time touch (haptic) sensations. The garment is controlled by an app that allow to feel hugs and music to be felt in real time while on the move. Another example is Pauline Van Dongen a fashion designer specialized in smart textiles and smart clothing. Between her projects it can be found Issho a smart denim jacket which strokes the wearer's back in response to touch. This jacket help people to be more aware and present through the

sensations experienced when wearing the jacket. The garment system uses a microcontroller that turns on when it senses is being worn.

By its engaging with the body, smart textile wearables have opened a vast filed of opportunities for designer that combine their knowledge with other disciplines in application areas such as wellbeing and lifestyle. Knowing on programming smart materials allows to the designers to create textile and clothes for relaxation, gaming, psychotherapy, and medical diagnosis (Tomico, Hallnas, Liang, & Wensveen, 2017). Designers can make modern digital technologies functional, meaningful, and socially acceptable.

In terms of body appreciation and body wellbeing smart clothes is an option in where fashion is not only taking care of the appearance. Clothing could bring an extra service to generate a body positive image on pregnant women, through the implementation of a system that help women to relax and improve their happiness. **Designer have started to create projects to help the body to feel better**, for example Vibe-ing a self-care garment which make the body to feel, move and heal through vibration therapy. It senses people touch and vibrate on specific pressure points on the body. The structure garment based on textile pockets permitted programming the exact areas and the way of stimulation on the body depending on the specific person's need for rehabilitation and healing. Another two examples are Fysiopal and Mysa. Fysiopal is a posture awareness top, which correct bad upper-body posture by alerting the wearer when they are slouching. The top uses an app to measures the position of the neck shoulders and back, when these measurements are altered, the top will softly vibrate, alerting the wearer to change how they are sitting or standing. Mysa is a tactile breathing guidance. It is a shirt to response to the work-related stress. The smart shirt creates a moment of relaxation by guiding the wearer through breathing exercises using vibrotactile feedback. Breathing exercises are translated into haptic patterns, delivered by six vibration motor positioned along the spine.

These are just a few examples of how fashion through smart clothing is trying to help people to relieve pain and relax the body. In addition to helping them to correct their body behaviors to prevent future body problems. It needs to be understood that wearables have the goal to be the **amplifier of the human body, enable interaction and communication, while also combining aesthetics and style** (Tenuta, 2017). So, wearables provide protection and body enhancement through artificial second skin that can be accepted inside the Body positivity movement like a tool to generate satisfaction on people.

It is important to indicate that although there are currently many wearables

related to pregnancy, most of them are focused on monitoring the health of the fetus or baby, even if few mothers on the survey indicated that this caused them anxiety, the objective of this project is to take the perception and experience of the women, that have been forgotten, related with their physical appearance, and the activities that they do to improve their body positivity image (physical activity, massages, yoga, etc.). For that reason, the examples before mentioned are more related with the body wellbeing, and not with the pregnancy topic.

As it can be perceived, the **body positivity movement is one of the elements that has helped designers to rethink the current fashion system**, since the beauty portrait until the manufacturing system, incorporating new technologies that help to generate a more open social integration diversity. In addition, it has opened the possibility of generating products that promote the well-being of the body, putting it as the main factor. Those elements are important because, in a society in which everyone is different the industry must offer good quality products taking care of their consumers in a physical and mental level.

In the next section will be presented a series of study cases that will be analyzed to understand how they work, what kind of technology and materials they use and how is their user experience. This will help the project to have an overview of what is now in the market and detonated the inspiration for the final proposal of the project.

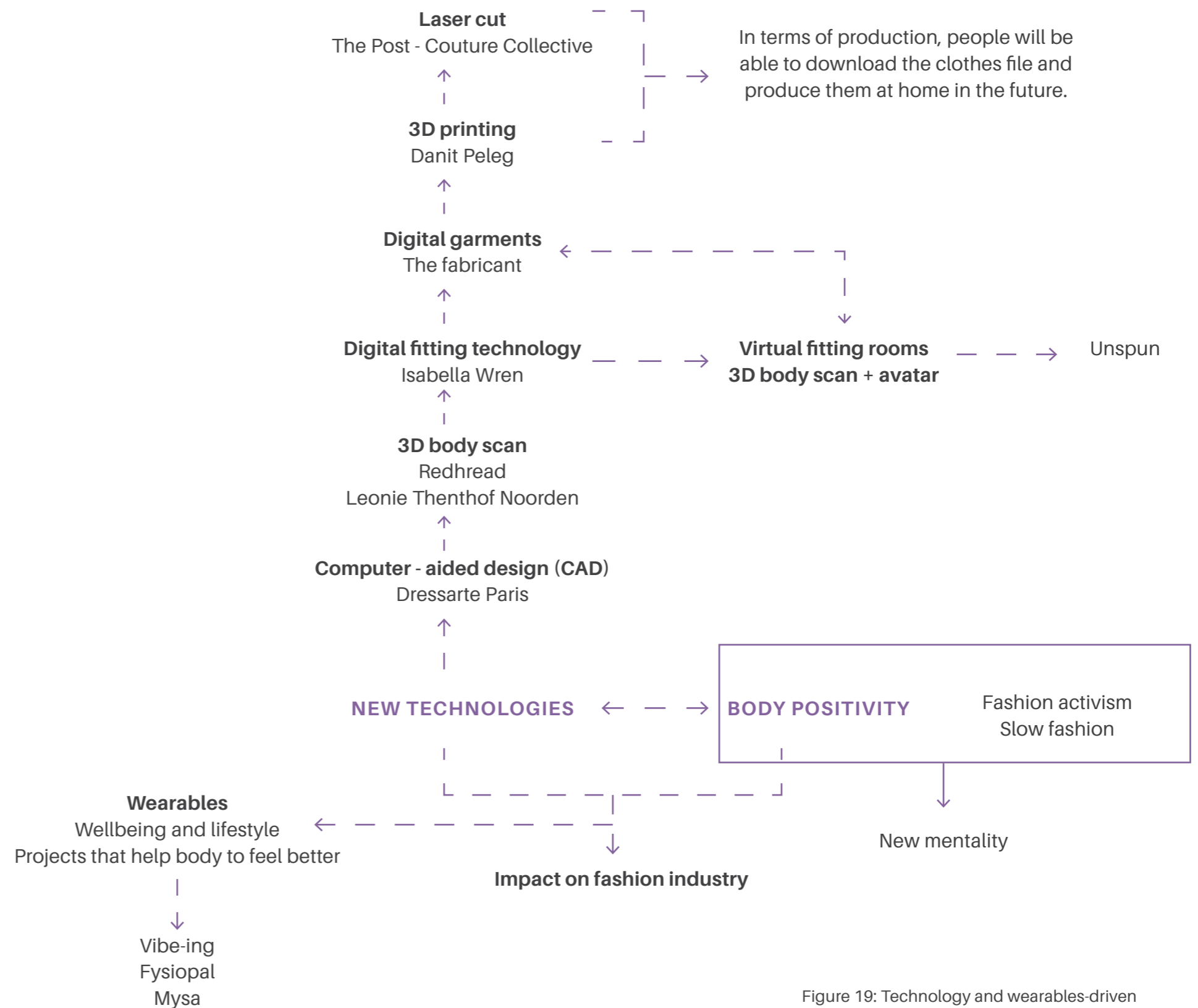


Figure 19: Technology and wearables-driven redefinition of body standards in the fashion industry

4.4

STUDY CASES

In this section a series of studies cases will be examined. The main is to understand how these projects work, what kind of materials and technology they use, how is their user experience, between other characteristics that could help the project to have an overview of what is now in the market. This will detonate ideas and inspiration to generate the final proposal of the thesis.

Because the subject of body positivity covers both the psychological and the physical side, it was tried to research cases in different areas related to the subject. Will be presented **projects related with the representation of the women on the media, projects related will inclusive manufacture system, and projects related with the wellbeing of the body.**

4.4.1 MEDIA AND BODY PORTRAIT

These cases were chosen because they seek to reflect diversity and show pride in the imperfections of the body. They seek to diffuse the idea that there is only one perfect body and invite people to value their image and love themselves.

BEHIND THE SCARS		
DESIGNER/ BRAND	Sophie Mayanne	YEAR OF LAUNCH 2017
<p>Behind The Scars is a photography campaign that celebrates scars of all shapes and sizes. The work of Sophie Mayanne encourages people around the work to love their skin, and their imperfections. She tells the story behind the scars and helps women display them with pride. The campaign is aiming to capture 1000 different scars stories in total.</p>		
CATEGORY	STRUCTURE	MATERIALS
Photography cam- paign body positivity	Website, social media camping, Instagram	Images and video
STRENGTH		WEAKNESS
<p>Teaches people not to be ashamed of their body. Special connection between scars and personal life. Sometimes prevention of sickness. Promote diversity and acceptance.</p>		<p>Creates awareness and show diversity but does not show a deep solution to the problem</p>

REAL BEAUTY



DESIGNER/
BRAND

Dove

YEAR OF LAUNCH

2004

Real beauty is a campaign, based on the real truth about beauty, a global report revealed that 2% of women around the world would describe themselves as beautiful. The main message was that the women's unique differences should be celebrated rather than ignored, to change women's attitudes toward their perception of beauty. This campaign was accompanied by a Dove's self-esteem toolkit, an online resource that includes workshops, activities, guides, and videos to aimed at build girl's self-esteem.

CATEGORY

STRUCTURE

MATERIALS

Multichannel campaign body positivity. It was focused on inner beauty and confidence.

Website, social media camping, Tv commercials, magazines, talk shows.

Images, video, manuals of activities.

STRENGTH

WEAKNESS

Global conversation about the definition of beauty. Brought diversity on the media. Focused on utilitarian outcomes (function). Proportioned tools to improve the self-esteem.

The campaign is still using the concept of social comparison. It is missing cultural diversity. The models are not 100% real. They do not have scars, flawless skin.

MOTHERCARE'S "BODY PROUD MUMS CAMPAIGN"



DESIGNER/
BRAND

McgarryBowen

YEAR OF LAUNCH

2017

Mothercare's was Instagram a campaign that showed ten new mother images taken by the photographer Sophie Mayanne without retouch. The aim was that moms of all shape and sizes could feel identified and generate confidence in their imperfections. Support the true journey of motherhood and their physical changes.

CATEGORY

STRUCTURE

MATERIALS

Instagram campaign focused on motherhood beauty and confidence.

Instagram

Images

STRENGTH


WEAKNESS

Show the reality of motherhood (changes on the body, and imperfections).

Even when the images are not retouched, they look very prepared. The composition of the image, with the baby in her arms, does not seem real.

4.4.2 ADAPTABLE TO THE BODY

These cases were chosen because they show a new approach to the body. Designers are creating products that adapt to the user's bodies. The projects include systems that permit the clothes expand, contract and modified to adapt to different structures. These incentives the movement and gives freedom to people.

PETIT PLI		
		
DESIGNER/ BRAND	Ryan Mario Yasin	YEAR OF LAUNCH 2017
<p>Petit pli is a company that sell clothes for children and adults that adapt to the body. For the kids the clothe grows as the body do. The child can use the garment from 9 months of age to 4 years. In total, the garment grows 7 sizes, "one size fit all." For adults support the capacity of the body to transform and move, especially during pregnancy. The clothes are made with a special structure that can stretch and contract and that brings freedom in movement to bodies. The brand is sustainable, the materials that it uses are recyclable. Their production is made on ethical ecology manufactures on Portugal and London. This project born for the necessity to reduce the consumption and waste.</p>		
CATEGORY	STRUCTURE	MATERIALS
Clothes for child development, and adult body adaptation to change.	Negative Poisson's ratio. Materials know as auxetics, become thicker perpendicular to the applied force. The clothes have these auxetic properties by folding the material to create structural pleats. The pleats expand or collapse in multiple directions which allows to people to move freely	Images
STRENGTH	WEAKNESS	
Sustainable, long-term economic, adaptable to the body, free movement, it expands and contracts, reduce the consumption and generation of waste.	Cannot be used after the child exceeds the seven sizes.	

NUMBAT GO		
		
DESIGNER/ BRAND	Wombat & Co	YEAR OF LAUNCH 2015
<p>Numbat Go is a foldable lightweight baby wearing jacket to carry the baby everywhere. The jacket folds into a shoulder bag in only three steps. It can be used during pregnancy, front babywearing, back babywearing, and normal use.</p>		
CATEGORY	STRUCTURE	MATERIALS
Modular clothes body adaptation.	Modular clothes that can adapt to different stages of the pregnancy.	Fabric composition 86% polyester 10%tpu 4%spandex. Water repellent, wind-resistant, breathable, technical fabric
STRENGTH	WEAKNESS	
Long-term economic Adaptable to the body Free movement Breathable, water repellent, wind resistant	It is not sustainable and biodegradable.	

THE GLOWE MATERNITY LEGGING



DESIGNER/
BRAND

Lucy Ovington

YEAR OF LAUNCH

2014

Glowe is a support legging that help women to relief pain and grows as the body do. It is a comfortable garment that can be used during the nine months of pregnancy and beyond. The patent pending internal bonded system cradles the women's bump to alleviate lower-back pain and pelvic pressure, providing support of a maternity belt with none of the bulk. It can be used after the pregnancy.

CATEGORY

STRUCTURE

MATERIALS

Adaptable and support clothes.

Adaptable legging made of stretchable materials with a maternity belt embedded.

Body: 86% Nylon
14% elastane.
Lining: 85% Nylon
15% elastane.

STRENGTH

WEAKNESS

Long-term economic
Adaptable to the body
Free movement
Support, comfort, uplifts
It can be used to do different activities (versatile)

It is not sustainable and biodegradable.

"ONE |OFF" COLLECTION



DESIGNER/
BRAND

Martijn Van Strien

YEAR OF LAUNCH

2015

The post-couture in 2015 launched the "One |Off" collection, in which the consumers could customize the clothes according to their measurements. The file could be downloaded to be produced on local laser cut makerspace or delivered as a kit. The garments could be assembled using an innovative construction technique, which does not require the use of a sewing machine. This makes the designs modular, so parts can easily be adjusted and replaced, without having to throw away the entire garment.

CATEGORY

STRUCTURE

MATERIALS

Size custom modular clothes body adaptation.

Modular clothes with innovative construction technique, which does not require the use of a sewing machine.

Spacer Fabric - a 3D-knitted material like neoprene and made from recycled PET bottles. Laser cut.

STRENGTH

WEAKNESS

Can be recyclable and repair
Long-term economic
Adaptable to the body
Free movement
Reduce the consumption and generation of waste
Reduce transportation

It is necessary to have a laser cut close. Laborious to put together.

ONEP-WINGS



DESIGNER/
BRAND

Deb Cumming
and Nina
Weaver

YEAR OF LAUNCH

2014

Wool laser cut patterning for functionality and visual intrigue. The one-piece pattern transforms to a 3D garment with elements of fit, form and drape when applied to the body without further construction. To display the graphic nature of the single piece, the garment design is integrated into a flat wool felt wall panel. The coat pattern piece is an image of a winged creature in flight, highlighting the shift from 2 dimensional to 3 dimensional. The laser cut industrial wool felt fabric was a natural choice to provide insulation and warmth for the interior wall panel. A camouflaged bird-like shape plug is removed to reveal a duplicate black wool piece which when wrapped on to the body forms a winter coat with qualities of drape, movement and comfort. The coat then returns to the wall under the wool plug as an absent wardrobe after wear. This concept leads to possibilities of multi-use and medium of wool surfaces.

CATEGORY

STRUCTURE

MATERIALS

Body adaptation.

Wool laser cut patterning for functionality and visual intrigue., which does not require the use of a sewing machine.

Wool

STRENGTH

WEAKNESS

Adaptable to the body
Free movement
Reduce the consumption and generation of waste
Reduce transportation

It is necessary to have a laser cut close. Laborious to put together.

4.4.3 SERVICE SYSTEM

These cases were chosen because they show how brands are using new technologies to create personalized services. They include different body types and eliminate the conception of one size fit all. This kind of services make people to feel happy and comfortable in the buying process.

DRESSARTE PARIS



DESIGNER/
BRAND

Nathalie
Neully

YEAR OF LAUNCH

2017

Dressarte Paris is a sustainable online atelier that produces custom and made-to-measure casual and bridal clothes from upcycled and eco-friendly fabrics. The brand encourages women to express their style, identity, and self-confidence by allowing them to modify the design of clothes and adapt them to their body measurements.

CATEGORY

STRUCTURE

MATERIALS

Custom service, sizes.

Website, personalize system.

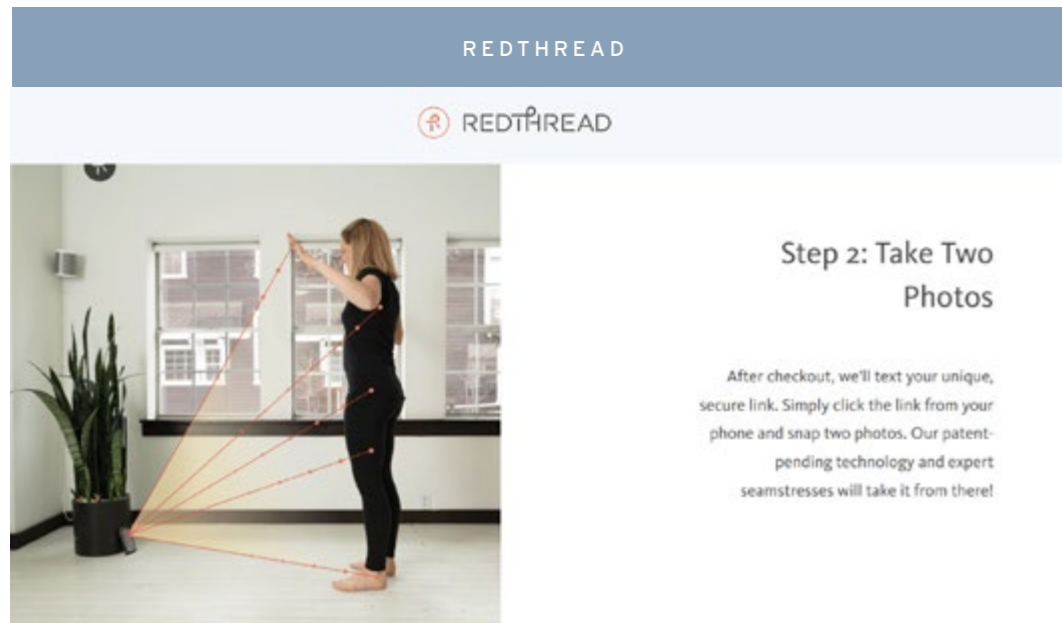
CAD alteration systems (Clo3d), website. Physical structure production.

STRENGTH

WEAKNESS

Only produce what is needed. Custom system. Unique designs. Digital tailoring. Service accessible to everyone around the world. Online. AR experience. Support local production. Perfect fit. Sustainability (stock high quality fabrics).

The shopping experience is lost. Clients cannot feel the materials.



DESIGNER/ BRAND	Meghan Litchfield	YEAR OF LAUNCH	2018
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Redthread is brand that eliminate the sizes. The brand develops a patent-pending process that combines mobile scanning measurements technology with traditional tailoring. It creates the garments at the exact measurements of the clients. In three steps through its website. The customers fill out a "fit quiz" and capture a series of full-body photos with their phone. Redthread pulls 3D measurement data from those photos and combined with a customer's fit preferences, creates a made to order item.

CATEGORY	STRUCTURE	MATERIALS
Custom service, sizes.	Website, personalize system.	Website. Scan cell-phone. Data base. Physical structure production.

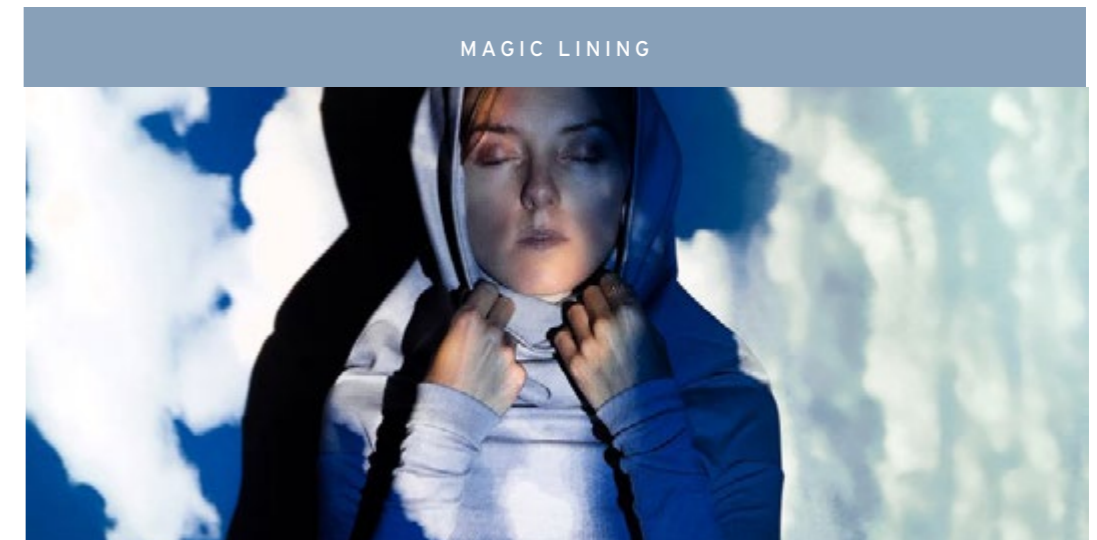
STRENGTH	WEAKNESS
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Custom system. Good tailor system. Ask preference of the client (guide them). Service accessible to everyone around the world. Online. Support local production. Personalized fit. Delivered to the door, lifetime fit guarantee.

Clients cannot feel the materials.

4.4.4 WELLBEING

These projects were chosen because they focus on taking care of the body, helping it to relax, and correct bad habits. They teach people how to appreciate their appearance through the experimentation of pleasure.



DESIGNER/ BRAND	Kuusk, K., Tajadura-Jiménez, A., Väljamäe, A.	YEAR OF LAUNCH	2018
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Art-science collaborative project that combines neuroscience, body-centered design, and 2D vibrotactile array-based fabrics to alter body perception. It is a garment that help to study the effects on body perceptions and emotional responses of various vibration patterns within textile that are designed as spatial haptic metaphors. The clothes use tactile feedback, to increase vibrotactile patterns to communicate messages. These patterns were designed based on "material perception" such as rock, water, and a cloud, to provoke different body perceptions.

CATEGORY	STRUCTURE	MATERIALS
E- textiles, wearable clothes for body perception	Stretch fabric that contains electronic components distributed in different ways. The elements of the structure are used to produce different and augmented perceptions of the body.	Vibration motors, electronic components, and textiles.

STRENGTH	WEAKNESS
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This kind of garment can be used to alter the perception of body posture, size, or weight among other bodily sensations, as well as to impact on emotional responses.

The electronic material generate waste that is difficult to recycle. The garment needs to be tight and close to the body.

FYSIOPAL



DESIGNER/
BRAND

Pauline Van Dongen

YEAR OF LAUNCH

2016

Fysiopal is a posture awareness top, which correct bad upper-body posture by alerting the wearer when they are slouching. The top uses an app to measure the position of the neck shoulders and back, when these measurements are altered, the top will softly vibrate, alerting the wearer to change how they are sitting or standing.

CATEGORY

STRUCTURE

MATERIALS

E- textiles, wearable clothes for body perception and well-being

Stretch fabric that contains electronic components distributed on the back and shoulders.

Vibration motors, electronic components, and textiles. App/cellphone.

STRENGTH

WEAKNESS

Corrects bad habits. Prevents discomfort. Can be used in all the occasions. It is washable washed.

The electronic material generate waste that is difficult to recycle. The garment needs to be tight and close to the body.

MYSA



DESIGNER/
BRAND

Pauline Van Dongen

YEAR OF LAUNCH

2019

Mysa is a tactile breathing guidance. It is a shirt to response to the work-related stress. The smart shirt creates a moment of relaxation by guiding the wearer through breathing exercises using vibrotactile feedback. Breathing exercises are translated into haptic patterns, delivered by six vibration motor positioned along the spine.

CATEGORY

STRUCTURE

MATERIALS

E- textiles, wearable clothes for body perception and well-being

Stretch fabric that contains six small vibration motors that are positioned along the spine and interconnected by printed electronics.

Vibration motors, electronic components, and textiles. App/cellphone

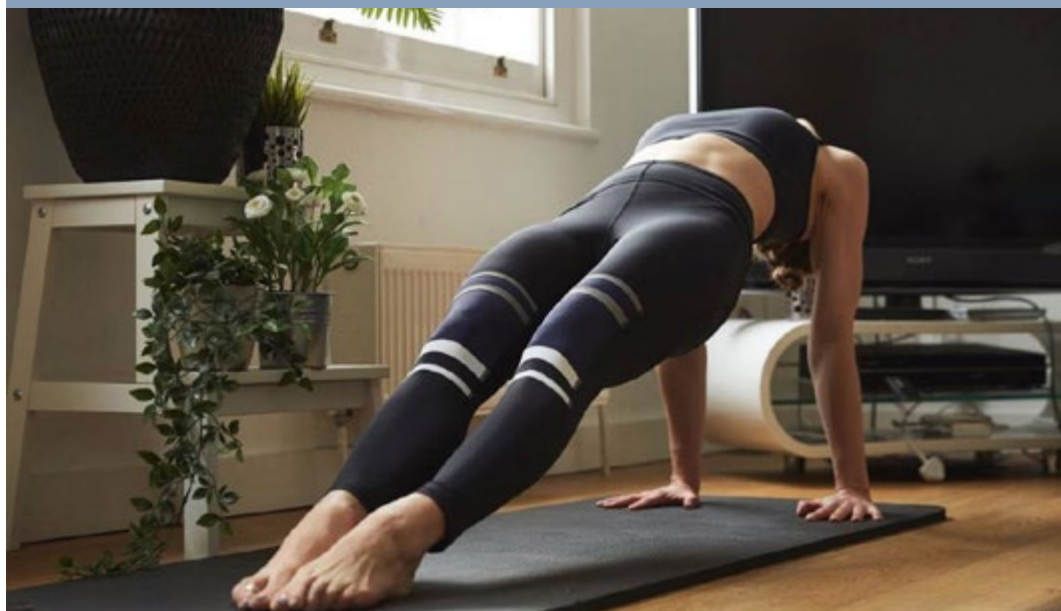
STRENGTH

WEAKNESS

Corrects bad habits. Prevents discomfort. It is washable washed. Relax the body.

The electronic material generate waste that is difficult to recycle. The garment needs to be tight and close to the body.

NADY X



DESIGNER/
BRAND

Wearable X

YEAR OF LAUNCH

2013

Nady X is a posture monitoring and vibrational guidance. It allows to people practice yoga without an instructor. People can practice yoga in their own terms with the help of haptic feedback (vibration) and an app. Users only needs to synchronize their cellphone with legging electronic mechanisms. If the posture is not correct the users receive a vibration in the areas to correct the position.

CATEGORY

STRUCTURE

MATERIALS

E- textiles, wearable clothes for body perception and well-being

Stretch fabric that contains small vibration motors that are positioned along the legging.

Vibration motors, electronic components, and textiles. App/cellphone

STRENGTH

WEAKNESS

Corrects bad habits. Prevents discomfort. It is washable washed. Relax the body.

The electronic material generate waste that is difficult to recycle. The garment needs to be tight and close to the body. Battery life approximately one hour.

THE SEA-BAND MAMA!



DESIGNER/
BRAND

Sea Band

YEAR OF LAUNCH

N/A

Sea band is a natural method to relief nausea. The band uses acupressure and can be used in conjunction with an essential oil with ginger and spearmint. The accessory is a drug-free solution effective for most types of nausea. Sea-Bands is a knitted elasticated wristband that works because of a plastic knob sewn into the side of the inside of the wristband which exerts pressure and stimulates the P6, or Nei-Kuan, acupressure point. It has been proven that pressure on this point relieves nausea and vomiting.

CATEGORY

STRUCTURE

MATERIALS

Accessories body wellbeing

The accessory is a knitted elastic wrist band, which operates by applying pressure on the Nei Kuan acupressure point on each wrist by means of plastic stud.

Knitted material, and plastic.

STRENGTH

WEAKNESS

Natural relief, No contains drugs, reusable, washable.

It is not recyclable. It is only works on the wrist points.

BELLY BAND



DESIGNER/
BRAND

N/A

YEAR OF LAUNCH

N/A

Belly band is a kind of belt designed to support lower back and abdomen during pregnancy. These accessories may provide benefits to active women specially during the second and third trimesters. These instruments help to decrease the pain of the low back, the sacroiliac joint pain, round ligament pain. Furthermore, these bands provide gentle compression during activities, this help to support the uterus and reduce discomfort from movement during physical activity. The accessory also provides external cues for posture, which prevent overextension of the lower back. Thus, it provides comfortability in the daily activities during pregnancy but also it can be worn after pregnancy for support.

CATEGORY

STRUCTURE

MATERIALS

Accessories body wellbeing

Belt that supports the lower back, some of them use Velcro band to fasten into place, all of them are adjustable. They are used under the clothes.

Elastic breathable soft cotton. Velcro band

STRENGTH

WEAKNESS

Natural relief, No contains drugs, reusable, washable, posture corrector.

It is not recyclable. It is visible ugly, need to be used under the clothes. Not practical.

COMPRESSION SOCKS FOR PREGNANCY



DESIGNER/
BRAND

N/A

YEAR OF LAUNCH

N/A

Compression socks are garments that help to relieve painful swelling in the legs and feet. For pregnant women it is recommended to wear compression socks at the end of the second trimester and in the third trimester to help them to reduce swelling, improve the circulation, relieve aches and minimize varicose veins.

CATEGORY

STRUCTURE

MATERIALS

Accessories body wellbeing

Compression stockings are constructed using elastic fibers or rubber. These fibers help compress the limb, aiding in circulation.

Elastic breathable fibers or rubber.

STRENGTH

WEAKNESS

Natural relief, No contains drugs, reusable, washable.

It is not recyclable. It is visible ugly, need to be used under the clothes.



DESIGNER/
BRAND

N/A

YEAR OF LAUNCH

N/A

Maternity bra is a special bra that help to support the breast and back. It relieves the pain of the back, breast, and neck. Moreover, it makes easier the breastfeeding, and some have special patches that help against milk spills.

CATEGORY

STRUCTURE

MATERIALS

Body wellbeing, support clothes.

Comfortable with special structure to be able to untie quickly and with small pockets to introduce absorbent nursing pads

Expandable materials, Nylon, Spandex, material grows with the body

STRENGTH

WEAKNESS

Free movement
Support, comfort.

It is not sustainable and biodegradable. Ugly designs.

4.5

CASE ANALYSIS

With this research, it can be understood that there are different types of solutions that the market is starting to implement to solve body dissatisfaction. Even when the case studies are not related to the pregnancy process, they represent possible solutions for the development of a positive image related to the well-being of the body.

In the case of media body portrait representation, brands are showing a **more diverse physical image on their channels**. The cases are revealing other face of what means to be "perfect and special." They are teaching people to appreciate their appearance and their unique differences. They open to a more visual **dialogue of diversity through social media and multichannel campaigns** (depending on the size of the project). However, they still represent a selected sector in which despite showing different sizes, the models still have perfect skins, and they are mostly white. Furthermore, some of these campaigns do not implement higher impact solutions. They only perform tasks that remain in superficial layer, but they, as has been shown in the previous chapters, help to diversify beauty, which help women to feel better. Carrying out a campaign is essential to show other beauty roles, but it is not enough to solve body dissatisfaction in women.

Campaigns focused on body image during pregnancy are almost non-existent. On media the perfect image of the pregnant woman is recurrent. She does not have any imperfection, she is happy, and her recovery is fast. There is never a real portrait of the period of adaptation to this new stage. Now is starting to speak more about this topic but the materials are limited. It is as if showing the real face of this period was uncomfortable for the media and society.

The research for the adaptation of the clothes to the body have become essential to generate a perfect fit and a higher confidence on people. The new way of thinking and the technologies has brought the **discover of materials, and mechanisms to adapt the clothes to changes and different bodies**. Designers try to find how clothing could be used to make it **functional and durable**. The ideas are delimited for the manufacture technologies and others for the function that the clothes will have. In the case of the pregnancy the projects are focused on adapt the textiles to the body during the three gestation stages and the postpartum. The projects search to fit the garment perfectly, allowing the movement, and bringing comfort on the pain areas. The products on the research **show structure designed to expand and**

contract, as the body adjust, and to separate into pieces to allow modification of the garment.

In terms of the service the tendency is targeting **online sales, offering custom systems**. The new structures consider both the size and proportion of the body as well as the taste of the client. The modification of service systems has occurred mainly in small businesses. **Online sales permit to offer tailored products**. This method helps women feel good during the purchase and guaranteeing that the garment will fit perfectly to the body. In these cases, brands are using digital **tailoring from questionnaires, body scanners and CAD alteration systems**. The entrepreneurs also bet for these services because they can offer unique products, they only produce what is needed, and their investments are reduced. It also allows to the small businesses to be present around the world. A disadvantage is that people lose the experience of go to the store and feel the materials. However, this can represent a plus for brands that share to promote positive image. Because they offer tailor-made clothing and people can avoid the discomfort of trying on clothes in the store.

The wellbeing of the body is indispensable to generate positive image on pregnant women. It can be appreciated products on the market that that are responsible for relieving pain and dizziness during pregnancy. They provide support, structure, and natural pressure methods. Although these products are effective, they are not attractive for people. There exists a lack of design that limits people to use them.

As the text have mentioned on previous

sections, **wearables have a potential to be one of the tools to take care of the body**. The small scale of the electronic elements has brought the possibility to implemented them on garments that help people to alter their perception of their body, correct bad habits, and help the body to relax. Although their designs are more attractive, the integration of the electronics represent a challenge, because the garment must be comfortable, washable, and durable for people. For each element must be considered position, structure, circuit, etc.

Between the most important requirements that can be perceived from the wearable study cases are the contact with the skin and the use of a platform or cellphone to control the user experience. The electronics should be as close to the body as possible. It is important that they could be in contact with the skin to have better results. The use of a platform to register the activity or activate the mechanisms is also important to proportionate a good user experience. This kind of platform motivate people to use the dispositive. In terms of electronic parts, they need to be small and flexibles, with the possibility to follow the body silhouette.

This case of studies research has brought a background of what is happening on the market. How every project work, which are their main elements and mechanism, which types of materials they use, what area their advantage and disadvantages. This helps the project to understand and plan the direction of the possible solution and serves as inspiration. Furthermore, it helps to indicate the position of the project's solution on the market and their possible scenarios.

4.6

CONCLUSION

The rules are changing. **With the emergence of the new mentality towards the concern of social and environmental processes, the fashion system has been questioned**. Since 2012 with the reborn of the body positivity movement on social media, the fashion world has begun to adopt **values and requirements to make the industry more inclusive to foster diversity**. Media and brands have started to include variety of sizes on their products, and models with unconventional beauty on their runways and advertising. Body positivity campaigns can be a useful tool to promote the valorization of unconventional physical features as well as for the propagation of different roles models. These instruments are a key piece for the introduction of a of a healthier industry that thinks about the repercussions of its advertising, and the health of their consumer in a physical and mental level.

The movement also have incentivized the approach to new production systems that allow the **introduction of customization**. Currently it can be appreciated that different brands, especially small entrepreneurs, are starting to search and apply different technologies that have given them the possibility to reorganize the manufacturing processes to offer a digital tailoring that could adjust to differ-

ent bodies. Technologies such as 3D scans, CAD alteration systems, Laser cut, 3D printing, allow to know the exact measurements of the consumer, generate an accurate digital prototype, work together with the client, produce at home, between other advantages. These special characteristics permit to the designers the possibility to offer products to people that fit them perfectly and that could fulfill their style's requirements.

The brand and designers are also thinking in new ways in how to cover the body, with the help of the technologies and new materials, they are thinking in products that can expand, contract and modified to last more and help in the consumer's activities. The designers are thinking on the functionality of the garment. Producing with innovative patterns can bring liberty and movement to the user and reduce the waste and pollution on the manufacture processes, product life, and disposal.

Coupled with technologies and new materials, **the growth of online shopping has increased purchase personalization services**, which stand out for ask the opinion and dimension of the people through different user experience that enrich the practice of buying online. The creation of **digital tailoring and virtual fitting rooms** made eas-

ier the buying experience to people with different physical characteristics. These methods **could promote an environment of respect avoiding the feeling of shame**. Small brands are betting for this option because also represent and opportunity to offer unique services, have less waste, and start with small investments.

Fashion have also started to change the way in how it approaches to the human body. Designers are looking for a **way to promote wellness through include technology on clothing**. Smart textile by their engaging with the body represent an opportunity to encourage the enjoyment of physical qualities. With these technologies designers are making **functional, meaningful, and socially acceptable products**. They are designing a second skin to amplify the human body to enable interaction and communication combining aesthetics and style. Wearables can provide protection to body; this could made them ideal to promote body positivity.

Right now, in the market can be appreciated different brands that encourage body positivity and body wellbeing. These products try to generate the change to a more inclusive industry in which people, with different physical qualities can feel identified and treated with respect. On the topic of pregnancy brands are focusing on offer comfortable products that help women during the process but some of them are forget the functionality, design, and time of use. Even all the mentioned cases on this chapter lack sustainability values and none of them is 100% focused on diminishing the feeling of body dissatisfaction. Therefore, the design approach to generate a comprehensive solution for this problem is essential.

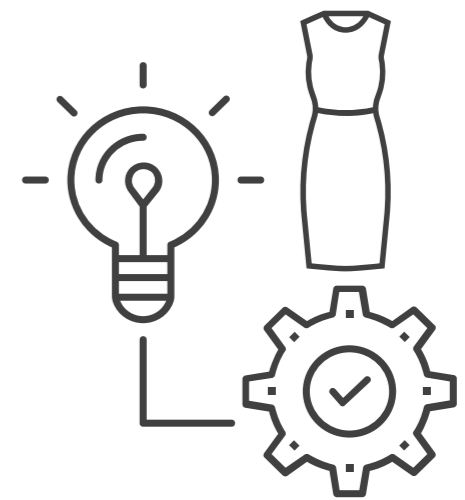
Having a broader view of what is currently happening in the market, the design industry, and the results of the user-centered research, the thesis project proposes the design of a **product service system**. Which could offer products adaptable to the woman's body during pregnancy and after pregnancy. The aim is to make **tailor-made products that can offer freedom of movement, comfort, and personalized style**. The project intents to introduce these products through a digital customization system, which across a platform it will give users options to select their preferences, include their size and view their custom items in a virtual fitting room with their personalized avatar. In the next section will be explained Nawale, its characteristics, its components, and the new technologies used to generate this proposal. It is important to mention that Nawale is focused on develop maternity products within a responsible system. Sustainable alternatives where also explore to bring a more **democratic design**.



Figure 20: Follow-up of the design process, until this chapter, the sections have been commented on: literature review, user-centered research, and state of the art.

**CHAPTER FIVE
NAWALE, A
TRANSFORMABLE
CO-DESIGNED DRESS
COLLECTION FOR
CHANGEABLE BODIES**

5



THE SOLUTION PROPOSAL

Nawale name is composed for **nawal + e**. Nawal word comes from the Nahuatl, language spoken by "Aztecs." It means a person with the ability to transform their body into an animal, object, fire, or a meteorological phenomenon. The e refers to the inclusive language in Spanish speaking people. The Inclusive language or non-sexist language refers to the creation and use of terms that make visible demographic groups with gender identity and sexual orientation different from masculine or feminine. Nawale is the name of a brand that **arises from the need to generate personalized and tailor-made products for pregnant women to help them to reduce body dissatisfaction**. The aim is to **offer tailored products that could adapt during the pregnancy and after the pregnancy to the body**. It intends to give women **perfect fit, freedom of movement, comfort, and personalized style through the design of a product service system**. Nawale is also compromised with the environment, for this reason it searches to **design maternity items with sustainable alternative options to develop a more democratic manufacturing in which the user can become a co-creator and produce less waste**. Across a platform, users will have the option to select their preferences, include their size, and view their custom items in a virtual fitting room with their personalized avatar. The fitting room will show them how the garment and their bodies change, and how they match during all the stage of pregnancy.

Nawale project development was divided in **three main steps: product design, distributed production and participatory design, and digital fashion retailing**. Product design section was focus on build products that could be adaptable, customizable, and flexible. For the products were implemented different techniques and technologies. It was explored the tool Make/Use to develop zero waste patterns in which modifications and personalization can be made easy without the generation of fabric waste. Digital prototyping also was implemented on this segment. This method permit designer, and users to test product's aesthetic and proportion. It enables communication between the designer, manufacture, and consumer to create a custom pattern to eliminate size standardization.

Auxetic figures were employed to achieve flexibility on the products. Auxetic figures gives materials the property of expand in all directions when they are stretched, and they shrink in all directions when they are compressed. This permits to clothes to form a dome shape, which perfectly fits the changing shapes of the belly through pregnancy period, bringing conform to the mother. The adaptability was given to the prod-

ucts by implementing lacing fastener mechanism on different areas of the garments. Lacing is a fastening method which permit to fit closely or tight the clothes to the body. The technique permits women to adjust the garment on specific areas, to reshape their figure as they want or as they feel more comfortable.

Distributed production and participatory design were implemented to generate a more democratic project. Currently brands are searching for new ways to involve the user creativity and ability to constantly reinvent products, and consumers are not accepting the imposed products on the market. With this new philosophy based on networking communication, fashion can reduce their impact on the environment and proportioned a fair industry within society. In the project were explored two ways of to bring a networking production. The first one was the implementation of connectors on the design products, the connectors are structures that allow the fabric to be joined without the need for a sewing machine. These structures can be manufacture by laser cut on FabLabs around the world. FabLabs are interconnected spaces (makerspaces and hackerspaces) through an international network of collaboration, equipped with advanced technology. These two elements help the project to be produced on an unconventional way, in which people became an active consumer, reducing shipping transportation of materials and products.

The final approach of the Nawale project was the implementation of a digital fashion retailing, focuses on introduce Web 3.0 technologies. The aim was the creation of a platform that could help women to customize the products. The approach of technologies as size recommendation, fit recommendation, and fit visualization can improve the customer experience and offer tailor and custom products that help women to reduce the stress caused by buy clothes during pregnancy.

This chapter contain a detail description of each element that compose the creation of Nawale brand, as well as the motivation of their selection. Also, in the following sections will be explained the material selection and laser cut technology implementation.

5.1

MOTIVATIONS TO GENERATE AN INCLUSIVE AND SUSTAINABLE SYSTEM

Ellen MacArthur Foundation establish in its report (2017) that between **2000 and 2015 clothing production doubled, while over the same period the number of times an item of clothing is worn before it is thrown away decreased by 36%**. Customers lose USD 460 billion by dump clothes that they could continue to wear, in some cases is estimated that garments are discard after just seven to ten wears.

Furthermore, it is estimated that less than **one percent of the materials used to produce clothing is recycled to create new clothing**. This represents a loss of more than USD 100 billion in material each year. (Ellen MacArthur Foundation, 2017). In most of the cases the recycling consists in give the materials to other industries, as insulation material, and wiping clothes making difficult their re-capture.

Ellen MacArthur Foundation found (2017) **that most of the textile industry depend on non-renewable resources approximately 98 million tons in total per year**. Moreover, **textile production uses around 93 billion cubic meters of water annually**. It is considered that 20% of industrial water pollution comes from dyeing and textile treatments. In recent years was discovered that around half a million tons of plastic microfibers are spilled during the washing of plastic - based textiles such as polyester, nylon, or acrylic and end up in the oceans.

The textile industry footprint extends beyond the use of raw materials. **Fashion produced 2.1 billion tons of greenhouse gas emissions in 2018 - 4% of the global total** (Ellen MacArthur Foundation, 2021). Likewise, the textile industry

not only represents a risk for the environment but also for people. Many workers work under poor conditions facing environments with hazardous substances and unsafe processes. Local communities also are affected. People suffer for poor environmental practices; an example is the water. Discharging water with dangerous chemical affects local rivers used for fishing, drinking or bathing.

Demand for clothing is growing quickly, if this growth does not stop, it is estimated that **by 2050 total clothing sales would reach 160 million tons, increasing the negative impacts**. This also could affect fashion business. Right now, thank you to lower prices and the increases on revenues (from overstock, stockouts, and returns), profit margins of the world's leading apparel retailers decreased by an average of 40% from 2016 to 2019. The situation exacerbated in 2020 by the impact of the Covid-19 pandemic (Ellen MacArthur Foundation, 2021).

The data show that the **actual fashion industry is failing**. The current fashion system production is linear, "take-make-dispose" (Colasante & D'Adamo, 2021). This pattern allows companies to mass-market, manufacturers to mass-produce, and consumers to purchase the latest trends for cheap. Like consequence amounts of no-renewable resources are extracted to produce clothes that are used for only short period, and eventually ends up in landfills or are burned. "The linear production is dead" "The fashion industry will be forced to come up with new ways of making business" these where the words of Ellen MacArthur (Ang, 2019) and Stella McCartney (Ella, 2019) both promoters of the circular fashion system.

Circular Fashion system is "clothes, shoes or accessories that are designed, sourced, produces and provided with the intention to be used and circulate responsibly and effectively in society for as long as possible in their most valuable form, and hereafter return safely to the biosphere when no longer of human use." Dr. Anna Brismar (The honest Consumer, 2022).

The strategy of this system is **minimized waste through a "take - make- reuse"** approach to apparel production and consumption, **where a product, once ethically produced, does not leave the system until it has been reused or recycled to the point that it cannot be reused anymore, after it is safely returned to a biodegradable state** (Naeun, Hongjoo, & Bharath, 2021). Circular Fashion System is based on circular economy that refers to an industrial system that is restorative or regenerative by design. This means that traditional end of life is replaced by practices that reduce, re-use, repair, remanufacture and recycle (Colasante & D'Adamo, 2021).

This new textile economy relies on **four ambitions** (Ellen MacArthur Foundation, 2017). The first, is the **phase out substances of concern and microfiber release**. In this phase the industry must ensure that the material input is safe and healthy to allow cycling and avoid negative impacts during production and dispose. Materials must enable large scale recycling. The second, is **related with transform the way clothes are designed, sold, and used to break free from their increasingly disposable nature**. The industry must increase the average number of times clothes are worn. This can be made through-out produce clothes with higher quality and

LINEAR ECONOMY



CIRCULAR ECONOMY

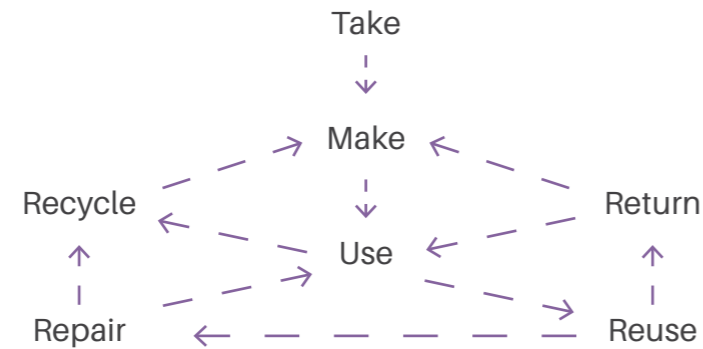


Figure 21: Linear economy vs Circular economy

provide access to them via new business models. The main is to create perception that clothing is durable and not disposable. Third, **radically improve recycling by transforming clothing design, collection, and reprocessing**. The fact that clothes can be recycled helps industries to recapture the value of the materials once they are not used. This helps industries to save money during their production system and reduce the negative impact of their clothing disposal. To achieve this, companies must align clothing design and recycling process, peruse the use of new technology, stimulate demand for recycled materials, and implement clothing collection at scale (create demand on recyclable materials, to generate those industries invest in recycling businesses). Four, **make effective use of resources and move to renewable inputs**. When recyclable materials cannot be used, use renewable materials. Coupled with this also companies must move to more effective and efficient production processes, that uses less water, fewer inputs, or resources (fossil fuels and chemicals) and with a better energy savings.

It is important to mention the above, because this project aims to generate a sustainable alternative to improve body dissatisfaction in pregnant women. The intention is to create a system that incorporates elements that help women to feel comfortable and free without damaging the planet. Looking for production alternatives that could achieve what circular fashion system stablish (take - make- reuse). In the next section are explained the elements that compose this proposal.

5.2 PROJECT ELEMENTS

In the following points, the elements that make up this proposal are exposed. Those elements were selected based on their advantages to generate a product- service project that could bring comfort to pregnant women, making them feel better about the changes in their bodies during pregnancy, and give sustainable solution to generate a circular fashion system.

5.2.1 ZERO WASTE

Demand for clothing is growing quickly, it is estimated that by 2050 total clothing sales would reach 160 million tons (Ellen MacArthur Foundation, 2017), increasing the negative impacts that linear production brings. To reduce these effects, many of the industries have focused on finding solutions for the final phase of the product, such as recycling. However, few of them have focused on reducing their environmental footprint in their production process.

Right now, fashion designers are starting to search for **new ways to reduce the preconsumer textile waste**, waste created during the manufacture of fiber, yarn, fabric, and garments. Some of them are seeking to prevent and minimize fabric waste during the cutting stage of garment production. Every garment that goes through a pattern cutting process creates a patch of textile waste with an average of 15% per garment, while the estimated textile material used in garment production in 2015 was 400 billion meters (Nursari & Djama, 2019). This also represent economic problems for the manufacturer because even though there are some efforts for waste management through the use of fabric leftover, the problem remains due to the mismatch between the investment required to manage fabric waste and the value of leftovers which can come a cost to the producer (ElShishtawy, Sinha, & Bennell, 2021).

The main reason fabric waste is generated is because in the current industry the design and make process are separated. This means that the designers conceptualize the garment design, and the makers create the pattern to be cut in the most efficient way. However, this is still inefficient. This means that to be able to generate less waste, the minimization must come from the design phase. **Zero waste fashion design is based on the idea that fabric and form are interconnected. Designers must use the 100% of the fabric** (ElShishtawy, Sinha, & Bennell, 2021). In terms of sustainability zero waste intent to bring **timelessness and waste elimination**. It also can reduce the length of fabric required in garment manufacture (McQuillan, et al., 2018).

The concept of zero waste is not new. It can be seen in different cultures even before the industrialisation (Rissanen & Mcquillan, 2015). On the past fabric was treated with respect and care because the materials were scarce, and processes were slow. The traditional clothes such as the sari in India are based on wrapping long fabric on the body, others like the kimono are based on fold, draped and geometrical cuts. Currently, design zero waste process is based on these elements wrapping, folding, draping and the use of geometric cuts with the intention of search the most innovative way to create the garment.

Timo Rissanen and Holly Mcquillan on their book (2015) express that zero waste fashion design addresses inefficiency in fabric use by reframing fabric waste as an opportunity to explore the magic of fashion. **Zero waste celebrates experimentation and discovery of new forms.** This means that designer must

challenging traditional approach to fashion, to create a way to mitigate textile waste considering materials and environment.

By not having established rules, the process can be varied and therefore different solutions and processes can be generated. In addition to this, it must be understood that the integration of fashion design and pattern cutting is essential to create zero waste design. This means that the **pattern cut is an experimentation and creativity activity**. It is the activity that generates the idea (Rissanen & Mcquillan, 2015). However, this liberty on the design process and cutting produce that the final design piece cannot be displayed from the beginning, challenging to translate a 2D zero waste pattern into a 3D form. Furthermore, it might result in inconsistencies when implementing the final 2D pattern in a 3D form, and either the fit, silhouette or aesthetic will not be as planned by the designer (ElShishtawy, Sinha, & Bennell, 2021).

The liberty of the process, the value of textile waste on the industry, and the extent to which the hierarchies in design and production are flexible, affect the introduction of zero waste design on the industry (ElShishtawy, Sinha, & Bennell, 2021). Additionally, the hole system is limited by the financially imperative business model. This means that even with the increasing number of zero waste design approaches, industrial adaptation to the zero waste techniques in mass production remains one of the main problems of zero waste design practices.

To facilitate the implementation of zero waste in the industry, designers started to develop zero waste design support tools. McQuillan et al. (2018) created User Modifiable Ze-

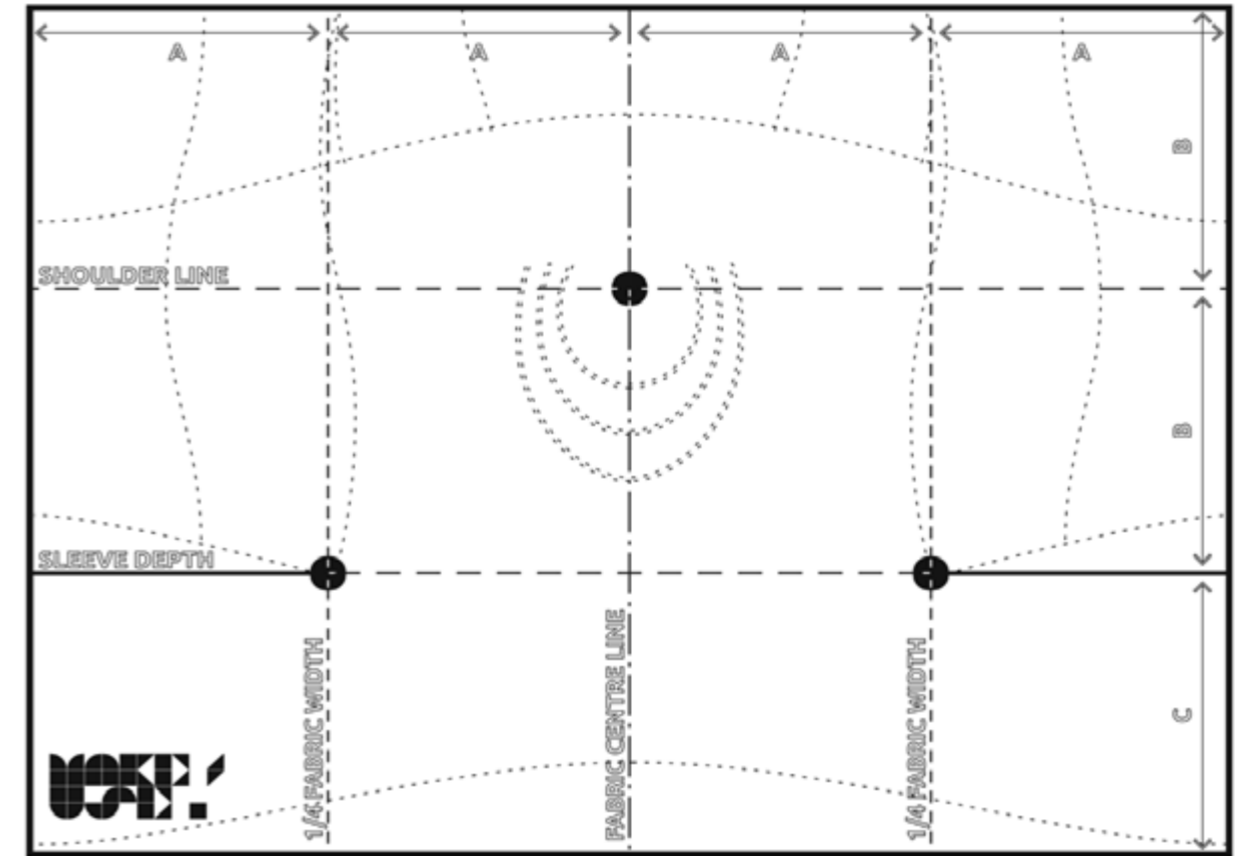


Figure 22: Make/Use Crop T-shirt grid, matrix (McQuillan, et al., 2018)

ro-waste Fashion **Make/Use tool** (figure 22). **It is a user-centered approach that allow to make and modified garments with no fabric waste.** The tool provide ready-made patterns, prints and templates with modification options that help users to change the design based on their preferences (embedded wayshowing system). Because the fabric is retained (kept by the user) the garment form is open and can be re-set (mended), re-cut and re-made using different cut lines.

The system in based on a **zero-waste matrix, a garment block that allows transferring the measurements of the user's body to a two-dimensional pattern** (based on the bog Coat). The matrix also can be adjusted to suit the interrelated parameters of fabric width/length, size/fit, and garment design variations. This instrument permit to generate an infinite zero waste designs, based on geometry and sequence of construction. The purpose is to increase access to zero waste fashion and provide flexibility required for further uptake in fashion industry (McQuillan, et al., 2018).

The system base offers four types of modifications (Scerbaka, 2020):

- Manipulation of the tubular volume's structures
- Rotation of parts influencing the silhouette; rotation is done by cutting the tubular construction with a curved line and rotating 180 degrees. This can improve the fit and freedom of movement.
- Changing and swapping parts to places that make asymmetric shapes in clothing.
- Resetting fabric parts - removing them off and resetting back to its original place.

The intention of Make/Use Tool is to explore how the users might engage with zero waste garments. It suggests that the **user can adopt a mode of active engagement rather than a passive consumption**, challenging the user-garment relationship (McQuillan, et al., 2018). When the user's made and modify the garment, they feel appreciation for it. It is a tool that intent to open the design (open design system), permitting the creativity intervention of the user and democratize the system by **seeing users as makers "doing, adapting, making and creating"** (Sanders & Stappers, 2008).

Although it has been proven that the method is complicated to apply for a person without sewing knowledge (Scerbaka, 2020). The tool has been embracing by retail clothing consumer & makers and used by international brands such as Patagonia and fast-fashion H&M (ElShishtawy, Sinha, & Bennell, 2021). Some researchers (Scerbaka, 2020) (ElShishtawy, Sinha, & Bennell, 2021) appeal that with this method is possible to produce a model or modified a model in an industrial production. It is just a matter of integrating cutting and packing process to adjust the design of automated makers.

Scerbaka in her research (2020) about the effectiveness of the method found that the **pattern technique can cover large range of sizes, and that it is easily adaptable to different bodies**. Freedom of movement is not restricted, clothes are comfortable to use, the garment silhouette does not distort the wearer's figure. Furthermore, she claims that the designs generated with Make/use tool produces classic shapes, addressing to a wide range of wearers, and that from an economic point of view the production can be economically advantageous.

Understanding what zero waste, and Make/Use tool are, and the advantages that these could bring to the manufacturing system. The thesis intent to apply them to create a brand that could offer custom products, through a digital platform, providing different pattern alterations to adapt the garment to the style of each person. In the next section will be explain why this system haven been selected and the advantages that brings to the project related with body dissatisfaction and pregnancy.

5.2.1.1 MAKE/USE TOOL SELECTION

This project will use Make/Use tool to generate zero waste pattern design. The intention is to **design products that can give different alterations to create different styles** with small modifications, and as well as offer products that help to reduce the damage on the environment caused for the actual fashion system. Although has been proved that the system is difficult to achieve for a person without fashion experience. The thesis project intent to offer the tool such as alteration service, that through a **digital platform could offer pre determinate alteration options to adjust the garment to customer style**.

The viability of create different modification in easy way on a pattern is vital for body dissatisfaction during pregnancy. How it has been mentioned before (chapter 2), during pregnancy clothes becomes a medium for which pregnant women can practice control about their own body. Do not have access to clothes that fit well and represent their personality could influence in generate bad feelings about their bodies. Currently, women point out that maternity clothes are limited in stylistic variety and restricted by size standardization. They argued that clothes in the market symbolized someone that they did not want to be associated with. **Make/Use tool can be adjusted to suit the interrelated parameters of fabric width/length, size/fit, and garment design variations.** These characteristics permit to offer customizable and made-to-measure products, vital elements to reduce body dissatisfaction during pregnancy.

The tool suggests that the user can adopt a mode of active engagement rather than a passive consumption. Make/Use is a democratic system with an open design process that **allow to create a cus-**

tomizable service with and accessible production around the word. These characteristics facilitate that the thesis project could offer a service, in which people can feel part of the process. The intention is to cause attachment between the garment and the user, to motivate people to wear it for more time, repair it and produced it at home. **Users became makers.**

It has been demonstrated that the tool is able to cover different range of sizes, and it can be **easily adaptable to different bodies.** The patterns **give freedom of movement and create comfortable clothes.** Indispensable requirements for women during pregnancy. Moreover, **the garment silhouette does not distort the wearer's figure,** thus it addresses a wide range of consumers. Opening the possibility of adapting it to different personalities and generated body positivity. The tool also, intends to eliminate the concept of waste, giving the pregnant woman the elements to reframe the garment even after the childbirth, extending product's life. Finally, Make/Use was chosen because it can be used in a small and industrial production. This means that it is a scalable process, giving opportunities of growth the project and market exploration towards other sectors.

The before mentioned are the reasons why zero waste and Make/Use tool are alternatives to create a product - service system that could reduce body dissatisfaction with a circular economy method. The project intent to introduce new democratic, sustainable and body positivity products on the actual market. In the next section will be presented the virtual prototyping (Clo 3d), other component of the proposal solution.

MAKE/USE TOOL SELECTION REASONS

- User as a maker
- Large range of sizes
- Easily adaptable to different bodie
- Freedom of movement is not restricted
- Open design process and product
- Comfortable clothes are generated
- Adjustable to different sizes and bodies
- Easy to produce in different parts of the world.
- Garment silhouette does not distort the user's figure
- Permit to create different styes for different users.
- Can be used on the small (customable) and industrial scale.
- Democratization of the process, "doing, adapting, making and creating"
- Functional life by providing embedded opportunities for alteration and visible repair
- The tool intents to eliminate the concept of waste. Given opportunity to reframe the garment

5.2.2 VIRTUAL PROTOTYPING

The use of Computer - Aided Design (CAD) alterations systems on fashion process have been implemented for several years. System as Gerber technologies and Lectra systems have focused on 2D pattern drafting and modification. The pattern making techniques of these process mainly consist in individual pattern generation based on the manipulation of complex geometries and structures, and individual pattern altering based on grading rulers. However, the flexibility of the garments makes that parametric design and grading rules entirely depends on patter maker's experience (Jankoska, 2021). Added to this, the initial settings of the CAD system can be laborious and pattern alteration difficult, causing the standardization of sizing and the impossibility to offer custom and made - to measures products (Istook C. L., 2002).

As a potential technical solution, **3D virtual fit simulation technology has been introduced in the fashion system as a progressive way of rapid prototyping** (Jankoska, 2021). This technology consists in transfer all that once was made on paper, drawing, print or fitting directly on the mannequin to a third dimension on the screen (Education for fashion tech, 2018). Virtual prototyping allows designers, manufacturers, and users to test product's aesthetic and proportion. Look, shape, manufacturing, and physical behavior can be defined. Designers can interact with the prototype, test its usability, visualize, and test it in different stages with diverse users. Likewise, the final product can be shown to

buyers. They can interact with it and even personalized it before going to production (Education for fashion tech, 2018).

Virtual prototyping brings positive effects onto fashion industry. **It improves communication between the parties involved** in the product development process, **fewer samples are produced, lower transportation costs, use of less materials and, it saves time** (Siersema, 2015). 3D technology enables innovation, making all processes **faster and smarter**. It changes the traditional production development cycle from design > built > test > fix to **design > analyses > test > built** (Education for fashion tech, 2018).

In terms of made measure products virtual prototyping has **opened the door to virtual tailor services and products**. This technology can convert 2D patterns into a finished sewn garment and placing it on a virtual model which has the identical body shape and measurements of the consumer based on designer's input. The simulation of these garments can be quite precise, as a physical sample. It is important to mention that in addition to obtain a perfect fit it must be taken into consideration materials and avatar position (Jankoska, 2021). Siersema (2015) in her article explain that designing 2D patterns and 3D digital simulation of clothing model on an avatar, has several advantages. First, alterations made on 2D, or 3D are immediately visible in both the patterns and the simulation. Second, the 3d simulation is a conse-



Figure 23 : Clo3d increases the number of samples produced in a short time than estimated in average production (Clo3d website, 2022).

quence of the 2d patterns created, therefore the 2d patterns can be plotted and used on garment production. Third, the simulated garment is visible from all sides so people can see the design from all angles and adjust it if necessary. This makes it possible that errors in fit, in prints, proportions, balance, shape construction lines can be corrected sooner. Fourth, alterations can be made relatively fast, and the process is self-correcting. Fifth, fabric drape can be assessed and adapted from fabric library. Sixth, a fast and exact positioning and scaling of prints, logos, and other details can be obtained. Seventh, new ideas can be tried quickly, and changes be visualized. Eighth, complex garments shapes can be visualized. And ninth, fabrics are unlimited available.

These characteristics **help to create garments that perfectly fit customer clients and helps to reduce the returns of items purchased online that currently has a high rate of 28%**. Reducing returns means extending the cycle of clothes (Education for fashion tech, 2018). Brands are implementing this technology in their ecommerce service. They are introducing virtual fitting rooms which enable consumers to develop a virtual model which looks like them by entering a series of measurements and shape parameters (Fan, Yu, & Hunter, 2004). Users can see how the garments fit them and therefore they make a more conscious purchase adjusted to their style and physical characteristics. (This is going to be explained a detail in the digital retail section).

In terms of zero waste process McQuillan on her article (McQuillan, 2020) **expressed that virtual prototyping helps to solve product development visualization.** Zero waste method is a trial-and-error approach, in which designers work on a flat pattern, therefore they cannot visualize the final piece until it is produced into a 3D garment. This frequently brings fit, silhouette or shaping errors. 3D software allows **zero waste designers to create clothes digitally while simultaneously analyzing the result.** Designers do not create or take steps blindly; meaningful modifications can be done. In addition to this, the use of fabric for samples is also reduced, making virtual prototyping an excellent tool for zero waste philosophy.

McQuillan also stated (2020), that this technology helps to introduce zero waste design into industry process. In her experience she expresses that virtual prototyping facilitates communication between companies and the designer, not only in the design process but also allowing remote collaborations. Open the system to a more democratic structure.

Companies and designers are starting to use software that permit the virtual of prototyping of garments. Clo3D is a software from South Korea born in 2009 that permit virtual clothes visualization and prototyping. This software is intuitive, and expansible enough to design anything designers want (BOF team, 2020). It can accurately express the style and shape clothing structure by transforming two-dimensional patterns into three-dimensional ones. The software integrates the building of a human model, 2D samples, 3D garments virtual stitching, fabric simulation, and dynamic virtual display (Wang & Cho, 2021).

Clo3D works with the use of a virtualized window and a boilerplate window, showing a 3D model and a 2D pattern. The data between the two windows is synchronized, making the process fast and intuitive. After the virtual design is definitive the pattern can be used in the production of sample clothes. Inside the software it can be created a parametrize human model, which changes by altering its measurements to match them with the user size. Once the avatar is created the software permit to sew virtual pattern on to the human body to generate the three-dimensional garment. During this process the modifications and its effects can be checked instantly. The software also offers a huge gallery of fabrics, materials, and haberdashery. Which can be applied to the model. This permit to see how materials, buttons, zippers etc. behave. The properties of the materials can be altered (color, weight, pression etc.), to match the specifications that the creator needs. They can also build their own materials or bring them from other databases. In this phase the comfort, fitting, and distortion of the garment can be tested. **Clo3D counts with tools that show the pressure distribution and reflect the stress level of the clothes when they are worn on the model.** When the final design is defined the design can be displayed in a static and dynamic way. The software offers different avatar poses that help to create renders or animations. This characteristic helps to test the garment in different poses but also helps to create a more attractive image to be presented to final clients or used on digital media. **An advantage of this is that designers can test the product acceptance in the market before the garment is made, reducing overproduction, waste of materials and help them to save money.**

It is important to mention that the software is compatible with others 3D software such as Blender, Maya, Cinema 4D given the opportunity to create a flexible workflow and enrich the renders and movement animations. Different mannequins with special characteristics can be created on alternative software and exported to Clo3D, opening the possibility to create custom products and an inclusive industry.

Simon Kin CEO of Clo Virtual fashion (BOF team, 2020), expressed that **the software intends to empower designers to design better without ever creating a physical sample.** For that reason, Clo3D team is searching in construct a software that can be intuitive, easy to use and that offers all the characteristics that a fashion designers and industry needs. Added to this they see the software like an alternative to reduce fashion pollution. The practice of physical sampling, creating prototypes and shipping materials causes a lot of environmental damage. Only the footwear industries contribute to roughly eight percent of the world's greenhouse gas emissions, according to consultancy Quantis. **Clo3D increases the number of samples produced in a shorter time than estimated in normal production, avoiding the waste and pollution consequences.** According with Clo3D website the software reduces sample process to 27 hours compared to 37 days without Clo and offers a 55 percent sample adoption rate compared to 15 percent without the software. Clo virtual fashion also stipulates that they open opportunities to new digital services. It offers digital touchpoints and services throughout the product development and design process such as Benefit by CLO, a virtual fitting platform, and CLO-SET, a collaboration, and data asset management platform for virtual garments.

The advantage of introducing virtual prototyping in fashion industry are immense. It makes the process faster; the inputs are lower, and the environmental impact is reduced. For these reasons this project proposes to use Clo3d software like a tool to generate and modified zero waste patterns in a most efficient way. The intention is that the software could help to offer a personalized garment system. Where the garments are made to suit the client and where the customers can digitally visualize how the clothes fit their bodies with the help of their avatar to generate a conscious purchase. In the next section will be explain why this software haven been selected and the advantages that brings to the project related with body dissatisfaction and pregnancy.

5.2.2.1 CLO3D TOOL SELECTION

The project will use Clo3D software to create and **modified zero waste pattern design in a more efficient way**. The intention is that the software could help to offer a personalized garment system. **Where the garments are made to suit the client and where the customers can digitally visualize how the clothes fit their bodies**. The main is also implement a tool that can help to change actual chain production to a more sustainable system.

Size standardization industry causes serious emotional problems in women. Size variation of clothes has a strong impact in the perception of the body for consumers, because even when people know that these sizes are not reliable and well-proportioned for different kinds of bodies, they still use them like a mark for weight gain. This makes them feel extremely unhappy when the clothes do not fit well. **Clo3D software permit to create a more open system in which each garment can be personalized**.

Clo3D **allows creating a pattern tailored to the client, eliminating the standardization of sizes**. Its tools like pressure distribution and clothes level stress help to create a garment that suit body customer even when the prototype is digital. In terms of pregnancy women feel that it was very hard to find maternity clothes that fit well to their bodies in every stage of the pregnancy. They had to accept what the market offered to their bodies. This caused them a big unhappiness related to their appearance because they feel that they lose control over their bodies. **With the creation of an avatar the clothes can be analyzed and tested in every stage of pregnancy**. This permits the creation of a garment that guarantees the perfect fit in each trimester event after the childbirth.

Women also present concern about how they would look when their pregnancy began show, where the changes in their bodies will occur and how garments will fit them. **In virtual prototyping, garments are visible from all sides, so people can see them from all angles, interact with them, and adjust them if it is necessary**. This could help women to have overview of their bodies. They can look how garment will reflect in their bodies and adjust them to their style. **The alteration and modification in Clo3D are relatively easier, faster, and the process is self-correcting compared with traditional sample generation**. A base pattern can be altered in an efficient way. This permit to make a system in which people can translate their style to create

unique pieces. Like have been mentioned before, to be able to feel good with their bodies pregnant women need to express themselves through their clothes. Clo3D could manufacture clothes that make them feel confident. It can produce fashionable and chic style that can fit everyone.

The software has also been selected for its efficiency in the fashion system. It improves the communication between parties involved in the product development process, **it facilitates the creation of zero waste pattern design**, it brings the possibility of creating innovation and making all processes faster and smarter. These are just some of the characteristics that make it ideal to be implemented in every manufactory process. What was most important for the project was to find a tool that help to reduce pollution, waste generation, and that could open opportunities to new digital services. **With Clo3D fewer samples are produced, lower transportations are made, and less materials are used. It also has a flexible workflow, what makes it compatible with other different 3D software and technologies such as laser cut**. The digital compatibility with other software brings the possibility to create special mannequins for people that do not have a standard body. The 3D can be implemented in commercial digital platforms, and the renders and animation can help to produce promotional communication to test the product on the market before its manufacture. Furthermore, the fact that 2D patterns can be plotted and exported in different formats help to introduce new manufactures process like laser cut and 3D printing. This feature has special importance, because the main of the project is to impulse new manufacture alternatives and open the system production to a more democratic one.

The before mentioned are the reasons why virtual prototyping and CLO3D software are alternatives to create a product - service system that could reduce body dissatisfaction with a circular economy method. The project intent to introduce new democratic, sustainable and body positivity products on the actual market. In the next section will be presented the 3D scanner technology. This technology goes together with the generation of avatars and mannequins presented above. Although the CLO3D programs have a predefined avatar. Scanner technology can generate a more detailed model of the user. Likewise, it should be noted that this technology was originally proposed it the beginner or the project. However, under the evaluation of the design proposal with the user, it was decided to eliminate it since users perceived it as dangerous and unreliable. These results will be presented in chapter 8

CLO3D TOOL SELECTION REASONS

- Fewer samples are produced
- Lower transportation cost
- Use of less materials
- It saves time
- Permit to create virtual tailor service and products
- Alterations can be made relatively fast, and the process is self-correcting
- It helps to create garments with perfect fit
- It facilitates the creation of zero waste patterns
- It can be observed the product physical behavior
- Best gallery of materials and haberdashery
- Final design can be displayed in a static and dynamic way
- Open opportunities to new digital services
- Final product can be shown to buyers before production
- The 2D patterns can be plotted and used on garment production
- Products can be tested for different users and in different stages.

5.2.3 SCAN 3D

Apparel products cannot be constructed to impeccably fit everyone using standard body measurements (Idrees, Vigbali, & Gill, 2020). The human body is a complex form. Everyone has different body type and weight which have a significant impact on how a garment would fit each person. In addition to this, the precise fit depends on anthropometrics methods (human measurements and classification of human body based on size and shape) that frequently are laborious, imprecise, and often depends on an expert.

3D body scanning is the action of capturing in 3D the human body using a 3D body scanner. The 3D scans generate thousands of data points which can be manipulated to create static or dynamic forms (Power, Apeageyi, Aileen, & Jefferson, 2011). Depending also on the desire application the scan can capture the complete body or only specific parts. The scanners generate a very detailed 3D (shape and size) model within a few seconds and can feature colors and texture to perfectly match the original subject (Aniwaa, 2021). This technology is automated, no contact is required and brings several advantages to the fashion system; it is a fast process, it is very precise, it is possible to create virtual avatars and mannequins, it helps solve the fitting problem, it allows to offer mass customization and made to measurements products. **3D body scanner also facilitates virtual fit testing and enhance online clothing shopping experience** (Power, Apeageyi, Aileen, & Jefferson, 2011). Other important characteristic is that for mass customization, the measurements procedure could be carried out only once, allowing to re-use the stored data for new garment orders. This can create enhancing opportunities for consumer loyalty in retail business terms.

Scanning today can be classified in four groups. Laser line, structured light, multi-view camera and millimeter wave systems. Laser and light-based systems introduce a single laser beam or flashes of light into the scanning area while cameras simultaneously analyze and record distortions that occur when these two-dimensional forms hit a 3D surface. Camera based systems, involve dozens of photographs that are compiled into a 3D form. In camera systems either the subject must rotate, the camera must move around the subject, or multiple cameras must collaborate within a rigging structure. Millimeter wave system can penetrate clothing to detect the form of the body

without undressing. This last one is not used on fashion because the technology is not designed to accurately record the dimensions of the 3D form, instead capturing just the initial distortions of the millimeter wave (Paganelli, 2019).

Most body scanning technologies (e.g., 3DMDbody, Botspot, Ditus, Fit3D, Texel) used in retail are expensive and require dedicated technical support, limiting their use to high-end department stores and specialist sports retailers. Thus, the fashion social, and economic benefits that body scanning offers are inaccessible to many people (Peng, Sweeney, & Delamore, 2012). **The growth of ecommerce generates the introduction of technologies such as 3D body scanning, size recommendations, fitting predictors, and virtual try-on simulations.** Such technologies are a compound of complex systems for the digital transfiguration of merchandising, manufacturing, and supply chain industries (Idrees, Vigbali, & Gill, 2020). With the aim of making 3D body scanning more accessible (price and mode of use) to online sales. In recent years, high- and **low-tech mobile applications have been introduced to the market.** These are easily accessible to customers and retailers. These applications are available with affordable prices (Idrees, Vigbali, & Gill, 2020). Mirrorsize, 3D size Me, 3D Greater, Bevel, Canvas, Itseez 3D, Qlone, Scandy Pro, Scann 3D, IBV, 3D look, 1 measure, Fit measure, Nettelto and size stream at home, are some of the applications present in the market. These technologies are introduced to provide digital body measurements for personalized fitness tracking. 3D body scanning applications can globalize made-to-measure apparel e-commerce market.

The mechanism of these applications works by **matching images of the user's body with scans that companies have done before.** They ask the clients to take a photo. Then with the use of a sensor, the app fit these images with the scans of different people stored on their data base. The apps give an accuracy of millimeters (Perez, 2021). **This technology allows fashion designers and retailers to enhance industry to more automated and precise systems of mass customization, virtual tailoring, and size recommendation system.** The technology will sponsorships better fitting garments and reduce the return rates. It is important to mention that to provide a good service, the applications must be easy to use and must be very precise when generating the user's sizes (Idrees, Vigbali, & Gill, 2020). **3D body scanning with mobile application: An introduction to globalise mass-customisation with pakistani fashion e-commerce unstitched apparel industry, 2020).**

To improve the fitting accuracy in a digital service, it is important to use 3D body scans. Even when the stablish avatar given for 3D prototyping is good

to generate a customize garment, it has been found that in some cases this method is not 100% precise. Balach et al. (2020) in their research points that 3D virtual fitting avatars software have perfectly smooth contours and are perfectly symmetrical. They do not present imperfections as lumps of fat or age changing body shape. Consequently, they cannot simulate how the fabric draping is affected by the asymmetry or lumpy body contours. They argued that **software does not accurately simulate the realistic fat distribution, real body asymmetry, skin elasticity, body firmness, and real muscle contours.** Due to body imperfections the fabrics and material behavior change. Fabric bending angle is different from one side of the body to the other. The fatty lumps might distort the fabric. Body fabric gap is smaller, and the fabric may lay on the top of these lumps, which could affect the garment fitting and fabric draping. A designer, who does not understand the fabric behavior and who is reliant on virtual avatars to create clothing patterns, may encounter issues with clothes not fitting correctly due to the software limitations. This could lead to a lack of customer satisfaction and loss of revenue (Balach, Cichocka, Frydrych, & Kinsella, 2020).

To create a more precise garment this project intended to use 3D body scan apps like a solution to generate a more accurate customer measurement. It was also selected to produce a best personalize service and to provide an easy way in how people can give their exact dimensions, without any previous knowledge. However, in the user testing service survey (chapter 8), a portion of the women argued that they would not be willing to share photos of their body on a platform they do not know. They consider it dangerous and unreliable. *"I don't like that I would be sharing pictures of my body on a platform that I don't know if it is not secure."* It is for this reason that the project decides to eliminate, for the moment, the 3D body scan from the custom platform service proposal. However, it was important to mention it, because this technology brings several advantages to fitting, customization, and ecommerce service that can help to reduce body dissatisfaction and to generate a more circular fashion system. This technology maybe can be implemented in a future in which the digital services could count with major security or when the project could have greater recognition that generates trust among users.

In the next section It will be explained Auxetic structures. Other element of the project that can bring comfort and adaptability to products during the different stages of the pregnancy. Furthermore, these structures can help to extend product life and create a personalized style system.

5.2.4 AUXETIC STRUCTURES

When an elastic material is stretched, it becomes longer in the direction of stretching and is typically thinner in the orthogonal direction. This behavior is defined like Poisson's ratio. This mechanical characteristic defines how a material expands or contracts transversely when being compressed longitudinally (Stavric & Wiltsche, 2019). However, there exist auxetic materials. **These materials possess a negative Poisson ratio. This means that they can expand in all directions when they are stretched, and they shrink in all directions when they are**

compressed (figure 24). This gives auxetics materials properties such as **variable permeability, energy absorption, resistance to fracture, and the ability to adapt to a bending force by forming a dome with double curvature** (Papadopoulou, Laucks, & Tibbits, 2017).

Stavric and Wiltsche (2019) in their article explain that auxetic materials are experimentally realized by perforating and cutting various motifs into a sheet of material, creating a network of solids and voids. Thin parts of material that connect solids act as hinges and allow auxetic behavior of the whole system. These structures are not rigid or static. **Their deformation is based on a geometry change, where the structures change from a relative stable state into a moveable kinematic state (figure 25).** Like have been mentioned when an auxetic material is stretched its volume increase in all directions. However, the material's volume is not really increasing. Namely, the whole structure is composed of different smaller parts which rotate against each other when forces are applied. Thus, "only" the overall volume (the material sheet) becomes larger. So, the hole system is a combination of materialized solid parts and the space (gap or void) in between.

Auxetic materials can classify in two categories, **monostable and bistable.** Monostable auxetic is a moveable structure, which allows a continuous, planar (or spatial), one degree of freedom motion. It changes its overall size (or volume) when it is moved. These patterns

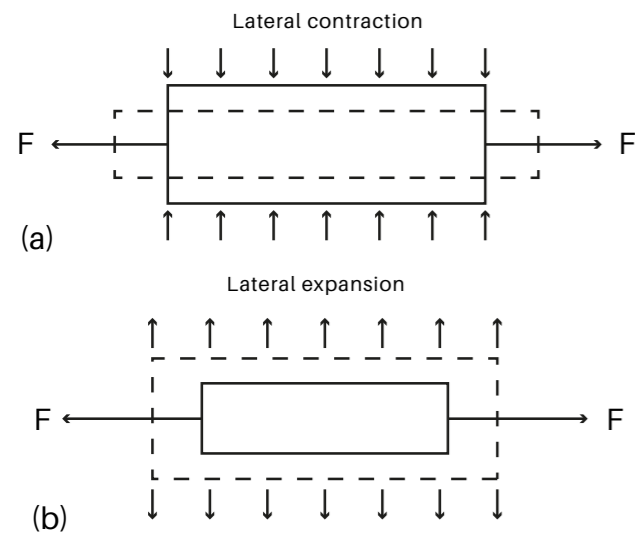


Figure 24 : Schematic diagrams of (a) conventional materials with a positive Poisson's ratio and (b) auxetic material with a negative Poisson's ratio under tensile loading (solid line and dash line respectively describe the materials before and after deformation) (Zhang, Lu, & You, 2020).

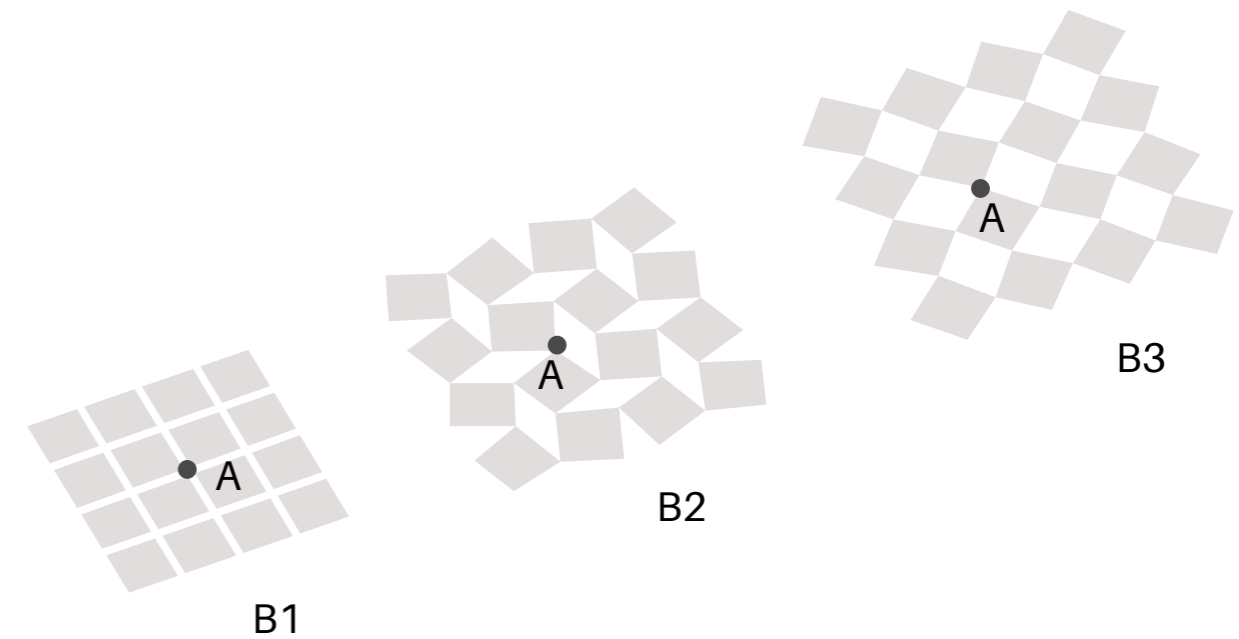


Figure 25 : An auxetic structure which is composed by smaller solid parts increases its overall volume by rotating the parts against each other. This leads to bigger bounding boxes $B1 < B2 < B3$ (Stavric & Wiltsche, 2019).

allow a precise kinematic one-degree freedom motion and throughout the movement the whole system stays flat. Bistable auxetic are systems of linked elements that are not moveable as long as rigid parts are used. To make the system moveable, elastic or bendable materials are used. The system always has a start position where all the parts are in one plane. If forces are applied the elements are bent and move out of the plane until they reach a stable end position, again in the plane. This means that bistable auxetics are used in materials that are bendable like paper, fabric, or sheet metal. When the system is moved, and the parts are not rigid they are bent into the three-dimensional space, and it is obtained three-dimensional forms. These figures cannot longer describe the process exactly in a kinematic way, since kinematic always describes the geometry and move-

ment of rigid parts (Stavric & Wiltsche, 2019). Auxetic materials have found applications in crash protection, body armor, fasteners, medical devices, sports equipment, aerospace technologies and fashion (textiles and clothing). Auxetic materials create new aesthetic possibilities and functional capabilities. One major benefit of **auxetic structures for fashion and apparel is their ability to transform into desired geometries by taking on complex shapes.** For example, if a geometry is applied to a material sheet to create an auxetic behavior, the sheet can adapt to the precise shape of the user's body. This adaptability could enable the manufacture of one-size-fits-all accessories and garments, because the material can adapt to anyone's body shape. This can benefit the industry as well as **create a more comfortable fit and feel for the customer** (Papadopoulou, Laucks, &

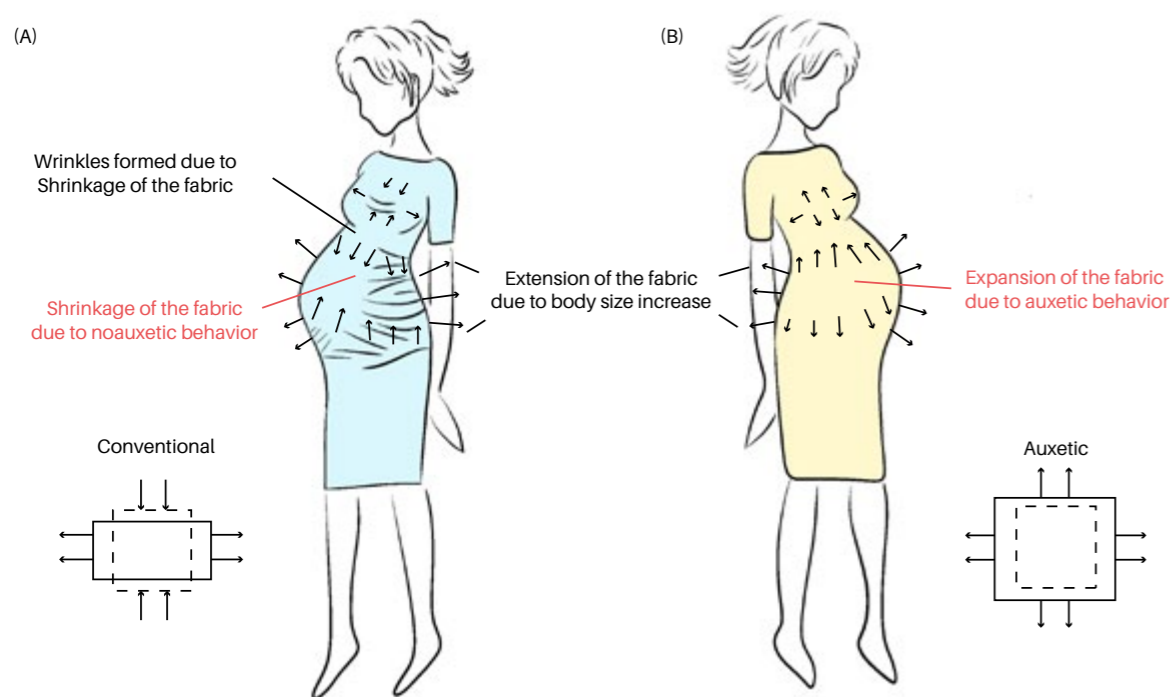


Figure 26 : Maternity dress (A) conventional maternity dress; (B) auxetic maternity dress (Hu, Zhang, & Lui, 2019).

Tibbits, 2017). Auxetic materials have been started to be explored on knitted and auxetic fabrics. These fabrics have lateral expansion property. The garments made with this raw material show size expansion and pore-opening effects when stretched. These two last qualities are very useful. With size expansion effect the garments made from auxetic fabrics are able to have size fitting and size growing properties which can be very useful for people in a period of growth such as children and pregnant women (Hu, Zhang, & Lui, 2019).

Hu et al. (2019) in their article explain that using clothes with **auxetic structures can help to save money and reduce waste**. For example, child grow up fast, so frequently parents need to buy new clothes for their children. Meanwhile, the old garments will be never used again and will be disposed. All these problems can be solve implementing auxetic structure on clothes to create garments that can fit children during grow up time. In addition to save money and reduce waste, auxetic clothes also can enhance the shape fit and comfort. When a garment is made with conventional fabrics, these use to restricts the movement of muscles and joints. They also produce addition-

al pressure on the skin, causing discomfort in the body area that is growing. This can be different using auxetic structures. The fabric will laterally expand instead of shrinking when stretched. Since the deformation of the auxetic fabrics adapts to the body, there will be no additional pressure. The properties mentioned can be used to make comfortable maternity clothes.

Currently elastics materials are using to produce maternity clothes. These clothes can expand with the belly until some point. However, the fabric stretches gradually with the growth of the belly. As a result, an increasing pressure is applied on the belly by the fabric due its elastic nature, which causes severe discomfort. The esthetic and shape of the garment also can be modified, the garment tends to deform, and wrinkles start to appear on the fabric surface. **With auxetic figures maternity clothes can expand in all directions. Thus, clothes will not cause pressure, because them can spread out and form a dome shape, which perfectly fits the changing shapes of the belly through pregnancy period.** When a garment has a perfect fit, it remains smoothy and tidy (Hu, Zhang, & Lui, 2019).

It should be mentioned that in addition to unusual deformation behavior, other properties such as air and moisture permeability are also enhanced to the open-up of auxetic fabric structures when stretched. **Auxetic figures can perfectly fit a hemispherical surface without too much force applied.** They provide good air permeability and soft handle. Du their porosity caused by their structure, auxetic fabrics can enhance air permeability allowing to transform the sweat from the interior surface to the exterior surface quick-

ly to keep the inner surface and skin surface dry (Hu, Zhang, & Lui, 2019). Although, auxetic garments have not been largely applied in garment industry. Fashion designer have started to explore these structures, because they permit customization, reconfigurability and self-adaptability. **Added to this, new technologies such as 3D printing, laser cutting, and numerical control (CNC) have made this type of materials approachable for designers** (Papadopoulou, Laucks, & Tibbits, 2017). Opening the door to provide custom garments that fit perfectly.

This project intents to use Auxetic figures to create custom, perfect fit items for pregnancy. The main is create a product that could adjust to the body clients and giving them comfort and confidence. This kind of product could help women to reduce their body dissatisfaction feeling. The project also intent to use the figures like a way of aesthetic personalization, people could select the figure that best suits their style. In the next section will be explained why we choose these structures and the benefit that can bring to reduce body dissatisfaction during pregnancy.

5.2.4.1 WHY TO USE AUXETIC STRUCTURES?

Most of the women surveyed for this project (Chapter 3) indicated that it was very hard to find maternity clothes that fit well to their bodies in every stage of the pregnancy. Frequently, they found alternatives such as using oversized, loose, and shapeless clothing. However, these actions affected their self-esteem and body appreciation. Auxetic structure can help to reduce these problems. **Its properties such as size growing, expansion in all directions when stretched, and the ability to fit a hemispherical surface without too much force applied, made it a perfect tool to create custom and perfect fit garments with good aesthetic appearance for pregnancy.**

Auxetic figures also can create garments that could give comfort. Women argued that one of the main characteristics that motivate them to buy a maternity garment was their desire to feel comfortable, especially in the last months of pregnancy. Auxetic cuts can ensure this, not only for its quality of adapting to the body and soft handle, but also for its air and moisture permeability. Clothes can maintain the body dry. Even the elastic materials used currently on maternity clothes, cannot ensure comfort. They can produce pressure in the belly. Combine auxetic figures with elastic materials could be a solution to this problem.

Furthermore, women expressed that maternity clothes are expensive, and since they are only used for a short period, they limited their expenses to buy the essentials. **Have a garment that could adapt perfectly during the different stages of pregnancy and even to be used after prenatal period can contribute significantly to the pocket of families.** With auxetic cuts, garments can be worn during all the pregnancy stages because it can adjust to the women figure. Women can avoid buying clothes every time their figure changes. This also reduces the waste of clothes. Women on the survey expressed that most of their maternity clothes were thrown away, given to another person, or kept in their closet, since it was not necessary to use them anymore, and they did not adapt to her figure after the baby was born. Auxetic structures can help to reduce this situation. **Clothes could adapt to body women after pregnancy, proportioned good fitting and motivate them to use the garment for more time.**

Auxetic garments possess qualities that can help women to reduce body dissatisfaction. Solving the previous problems mentioned can make females

feel good, not only in terms of their figure, but also by reducing the economic anxiety that many women experience during this period. **Auxetic figures as well were chosen for their aesthetic. They are nice shapes. This provides other element in which women can express themselves.** The project intent to give auxetic options to women to be able to personalize their garment. Women would be able to select a desired figure and place it on specific areas in which maternity clothes generate most pressure (waists, belly, breast). This will be other element in which mothers can express and create an active engagement rather than a passive consumption.

It is important to mention that **auxetic have also been selected for its viability to be experimented and be produced by new technologies.** In this case laser cut was used to create auxetic design on fabric. To find the best auxetic figures to be applied on clothes, and to be able to understand auxetic behaviors experiments were carried out on different materials with different thickness. During the experiments, various auxetic designs were chosen, including monostable and bistable design. These figures were also tested on Clo3d to understand their digital and simulation behavior on digital prototyping software. For this project is important to find how auxetic figures perform on a digital environment because costumers' avatar will be generated. **The fact that the figures are capable of being produced with new technologies can also generate a democratic process.** Since the parts can be produced in communities around the world. This also generates less pollution since shipments of materials and products are reduced. The experiments and results will be explained in detail on the chapter 6.

The before mentioned are the reasons why auxetic figures are a good alternative to design a product - service system that could reduce body dissatisfaction with a circular approach. The project intent to introduce perfect fit and customization to pregnancy products, to generate body positivity on women. In the next section the importance of adaptability on clothes will be explained. It will show different approaches to generate adaptable clothes and why this is important to reduce body dissatisfaction.

AUXETIC FIGURES SELECTION REASONS

- Customization
- Perfect fit
- Good Aesthetic appearance
- Shape adaptability
- Comfort
- Size growing properties
- They help to save money
- They help to reduce waste
- Air and moisture permeability
- Can fit a hemispherical surface without too much force applied
- Can be produced with new technologies as 3D printing and laser cut.

5.2.5 ADAPTABILITY

The introduction of low prices and fast fashion has fueled rapid consumption and created disposable fashion (Cao, et al., 2014). To prolong the service of a product and address the manufacturing problems of better products functionality, quality, features, customization, environmental friendliness, lower cost, and short delivery time, Gu et al. (2004) proposed an approach called “adaptable design.”

The philosophy of adaptable design is the ability to adapt to new requirements and reuse a product and design when circumstances change. Adaptation prolongs the service of a product in time (Gu, Hashemian, & Nee, Adaptable Design, 2004). There are two types of **adaptability: design adaptability and product adaptability.** Design adaptability is the flexibility in the design of products, so that this design can be modified to produce another product. It aims to reuse the same design for the creation of different items. It creates new products with similar patterns. **Product adaptability is the ability of a product to be adapted to various usages or capabilities. The adaptation is performed by the user. So, such modifications should be easy and reversible** (Cao, et al., 2014). This adaptability directly depends on the possibility of using the same product for other usages or extension of its service life as required. (Gu, Hashemian, & Nee, Adaptable Design, 2004). Frequently, product adaptability is achieved by modifying the existing products, such as adding new components, replacing or upgrading the existing parts with new ones, and reconfiguring the existing modules. **Users can benefit by reusing most of the elements of the existing product rather than having to purchase a new one** (Gu, Xue, & Nee, 2009).

The adaptation must be contemplated from the design stage of a product considering its “**utility,**” which refers to the usefulness or service of a product. Gu et al. (2004) in their article argued that utility is a key element to generate adaptable design. The operation of a product becomes obsolete if the circumstances change, or new functionalities are needed, or more efficient technologies are implemented. Instead of creating a new product from zero **adaptable design suggest adjusting the existing product to the new operational mode.** This means that its utility is extended. “**Extending of utility**” aims at increasing the functionality of the products into operational modes. If we focus more on product adaptability it needs to be contemplated its function modelling, which refers to potential functions that may be used in the

ADAPTABLE BENEFITS	DESIGN ADAPTABILITY (PRODUCER)	PRODUCT ADAPTABILITY (USER)
Adaptation performer by:	Producer, (also user in special projects)	User, (also producer in special project)
Results of adaptations	Several products from same design	One product or extended usages
Sequential extension	Upgrade, new model, customized	Extended service, adapt to needs
Parallel extension	Product variety, customization	Multi-purpose and versatile products
User benefits	Variety of choices, lower cost, product familiarity (repair and maintenance)	One product replace a few Upgrading Customization Adapting to new needs
Product benefits	Lower cost and time of design/production Design reuse Responsiveness Market share due to variety, customization	Better market share due to user benefits
Environmental benefits	Better use of resources during production, part salvage due to shared modules	Fewer products are made due their extended life, less consumption and waste.

Various aspects of design and product adaptabilities (Gu, Hashemian, & Nee, Adaptable Design, 2004).

future. Adaptable design also should be modelled in a way that can be easily changed to deliver different functions (Gu, Xue, & Nee, 2009). **It can be considered adaptable design as superior to design for recycling methods or design for reuse of components.** Because, while such methods mainly aim at reusing the material in a new product process, adaptable design aims at reusing the products in its current state, with the required adaptations for new operational modes (Gu, Hashemian, & Nee, Adaptable Design, 2004).

The objective of adaptable design is to effectively and efficiently maintain, improve or change the functionality of a products by enhancing its

adaptability. This could bring several advantages especially in the economic and sustainable state. Gu et al. (2009) explain that by **considering design adaptability, a new design and its products can be created more easily by modifying the existing design.** This also can result in saving in products development and lead time and costs for the producer. Thus, it makes the products more competitive in the market. It also gives the opportunity to design customized products based on user specific requirements. Moreover, user can modify the existing product rather than buying a new one. This reduces the cost to achieve the required functions. On the environmental side Gu et al. (2009) comment that when a product reaches the end of its life cycle, either some components of the retired product are reused in the remanufacturing process or materials are recycled in the production of other products. When components or materials cannot be reused, they have to be thrown away. **Adaptable design can reduce the waste created in the remanufacturing and recycling processes by only modifying a small number of the existing modules of a product to extent its life span with the required functions.**

In order to create products that could adapt to women during all the body changes of pregnancy and post-partum, the project intends to use product adaptability philosophy by implementing a mechanism on clothes that could permit adjustability on the garment to create a perfect fit. For the implementation of this mechanism potential functions in all the stages of pregnancy and an easy user experience were contemplated. In the next section will be exposed **lacing like an adjustable method to adapt garments to the body, which will permit women to have the control of the garment or accessory shape.** This new mechanism is a reinterpretation of traditional fastener lacing applied on corsets and long dresses, from the 17th century. The aim is to use new technologies such as laser cut to do the simplest way production and reduce waste on the process.

5.2.5.1 LACING AND ADJUSTABILITY

Standard sizing attempts to provide apparel to fit most consumers. Most manufacturers use this standard sizing system as a guide to develop size labeling and grading for all sizes. There is no regulation of this system for that reason every brand can select and adjust garments to what they believe it's the standard. This is frequently wrong (Pisut & Conneell, 2007). The standardization does not work, people cannot find clothes that fit them well, because everybody is different. This also affect the industry, fit problems are the main factors causing customers to return apparel products (Chen, 2007).

Apparel fit is defined as the relationship between the size and contour of the garments and those of the human body (Chen, 2007). So, problems arise when the interaction between human body and clothes does not match. Fit like have been mentioned before is an important element to create body positivity on women. When women do not see themselves fitting a particular standard size, they use to blade their bodies rather than the clothes for improper fit. Their self-confidence declines and shopping experience became a nightmare (Pisut & Conneell, 2007). With a more heterogeneous population with different body sizes and shapes the way in how garment is adjusted to the body must change.

Since many years ago people have searched and implemented techniques to fit clothes to the body. **Lacing is a fastening method used in clothes. It uses cord or ribbon laced through holes which may be eyelets or rings on the edge of garments.** It is usually used as fastener at the back and the front of the body, but it can be used on the sides as well as on the sleeves or hems of pants. Usually, the ends of the laces are tied off in a bow. **The advantage of a lacing fastener is that it makes the opening adjustable.** People can tight it as much as they want or as much as the garment ease allows (Sarina, 2022). Basically, lacing is a feature that permit to fit closely or tight the clothes to the body (Thursfield, 2022).

The earliest written and pictorial sources of lacing come from the 12th century. **On the past lacing was a very functional solution allowing wearing one robe as long as possible even if the body dimensions changed. This was of special significance for pregnant women** (Rybarczyk, 2020). On the Middle Ages women's dresses could be fitting with laced holes at the sides or in front of the dress (figure 27). Holes and laces were not very visible. The noticeable lacing appeared at the end of the 14th century (Rybarczyk, 2020). Rybarczyk (2020) on her article explains that laces in woman's outfit became more noticeable in the course of time and they gradually gaining a decorative



Figure 27 : Virgin and child surrounded by angels, Jean Fouquet, 1452, Royal Museum of Fine Arts. Close-up (Rybarczyk, 2020).



Figure 28 : Pair of stocking, c. 1590-1615, inv. no.: T.126&A-1938, Victoria and Albert Museum, London (Rybarczyk, 2020).



Figure 29 : Doublet, C. 1580, accession no.: 1978.128, Metropolitan Museum of Art, New York. Close-up (Rybarczyk, 2020).

function. Laces were also used to attach stockings to breeches (figure 28). On women case they also were employed to adjust the fabric to the leg. However, what made this technique more widely used was the implementation of a metal chape, thin metal sheet that was rolled to form a cylindrical tapering tube (Figure 29). The metal chape made easier to thread the lace through the holes (or special metal rings sewn on the fabric) and protect the end of the string from damage (Rybarczyk, 2020). **Lacing was extensively used as a fastener in western ladies' clothing, such as corsets and long dresses, from the 17th century to the beginning of the 20th century** (Rogers, 2022). Since then, lacing has almost exclusively used like fastener for shoes or as a decorative element (Rogers, 2022) (Sarina, 2022).

This project intents to bring back this technique, not as a decorative element but as a functional mechanism that help the women to adjust the items to their bodies during all the pregnancy stages. The aim is that women can control the garment and regain control of their bodies. **The technique will permit women to adjust the garment on specific areas to reshape their figure as they want and as they feel more comfortable.** The project has implemented this technique on zero waste garments **by using laser cut, in this way no other elements are needed on production, provoking that the mechanism can be manufactured in different body sections and**

around the world without the necessity of especial tools. In this case a sample was made (figure 30) to insure the holes size and the fabric behavior. The intention of the thesis is to execute adaptable design philosophy inside the fashion system, to generate adaptable customs products with less environmental footprint, but abut above all bring products to the market that can reduce body dissatisfaction. In the next section will be explain why adaptable design and lacing are good to create body positivity.



Figure 30 : Lacing as adaptable method for garment collection. The idea was to improve and synthesize the cord closure technique by implementing laser cut. In this way no other finish is necessary. The cord would be inserted through the holes generating the gather.

5.2.5.2 ADAPTABLE DESIGN AND LACING SELECTION

In the fashion industry, the size variation of clothes has a strong impact in the perception of the body for consumers, because even when people know that these sizes are not reliable and well-proportioned for different kinds of bodies, they still use them like a mark for weight gain. This makes them feel extremely unhappy when the clothes do not fit well. **Adaptable design and lacing can help to reduce this problem, by proportioned to women the control of the fit. People can create their perfect fit by adjusting the fabric to the body.** Women often seek for garment that help them to be in proportion. The lacing method could help to create the silhouette that they want. **This can give them the feeling of being in proportion because they will be able to adjust the clothing on the areas that they most like.**

On the case of pregnancy, women have problems to find clothes that adjust them in all the stages. They feel pressure to wear loose and shapeless clothes. This makes them to feel bad and unhappy with their bodies. **Adjustable and lacing methods can permit women to fit the garment to their bodies regardless of the changes that they could suffer in the process. This can create the feeling that they are in control of their bodies and their clothes.** Even if the garment is loose, they could adjust it to define their figure and belly.

Current maternity clothes are considered expensive by women, and since they only used them for a short period of time, they limit their expenses to buy the essential. Adaptable de-

sign search for extent the live, utility and services of the object. **Adapting lacing method to the clothes opens the possibility that the garments can be used throughout the pregnancy and after the pregnancy, adjusting the clothing to the needs of the mother.** This prolongs the life of the garment and women do not have to buy outfits every time their body changes. This also help to reduce the consumption of clothes that are sent to the trash once their functionality ends.

On the manufacture side adaptable design give the possibility of **offer custom products** based on mothers and women requirements. **The lacing method can be implemented in different areas of the body, where the mothers require an adjustment. Lacing also can be implemented like a functional and decorative element, given the possibility to women to adapt the cord or ribbon to their style.** Those are the reason why adaptable design and lacing are a good alternative to design a product service system that could reduce body dissatisfaction with a circular approach. The project intent to give power to women by controlling the garment fitting. In the next section will be explain the importance of open design to create new ways of production that permit that maternity clothes could be made in a better way and to be accessible around the world.

ADAPTABLE / LACING SELECTION REASONS

Adaptable design:

- Extending of utility
- Extension of product service life as required
- New design and its products can be created more easily
- Opportunity to design customized products based on user specific requirements
- Ability of a product to be adapted to various usages or capabilities
- User can modify the existing product rather than buying a new one
- Reduce the waste by only modifying a small number of the existing modules of a product to extent its life span with the required functions.

Lacing:

- Decorative function
- It makes the opening adjustable
- Permit to fit closely or tight the clothes to the body
- People can tight it as much as they want or as much as the garment ease allows

5.2.6 DISTRIBUTED PRODUCTION AND PARTICIPATORY DESIGN

The global mass-manufacturing system encourage overconsumption and obsolescence of products. This increases the waste generation and the easy replacement and disposal of clothing goods (Hirscher, Niinimaki, & Armstrong, 2018). Inside clothing manufacture in most of the cases, human right violations, toxic waste disposal and high price fluctuations of materials such as cotton occur. This manufacture also is implemented on poor countries with low environmental regulation (Hirscher, Niinimaki, & Armstrong, 2018). Circular economy is based on search a new way in how to replace and improve this industrial production that is destroying the planet (Smith, Baille, & McHattie, 2017). New alternatives are beginning to emerge that introduce another manufacturing system and encourage the user to recognize the value of products and good quality production (Hirscher, Niinimaki, & Armstrong, 2018).

Digital technologies have occasioned great changes in fashion production process by assisting the transition from a large-scale, centralised design and production system to ones that are decentralised or spread among smaller networking units (Ambrosio & Vezzoli, 2019). The serial production of finished products is **being replaced by the design of model, services, digital platforms, and semi-finished products that can be modified, customised, and finished by the consumers** (Ambrosio & Vezzoli, 2019). Clients are started to being seeing like a co-creator. **That goes from a passive user (the one that buy the finished final product) to the well-informed and self-creator one (user that interfere with the design of the product).**

The system is changing, brands are searching for new ways to involve the user creativity and ability to constantly reinvent products, and consumers are not accepting the imposed products on the market. Consumers therefore contribute to the conceptual definition of goods, rather than waiting for companies to decide for them (Ambrosio & Vezzoli, 2019). With the new technologies industrial production has been distributed, decentralised, and even the same users have created their own laboratories at home. **The self-production reduces the number of resources needed, the cost of production, packaging, transport, and it reduces the waste from unsold finished good. Products can be produced on demand** (Ambrosio & Vezzoli, 2019).

Furthermore, with these new systems the products are produced in the communities. This reduces pollution caused by excessive consumption of resources and transportation.

The active role of the consumer help to user to improve their manual skills and make them more aware of the waste-related issues. To learn new skills, **empowers consumers to challenge their fashion consumption habits, such as low-quality purchases and impulse shopping, producing more stable values regarding fashion choices** (Hirscher, Niinimäki, & Armstrong, 2018). They also develop a sentimental attached with the product. Effort and success of doing something by themselves provides them deep emotional satisfaction. This provokes that they want to keep it longer and look for ways to repair it or use it in different ways if it gets damaged (Ambrosio & Vezzoli, 2019).

With this system the waste of resources and the cost of storage and transport are much lower than in the traditional centralized production. Moreover, encourage collaboration between active consumers and designers, generating an exchange of ideas and skills that enrich the product and service. **Do-it-yourself, do-it-together, halfway products, and participatory design are some of the alternatives to introduce co-creative design on products.** The implementation of these depends on the consumer's freedom on the design intervention item (Hirscher, Niinimäki, & Armstrong, 2018). Participatory design is about involving the user in the design process with a special focus on people participating in the design process as co-designers (Ehn, 2008). Half-way products are design objects that are intentionally unfinished,

offering the end-user involvement in the final product outcome and its design, to enable a unique product, which can capture the experience of joint making (Faud-luke, 2009). Participatory design and Half-way products are frequently used together. With these strategies users can create unique pieces learning in less time with less skill. Do-it-yourself and do-it-together are activities that allow the consumer to fully produce a garment with their own skills supported by DIY Kits that contain materials and instructions. In these categories users became builders and designers, and they generate a longer-lasting emotional experience with less material consumption. It aims to increase products longevity through custom fit/style and person-product attachment through personal effort (Hirscher, Niinimäki, & Armstrong, 2018).

The thesis project intent to apply distributed production and participatory design. The aim is to create a product service system scalable that could be accessible in any part of the world, without damaging the planet and generating a circular economy approach. It also intends to introduce the user as a co-creator. They will be able to produce and assemble the garment in their communities. The project will use interlocking systems that permit people to cut the garment on laser cut technology and joints the clothes parts without the necessity of sewing machine. In the case of local production, the project proposed Fablab laboratories, workshops equipped with the necessary tools to produce the garment in the locality. These laboratories are located around the world, making the scope of the project scalable.

5.2.6.1 INTERLOCKING SYSTEMS / CONNECTORS

Post-couture is a project created by Martijn van Strien in 2015. The company based on the principle of open source that allows consumers to download, customize, produce, and self-assemble clothing designs. The products come in an instructive kit. Consumers can buy the made-to-measure designs or buy the patterns to modify and cut them at home.

One of the most interesting features of the project is that permit people to assemble the garment without the necessity of a sewing machine. It uses a series of connectors and slots or strings and slots. **The connectors are interlocking systems that permit to join the garment modules.** These connectors do not have a defined structure, although they frequently are geometrical forms. Their aim is to allow the union between the fabrics or materials in an easy way. The connector must be resistant to stretching and movement. Post-couture project uses a generative script in Grasshopper that calculates the distribution and the number of connectors that are needed for the ultimate strength (Me, 2017).

Including this kind of manufacturing within the design brings many advantages. **Connectors permit to create a modular design.** Modular design aims to develop products architecture consisting of physical detachable units (Gu,



Figure 31 : The Post-Couture garment made with connectors, Meshit collection 2017 (Martijnvanstrien Fern. CC, 2022)

Hashemian, & Nee, 2004). A module is a component or a group of components that can be disassembled non-destructively from the product as a unit. Since modules in modular products are relatively independent, these modules can be designed and manufactured separately. Each module can be attached, detached, modified, relocated, and replaced easily for upgrading, repair, recycling, or reuse (Gu, Xue, & Nee, 2009). People can repair only the piece that it damages without the need to throw away the entire product.

Connectors also impulse the distributed production. People can produce at home, they no need to be experts on the subject to produce and joints the garments parts. This reduces the shipping contamination. The emissions that are generated by shipment materials and items from long distance are reduced. This alternative production as well impulse the local employment. People can produce on small laboratories on their communities and exchange knowledge and skills. They also can personalize the products, by choosing the material and some cases the finishings. Garments produced with connectors are also easily to recycle, because they do not include other assembly elements such as thread, buttons, zippers, or glue. **Connectors can replace fasteners.** Another important characteristic is that once people receive the pattern file with their measurements, they can use it and produce the item as many times as they want.

This kind of manufacture initiatives are based on participatory design, half-way products, do-it-yourself and do-it-together. As it mentioned above, by directly engaging with the design of the piece ordinary consumers turn from passive buyers into active players of the production process behind their garments. These activities create an attachment between people and garment. This ensures the product life extension. Furthermore, this **kind of initiatives work on demand.** When custom manufacturing production is applied, no more clothes are produced that is needed. Connector's manufacture reduces the waste generated by production, consumption disposal, and return of products that does not fit perfectly. Also, **it can be more affordable.** People can buy only the pattern, which would be cheaper than buying a complete product, and they can use it and make the garments as many times as they want and require. Likewise, if a modular design is used, the user would only have to repair the affected area without the need to buy another product. It is important to mention that these types of designs have become more accessible and can be applied because they **can be produced with new technologies such as laser cutting.** This tool allows the cutting of different materials with different thicknesses and can be accessible to people through workshops on their communities.

The thesis intents to use connectors to create product service system

that could be accessible in any part of the world, without damaging the planet and generating a circular economy approach. The aim is that people can use new technology to generate a networked production where different parts intervene to produce a democratic and open design interaction. Furthermore, the connector were choices for their advantages on encourage a sustainable production as the reduction of shipping and the ability it gives garments to be easily recycled. It also was selected because it could bring a personalized user experience for pregnancy products to create attachment and prolong the item life. Even when connectors are not directly related to body dissatisfaction problems. It is important to make alternative production for this sector. Although, it can be mentioned that connectors can reduce garments prices and permit custom production. Two beneficial elements that help to reduce anxiety during pregnancy. In the next section FabLab laboratories will be explained like a collaborative and decentralization manufacture. It will be exposed like an alternative to generate a democratic product service system.

5.2.6.2 FABLAB

In the last few years, the access to the resources of digital fabrication tools have been increasing as their cost decreases, making certain models available to individuals or small communities (Posch & Fitzpatrick, 2012). This has led to the emergence of different manufacture systems. Inside these new approaches it can be find fabrication laboratories (FabLab). **These laboratories are series of interconnected spaces (makerspaces and hackerspaces) through an international network of collaboration, equipped with advanced technology** (Garcic-Ruiz & Lena-Acebo, 2018). The aim is to inspire people and entrepreneurs to develop their ideas on products and prototypes by giving them access to a range of advanced digital manufacturing technology (FABLAB Belfast / Nervecentre, 2022). **Usually these spaces include computer -controlled machines such as laser cut, milling machines and sign cutter, 3D printing devices, as well as electronics workspaces and necessary programming tools** (Posch & Fitzpatrick, 2012). The idea inside FabLabs is to provide the environment, skills, advanced materials and technology to make things cheaply and quickly anywhere in the world, **and to make this available on a local basis to entrepreneurs, students, artists, small businesses and in fact, and anyone who wants to create something new or tailored** (FABLAB Belfast / Nervecentre, 2022). People became technological protagonist rather than just spectators.

FabLabs give the opportunity to share information, resources, and projects globally within the laboratories network (Ropin, Pflieger-Landthaler, & Irsa, 2020). It is an open learning community. Users can build their expertise around means and methods of production in open, real, and virtual communities rather than in closed training settings. **FabLab promotes social interaction** (Troxler, 2011) This system also provides education and equipped spaces to people to carry out their projects, eliminating the barriers of knowledge and the use of new technologies. It is an open-source method. Production experience is not reserved for a small group, but it is available for everybody. Moreover, these spaces become centres of innovation. People and companies can explore new solutions and interesting research of unexplored topics. FabLabs are not purely private or purely public organisations. They are built on public and private partnerships (Troxler, 2011). On these laboratories is possible to create object from digital files and together with consumable materials they form an infrastructure to “make (almost) anything” (Posch & Fitzpatrick, 2012). FabLabs can charge for their services, if it is needed, but they always are accessible for people (Kohtala & Bosque, 2014). Fabfoundation on their website points that currently there exist 1750 FabLabs all over the globe, distributed on 100 countries and 24 times zones. **This opens the possibility that a business project can produce and expand around the world avoiding shipping pollution and manufacture investment.**

Based on Fablab system other types of networking collaboration focuses on specific branches are starting to emerge such as **Fabricademy**. Fabricademy is a **course that fo-**

cus on the development of new technologies applied in the textile industry. Their methodology goes from fashion industry to the upcoming wearable market. The aim is to develop and implement a new approach on how to create, produce and distribute textile and fashion elements, by using distributed manufacturing infrastructures and knowledge networks. Inside the program people investigate how textiles and fashion industry can benefit from new technologies, processes, and business models. It includes experimentation with human body, culture, and mindset by recycling, hacking, and sensing it, creating feedback loops with project development, where materials, aesthetics, sustainability, and customization play equal and important roles.

Fabricademy networking is based on “nodes” makerspaces (public and privates) equipped with manufacturing technology as FabLabs, but they also cover specific technology for fashion industry such as sewing machines, knitting machines, loom, basic biolab, workstations for CAD modelling, soft actuators e-textiles, embroidery machine, scissors, threads, yarns, natural fibres, big tables, and Roland text-art dye sublimation printer. Although this chain of collaboration is just beginning and does not have the same number of partners that Fablab networking, it opens the possibility of the creation of new spaces for students, entrepreneur, and people in general, that require specific textile and fashion equipment to do specific task.

The project intents to use **FabLabs laboratories on the production chain. The aim is that people can download the patter file from the product service system and produce it in their communities close to them.**

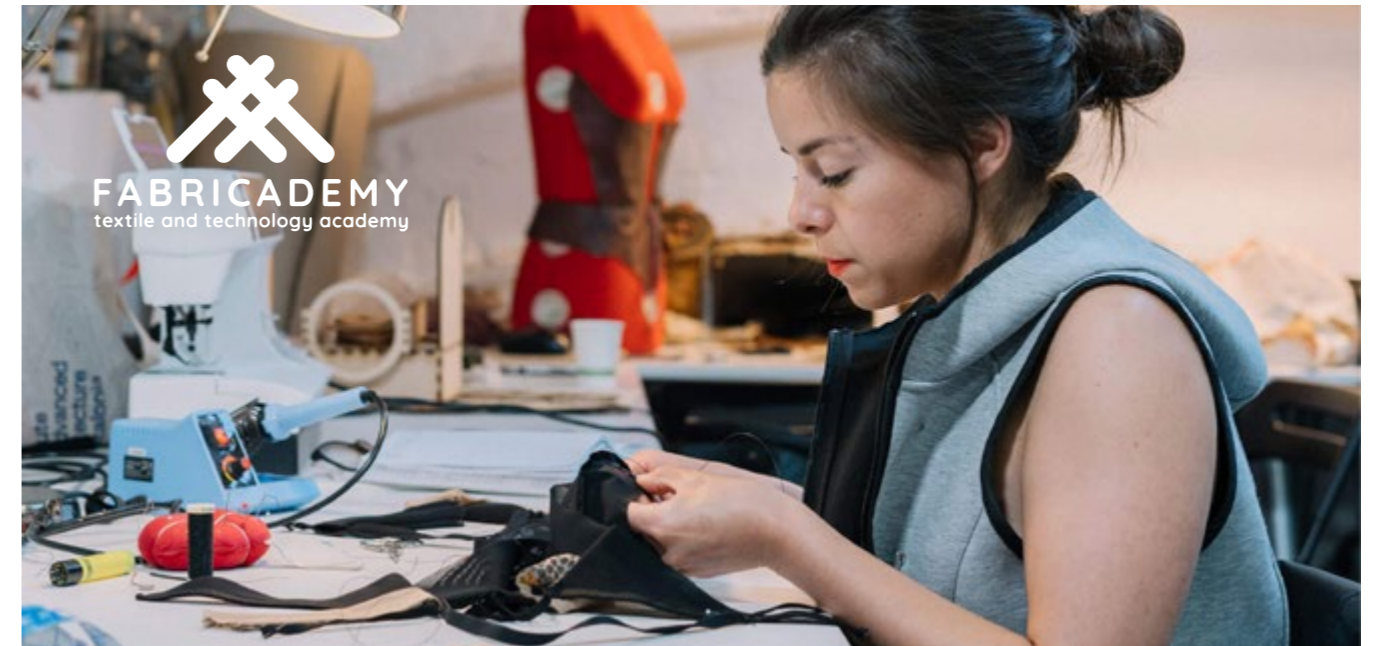


Figure 32 : Fabricademy Barcelona. Networking laboratories specialize in textile design.

This option can benefit the environment and user experience. The production can be cheaper, quickly and done around the world opening the possibility to scale the project to other areas of the planet. Furthermore, it promotes a social interaction that can help women to feel better and to create and special attachment with the garment. It also opens the possibility of personalizing the garment, women can choose the material that more suit them and even add other accessories. Collaborative networking brings new technologies closer to the people, such as laser cutting, which is a production tool that the project intent to use for its environmental and manufacture benefits. The use of this technology can be cheaper and accessible around the work thanks to the laboratories.

In general connectors and FabLabs permit the incorporation of a networked production that can help to change the current manufacture process, which, as has been mentioned before, damages the planet. The networked production is a collaborative and democratic design. It opens the possibility of a closer interaction between the designer and its user to create experiences and products that fit consumer’s needs. In the next section will be explained the laser cut technology. It is going to be described the benefits of using this tool in the production of clothing and accessories.

SELECTION REASONS

Distributed production and participatory design:

- Clients like co-creators
- Decentralised and distributed production
- Reduces the number of resources needed
- Reduces the cost of production, packaging, transport
- Reduces the waste from unsold finished good
- Products can be produced on demand
- Reduces shipping pollution of resources and product
- Help user to improve their manual skills
- Help user to change their consumption habits
- Prolonged object life (sentimental attachment)
- Collaboration between active consumers and designers

Interlocking systems / connectors:

- Permit to assemble the garment without the necessity of a sewing machine
- Permit modular design
- People can repair only the piece that it damages without the need to throw away the entire product
- People can produce at home, without any extra knowledge
- Reduces the shipping contamination
- Impulse the local employment
- Personalize products
- Easily to recycle
- People can produce their garment as many times they want
- Can be produced with new technologies such as laser cutting
- Democratic and open design interaction

FabLab:

- Equipped with advanced technology, laser cut
- Production cheaply and quickly anywhere in the world
- Opportunity to share information, resources, and projects globally
- Open learning community
- Social interaction
- Provides education and equipped spaces to people
- Centres of innovation
- Possible to create object from digital files
- Distributed around the world

5.2.7 LASER CUTTING

Laser is an energy source, whose intensity and power can be precisely controlled. (Nayak & Padhye, 2016). The laser beam can be focused to a desired object at specific angle depending on the application. Laser can cut a variety of materials from flexible fabric to rigid and strong metal (Belli, Miotello, Mosaner, & Toniutti, 2006). There exist three different kinds of lasers. CO2 lasers work by reflecting the light beam on mirrors. This tool is good to be used on acrylic plastics, leather, fabric, and paper. CO2 is used for non-metallic materials. Fibre lasers work through glass fibres that derive energy from pump diodes. It produces a small and stable focal diameter. It is the most expensive on the market, but it has a longer life compared with the others. Fibre laser is one of the most flexible lasers. It could be used to cut and engraving metal and thermoplastics. Nd:YAG/Nd:YVO lasers are used to cut crystal and ceramic. These machines possess an extremely high cutting power. They are applied to manufacture medical, dentistry and military products (3ERP, 2019). CO2, Fibre, and Nd:YAG/Nd:YVO lasers can have different sizes, dimensions, and power; the working area, and material dimensions depend on the size of the machine.

Knives on fashion manufacture have limitations especially with on delicate materials as the cutting force can move the fabric which led to inaccurate cutting. Laser equipment help to solve these problems due to the **advantages of accuracy, efficiency, simplicity, and the scope of automation** (Nayak & Padhye, 2016). Laser cutting has

become very popular on fashion and textile fields. **Designers get very detail pieces in small time.** This made it a cheaper process compared with traditional cutting methods (Mahrle & Beyer, 2009). **Laser cut does not have mechanical action, it has high precision of the cut components at high speed are feasible.** The production method is safer with simple maintenance elements, which can work for longer time than a knife (Nayak & Padhye, 2016). Furthermore, laser cutting can be integrated to computer technology. **It can manufacture the products at the same time when designing in the computer. This permits production base on demand and repeatability; people can use the same archive to cut the pattern several times.** The method is **suitable for cut a wide range of fabrics composites, leather, and synthetics.** It can be used also on natural fibres, but it creates a brown edge colour and sometimes the edged can fray. In synthetic materials laser cutting produces well-finished edged as the laser melts and fuses the edge, which avoids the problem of fraying produced by conventional knife cutters. During the cutting there are no unintended marks left on the fabric, which is particularly beneficial for delicate fabrics like silk and lace (Williams-Alvarez, 2014).

With the same machine also is possible engrave. Laser engraving refers to a subtractive method that modified the fabric surface with simple or complex patterns through laser beam scanning (Yuan, Jiang, Newton, Fan, & Au, 2012). This method gives the designers

the ability to apply unique design appearances without chemical applications with a more environmental process. However, laser cut also have disadvantages, one of its limitations is the number of the fabric that can be cut by the beam. Best result is obtained while cutting single or a few sheets, the accuracy decrease by putting several fabric layers. Moreover, there exist the possibility that the edged merge together especially in synthetic materials, and that the cutting process could produce toxic emissions (Nayak & Padhye, 2016). Nevertheless, it is good to be applied on custom and fit products manufacture. It is important to mention that this technology **can be accessible to people.** Like have been mentioned before, the access to digital fabrication tools have been increasing as their cost decreases, making certain models available to individuals or small communities (Posch & Fitzpatrick, 2012). Although, laser cutting is more expensive than a 3D printer to have it at home. FabLab laboratories permit the access to this technology with an accessible price on communities around the world.

The project intent to use laser cut tool to manufacture the products on the service system. The intention is to make zero waste patterns that could be cut easily by laser and ensemble at home with the connectors. Laser cut offers several advantages, as have been mentioned before, this process can help to create a more democratic design in which the user could feel part of the process. With the incorporation of the laboratories people can have accesses to the tool and produce at home. Furthermore, this method permit that the garments could be customized and produced by demand. Good quality finishes are obtained, this helps to avoid the

necessity of incorporate other process in the garment. Moreover, connectors are easier to be produced and people can use the same file garment as many times they want. Even if the products are not created in a networking production, laser cut have good benefits to improve the normal manufacture, as the liberty on design detail, its accuracy, efficiency, and its simplicity process. It is important to mention the detail and accuracy advantages because the project aims to use laser cut to generate the auxetic figures. These figures are small geometric elements that will be included on the zero-waste pattern design. They need a precision in the cut to generate the adequate expansion and to prevent the break. As the auxetic cut are created inside the garment structure, it is important also to avoid fraying. For that reason, it was considered to also use synthetic materials.

As explained in this section, synthetic fabrics have a better result for laser cutting. The intention of the project is to use synthetic materials because their edge melts and fuses avoiding fraying problem, which help to the development of connectors and auxetic figures. However, it is well known that this type of material pollutes a lot. So, the project proposes to use recyclable synthetic materials like an alternative. In the next section materials will be introduced to help the project to generate a product service system.

LASER CUT SELECTION REASONS

- It is clean and lint-free
- High working speed
- Contactless
- Good for small production
- Permit customization
- This service is available around the world
- Detail pieces in small time
- Production base on demand and repeatability
- Extremely high precision in cutting contours
- Suitable for cut a wide range of fabrics
- Well-finished edged
- No unintended marks left on the fabric
- Simple process due to integrated computer design
- Laser engraving and laser cutting combined in one step
- No fabric fraying in synthetic fibres due to formation of fused edges

5.2.8 MATERIALS

Growing population has put pressure on natural resources, which are expected to become more scarce (Sandvik & Stubbs, 2019). This will affect fashion industry, as the production uses natural fibres like cotton. Adding to this also the planet is facing an accumulation of textile waste, as fast production and consumption of clothing has led to a perception from consumers that clothes are disposable (Sandvik & Stubbs, 2019). Furthermore, it is estimated that approximately 63% of the textile fibres are derived from petrochemical products. Whose production and fate give rise to considerable carbon dioxide emissions (Sandin & Peters, 2018). Whereas cotton, the most popular natural fibre, contributes only about 24% and is related with water depletion and toxic pollution, due to intensive use of pesticides (Sandin & Peters, 2018). **Most of the textile environments impact are generated on the in later stages of production.** Wet treatment processes (dyeing, finishing, printing) and spinning of yarns and weaving/knitting fabrics produce major sources of toxic emissions and rely on fossil energy use (Roos, Sandin, Zamani, & Peters, 2015). To sum, **greenhouse emissions, water use, toxic chemicals and waste are the main environmental issues facing the textile industry** (Sandin & Peters, 2018). To generate a change the manufacture must create new production alternatives. Roos et al. (2015) expressed on their report that reuse and recycling are key elements to change the system. Increased textile reuse and recycling could potentially reduce the production of virgin textiles fibres and, in the case of reuse, also avoid engineering processes further downstream in the textile product life cycle, and thus reduce environmental impact (Sandin & Peters, 2018).

Ellen MacArthur Foundation (2017) define circular economy as the restorative and regenerative by design, and aims to keep products components, and materials at their highest utility and value. People can implement this philosophy by reuse, resell, remanufacture, and recycle. **Textile-to-textile recycling is a process of material recovery of pre- and post-consumer textile waste into yarns for new fabrics** (Sandin & Peters, 2018). Sandvik and Stubbs (2019) claim that textile-to-textile recycling can be a way to solve resources scarcity and clothes waste in landfill. They considered that enhancing recycling practices is a way of **redirecting textile waste away from landfills and utilising it as a resource. Recycling is done by disassembling, dissolving or shredding materials.** Fibres are then regenerated into new materials that can be used in industrial production of new textiles (Leonas, 2016). There exist three

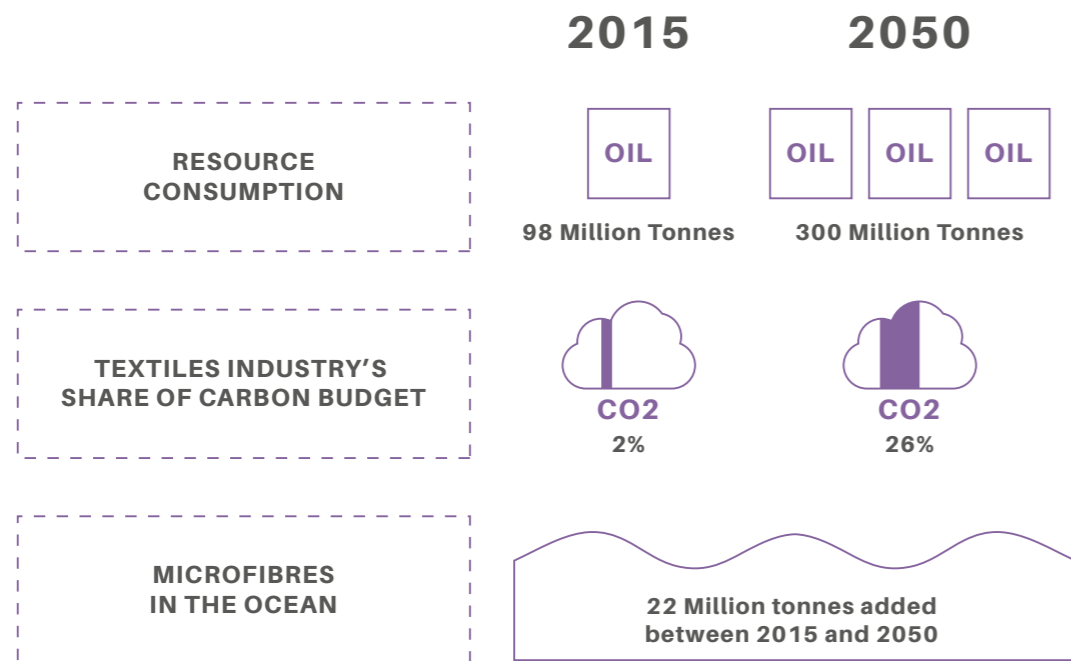


Figure 33 : The negative impacts of the textiles industry are set to drastically increase by 2050 (Ellen MacArthur Foundation, 2017).

ways of recycling textiles; **mechanically, chemically, and thermal**. Mechanical recycling covers processes of cutting, shredding and mechanically disassembling materials. Chemical recycling is a process where synthetic materials are broken down for repolymerisation (Leonas, 2016). Thermal recycling refers to the conversion of PET flakes, pellets, or chips into fibres by melt extrusion, but the flakes pellets and chips have been produced from PET wastes by mechanical means (Sandin & Peters, 2018). For example, from PET bottles. This comes up because PET staples fibres are mostly used to produce composites fabrics such as cotton-PET. It is difficult to recycle blended materials due the complexity of segregation. Therefore, such fabrics are disposed in the landfills. However, it is rather easy and economical to recycle used other plastic waste. This indicates that the simpler the material (without mixes), the easier it is to recycle.

In a system where **fabric and fibre recycling are fully integrated, new jobs are created and the resources needed are less** (Filho, et al., 2019). **Water, fossil fuels, and chemical consumption decreases**. Furthermore, this activity could become one of the solutions that helps companies to process of moving towards sustainable business performance. Textile recycling leads

products manufacturing towards a reduction of production costs, depending on recyclable materials being a low-cost and efficient alternative with low environmental impact (Filho, et al., 2019). It also creates opportunities for new start-ups to enter the market by dedicating their economic activity to textile recycling utilizing advanced technology to produce high valued-added products (Filho, et al., 2019). Textile recycling also raise awareness in the fashion and textile sector, about taking responsibility to reduce its pressure on raw resources in the face of growing global populations, fashion brands have started to incorporate textile-to-textile recycling in the production of their products (Filho, et al., 2019). In general, **recycle materials reduce environment impacts, mainly because the need for primary resources is reduced, and added to this it helps to create new business opportunities, delivering innovative, more efficient ways of producing and consuming**. It creates social integration and cohesion. Moreover, fabrics made with thermal recycling, keep plastics from going to landfill and ocean (Elven, 2018). These materials are good to be manipulated with new technologies such as laser cut, because recycled polyester is almost the same as virgin polyester in terms of quality (Elven, 2018). But thermal material's production requires 59% less energy and it reduces CO2 emissions by 32% in comparison to regular polyester (Elven, 2018). This technique also contributes to reduce the extraction of crude oil and natural gas from earth to make more plastic and it also helps to promote new recycling streams for polyester clothing that is no longer wearable (Elven, 2018).

The project intends to use recycled synthetic fabrics to produces adaptable maternity products. The intention is to use materials that can be cut with laser cut, without the necessity of implemented other finishing. Laser cut melts and fuses the edge of synthetic materials avoiding fraying problem. This characteristic is good for the project because its intents to use connectors and auxetic figures on the product design. However, it is known that polyester or based plastic materials, use a large amount of chemicals, energy, and water. They also produce many of emission of greenhouse gases during their manufacture. It is for that reason that the project intent to reduce these problems **by using recycled materials**. Although, most of the women interviewed in the project (chapter three) expressed that they search natural fibres for its comfort, the truth is that recycled materials can also offer them relief and good sensitivity to the touch. These materials also add the incentive that their garments are made with the objective of reduce waste and toxic emission during their production.

Other aspect of the project is that **products are thinking to only use one material**. How it was mentioned composited materials are difficult or sometimes impossible of recycle (Sandin & Peters, 2018) for their complex structure. It is for that reason that their products will have the requirements to use as few ma-

materials as possible in its construction. The main is that these products could be disassemble by mechanical technique and be reused in other products to extend the life of the materials. Recycled materials can also bring other advantages to the project, such as lead the project to the reduction of costs production and open de new opportunities to introduce ecological maternity products on the market.

The project did experiments to understand recycled materials behaviour with the laser cut, and about everything to be able to see their performance with auxetic figures and connectors. For these experiments three types of fabric with different thicknesses where used. Recycled cotton neoprene (0.0385 gr/cm²), recycled rasone (0.0186 gr/cm²) and mollettoni recycled fabric (0.0329 gr/cm²). These experiments confirm that **recycled textiles are good to work with laser cutting, but to ensure a good performance with auxetic and connectors fabric elasticity and thickness must be considered, this will be explained on detail chapter 6.** Util now have been explained the elements of the project with reference to the products design. On the next section It will be explain the foundations of the projects that are more related with the service and online purchase. The proposal service base on digital tailoring and digital customization. The aim is to create a product service system in which women can feel comfortable and included.

RECYCLED MATERIALS SELECTION REASONS

- Resources needed are less
- Creates opportunities for new start-ups
- Awareness about overexploitation of raw materials
- Leads manufacturing towards a reduction of production costs
- keep plastics from going to landfill and ocean
- Reduce the extraction of crude oil and natural gas from earth.
- Materials are good to be manipulated with new technologies such as laser cut
- Their production requires 59% less energy and it reduces CO₂ emissions by 32% in comparison to regular polyester.

5.2.9 DIGITAL FASHION RETAILING

Electronic commerce (e-commerce) is the buying and selling of goods and services, or the transmitting of funds or data, over an electronic network, primarily the internet (Chai, Holak, & Cole, 2020). **E-commerce has changed consumers shopping habits.** Consumers moving from physical to online retail are having a significant impact on high-street retail (Xue & Parker, 2020). At the same time COVID-19's impact on global economy is forcing consumers to become more trusting upon e-commerce retail (Xue & Parker, 2020). So, improving digital customer's experiences is companies' top business priority. **Customer experience refers to the multidimensional takeaway impression or outcomes predicted by the extent of engagement that is influenced by dimensions of physical and/or human interaction** (Sachdeva & Goel, 2015). Customer engagement (produced by people's interaction with environmental cues) generates the customer experience (Grewal, Roggeveen, & Nordfalt, 2017).

The simulation of fun, and feelings of pleasure and fantasy on retail are directly related with fashion. **The success of fashion retail depends on extent hedonic experiences which could achieve satisfaction and customer loyalty** (Colombi, Kim, & Wyatt, 2018). The extent or quality of hedonic experience is distinguished by the strength of engagement which contributes to the intensity of the motivational force experienced, and that of attraction to stimuli (Higgins, 2016). Interactions with environmental stimuli dictate customer's behavior. These interactions can

be created by the integration of the technology to engender pleasure in shopping and provide entertainment value. (Colombi, Kim, & Wyatt, 2018).

Various interactive technologies are being developed and implemented to provide a virtual store experience (Colombi, Kim, & Wyatt, 2018). Technologies classified as **web 3.0** (Idrees, Vignali, & Gill, 2020) **help to meet people's needs such as fitting and customization, and solve the main disadvantage of online retailer, which is that costumers cannot try the items physically before making purchase** (Colombi, Kim, & Wyatt, 2018). It is important to point out that current digital shopping store is based on web 2.0 technologies. These technologies are the ones that e-commerce have used since the fashion industry joined to online shopping. The current system is center on participatory platforms, through which consumers can download content, as well as contribute and produce new content by uploading (Idrees, Vignali, & Gill, 2020). These technologies are viewing technology (image view, zoom, 360 product rotation etc.), and service technology (product recommendation, blogs, hashtags etc.). By their characteristics these technologies do not meet customer demands during the online purchase as they lack the sensory technology of size, fit recommendation, and visualization, leading then to the error of size and style selection (Idrees, Vignali, & Gill, 2020).

Web 3.0 technology include data. By utilizing metadata rooted in websites, data can be transformed into valuable information

and intelligent agents, responsible to locate, evaluate, store, or deliver data (Morris, 2011). **Intelligent agents are software programs which collect information based on the user's collaborations with the web and accomplish jobs in favor of the user** (Idrees, Vignali, & Gill, 2020). To explain these technologies, they will be divided on two main branches metaverse fashion technologies and Intelligent Web 3.0 fashion technology.

Metaverse is defined as virtual world which is embedded in technology and web-interactions. In meta-verse, users from anywhere can interact with other users as avatars. Boundaries are annulled. People can communicate through metaverse, this allows playfulness, transfer of knowledge and transactional commerce (Davis, Murphy, Owens, Khazanchi, & Zigungs, 2009). Meta-verse fashion technologies include augmented technologies and virtual reality. The second one is the virtual experience of feeling of being engrossed in the virtual atmosphere (Idrees, Vignali, & Gill, 2020). Virtual technologies in e-commerce platform are present as avatars to mix and match for dynamic product view, virtual fitting rooms, virtual catwalk, and virtual body scan.

Avatars to mix and match for a dynamic product view, are technologies that enhance entertainment and encourage consumers to revisit a website. In some cases, consumers can mix match products on avatar for a dynamic product view. This technology is a consumer-oriented technology. Avatars permit telepresence, which is a feeling of physical atmosphere. It is described as a place where users can take part with interactive experience (Fiore, Kim, & Lee, 2005). Virtual models can also enhance perceived

enjoyment and hedonic value as well as perceived ease of use and usefulness (Idrees, Vignali, & Gill, 2020).

Virtual fitting rooms (virtual try-on) allows more physical contact with clothes. It is a virtual identity that consists of a 3D model created by inputting the customers' measurements, and physical characteristics (avatar) that is used as a platform for trying clothes. (Colombi, Kim, & Wyatt, 2018). Innovation and image interaction is designed to simulate the digitally store essence. This simulation permits the creation and manipulation of product or environmental images to simulate experiences with product or environment. The creation of the avatar permits the introduction of the customer on the cyberspace and allow virtual social interaction. This help to get information about client experience (Colombi, Kim, & Wyatt, 2018) which helps to increase shopping enjoyment. This technology provokes the sensation of **"being there"** with a product, as in a store. It also improves customer's confidence in apparel fit and reduces perceptions of risk associated with online shopping (Colombi, Kim, & Wyatt, 2018). **People perceive these tools useful and entertaining.**

The other main branch inside e-commerce technology is **Intelligent Web 3.0 fashion technology. This technology is possible for the develop of IT technologies that permits betterment in data assembling, storage, processing, personalization, and information of virtualization** (Idrees, Vignali, & Gill, 2020). Intelligent web 3.0 is the foundation of AI technology which comprise of web mining and web farming technologies (Zhong, 2003). This technology is linked with a large amount of data utilization and collec-

tion. Web 3.0. is suffering an internet evolution stage that permits the incorporation of advanced technologies such as, social networks, big data, and internet of things (IOT). IOT is an internet term in which the internet acts as a medium and connects physical equipment with apps to provide services and communication (Idrees, Vignali, & Gill, 2020).

Intelligent Web 3.0 fashion technology offers a variety of tools that previous were developed by analyzing body-scan data, which was collected by surveys or by using 3D body scanning technology. **Virtual size and fit platforms are classified on size recommendation, fit recommendation, and fit visualization.** Size recommendation or prediction is based as its name says on recommendations. This size advice is given for the brands by asking the users to put their basic measurements (weight, height and fit) on the platform, or by analyzing previous user purchase history. Enabling the data helps brands to predict the perfect size to achieve the best fit (Idrees, Vignali, & Gill, 2020). This tool satisfies consumers and reduce the perception of risk before buy the item. It eliminates the confusion, and it can help to decrease the return of garment bought online (Idrees, Vignali, & Gill, 2020). There exists also a personal stylist tool. This tool assist consumers by suggesting a range of garments that suit user' profile. Usually, brands reach this by asking their clients basic body measurements and questions regarding to colors, personal likes, and dislikes in styles (Idrees, Vignali, & Gill, 2020).

Fit recommendation is provided with the consumer's basic measurements which are matched by similar body measurements online or with other users having similar body

types. These users can view each other and comment on the size and fit of a particular garment. Some fit recommendation platforms use size charts that allow consumers to compare them against their own measurements while making online purchases (Idrees, Vignali, & Gill, 2020). Inside this category we can also find size and style recommendation, in which consumer information includes personal preferences. Likes, body shape, body measurements and lifestyle. By obtaining user information by interaction and collaboration, the system provides a personal recommendation to buyers. Moreover, users with identical preferences receive collaborative recommendations and useful product suggestions are delivered to user's base on their size and style (Idrees, Vignali, & Gill, 2020).

Fit visualization is giving by 3D avatars technology, brands use them to view personalize images with try-on garment options. Consumers can view tightness and looseness of garments displayed by tension maps. Personalized avatars are created with basic body measurements provided by consumers during the purchase experience (Idrees, Vignali, & Gill, 2020). Which facilitates confidence and adjustments of the garment if the services allow it.

The quality of these experiences involves customer's feeling of individuality when they experience a personalized service context and intelligent objects that possess the ability to sense, communicate and compute individual customers' specific characteristics (Colombi, Kim, & Wyatt, 2018). Web 3.0 technologies embedded with artificial intelligence and semantics can better analyze the demand and choices through deductive reasoning generating a boot in

e-commerce industry. The implementation of these tools on digital platforms brought the opportunity to **introduce automated tailoring.** 3D body scanning, virtual sizing, and fit interface instruments improve the quality of personalized garment production (Idrees, Vignali, & Gill, 2020). Furthermore, Web 3.0 technologies help to create customer engagement, achieved via various approaches, depending on the retail context, as well as the interactive digital technology tools implemented. **These technologies also engage people because they offer the opportunity to co-create products virtually** (Colombi, Kim, & Wyatt, 2018). They increase purchase behavior, and loyalty (Colombi, Kim, & Wyatt, 2018).

The project proposes the design of a platform in which people can personalize maternity products based on Web 3.0 technologies. The main is design a product service system in which **women can feel cocreators.** They will have the possibility of customizing their garments and accessories with their measurements and select their style through predeterminate modifications on a 3D virtual platform. **This platform will be based on avatars to mix and match for a dynamic product view tool and fit recommendation tool.** Beyond improving retail and interaction on the page, the project ensures that this type of technology can help create a more inclusive system that helps reduce dissatisfaction on women in the next section will be exposed the reasons

5.2.9.1 WHY WEB 3.0 TECHNOLOGIES SELECTION?

During the project, women stated that it is difficult find clothes that fit them well. Women express that they feel pressure to change their figure and be slim because the fashion industry only make clothes for small sizes, so if they want to look fashionable and chic, they need to be thin. This is an error in the system not only for produce with a standardization of sizes but for not offer a service in which people could feel secure about their purchase. Web 3.0 technologies can help women to have a better customer experience. Based on their system they allow fitting and customization. Brands can provide a more personalized service in which women could feel secure, and integrated. This system improves the quality of the service by made it more inclusive. Furthermore, the technologies permit to offer custom products, which help to integrate the customer on the design. User can become co-creators.

Women search for clothes that make them feel “in proportion”. Wearing dresses that fit nicely, encourages people to feel more comfortable and to gain confidence. To have an interactive space in which they can see how the garment fit their bodies and styles improve people security. These tools reduce perceptions of risk of the fitting and the money invested. Women also expressed that sometimes shopping became a nightmare. Since the problem was not only not finding clothes in their size, but also the experience of being in a space with more people watching them. The technologies can give them and space in which they could feel secure, a space where they do not feel judged. The tools can also create the perception that the brand is inclusive and that they care about the conform of its customers.

Beyond of help women to find their correct size, these technologies can bring entertainment, and playfulness. Increasing visits on the store and purchases. They also can help to reduce the return of garments reducing shipping pollution. These are some of the reasons why the project wants to implement Web 3.0 technologies on the product service system. The main is create an online platform in which women can be cocreators by selecting pre-defined modifications and styles of the measure-made products. Women will have the possibility of see the garment on and personalized avatar and explore the fitting for different angles. The project wants to give pregnant women the confidence that the garment will fit them during all the pregnancy and after the pregnancy. It also wants to create and space in which women feel secure, which can help to reduce insecurities on their bodies.

WEB 3.0 TECHNOLOGIES SELECTION REASONS

- Allows fitting and customization
- Enhance entertainment
- Allows playfulness, transfer of knowledge and transactional commerce
- Enhance perceived enjoyment and hedonic value
- Social interaction
- Improves customer’s confidence in apparel fit and reduces perceptions of risk associated with online shopping
- Helps brands to predict the perfect size to achieve the best fit
- Decrease the return of garment bought online
- Consumers can view garment fit on their bodies
- Automated tailoring
- Improve the quality of personalized garment production
- Offer the opportunity to co-create products
- Increase purchase behavior, and loyalty

5.3

CONCLUSION

In this chapter were presented the elements that compose the design proposal. **Nawale intent to be an inclusive brand that gives people adaptable, flexible and zero waste tailor-made products by the implementation of new technologies, tools, processes, and services. The aim is to give women perfect fit, freedom of movement, and comfort. Nawale is also compromised with the environment, for this reason it searches to design maternity items with sustainable alternatives that break with the current fashion manufacturing system.**

Zero waste and Make/Use tool, create a more democratic design process by changing the linear fashion system to one of “doing, adapting, making, creating.” This tool permits the alteration of patterns in an easy way to proportionate tailor-made products. The tool is inclusive because it can be applied to a large range of sizes and its design does not restrict the user movement. Zero waste design process can be made easier with a digital prototyping tool. **The software Clo3D**, permit the project to visualize the prototypes during the design exploration. With the software alteration on patterns can be made relatively fast, and the process is self-correcting. Furthermore, this tool improves the communication between designer, manufacture, and customer.

Comfort and adaptability are two requirements for pregnancy clothes. **Auxetic figures** can help to fulfill these needs. The auxetics structures, by their characteristics and size expansion, are able to reduce the pressure of clothes in the growing body areas. They can form and hemispherical surface that permit a perfectly fit in the belly. Adaptability also can be fulfilled through **lacing fastener**. The mechanism is adjustable so it will permit women to modify the garment, controlling its fit. This mechanism also can help the clothes to extent their use life, by allowing the garment to adjust during the pregnancy and after the pregnancy.

To be able to change the current fashion system It is necessary to implement new processes that generate a more democratic interaction. **Distributed production and participatory design** are two alternatives to include the user during the process design and reduce the environmental impact on the planet. With these methods the fashion industry is decentralized, products can be produced on demand. Distributed production and participatory design prolog the life object by creating a sentimental attachment with the user. **Connectors** are a way to implement participatory design, they facilitate production on communities, reducing shipping and boosting local employment. Furthermore, their implementation on products help to recycle clothes in an easier and better way, because they reduce the use of threads, zippers and buttons. Connectors also impulse modular design, which help to only change or repair the damage dress area. **Fablabs** are laboratories that make available the implementation of a distributed production. These laboratories around the word bring technology closer to people in a playful and economical way. They give the opportunity to share information, resources, and projects globally. This permit that projects like Nawale could be scalable. On these laboratories people can find technologies as **laser cut**. This technology permits the creation of detail products with a more economic approach than conventional processes. Laser cut gives the user the possibility of produce only when it is necessary, on demand, and by customization. The process is simple and does not require direct contact which reduce jobs risk.

Connectors and auxetic figures require a production simple and a clean, a production that stop the fraying of the fabric without the intervention of other finishes. Laser cut can solve these requirements. However, to be able of do this petroleum-based materials need to be used. These materials are pollutants, that is why the project proposed to **use recyclable materials**. These materials reduce the extraction of crude oil and natural gas from earth. They require 59% less energy and they reduce CO2 emissions by 32% in comparison with regular plastic base materials. The implementation of recycled materials reduces overexploitation of raw materials and give a second use to plastics, keeping plastics from going to landfill and ocean.

To be able to approach products to people, Nawale thought in the implementation of a **digital service that consist of a platform** in which people will be able to personalize and see their garments on virtual fitting room. To make this possible the implementation of **Web 3.0 technologies are required**. These technologies allow fitting and customization service. With them people can interact with the product in a digital, playful, and entertainment way. They provoke engagement and loyalty. They also permit brands to offer products that adapts better to clients’ body, this improves the shopping ex-

perience. On the platform people can also become co-creator. By given brands options to personalize the garment people can feel integrated on the project. This improves costumer's confidence in apparel fit and reduces perceptions of risk associated with online shopping.

The advantages before mentioned, of each element included on the develop of Nawale project, also benefit to reduce body dissatisfaction on women during pregnancy. With them, it can be possible **to create adaptable products that adjust the body during the different stages of pregnancy**. These elements create conform and proportioned free movement. Furthermore, women can feel that they have the control of their bodies by adjusting the garments like they want. With the system process women could feel integrated and feel confidence about the product, they can feel motivated to buy an environmentally responsible item. For those reasons, it was important to consider all these elements on the proposal. **Each one of them contributes an important piece to generate a system different from the current one. A more inclusive system, with fewer environmental consequences.** Like have been mentioned before, to be able to create the adjustable, flexible, and cooperative products connectors and auxetics figures were tested. On the next chapter the experiments realized will be exposed. Focusing on the advantages and disadvantages of the implementation of the figures on different materials and by producing them by laser cut.

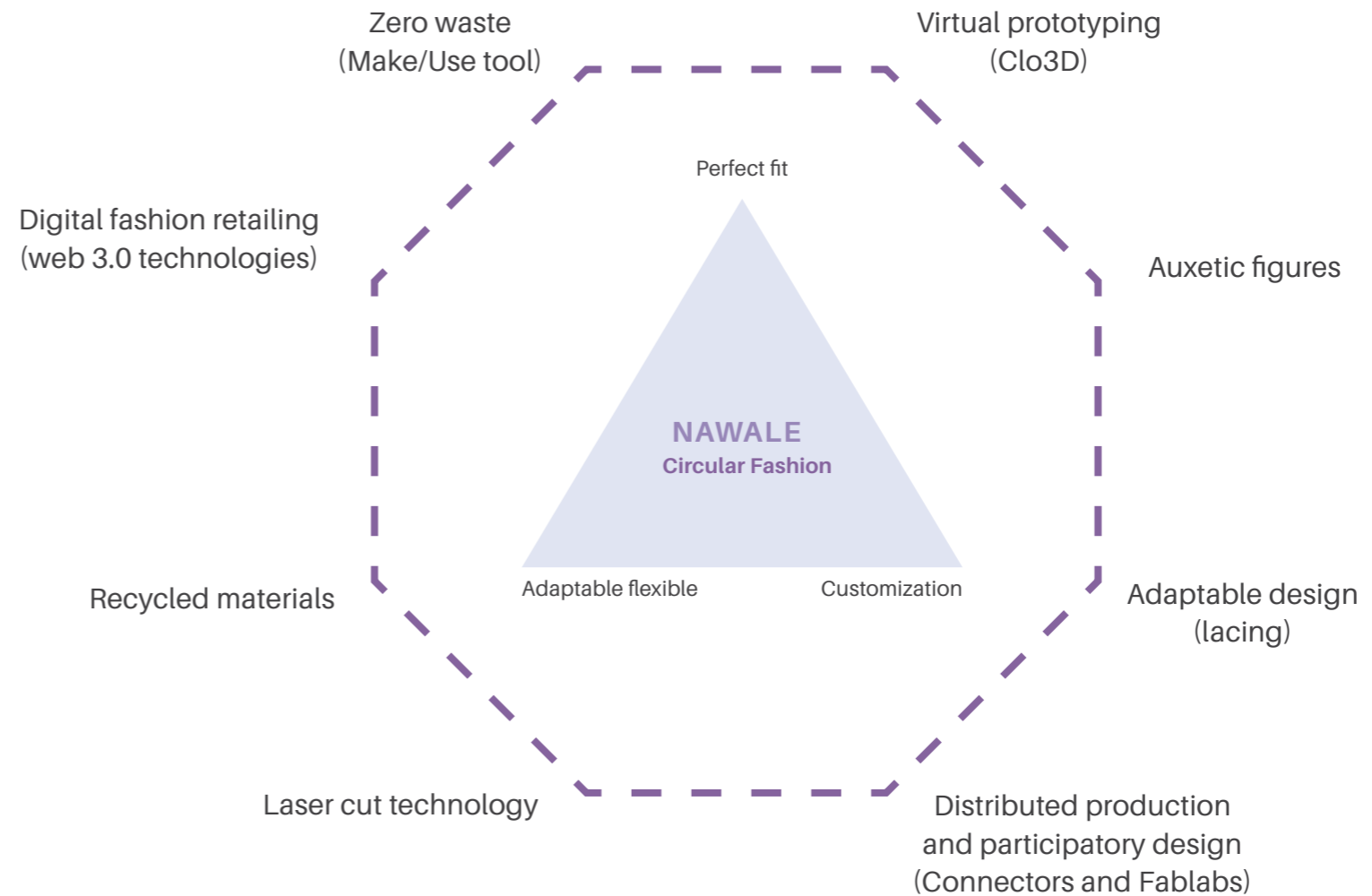
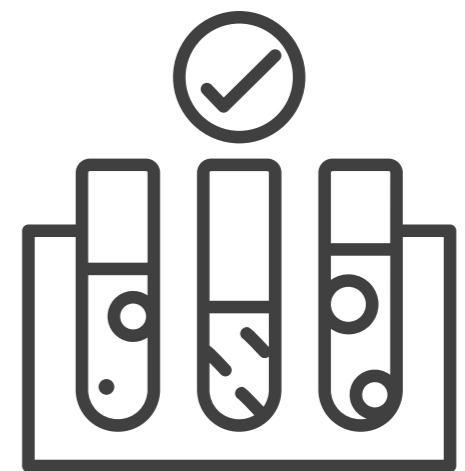


Figure 34: Elements of the design proposal

EXPERIMENTS ON AUXETIC CUTS AND CONNECTORS

6



EXPERIMENTS

In this chapter, there will be showed the process and result of the development of some samples and experiments to see the auxetic cuts and connectors behaviour done on synthetic fabrics. Their viability will be studied for the type of garment and accessories in which they are going to be applied. It will be observed also their resistance, their aesthetic, and other exclusive properties of each element. The aim is to classify them. To see in what areas of the garment they could be better implemented and to select the best ones to be applied to the products.

It is important to mention that both sample experiments (auxetic figures and connectors), were made with three different materials with different characteristics. Recycled cotton neoprene, recycled rasone, and mollettoni recycled fabric. The project wanted to identify which materials work best in each of the figures and connectors, and their performance with different thicknesses and textures. In the table 1 the material characteristics can be appreciated.

6.1

AUXETIC

As stated in chapter five, the auxetic figures can expand in all directions when they are stretched, and they shrink in all directions when they are compressed. When auxetic cuts are applied to fabrics, they can proportionate additional properties to them, such as permeability, energy adsorption, and the capacity to fit hemispherical surfaces without too much force applied. Auxetic figures can be a great element to implement in maternity clothing as the garments can expand in all directions. Therefore, the clothes will not cause pressure and they could adapt to the development of the belly due to its expansion property to form a dome.


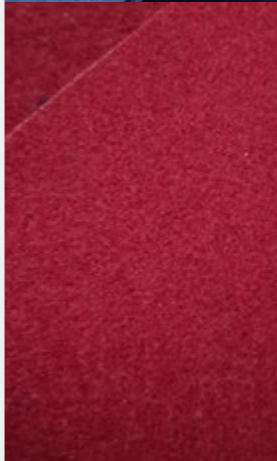

ASSIGNED NOMENCLATURE	MATERIAL	NAME	CHARACTERISTICS	WEIGHT	SEASON
A		Rasone	100% polyester Woven fabric Light, soft to the touch Fresh feeling	0.0186 gr/cm2	SS
B		Mollettoni	65% polyester 35% viscose Non-woven fabric Texture, soft, smooth as felt, with resistance Warm feeling	0.0329 gr/cm2	FW
C		Cotton Neoprene	92% polyester 8% spandex Knitting fabric Soft, comfortable texture and warm feeling Elastic	0.0385 gr/cm2	FW

Table 1: Materials, connectors and auxetic figures experimnets

In this section there will be explained the experiments and samples realized of eleven auxetic figures (figure: 35), on three different materials. The aim was to observe their behavior and select the best ones to be applied to Nawale products. Their behavior was also explored in digital prototyping.

The intention was to see how the figures behave in the software (CLO3D), to compare the differences between a physical and a digital sample find out the advantages and disadvantages of each one.

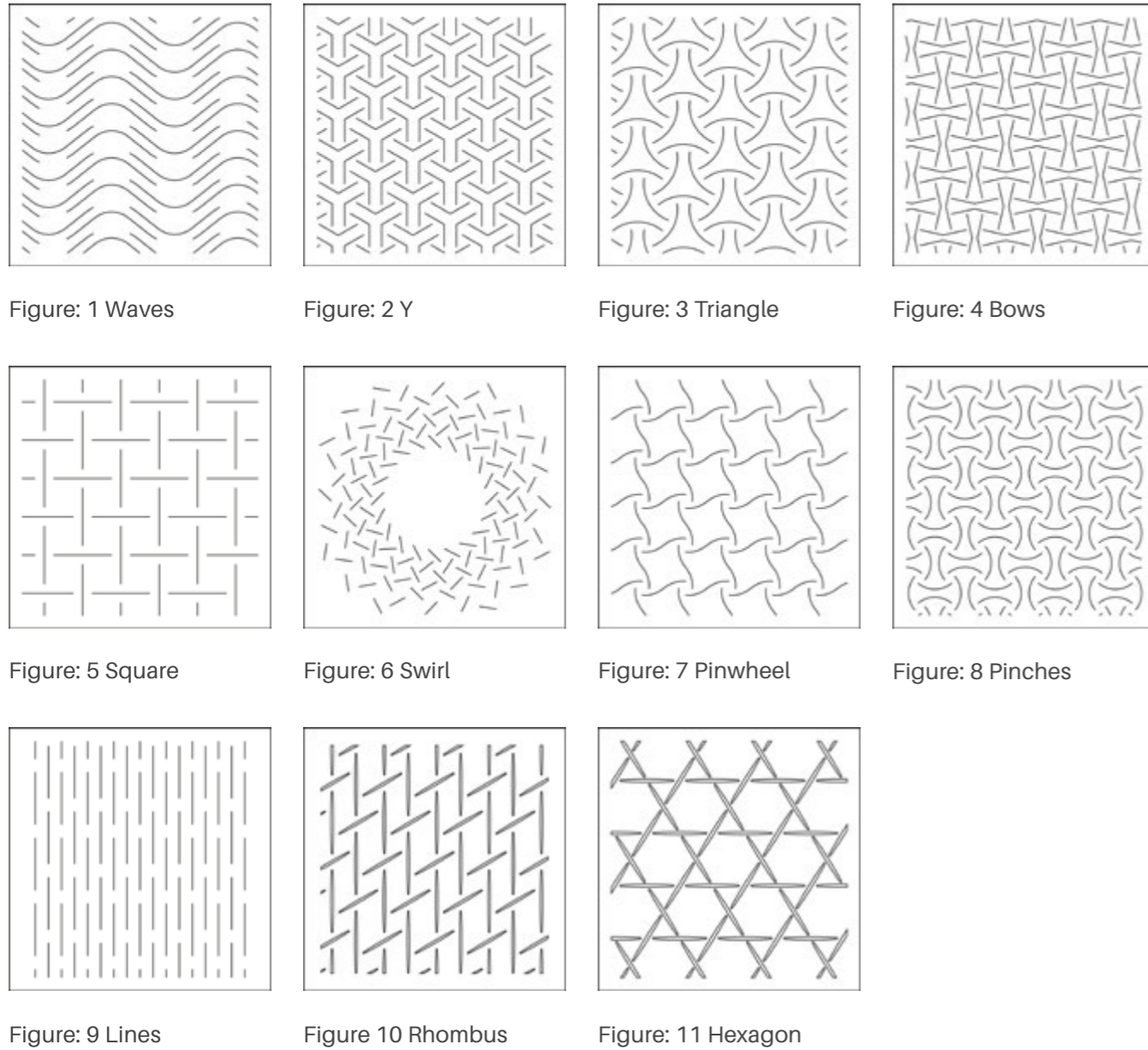


Figure: 1 Waves Figure: 2 Y Figure: 3 Triangle Figure: 4 Bows
 Figure: 5 Square Figure: 6 Swirl Figure: 7 Pinwheel Figure: 8 Pinches
 Figure: 9 Lines Figure 10 Rhombus Figure: 11 Hexagon

Figure 35: Eleven auxetic figure for experiments

6.1.1 EVALUATION

During the experiments, five properties were evaluated: expandability and flexibility, aesthetic, texture, manufacturing difficulty and digital behavior. To each property were assigned values that gone from 1 to 3, in which one is bad, two is average and three is good. At the end of each evaluation, the results will be compiled to be able to observe which of the figures has better qualities and adjust to the needs of the project. In the next table, it can be seen the criteria assigned to each value depending on the property.

PROPERTY	VALUE		
	1	2	3
Expandability and flexibility	It does not have great flexibility.	It has medium flexibility.	It has great flexibility.
Aesthetic	It does not look good when it comes to expanding. There exists to mush deformation of the figures.	It looks nice when it expands but present some deformation.	It does not present a great deformation. The figures look nice and clean.
Texture	It creates a scratchy and unpleasant texture to the touch.	It has a good feel texture, but not that comfortable.	The texture created is soft and pleasant to the touch.
Manufacturing difficulty	It breaks, it frays. It burns. It does not good to be used with laser cut machine.	It does not break; it does not fray. But it still requires special adjustments to be used on laser cut machine.	It does not break, it does not fray, and it does not have any complication of been produced on laser cut machine.
Digital behavior	It does not change. The visualization is not well developed. It seems to be static.	It behaves a bit like the physical sample, but it is still not 100% accuracy.	It behaves like the physical sample. It looks real.

6.1.2 SAMPLE PROCESS

As mentioned before, the samples were made in three different materials with different characteristics. Recycled cotton neoprene (C), recycled rasone (A), and mollettoni recycled fabric (B). The project wanted to identify which materials work best in each of the figures, and their performance with different thicknesses and textures. After selecting the materials, the elaboration of eleven monostable and bistable auxetic figures were made. For this task, software illustration was used. This software converts figures to vectors, which can be read by laser cutting machines for manufacturing. Illustration also creates compatible files for Clo3D to be able to create the digital sample. During the vectorization, two points were considered. To leave enough space between the figures, to create stronger joints to prevent structures from breaks, and the size of the figures to avoid the creation of huge holes that could uncover the user skin. The samples were made in a size of 10 x10 cm. Once auxetic figures were finished, they were divided into three files. Each of the files corresponded to each material to be used. Likewise, in each file the work area was indicated, and the lines to be cut were marked in red. Having the files ready. It was possible to proceed to the cut.

For the creation of the digital samples, each of the files was transferred to Clo3D, where 10x10x10 cm cubes were made. Auxetic figures were placed on the upper face of the cube. To make the cuts of the figures on CLO3D software possible, trace tool was used on each base line that made up the auxetic figure. Then, on each cube the tool pressure was used to give volume to the piece, and to be able to see the figure's behaviour. To each cube the material characteristics were assigned.

6.1.3 RESULTS

In the next tables, the result of eleven samples will be presented. A value was assigned to each property, and some interesting notes about the auxetics behaviour on materials. At the end, the values were summed up to identify which of the figures could be the best ones to be applied to the products and accessories. The images presented in the result were taken during experiments.

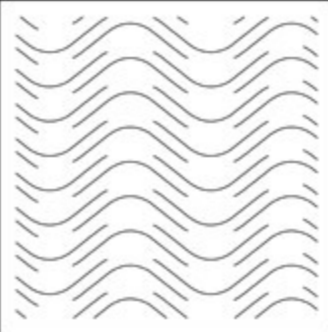



FIGURE: 1 WAVES			
TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	B	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	3	It expands a lot, no through the sides, but upwards. It forms a huge curve; it is a bistable structure.	
Aesthetic	2	It is not bad, but as it is a bistable structure, so it needs to be careful with the three-dimensional forms.	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	1	It was difficult for the software to reinterpret the figure.	
Results	12	It is good to apply accessories, because the cuts are big and create dome space, but it creates big holes.	

FIGURE: 2 Y

TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
MATERIAL	A	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	3	It expands to all sides.	
Aesthetic	3	N/A	
Texture	2	It is not so soft to touch for the burn edges.	
Manufacturing difficulty	3	N/A	
Digital behavior	3	N/A	
Results	14	In general, the figure has great performance, maybe with a different fabric the texture could have a better feeling.	

FIGURE: 3 TRIANGLE

TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
MATERIAL	B	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	2	It expands, but the material is not so flexible.	
Aesthetic	3	N/A	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	2	It was difficult to define the figures	
Results	13	It is a nice figure; but it could be better applied it in a more flexible material.	

FIGURE: 4 BOWS


TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	A	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	3	It is very flexible structure.	
Aesthetic	3	N/A	
Texture	2	The burn edges are not smooth.	
Manufacturing difficulty	3	N/A	
Digital behavior	2	It was difficult for the software to interpret the lines.	
Results	13	It is a nice figure; very flexible. The texture is not so enjoyable, but maybe with other material it can softer.	

FIGURE: 5 SQUARE

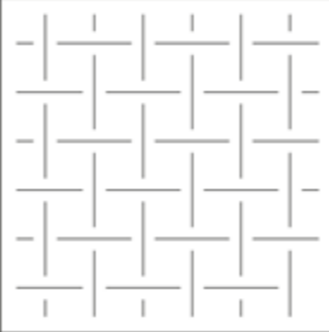



TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	C	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	3	It is very flexible structure; it adapts very well to the fabric.	
Aesthetic	3	N/A	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	2	On the edges it was difficult for the software to interpret the lines.	
Results	14	It is a nice figure; very flexible, and comfortable to touch. The fabric adjusts very well to the figure.	

FIGURE: 6 SWIRL



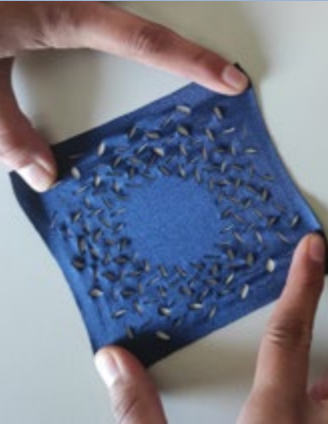
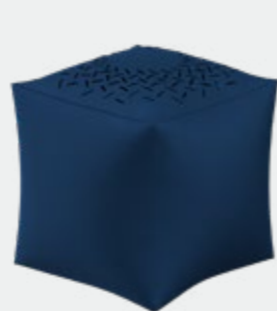
TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	A	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	2	It is flexible enough to small details, where the body does not change a lot.	
Aesthetic	3	It is very aesthetic, it can be use like a decoration.	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	1	The software cannot interpreted the opening of the holes.	
Results	12	It is a nice figure; It can be used on details and in zones to not reveal to much skin.	

FIGURE: 7 PINWHEEL

TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	B	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	2	N/A	
Aesthetic	3	N/A	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	2	N/A	
Results	13	It is a nice figure; It is flexible. It could have more flexibility with other material.	





FIGURE: 8 PINCHES			
TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	C	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	3	It is very flexible	
Aesthetic	3	The figures are, well defined it looks nice.	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	2	It looks nice but, it is difficult for CIO3D to interpret the holes in some areas.	
Results	14	It is a nice figure; It is very flexible, and the figures are well defined. It adapts well to the fabric characteristics.	

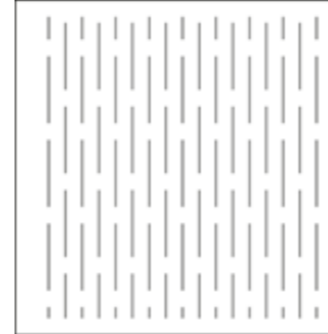
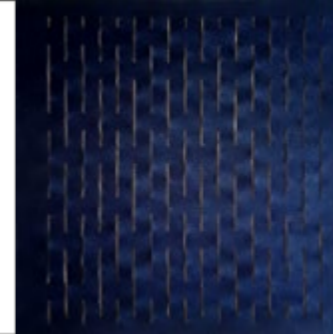
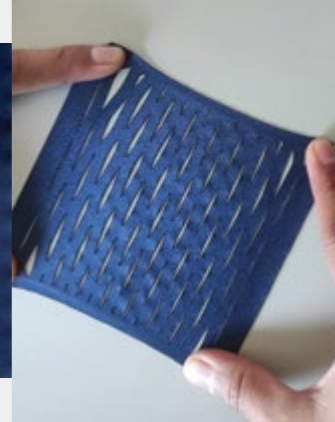

FIGURE: 9 LINES			
TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	A	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	3	It is very flexible, but it expand more on a curved surface.	
Aesthetic	3	N/A	
Texture	2	It is not so soft.	
Manufacturing difficulty	3	N/A	
Digital behavior	2	The software has some problems to read the opening of the lines.	
Results	13	It is a very flexible figure, but the burn of the edged generates a gritty feeling.	

FIGURE 10 RHOMBUS

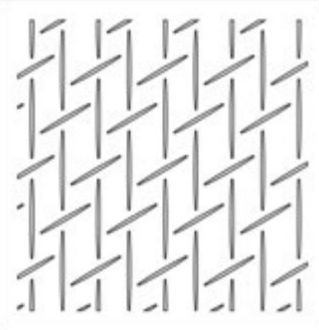



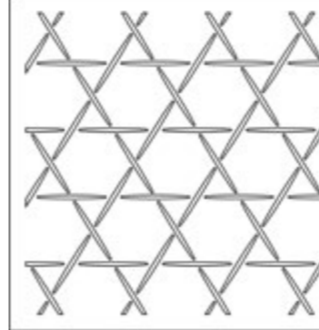


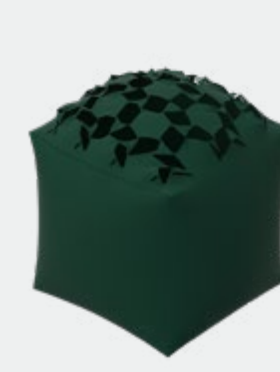
TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	B	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	2	It expands more on a curved surface.	
Aesthetic	3	N/A	
Texture	3	N/A	
Manufacturing difficulty	3	N/A	
Digital behavior	1	The software cannot read the opening of the lines.	
Results	12	It is a figure that expands more on a curve surface. It can be good to try on a more flexible material.	

FIGURE: 11 HEXAGON

TECHNICAL DRAWING FOR LASERCUTTING	TEXTILE CUT	CHECK ONSTREACTHABILITY	SIMULATION ON CLO3D
			
MATERIAL	C	SIZE SAMPLE	10x10 cm
PROPERTY	VALUE	INTERESTING NOTES	
Expandability and flexibility	1	It broke at the time of expanding,	
Aesthetic	3	It looks like flowers.	
Texture	3	N/A	
Manufacturing difficulty	1	The cuts are close, so the joints are small and it broke.	
Digital behavior	2	N/A	
Results	10	It is a cool figure, aesthetic, but it must be taken in consideration the size of the joints and tolerance as they can break.	

Volume expansion was present in all samples. Some at an intermediate level, like figure ten and figure seven and others with great flexibility as figure eight and figure four. It was visible that the expandability of the auxetic cuts is directly linked to the materials on which they are applied. For example, in material B, the figures did not show as much flexibility as in fabrics A and C. In the case of material C, the figures responded very well, especially since it was a flexible material by nature. The figures increased their volume much more than expected. Some of the cuts (as figure one and figure nine) have a bigger expandability when they are applied on a curved surface, because their volume increases on the z axis.

The aesthetic of the figures was nice. It needs to have in consideration the three-dimensional forms that appear with bistable figures (see figure one, figure two, and three), since they form third-dimensional surfaces that can change the aesthetics of the garment or accessory. Likewise, it can be indicated that the smaller the cuts the lower their expansion. But aesthetically they look cleaner and more delicate (figure six). Small cuts also can be used on details and in zones to not reveal too much skin.

The samples with the best texture were those made with material C followed by material B. These samples proved to be soft to the touch, even when the figures were bistable figures with three-dimensional forms, they always kept a smooth and delicate texture. In the case of material A, the contours are sealed, generating a slightly scratchy texture. Although the texture is not uncomfortable, it is not so soft to the touch.

For most of the samples, except for figure eleven, the manufacturing process was easy and clean. The samples did not break and did not fray. Nevertheless, in the case of the cuts, it was clear that during the preparation of the structure (the vectorization), it must take into consideration the distance between the figures to have enough space for the joining points. This will create stronger unions to prevent the material from breaking like it did with the figure eleven hexagon.

Some digital samples presented errors. They do not look, or do not behave like a physical sample. It was difficult for the software to identify the space and gaps created by the fabric flexibility (refer to figure nine). It was also difficult to see the volume increase on small cuts (figure six). In some cases, the figures that remain on the edge did not suffer any alteration. This can be observed in figures five and three. The figures two, three, and four showed behavior more related to the reality. However, in general it can be concluded that digital prototyping samples of auxetics figures are not realistic. It can be a preview of the figure, but it will not be enough to understand their behaviors. Even

during their development, the software indicated several errors, especially if the cuts were very close to each other, so modifications were made to be able to translate the auxetics figure to a digital environment. This indicates that to evaluate auxetic figures it will always be necessary to produce physical samples.

Once we analysed all the properties of each sample, it was possible to indicate that **figure eight pinches, figure two y, and figure five square, were the best scored with 14 points.** The three of them are structures simple monostable. This means that they have one degree of freedom motion. It will be possible to apply these figures in different areas of the body since their characteristics allow it. The rest of the samples ranked at 12 and 13 points are also good to be applied on the accessories and clothes. However, it is necessary to put attention to their flexibility and aesthetic qualities. For example, the figure six is good to be applied on the chest, because it permits a moderate expansion and offers nice decoration, the same as the figure seven. This figure forms small domes that can adapt well to the breast. The figures nine and one, can be good to be applied on body areas in which a large curvature is formed, since these cuts have greater flexibility in non-straight zones.

The only auxetic cut that was discarded for future applications was figure eleven, because it got the lowest score. It broke and it needs a major adjustment on the file preparation. It is important to point out that material C was the material with the best performance. Since it was flexible, soft and it did not burn and fray. It will be interesting for future experiments to produce some auxetic figures samples on cotton neoprene will a small thickness, fabric for spring summer seasons.

6.2

CONNECTORS

The connectors are interlocking systems that allow the fabric to be joined without the need for a sewing machine. These connectors do not have a defined structure, although they frequently are geometrical forms. Their aim is to allow the union between the fabrics or materials in an easy way. The connector must be resistant to stretching and movement. The interlock systems permit people to design modular garments and impulse distributed production by allowing people to produce in their communities.

In this section there will be explained the experiments and samples of nineteen connectors (figure 36) on three different materials. The aim was to observe their behavior and stretch resistance, to select the best ones to be applied to Nawale products. The interlocking systems were explored on straight and curved silhouettes to see in which of them they behave better.

6.2.1 EVALUATION

During the experiments, four properties were evaluated: stretch resistance, aesthetic, manufacturing difficulty and assembly difficulty. To each property were assigned values that gone from 1 to 3, in which one is bad, two is average and three is good. At the end of each evaluation, the results will be compiled to be able to observe which of the interlocking systems has better qualities and adjust to the needs of the project. In the table 2, it can be seen the criteria assigned to each value depending on the property.

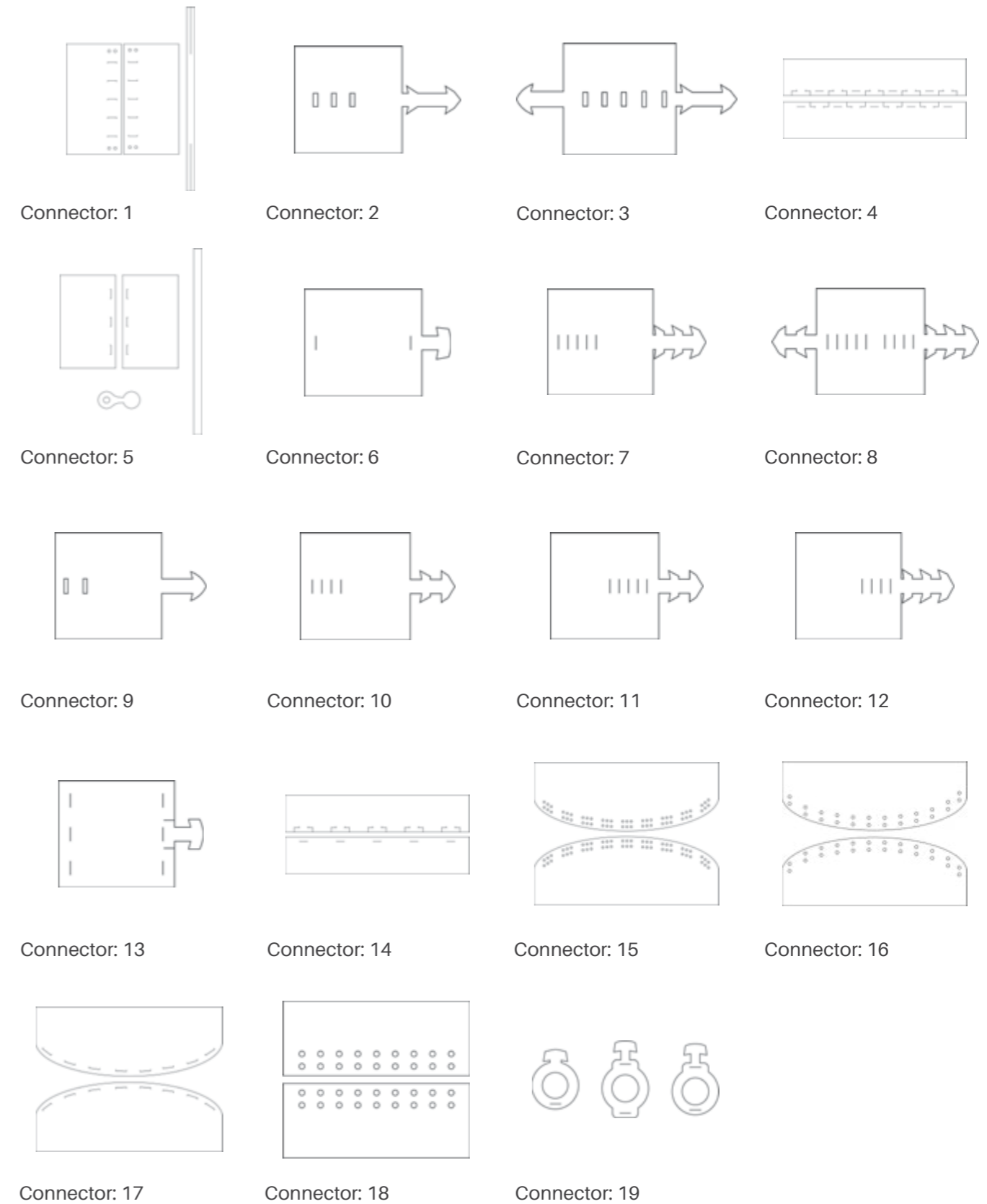


Figure 36: Nineteen connectors for experiments

PROPERTY	VALUE		
	1	2	3
Stretch resistance	The union does not resist, it opens very easily when stretching the fabric.	The joint resists a little when stretching the fabric, but it opens with the frequency of stretching.	The union remains intact when stretching the fabric, it does not break.
Aesthetic	They do not look good, it generates lumps.	They look good, but they generate deformations.	They look good. They help to generate design details, or they are not visible at all.
Manufacturing difficulty	It breaks, it frays it burns. It does not good to be used with laser cut machine.	It does not break; it does not fray. But it still requires special adjustments to be used on laser cut machine.	It does not break, it does not fray, and it does not have any complication of been produced on laser cut machine.
Assembly difficulty	It is not easy to assemble, it takes a lot of time.	It is more or less easy and quick to assemble.	It is easy and quick to assemble, it is intuitive.

Table 2: Evaluation criteria connectors

6.2.2 SAMPLE PROCESS

As mentioned before, the samples were made in three different materials with different characteristics. Recycled cotton neoprene (C), recycled rasone (A), and mollettoni recycled fabric (B). The project wanted to identify which material works best in each of the connectors, and their performance with different thicknesses and textures. After selecting the materials, the elaboration of nineteen interlocking systems were made. For this task software illustration was used. This software converts figures to vectors, which can be read by laser cutting machines for manufacturing. During the vectorization, it was considered to make connector samples for straight and curved silhouettes. It was also considered their function. For example, it was considered the creation of connectors that could be assembled by geometric figures and that were easy to place on the edges of products. It was also considered to include connectors that could replace buttons and zippers, and any other type of fasteners that clothes used to utilize. Finally, it was also thought to add connectors that would serve as decoration.

Once the connectors were finished, they were divided into three files. Each of the files corresponded to each material to be used. Likewise, in each file the work area was indicated, and the lines to be cut were marked in red. Having the files ready. It was possible to proceed to the cut.

6.2.3 RESULTS

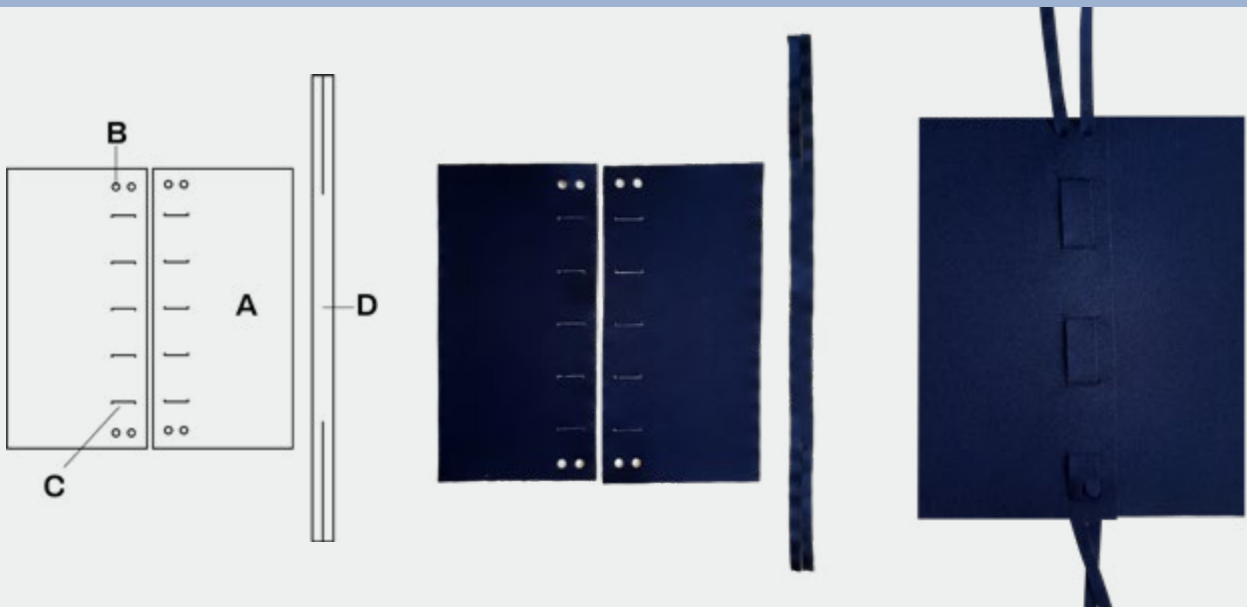
In the next tables, the results of nineteen samples will be shown. A value assigned to each property will be pointed out, and some interesting notes about the connector's behaviour on materials will be exposed. At the end, the values were summed up to identify which of the interlocking systems could be the best one to be applied to the products and accessories. The images presented in the result were taken during experiments.

CONNECTOR: 1

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL A SIZE SAMPLE A: 6x12 cm, B: 1.5 cm r, C: 1cm, D: 0.9x20 cm

PROPERTY VALUE INTERESTING NOTES

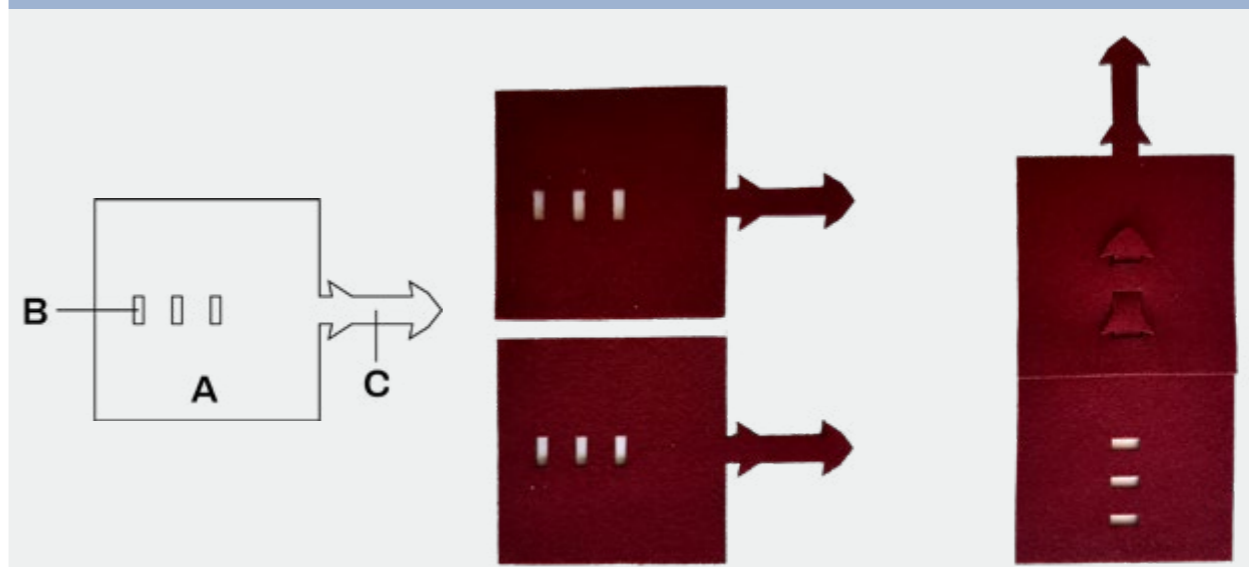
Stretch resistance	3	The join is very resistant.
Aesthetic	3	It IS nice and smooth. It does not generate lumps more than in the final closures, in which a bow must be applied.
Manufacturing difficulty	3	N/A
Assembly difficulty	3	It is easy and quick; however, it is not intuitive.
Results	12	The connector 1, is nice, easy to put together, and stretch resistant.

CONNECTOR: 2

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR

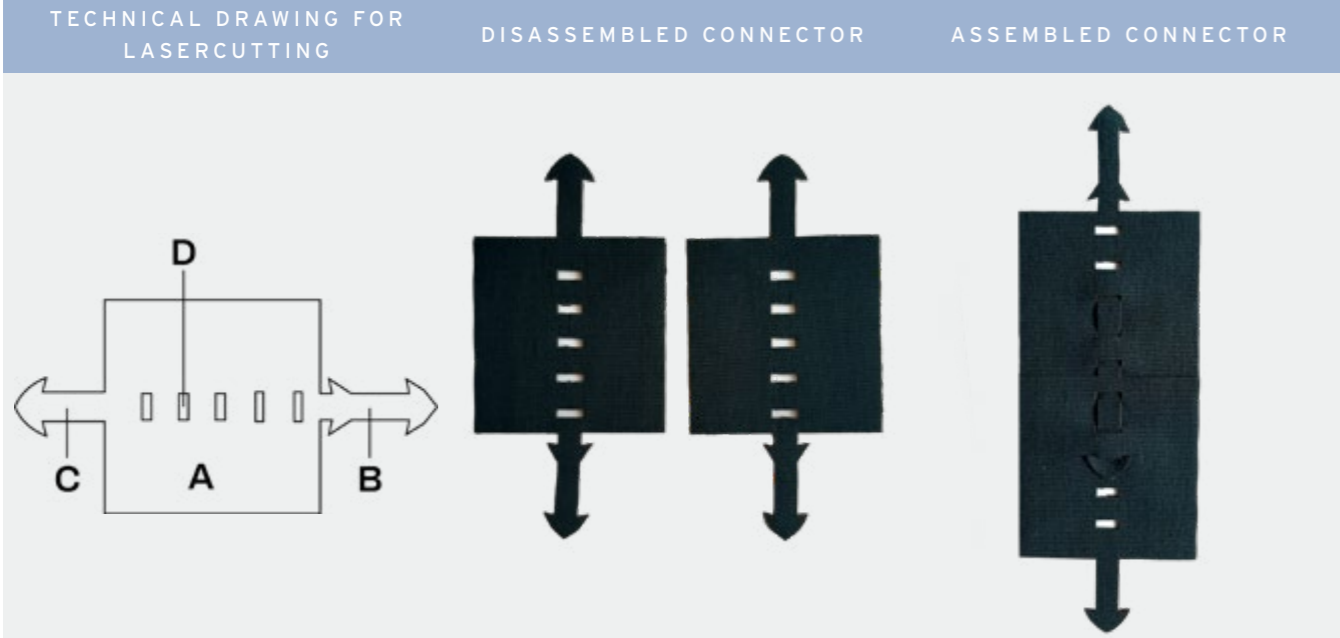


MATERIAL B SIZE SAMPLE A: 5x5cm B:.2x.6cm C: 1.5x2.8cm

PROPERTY VALUE INTERESTING NOTES

Stretch resistance	1	It is not resistant when a lot of force is applied, it will be better to try it on fabrics with a greater thickness.
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	10	In the connector 2, joint tolerance should be reduced or tested on heavier fabrics. In material B there is a lot of movement between the pieces.

CONNECTOR: 3



MATERIAL	C	SIZE SAMPLE	A: 5x5cm B: 2.7x1.2cm C: 2.1x1.2cm D: .1x.6cm
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PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	1	It does not resist, this fabric is not suitable for use with connectors, it does not have resistance. Likewise, there is the need to reduce the tolerance of the joints or use a thicker material.
Aesthetic	1	It is not good, not very aesthetic, it seems that it spreads. The joints bend forming lump.
Manufacturing difficulty	3	N/A
Assembly difficulty	1	It becomes difficult because the fabric does not have body or weight.
Results	6	It is a connector that does not resist. The material is not the most suitable, it has no resistance.

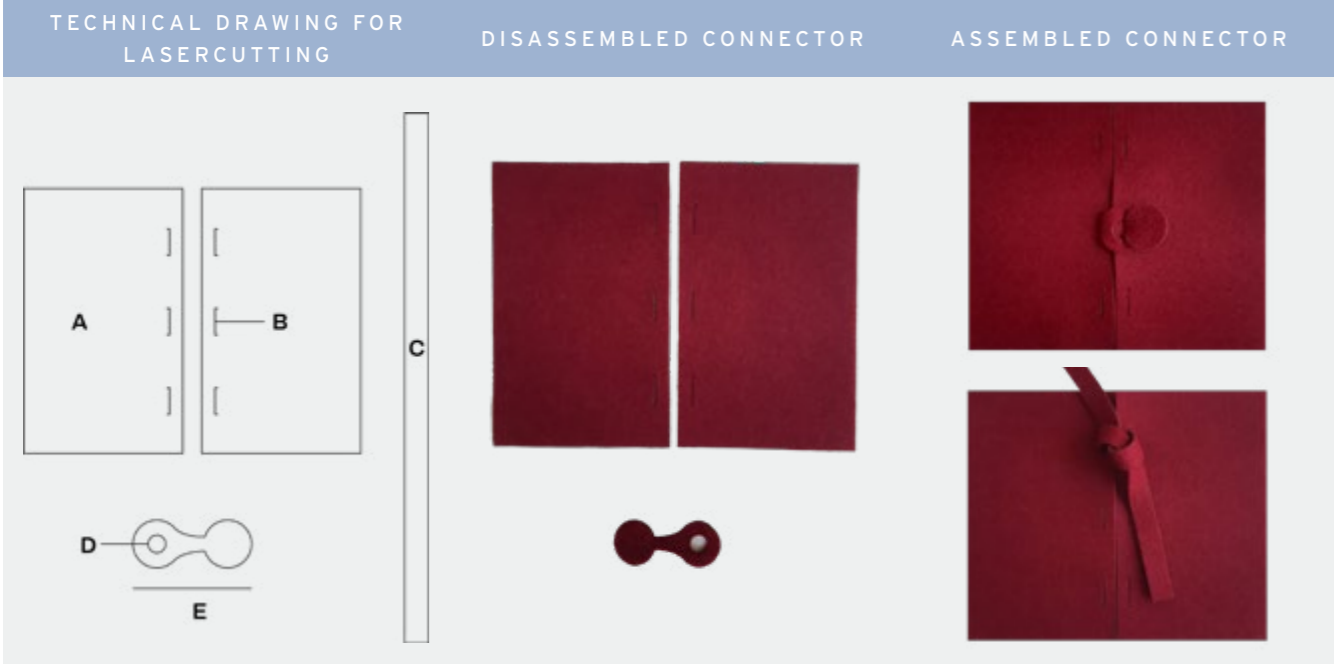
CONNECTOR: 4



MATERIAL	B	SIZE SAMPLE	A: 4X20cm B: .9cm C: 2cm
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PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	1	N/A
Aesthetic	3	It has a nice aesthetic; it looks like a normal seam.
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	10	Although it has good aesthetic and manufacturing characteristics, it will not be good to apply on the products, because it does not resist and disconnects very easily, it needs modifications in its design to form a stronger padlock.

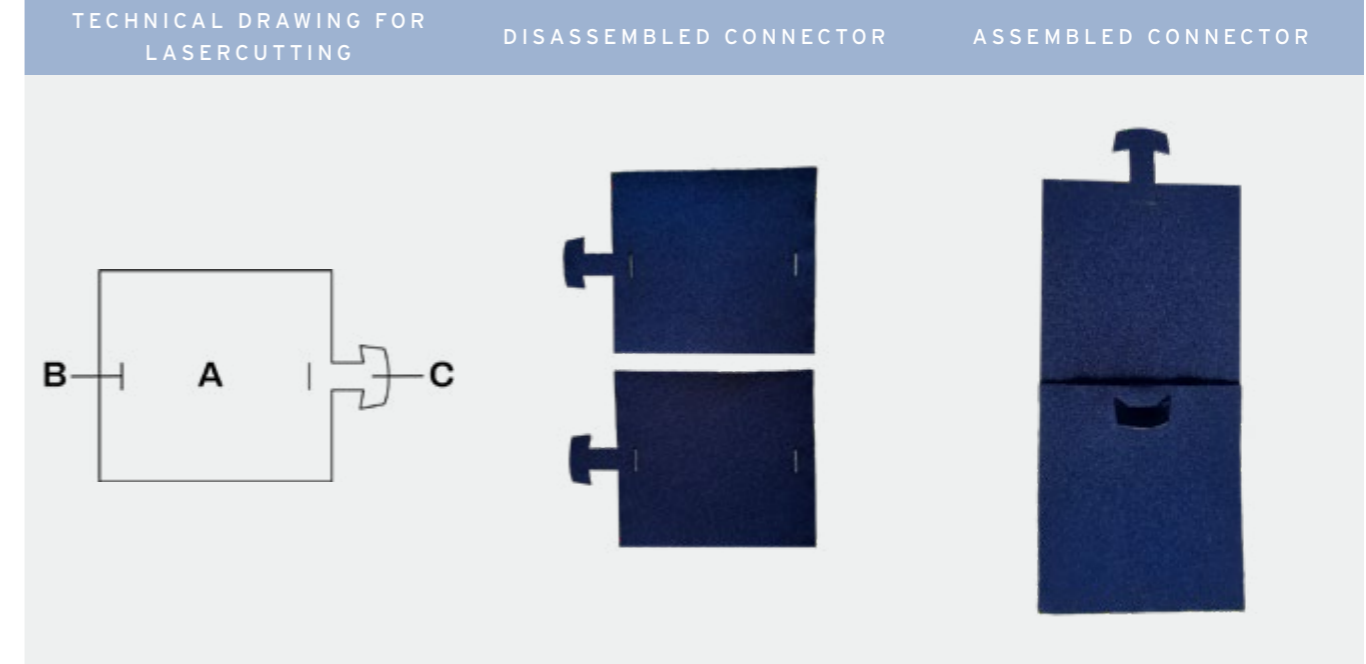
CONNECTOR: 5



MATERIAL	B	SIZE SAMPLE	A: 6X10cm B: 1cm C: .9x20cm D: .3 cm r E: 4.5x1.8cm
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PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	3	It has very good resistance, it can be used to replace buttons and zippers.
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	12	It has great performance. It is resistant and can be used to replace buttons and zippers, easy to assemble.

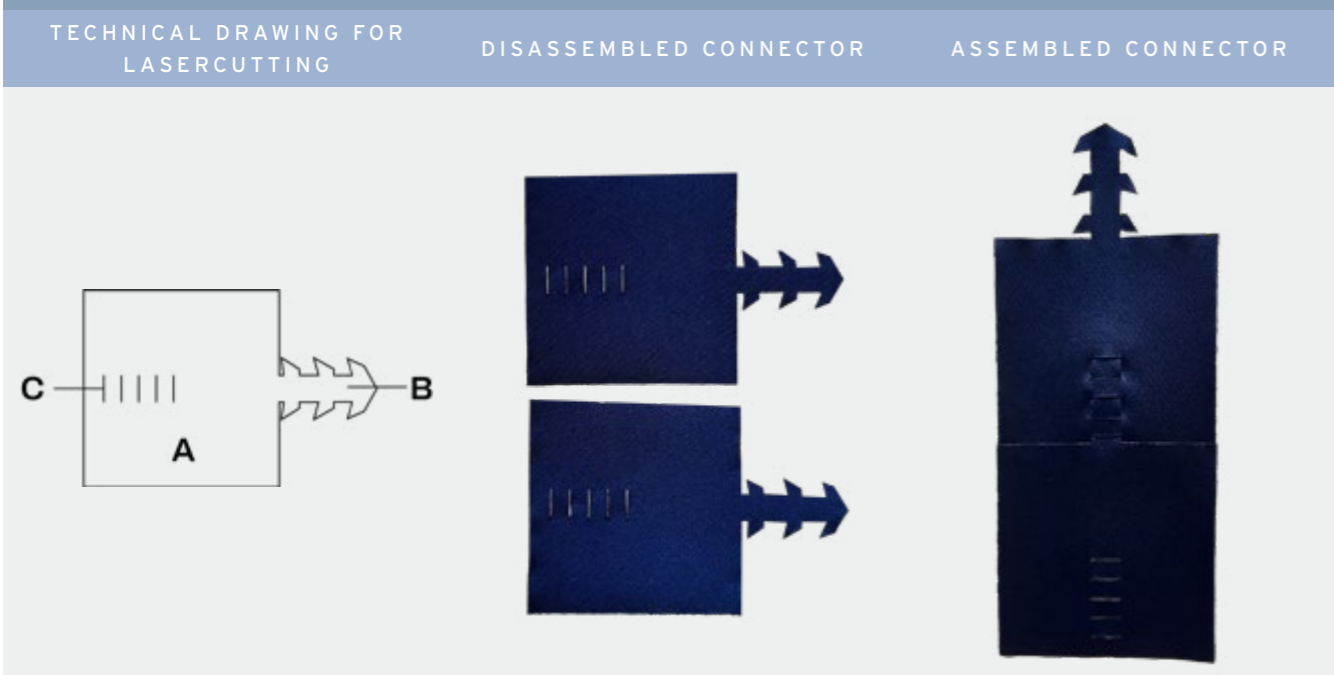
CONNECTOR: 6



MATERIAL	A	SIZE SAMPLE	A: 65.5x5cm B: .6cm C: 1.3x1.5cm
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PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	1	The material does not have resistance or friction for that reason the connector does not work and breaks easily.
Aesthetic	3	It has a beautiful aesthetic, very soft and delicate.
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	10	The connector has good aesthetics and is easy to assemble, however it is not resistant. For future samples it would be good to try on a thicker, friction material.

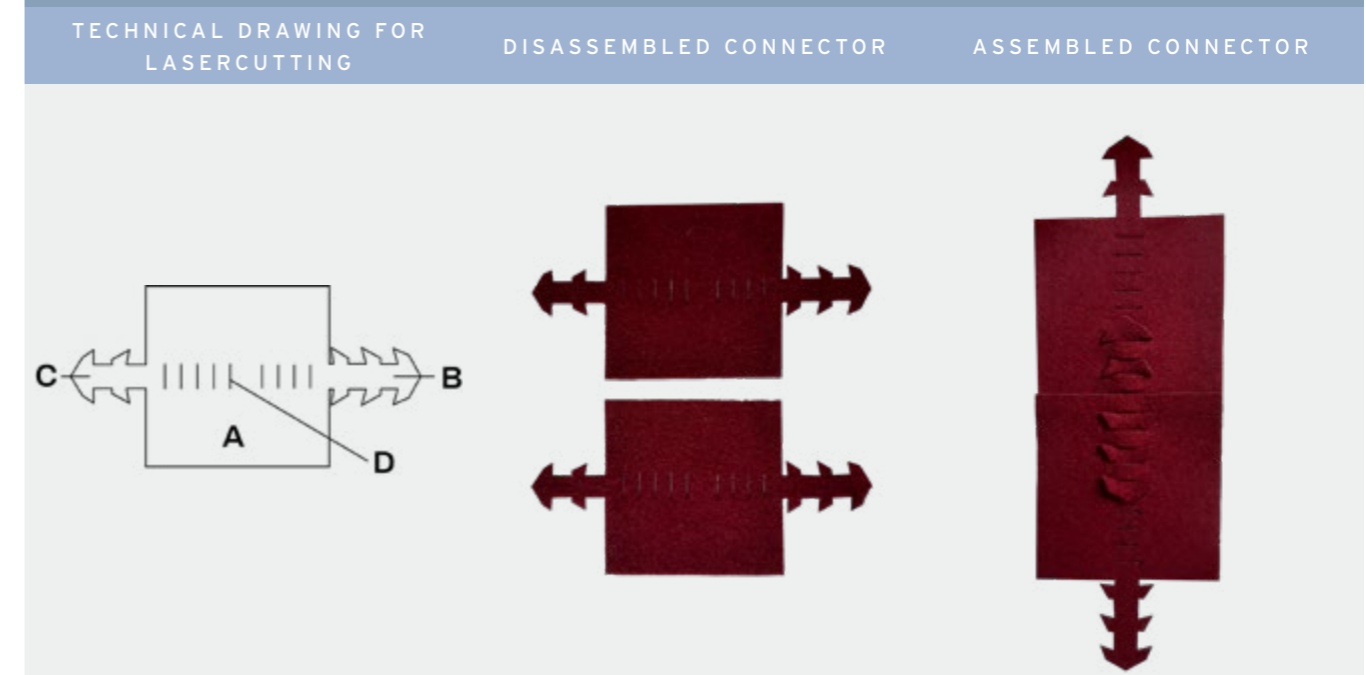
CONNECTOR: 7



MATERIAL A SIZE SAMPLE A: 5X5cm B: 2.5x1.6cm C: .6cm

PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	1	The material does not have resistance or friction for that reason the connector does not work and breaks easily.
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	2	The assembly passes through several holes slowing down the process.
Results	9	The connector has good aesthetics and is not so easy to assemble, and it is not resistant. For future samples it would be good to try on a thicker, friction material.

CONNECTOR: 8



MATERIAL A SIZE SAMPLE A: 5x5cm B: 2.5x1.6cm C: 2x1.5cm D: .7cm

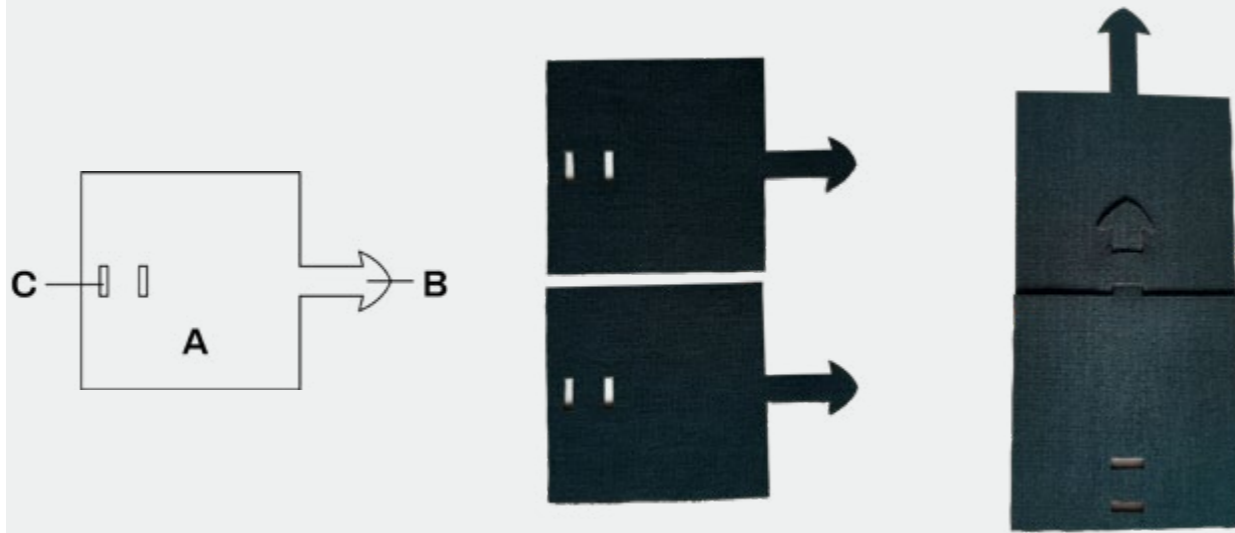
PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	3	It has excellent resistance, does not break.
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	2	The assembly passes through several holes slowing down the process.
Results	11	It has excellent resistance. The only detail is that because it has many connection points it can be a bit complicated to assemble.

CONNECTOR: 9

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL C SIZE SAMPLE A: 5x5 cm B: 2x1.3cm C: .1x.6cm

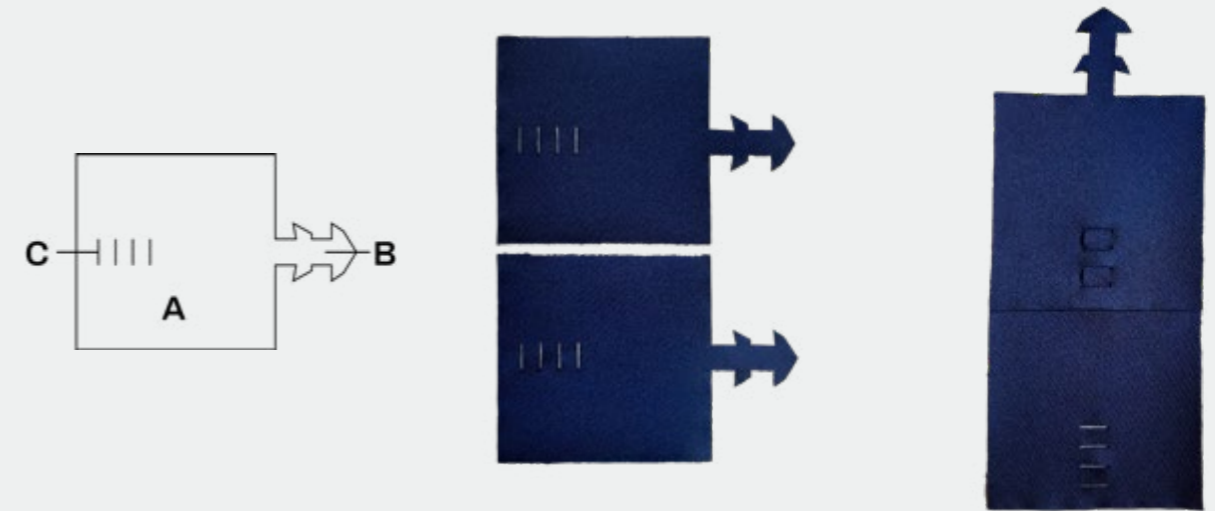
PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	1	It is not resistant when a lot of force is applied, it will be better to try it on fabrics with more thickness.
Aesthetic	1	It does not have good aesthetics for the same reason that the material is not the best and the links are very big they need to be reduced.
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	8	This figure does not have good resistance or aesthetics, material C does not behave well with connectors.

CONNECTOR: 10

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL A SIZE SAMPLE A: 5x5cm B: 2x1.5cm C:.6cm

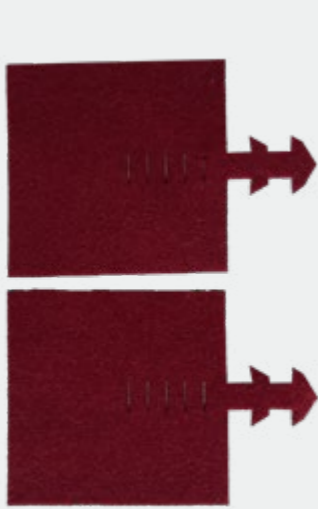
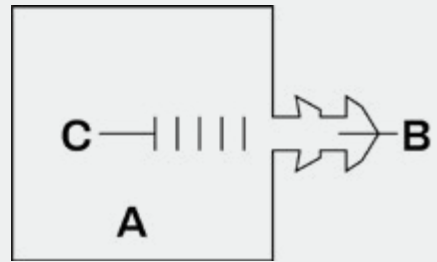
PROPERTY	VALUE	INTERESTING NOTES
Stretch resistance	1	N/A
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	10	This kind of connectors will have to be tested on another thicker fabric, since they have very good visual characteristics, but the fabric is not thick enough, or it does not create friction.

CONNECTOR: 11

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL B

SIZE SAMPLE

A: 5.5cm B: 2x1.5cm C: .6cm

PROPERTY

VALUE

INTERESTING NOTES

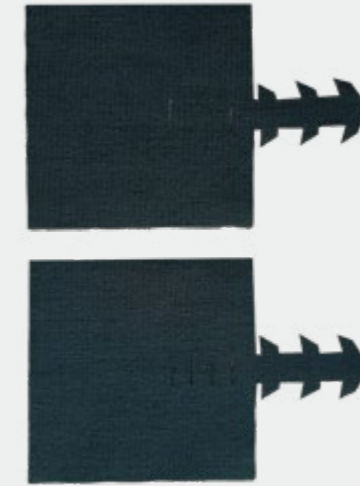
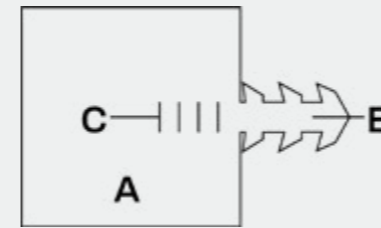
Stretch resistance	3	It is very resistant, the best of all those presented so far.
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	12	The connector is very resistant to stretching, has good movement behavior, looks good. It takes time to put together, but it is very intuitive.

CONNECTOR: 12

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL C

SIZE SAMPLE

A: 5x5cm B: 2.5x1.5cm C:.6cm

PROPERTY

VALUE

INTERESTING NOTES

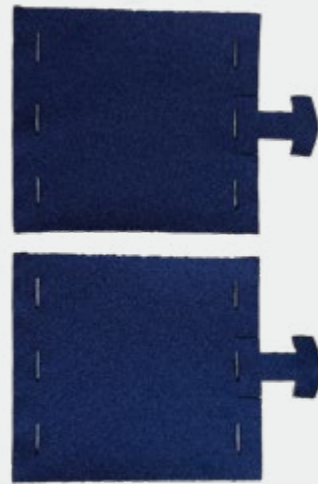
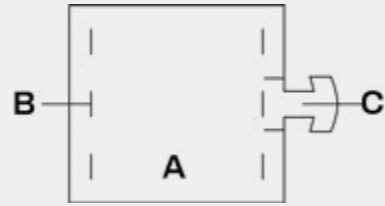
Stretch resistance	1	It has very poor resistance. The fabric is not suitable. It will be good to try on material B
Aesthetic	1	The material folds and creates bulges and deformations in the fabric.
Manufacturing difficulty	3	N/A
Assembly difficulty	2	It's a bit time consuming to put together, but it's intuitive.
Results	7	The connector is not resistant. This is because the material is not suitable. More tests will have to be done on material B or on another material with more body. This will also help improve its aesthetics.

CONNECTOR: 13

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL A

SIZE SAMPLE

A: 5x5cm B: .6cm C: 1.3X1.4cm

PROPERTY

VALUE

INTERESTING NOTES

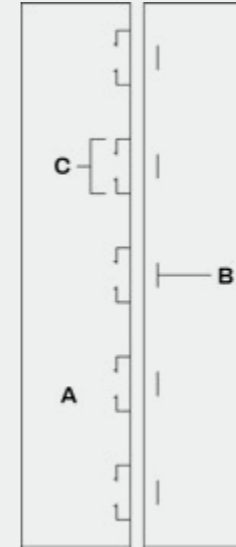
Stretch resistance	1	It is not resistant. The fabric is not suitable.
Aesthetic	2	Although it does not look bad, it needs to keep in mind that the tip of the connector is exposed on both sides.
Manufacturing difficulty	3	N/A
Assembly difficulty	1	It is difficult and unintuitive to assemble. It's confusing.
Results	7	It is a connector that breaks. It is better to try it on another type of fabric. Its aesthetic shows the head of the connectors on both sides, it can be a decorative element, but people must be careful how to use it. It is difficult to assemble, it is confusing and unintuitive

CONNECTOR: 14

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL C

SIZE SAMPLE

A: 4x20cm B: .9cm C: 2cm

PROPERTY

VALUE

INTERESTING NOTES

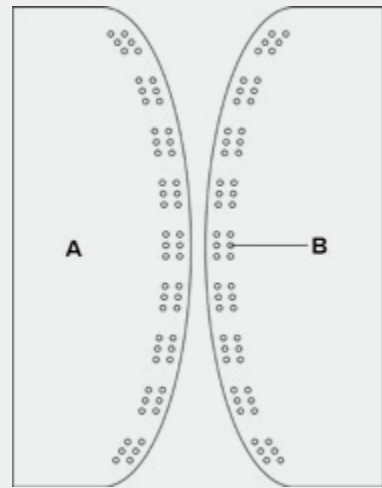
Stretch resistance	1	It is not resistant. The fabric is not suitable, and it is necessary to include padlocks on both sides. It necessary to modify this connector to use it.
Aesthetic	1	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	1	It is not difficult to assemble, but the locks are very bad.
Results	6	It is not a good connector. It must be redesigned.

CONNECTOR: 15

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL A

SIZE SAMPLE

A: 5.5x17.5cm B: .1 cm r

PROPERTY

VALUE

INTERESTING NOTES

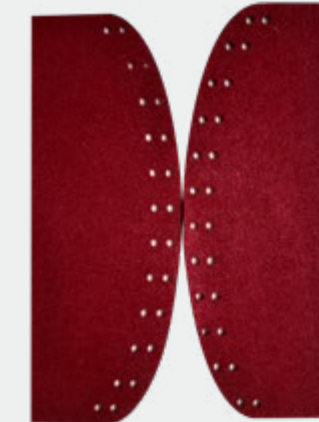
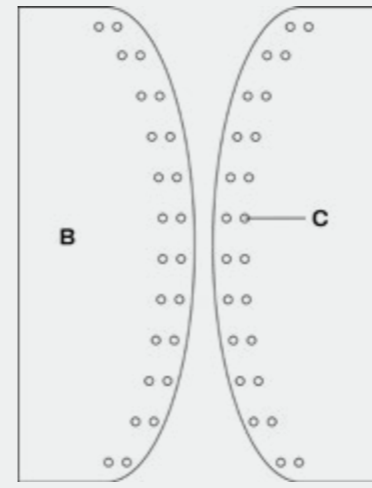
Stretch resistance	3	Very resistant
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	1	It's unintuitive and takes a long time to set up.
Results	10	Although it has good resistance, it takes a long time to assemble and is not intuitive.

CONNECTOR: 16

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL B

SIZE SAMPLE

A: 6.5x17.5cm B:15cm

PROPERTY

VALUE

INTERESTING NOTES

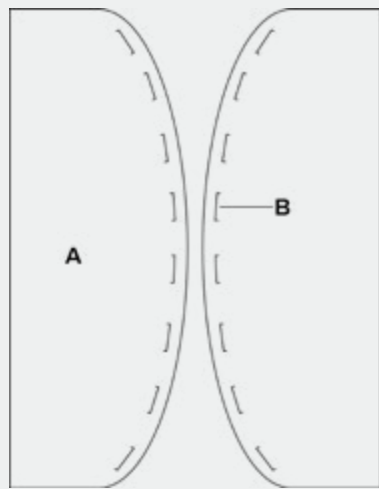
Stretch resistance	3	Very resistant
Aesthetic	2	When stretched it opens a little and forms small lumps.
Manufacturing difficulty	3	N/A
Assembly difficulty	2	Takes time to insert each cord.
Results	10	It is resistant, but as it is a thick fabric, it creates very thick joints that can be uncomfortable for the user. It also takes a bit of time to put together. In the extension of the curve very large lumps are formed.

CONNECTOR: 17

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL C

SIZE SAMPLE

A: 6.5x17.5cm B: 1cm

PROPERTY

VALUE

INTERESTING NOTES

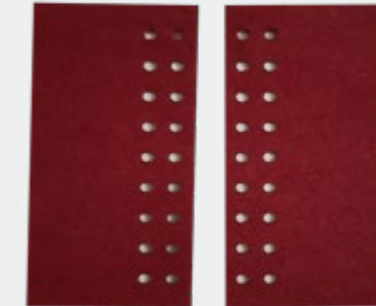
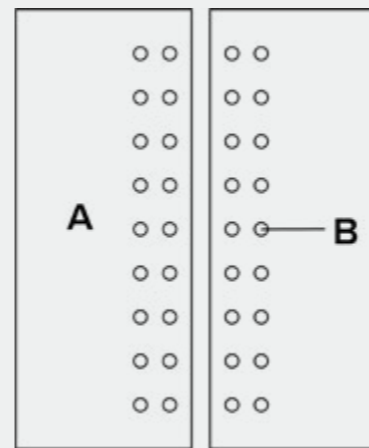
Stretch resistance	1	N/A
Aesthetic	1	The fabric does not have enough body to support the strip of material and wrinkles.
Manufacturing difficulty	3	N/A
Assembly difficulty	1	It is difficult because no part has rigidity.
Results	6	It is not a good connector, it breaks, it opens when stretched and the weight of the connectors makes the fabric hang and forms lumps and wrinkles.

CONNECTOR: 18

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL A

SIZE SAMPLE

A: 4x10cm B: .15cm

PROPERTY

VALUE

INTERESTING NOTES

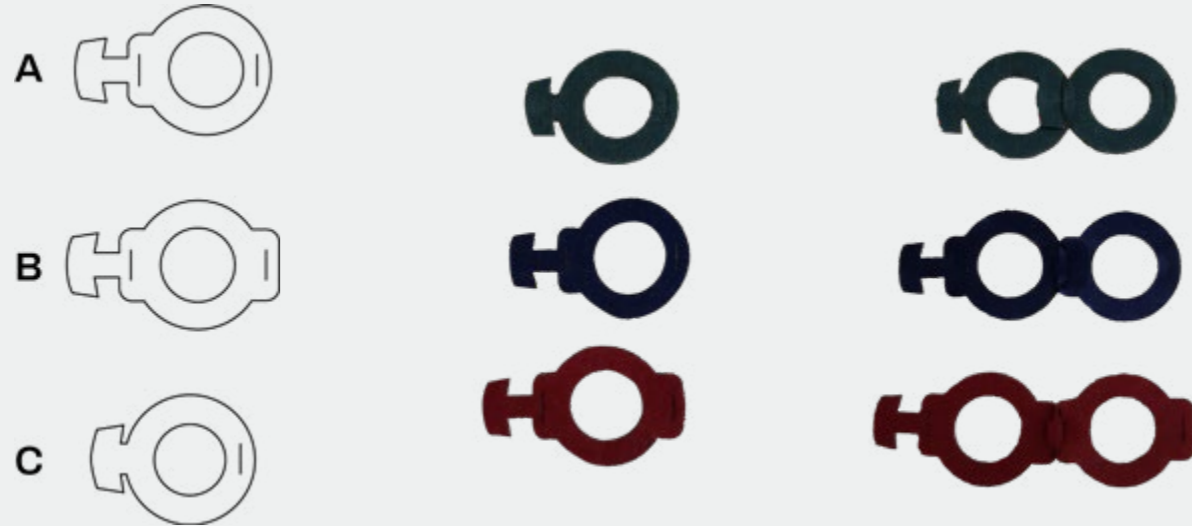
Stretch resistance	3	N/A
Aesthetic	3	N/A
Manufacturing difficulty	3	N/A
Assembly difficulty	3	N/A
Results	12	It is a good connector the way in which the pieces are interlocking does not generate deformations and integrates a decoration element (laces).

CONNECTOR: 19

TECHNICAL DRAWING FOR LASERCUTTING

DISASSEMBLED CONNECTOR

ASSEMBLED CONNECTOR



MATERIAL	B, A, C	SIZE SAMPLE	A: 4X3cm B: 4.5x3cm C: 3.5x3cm
PROPERTY	VALUE	INTERESTING NOTES	
Stretch resistance	B= 3 A=1 C=1	The only one that resist is the one made with B material.	
Aesthetic	3	All of them looks nice	
Manufacturing difficulty	3	N/A	
Assembly difficulty	3	N/A	
Results	B=12 A=10 C=10	All three are easy to assemble, they are very aesthetic, they can help to decorate the garments. However, only one is resistant due to the type of material used. It will be necessary to do more tests of the other two with material B.	

The stretched resistance of the connectors is directly linked to two main elements, the materials in which they are used and the design of the lock. **All the connectors made with fabric B had the best scores** (see connectors two, five, eight, eleven, eighteen, and nineteen). This material is thick and has friction. Its characteristics help connectors to have a better performance. It was difficult to separate the join because the fabric has more body, more structure. This helps the connector to not lose the figure and stay stable. In materials like A and C the connectors did not work well at all. These fabrics, by not having enough structure and not generating resistance, induce the interlocking systems to break and to not maintain the union. In the case of elastics materials as fabric C, the connectors were weak for the material nature. On the samples, it was visible that elastic materials produce elongation in the fabric provoking feeble and not well-adjusted joins (see connectors three, nine, twelve, fourteen and seventeen). In some cases, the weight of the material, as in the connector seventeen, causes the cuts to open. The weight causes the fabric to stretch.

The resistance of the stretching is also linking on the lock design. In the experiments it could be observed that in light materials, as the A, the strings and slots were the best option (see connectors one and fifteen) these connectors do not break because there is a lock generated by a knot, or by an intertwining of a thread over the entire surface that make impossible to break it. Likewise, the tolerances between the joints and the thickness of the materials must be considered. The cuts where the connection and slot are attached must be a little smaller than the thickness of the material. This will produce friction and resistance. In the connectors two, three and nine, the cuts in which the connections were joined were bigger than the material thicknesses, this produce that the connectors had no resistance and therefore they open. On the samples, it was also evident that the interlocking system with connectors and slots on both side working better and have better resistance than the ones with connector in one side and slot in the other. On the connector fourteen, only the connectors were placed on one side and the slots on the other, this triggered only one point of union, which was insufficient to resist stretching. In the experiments it can be observed that the more points of union the connectors have, the greater their resistance to breaking; although this implies that it takes longer to assemble (connector 8). It is important to point out connectors can work as fasteners. On the sample five, the connectors had an excellent resistance. They can be opened and closed as many times as necessary without losing form and join force.

Ten of the nineteen connectors tested presented excellent aesthetic (connectors one, four, five, six, eight, ten, eleven fourteen, eighteen, nineteen). They

look good smooth and do not form wrinkles or bumps. The experiments showed that the deformations in the joints appear when there is an accumulation of material and a pronounced curve, for example connectors seventeen and sixteen presented deformations, because the material acted as an extra weight in the curves. In the case of the connector seventeen, due to the properties of the fabric, the joints were very big and thick. This can be used as decoration, but it could be inconvenient for the user. On light materials the behavior of the curve is better. On the sample fifteen the joints were smooth. There was not extra weight on the edged that could affect the fabric behavior.

The connector that could act like fasteners have a nice aesthetic (connector five). In this case, a decorative element could also be added to the ends, to personalize the garment. Other element that could work like a decorative element are the tips of the connector. In some cases, the unions are flashy and have volume from one side and from the other are plain (connector four is a good example). In other cases, other interlocking systems have forms that appear from both sides (connector thirteen). These elements must be taken into consideration within the design since they are details that will impact the aesthetics of the garment. Moreover, the aesthetic on light materials, as the fabric A, is nice (see connectors six, seven, ten). They look soft, the texture is pleasant to the touch, and no wrinkles or lumps are formed. However, as has been mentioned before these materials are not resistant to stretching. But it can be considered that the thinner the material, the better aesthetics the connector will have. Aesthetics is also linked to the type of material used. Samples made with material C showed many

errors (connectors fourteen and twelve). All because the material has no structure. The joints bent, wrinkled, and form lumps.

All the samples had a great result on the manufacturing process. They do not break and do not fray. The materials edged were sealed and it was not necessary to implement other finished. Like the auxetic figures, on the connector design it is necessary to take in consideration the distance between the connector and the slot, to increase the joint points and avoid breakage. An important note is that in some cases, it must have in attention also the distance between connectors, to prevent that they could be too close or far between them and create problems during the cutting and assembling.

Materials influence the assembly of connectors. On the samples three, thirteen, fourteen and seventeen, was difficult to assemble the pieces because the material does not have the best resistance and friction. The lack of structure in the fabric also makes it difficult to insert the connector in the slot. As mentioned before in light materials the best connector to apply are strings and slots. This option gives connectors good resistance to break up, but the assembly process became exhausted. It takes a lot of time and a lot of detail (connector sixteen) to join the pieces. This kind of connectors also, are recommended to be applied on pieces that are not intended to change. Since the connectors are all connected to each other like a chain, so if the union breaks, it will open the entire surface where it was applied.

A detail that makes the assemble process easier and intuitive was the heads of the connectors. The shape of an arrow on the tip

indicated that this form had to enter or pass over the slot (connector eight and eleven). However, as much of the other connectors also involve folding or manipulating the fabric in a different way (connectors one, five, and six). It is necessary to include in each one a manual with instructions. Moreover, if the connectors have more points of contact, it is more resistant to stretching, however it must be considered that this makes the assembly process slower. Because there are more slots where the connector must be inserted.

Once the analysis and sump result of each property was made, it can be concluded that all the connector with score between seven and less were discarded to apply on Nawale products (connectors three, fourteen, seventeen). These connectors present problems on design and materials resistance. Even went exist the possibly to experiment them on other materials, their structure design is not enough to maintain the padlock between the fabrics. They need a redesign. On contrary all connectors scored on eleven and twelve (connectors one, five, eight, eleven, eighteen and nineteen), are optimal to be used in the design of the products, their implementation may vary depending on the area of the garment, to find the best that suits the clothing silhouette without altering its function and aesthetic. They will also adjust to the fasteners needs. This means to the areas, in which open or close the garment with frequency is necessary (example connector 8). Connectors scored between ten and eight will be used based on specific requirements. Most of these connectors ranked lower because the material in which they were tested was not the ideal or because require time to be assembled (connector six, seven, nine, ten, fifteen and sixteen). For the material side, it

is necessary to make more samples of these ones on the fabric B (material with the best performance) to have a complete view of their behavior. However, based on that some of them are similar to the ones with the best score, it can conclude that they will have a great performance too. On the side of ensemble time, the connectors have a great performance. But it needs to have in consideration, that this task requires patience.

Base on the experiments it can be concluded that connectors in general require specific requirements to work and have a nice performance. To start connector works better on materials with body and structure. This does not depend on the weight (because material C it is the heaviest and it had the worst result) but depends on the friction and resistance that the material could give to the connection. So, materials with body, and resistance will have better performance. However, this limits the selection of materials for design and production. Designers must be very careful on select fabrics that could fulfill the user requirements and connectors production. Furthermore, the experiment data show that the connectors work better in straight patterns than in curve patterns. The steeper the curve, the more difficult it is to implement connectors. This must be taken into consideration, especially when generating the patterns. So, material and pattern will influence the silhouette of the garment. Additionally, it needs to take in account that connectors head or tip need space. This means that designer must contemplate to leave space on the patterns to implement the connectors.

6.3

CONCLUSION

Auxetic figures and connectors are elements that help to create an alternative fashion system in which people could feel integrated by provide them personalized products with perfect fit and making them participate on the process as cocreators. In this chapter was possible to observe the behavior of the auxetic structures and connectors in synthetic materials, to classify them and evaluate their properties. The aim was to find the best ones that adapt to project requirements to be able to apply them to product design.

On the samples of auxetic figures, it was possible to observe that all the structures have a degree of expansion. This degree of expansion depends directly on the materials in which the figure is used. The more flexible the material, the more expansion the figure will have. The auxetic figure tested demonstrated to have good aesthetics in both states (before expansion and after expansion). However, it is necessary to take in consideration, on the garment design, the third-dimensional surfaces that could appeared on bistable figures, because these can alter the aesthetic of the garment.

The size of the cuts and figures also can influence the aesthetic and behavior of the auxetics materials. The smaller they are, the better aesthetic the fabric will have, but less expandability it will offer. On the contrary the larger the figures, the less aesthetic they will have but their expansion will be better. The texture of the figure also is influenced by the material. For example, material cotton neoprene (C) and molletoni (B) have best performance than rasone (A). Materials C and B indicated to be smoother and delicate to the touch that the material A, in who the edged create a scratchy texture.

On the manufacturing process the figures did not have problems about fray, and most of them did not break. Nevertheless, the sample figure eleven hexagon demonstrated that it needs to be very careful, about to leave enough space on the joins to avoid breaking. On the digital samples process it was revealed that software still does not have the capacity to simulate 100% the real characteristics and behavior of auxetic figures. It is necessary to always develop a physical sample.

The auxetic figure with better score (14 points) and that will be used on Nawale project are figure eight pinches, figure two y, and figure five square. However, the others ranking on 12 and 13 points will be applied too, but it will take in consideration their special characteristics and requirements. The only figure discarded was the figure eleven hexagon, because its design requires bigger intervention.

The connectors are other elements that will be incorporated on Nawale products. During the samples development it was tested their stretched resistance. A property of vital importance because it will guarantee the ensemble and life of the garment. The connectors that resist more to the stretching were the ones made with the material B. This material presented more structure and friction than material A and C. On the experiments it was discovered that a connector will work well if the material in which was created generate resistance. This resistance can be given by the texture, weight, or structure of the fabric. The resistance of the connectors is also related with their lock design. To make possible to create a perfect lock, it must take in consideration the tolerance of the connector and slot with reference to the material thicknesses. The resistance also can be achieved by implementing connectors and slots on the two pieces that are intended to be joined. By having more points of union, the connector is more difficult to break; although this implies that it takes longer to assemble.

Connectors have characteristics that can impact on the aesthetics of the garments. The heads of the connectors can generate volumes and in some cases the alteration of the silhouette on the clothes. Furthermore, the

aesthetic is related with the material in which the connector is applied. For example, with the material A, the connectors create soft and pleasant texture. It can be considered that the thinner the material, the better aesthetics the connector will have. Depending on the style and aesthetic that collection intents to show, thick or thin materials can be chosen considering the aforementioned.

The manufacture process of the connectors was simple, none of them presented cutting or fraying problems. It should only be taken in consideration the distance of the connectors, to prevent them from being too close or too far. In the assembly process, the connectors ranged from easy to difficult, especially considering how intuitive and how fast it was to assemble them. On the samples was discovered that the heads of the connectors, in form of arrow, helped to intuit the assemble of the piece, because the tip indicated that this form had to enter or pass over the slot. However, it was determinate that all of them needed a manual with instructions of how-to ensemble the pieces.

Integrating auxetic figures and connectors on the product design require the analysis of different requirements. To start the materials. On auxetic figure the material that had the best performance was material C, because this material expanded more than the others and its texture was very soft to the touch. However, the material C was the one with the worst performance on connectors samples. This material does not generate resistance in any of the connectors, so many of them were discarded to be used in the final products. The material that bests performance on interlocking system samples was the material B. This material for its characteristics helped create strong and resistant joints. The ma-

terial B on auxetic figures has a nice performance. The figures did not expand as much as those made of material C, but they had a better texture to the touch than material A. For these reasons it was decided that **the best materials to apply on design products are the ones that have the characteristics of the material B.** This material permits the implementation of the connectors and the good performance of auxetics figures.

On the experiments it was also discovered that **connectors work better on straight patterns**, since the connectors on curves patterns generate alterations in the fabric and the design. The interlocking systems on curve patterns are also more difficult to join. This task can result difficult for the user for the time and patient that it needs to be executed. Furthermore, on the pattern design with connectors will be necessary to leave space to employ the interlocking systems. Some of the connectors have an extra head that require at least two centimeters to be applied on the pattern. The extra head needs to be applied on the edge of each garment piece. This could bring a challenge on zero waste patterns because the objective is to use the complete fabric area. On the contrary, auxetic figures are a little simpler to be implemented. They adapt better to curves due to their property of forming domes without the application of much force. They also can be implemented on straight areas, although its expandability can be less, depending on the auxetic design selected. For its application, also is necessary to take in consideration the uncovered areas that the designs can give, since this implies showing the skin of the user.

During the process of comparison and anal-

ysis of the two elements (auxetic figures and connectors), it was concluded that **connectors have more requirements, which limit the design and product proposal.** However, our user, pregnant women, search for more alternatives that permit them express themselves to redefine their personality. In the case of clothes, they search for some things that could adapt to their body changes, that gives them aesthetics and comfort. The changes on the body women are composed for curves, which leads to the creation of patterns with rounded figures to generate more space in the abdominal area. Women also want to find alternatives for hot and cold weather, the fact that the connectors can only be used with materials with properties such as material B, limits the season of the products. For these reasons, **it was decided to offer women the two alternatives, traditional production and networking production.** Products made with connectors and auxetic figures, which they can produce at home, and products produced on the conventional way (on the brand workshop). These products will be designed with auxetic figures but not with connectors. To conclude this chapter on the figure 37 will be showed the final selection of auxetic figures and connectors that will be implemented on the design products. These elements were the best. They proved to have the necessary properties to develop good performance on products. The auxetic figures and connectors will be combined to create the alternative to personalize the product and enrich consumer experience.

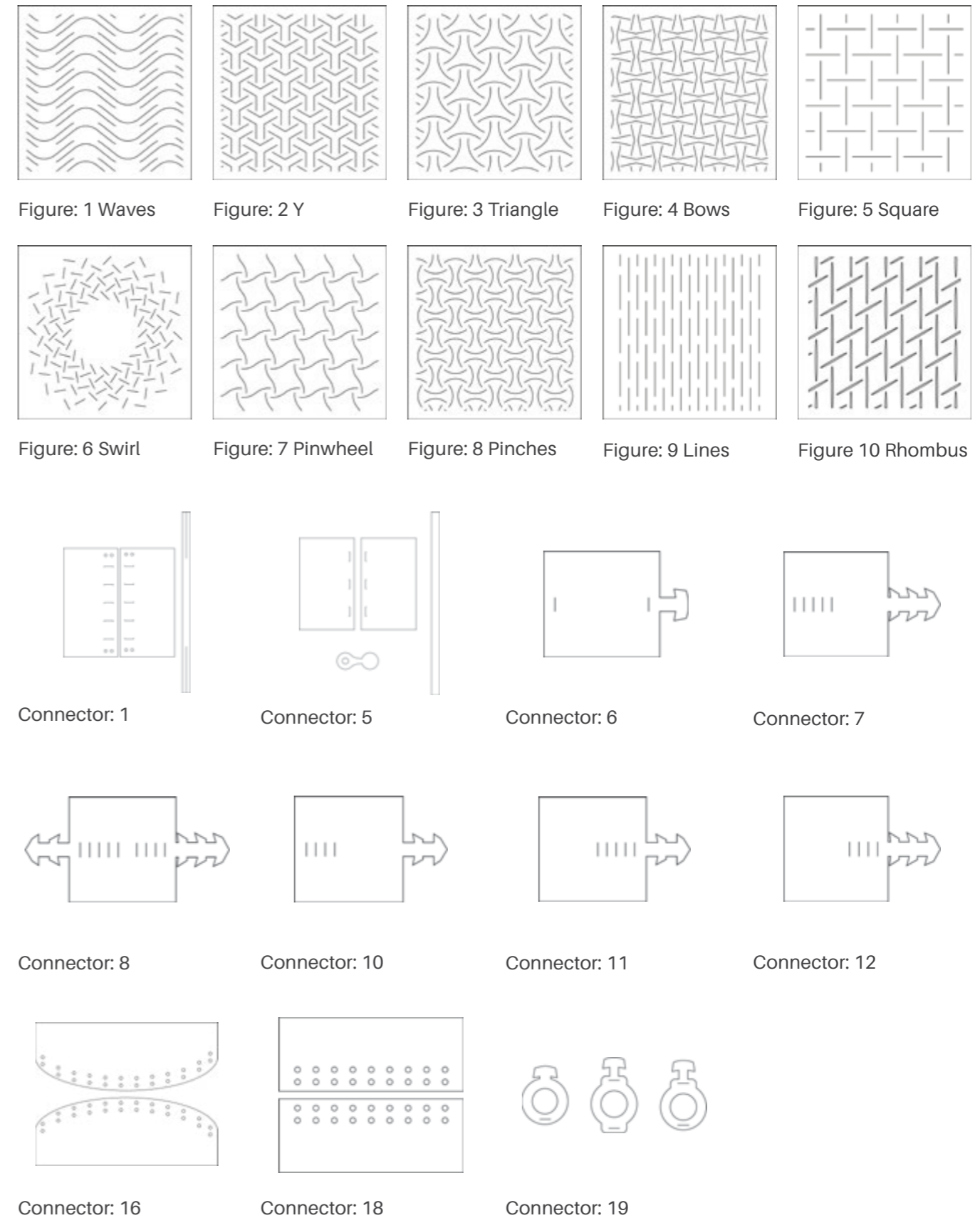
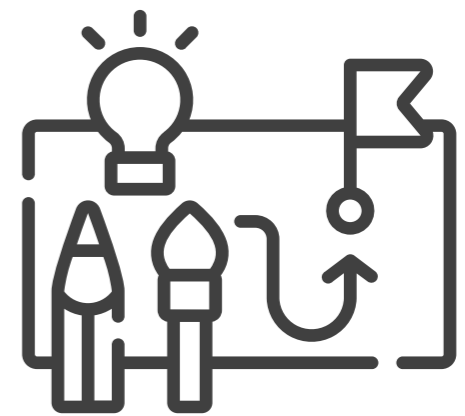


Figure 37: Final selection of Auxetic figures and Connectors.

CHAPTER SEVEN PRODUCT SERVICE SYSTEM DESIGN PROCESS

7



DESIGN PROCESS

7.1

VISUAL IDENTITY

In this chapter it will be presented the Nawale project development. Product, service-platform, and branding designs. The aim is to explain the entire process from the creation of the products to the design of the platform using the components of chapter five and the experiments results of the chapter six. In this space will be presented the design of three products two dresses and one belt accessory. The two dresses born for the idea of give people the alternative to choose between the two ways of producing their garments, through a traditional manufacture or through a networking manufacture using connectors (DIY). The belt born for the idea of proportionate and additament to women to relive lower back pain. The accessory is thinking to be produced in the two manufacturing proposals (normal and networking).

On this chapter also will be exposed the development of Nawale identity and branding. That goes from understand the user requirements and bring an unexpected and less traditional view of what is be mother. When a woman becomes a mother, society pigeonholes her into a stereotype in which the woman does not feel identified. Women does not want to feel old; they want to still conserve part of the antique personality but incorporating new experiences. The project intents to break the stereotype that women should be cute, wear pastel colors, that they should be perfect. Nawale intends to implement feminist values and psychology theory on their visual identity to help women to feel better with themselves in a funny and interactive visualization and performance.

Also, in this section will be show the service and the beginning of a platform design. From which the user will have access to the products. On this platform was contemplated the user experience design and the implementation of web technologies 3.0. The objective is to offers a democratic, inclusive, and comfortable service that help women to feel good and have confidence on the products that they are buying. All these elements have helped to build Nawale brand that arises from the need to generate personalized and tailor-made products for pregnant women to help them to reduce body dissatisfaction. Develop proposal to solve this problem is of vital importance to create a society in which women could feel save and free.

In this section will be presented the Nawale visual identity, which goes from understand the user requirements and bring an unexpected and less traditional view of what is be a mother. Nawale intends to implement feminist values and psychology theory on their visual identity to help women to feel better with themselves in a funny and interactive visualization and performance. Nawale wants to break with the stereotypes of the perfect mom. Although the personality of women is redefined during pregnancy, what was discovered in the user-centered research (chapter three), is that they do not want to feel old, they do not want to lose that part of them that made them feel free and independent.

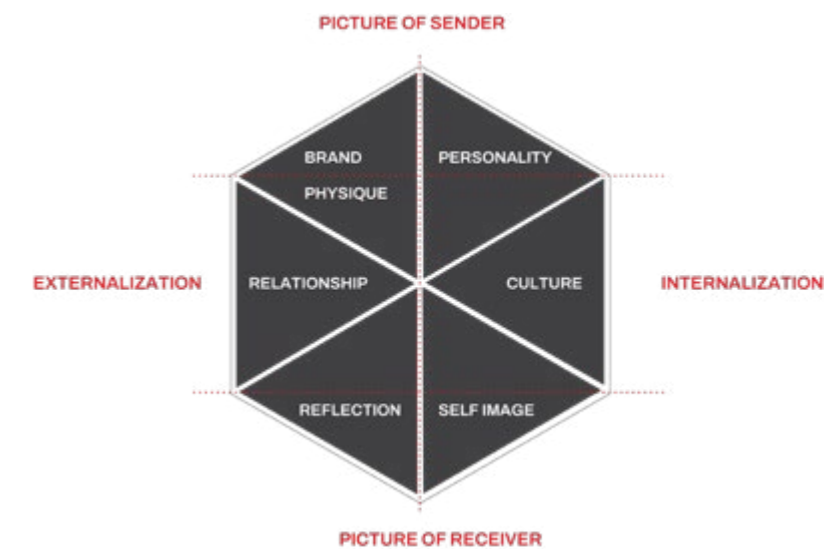


Figure 38: Kapferer prism model tool.

Incorporating **feminist values** (figure 39) on the brand could help to prevent body dissatisfaction. **Exposure to feminist perspectives increases women’s body satisfaction through growing feminist identity.** Women with traditional views have more danger internalize sociocultural beauty standards than women with more free thinking about the stereotypes. Feminist theory can work as a filter in which cultural messages about beauty are challenged rather than passively accepted. It could be an alternative to interpret the media messages in a positive way to promote empowerment and positive body image. Nawale intends to promote the feminist discourse of “taking control” to enhance body image on women.

The brand image definition was development using the Kapferer prism model tool (figure 38). This tool helps to communicate the meaning and values of the brand. The prism also reflexes the expected meaning and values toward the brand by the consumer (Galli, Boger, & Taylor, 2019). The model is divided on six aspects of brand identity: physique, personality, culture, relationship, reflection, and self-image. The brand physique refers to the tangible characteristics of the brand (logo, colors, packaging). Personality refers to its emotional nature (the brand’s character). Culture refers to value and basic principles. Relationship refers to the exchange of contents and meaning between people. Reflection refers to the stereotypical user of the brand. And self- image refers to the mirror that target groups holds up to itself (Pirvani, 2009). These six aspects are divided over two dimensions (Galli, Boger, & Taylor, 2019). The constructed sender (created image of the brand) versus the constructed receiver (how the brand expects the actual consumer to be reflected in the brand), and the externalization (external expression of the brand identity in terms of its physical qualities, how it interacts with the consumer, and the ideal type of consumer) versus the internationalization (brand personality, DNA and values of the brand, and how the brand will impact the consumer’s self-concept). Following Kapferer prism model, made possible to identify the symbols, user preferences, colors, figure, between other elements, that could adapt to the brand visual identity.

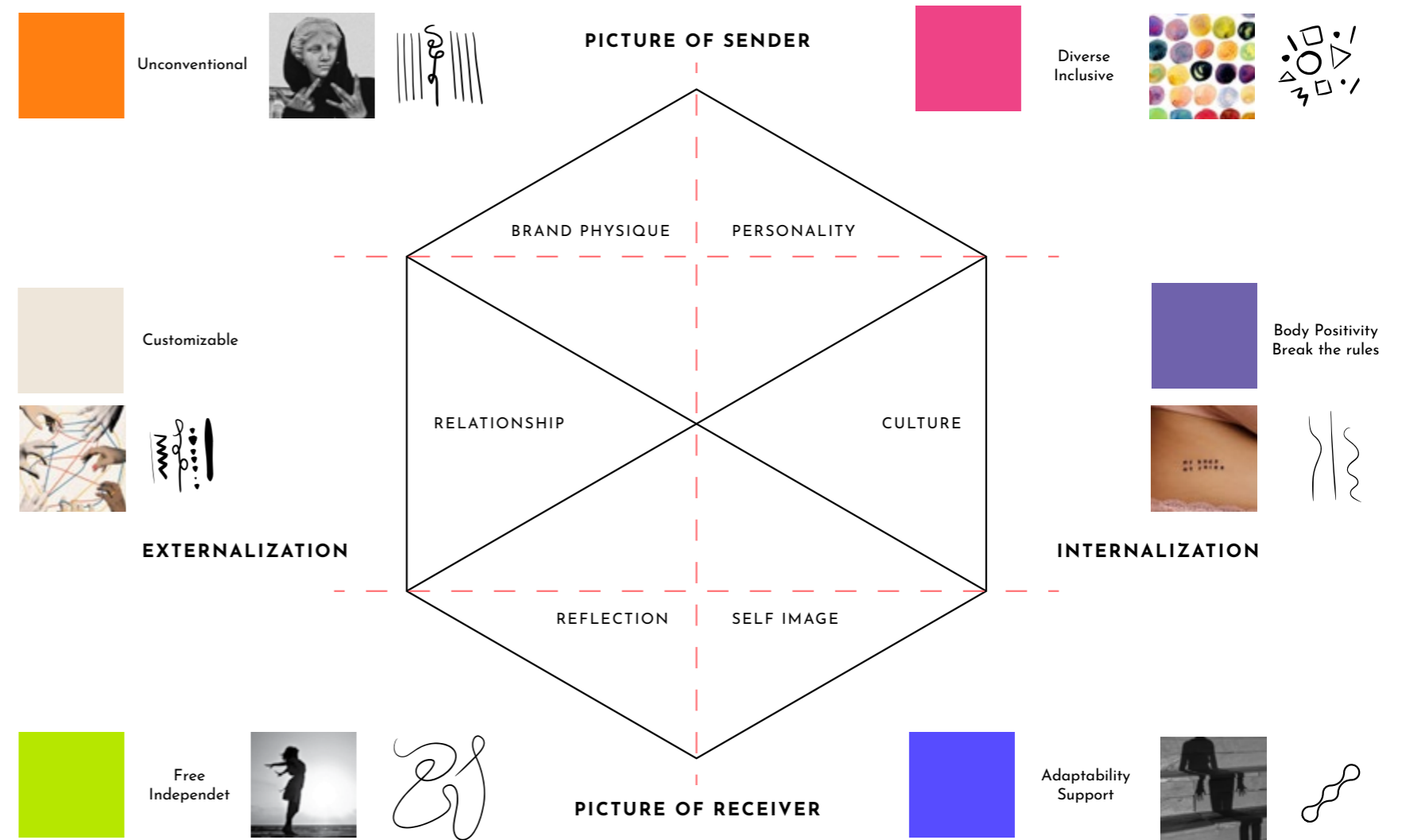


Figure 39: Nawale prism reflects the identity of the brand. It wants to show an unexpected and less traditional view of what is be a mother. It follows body positivity movement philosophy.

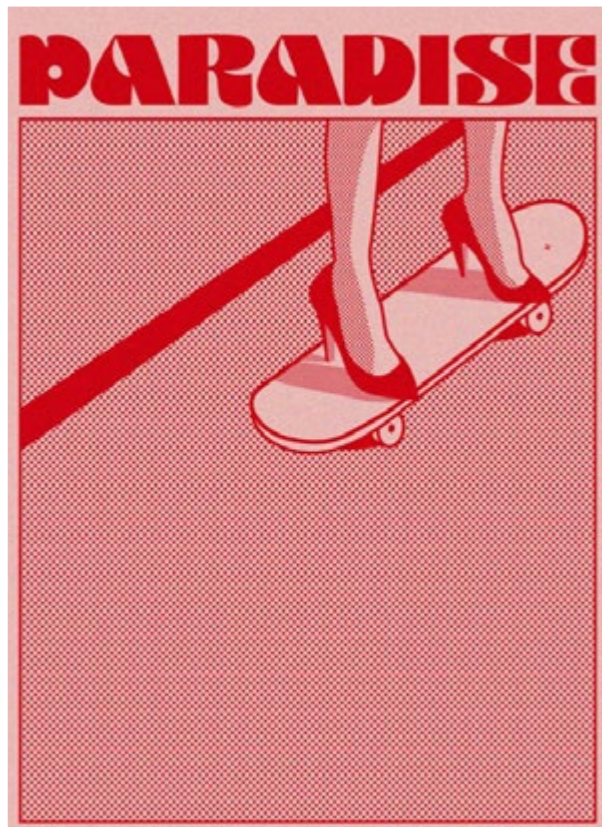
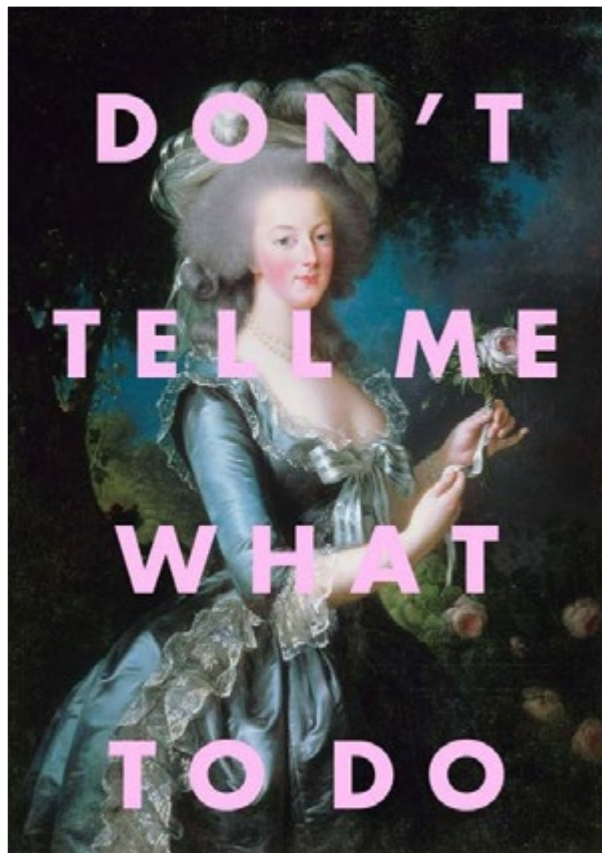
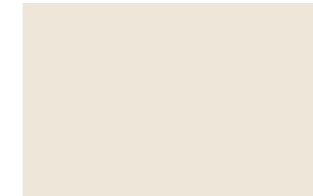


Figure 40: Inspiration feminist values. Exposure to feminist perspectives increases women's body satisfaction through growing feminist identity. Feminist theory can work as a filter in which cultural messages about beauty are challenged rather than passively accepted.

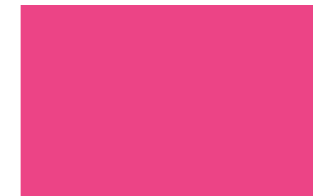
COLORS

COLOR 1



White: peace, purity, nothingness (blank canvas to customize).

COLOR 3



Pink: LGBT rights, feminine.

COLOR 4



Orange: Creativity, innovation, rejuvenation, energy.

COLOR 2



Purple: Feminism, fight (mix blue with pink, the colors traditionally associated with women and men).

COLOR CONTRAST 1



Green: Feminism, life, energy, fertility, youth, liberty.

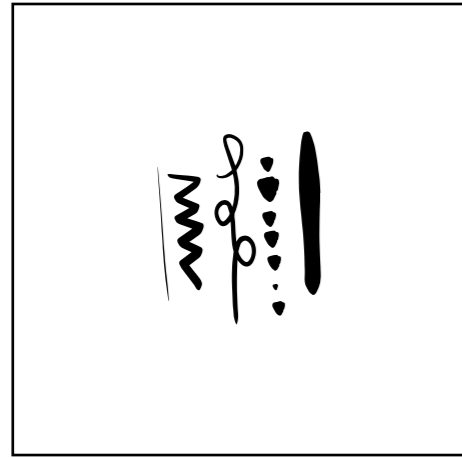
COLOR CONTRAST 2



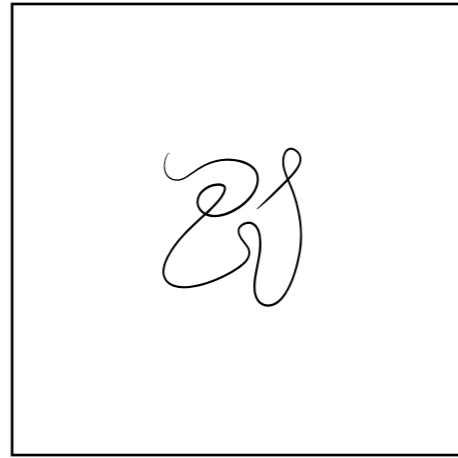
Blue: Calmness, serenity.

TYPE OR SIGN

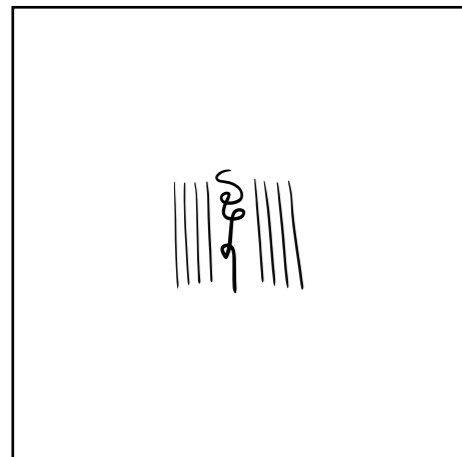
LOGO



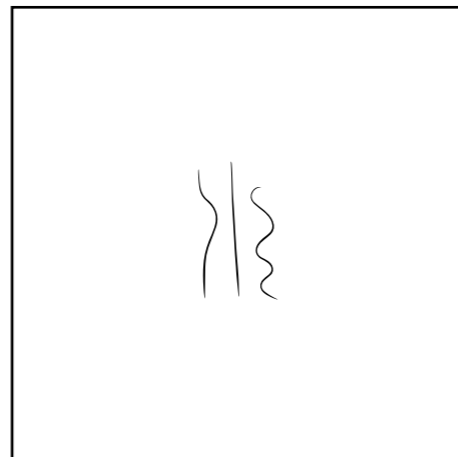
TYPE OR SIGN 1



TYPE OR SIGN 2



TYPE OR SIGN 3



TYPE OR SIGN 4

Nawwale

Figure 41: Signs that came out of the exploration of elements with the prism of Kapferer. Curves, lines of different thicknesses and styles. Forms that expand, contract, and move.

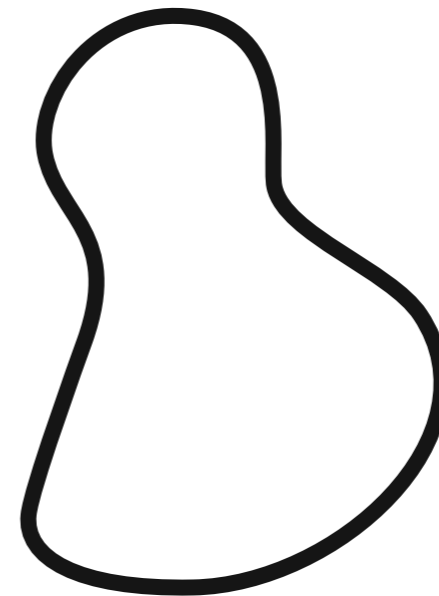
MEANING

Figure 42: Nawale name is composed for nawal + e. Nawal word comes from the Nahuatl, language spoken by "Aztecs." It means a person with the ability to transform their body into an animal, object, fire, or a meteorological phenomenon. The e refers to the inclusive language in Spanish speaking people. The Inclusive language or non-sexist language refers to the creation and use of terms that make visible demographic groups with gender identity and sexual orientation different from masculine or feminine.

Nawal + e

SIGN

Figure 43: Signifier, curve that transforms, representation of the changes in women during pregnancy. Deformation.



Nawwale



Figure 43: corporate identity mockups

7.2

PRODUCT DESIGN

In this section will be presented the design of three products two dresses and one belt accessory. The products were designed by utilizing the elements explained on chapter five as Make/Use tool, Clo3d, and lacing fastener. Moreover, on the design were also implemented the experiments result from chapter six such as connectors and auxetic figures. The products were intended to be manufactured on laser cut in based plastic materials.

7.2.1 USER AND DESIGN INSPIRATION

Before to start explaining the product design process, it is important to mention that the products were designed focused on **satisfying the needs of women during pregnancy and postpartum**. As mentioned before (chapter three) women refer to pregnancy as a deformation process in which they are forming a new identity. During this process they want to use and find things that make them feel secure. They look for activities that help them stay active and relaxed. At the same time, they look for spaces where they do not feel judged and where they can feel free. The support on this stage is vital. Feel identified and share experiences with other women helps them feel confident and reduces anxiety caused by pregnancy. Many of these women carry out a work activity, where they express that it is difficult to find pregnancy clothes that adapt to their body and style, clothes that make them to feel secure. Nawale

project intents to design products for these women, who are looking for personalized products to use at work and in daily life, to help them feel safe and comfortable. Furthermore, Nawale will design products for women interested on change the current fashion system and promote the sustainability values.

Once establish the user profile. It is important to comment that the products **inspirations come from traditional clothes, from Mexico and Japan**. On the past fabric was treated with respect and care because the materials were scarce, and processes were slow. Based on the respect of the fabric the patterns and silhouette of the garment were inclusive because the silhouettes were adjustable to many body types. These traditional garments serve as inspiration to generate zero wate inclusive products.

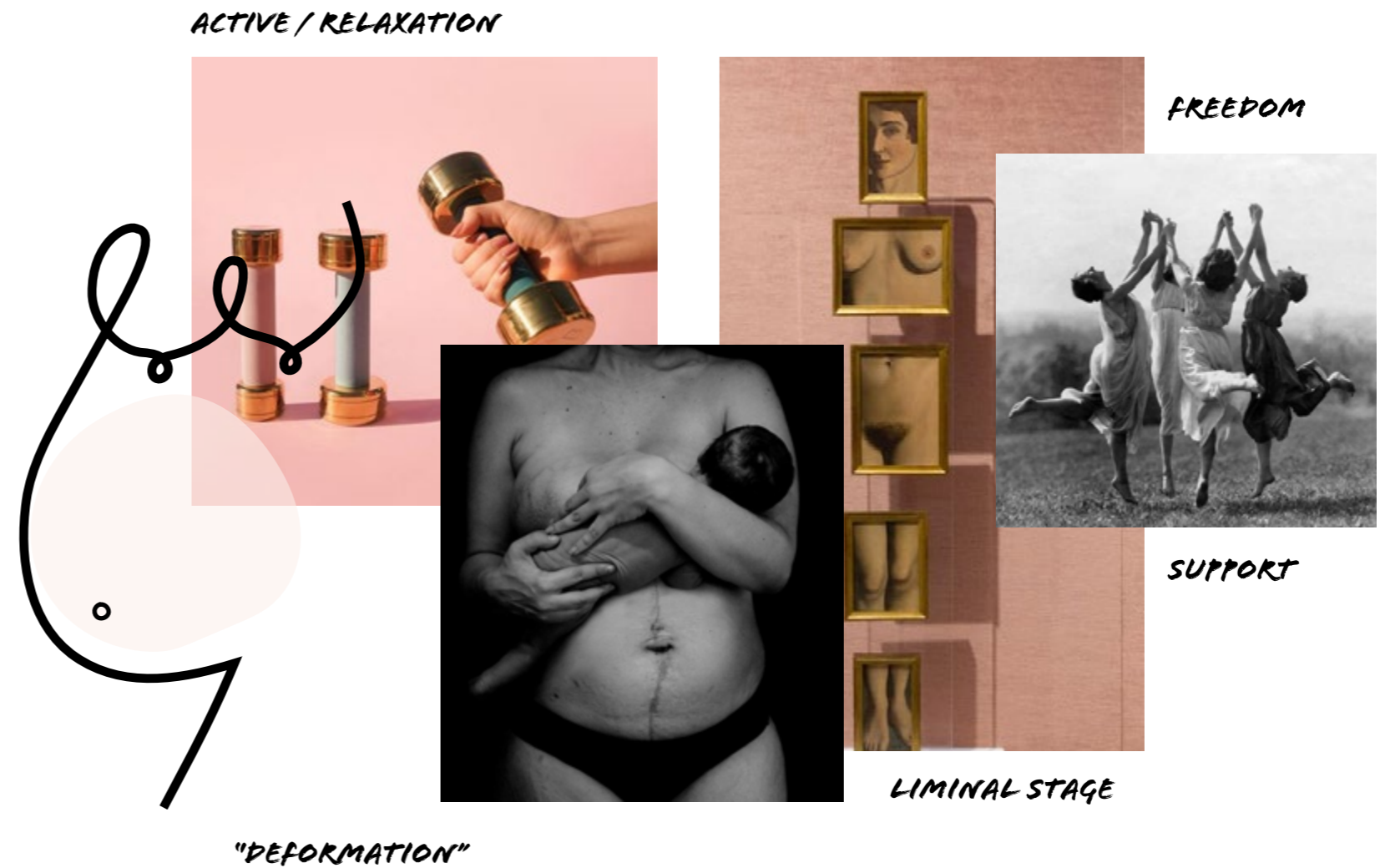


Figure 44: User moodboard

NEEDS THAT THE PROJECT WILL FOCUS ON

- PERFECT FIT
- ADAPTABLE
- MOVEMENT
- COMFORTABLE
- EASY TO WEAR
- CUSTOMIZATION
- LONG LASTING LIFE
- HELP TO RELIEF PAIN
- TREND AND YOUNG STYLES
- PERMIT THE BREAST FEEDING
- HELP TO CARRY WEIGHT (BELLY, BREASTS)
- NICE AND SOFT TEXTURE (BREATHABLE, STRETCHABLE)



Figure 45: Designs inspired by traditional costumes, straight, clean and simple figures.

7.2.2 DRESSES

Within the project, the Make/Use tool was used to generate patterns that could allow alterations, in an easy and tailored way, without generating fabric waste. The goal was to offer different customization elements, so that women could choose from the options and create their own style. With this tool two dresses were designed, **kimono and western dress**. **Kimono dresses** was thinking to be produced on traditional manufacturing process and western dress was designed to be produced on networking production.

The first step on the design of the dresses was the exploration of the zero-waste technique. Since zero waste design does not have a stablish rules to generate designs, and it is impossible to visualize the final product on the first stages. So, the beginning of the dresses design started with **exploration on paper and scissors following the Make/Use tool**. With the tool, it was possible to explore the garments alterations by cutting and attaching paper in different positions. Then by having an idea of the different modification that could be done in each dress. **The designs were transformed on digital prototyping by using CLO3d software**. With this tool was possible to see a more realistic behaviour, the performance of the pattern on a body, the fabric texture and movement, and about everything the alteration that the dresses could have during the pregnancy body changes.

For the two dresses a total of four alteration options were explored. Modification in the **sleeves, the neck, the length, and**

the pockets. The Kimono dress includes three types of necks (collar, triangle, square), three sleeves' options (with sleeves, open sleeves, and without sleeves), three types of length (to the knee, below the knee, and mullet) and finally the option of have pockets or not have pockets. Kimono dress pattern is based on the exploration of curves to create more space on the abdominal area. The pattern is composed of two parallel curves that cross the pattern matrix from side to side. This design leaves more fabric on the abdominal area and accentuates the waist, creating an hourglass silhouette.

As have been mentioned before connectors does not work so well on curves. For that reason, it was decided to alter the kimono dress to adjust the design to the connector requirements. In this way, the two production alternatives (traditional and networking) can be offered to the customer. The pattern alteration of western dress is more limited than the previous one, because the pattern was subject to the requirements of the connectors, in which straight lines are essential to have a nice performance. Western dress modifications include two types of necks (square and triangle), three sleeves' options (long sleeves, short sleeves, and without sleeves), three types of length (below the knee, to the knee and above the knee) and the option of used it with pockets or without pockets. Western dress is based on Make/Use tool base lines that refer to traditional kimono in which the pattern is based on rectangles.

On the western pattern dress also were added the connectors. These interlocking systems

were adapted on the edges with the intention of avoid the fabric waste and allow the assembly of the garment to be easy and fast. On the design of the western dress also connectors were thinking as a selective option to give to the user another option to personalize the garment. Connectors can also intervene in the design of clothing as decorations.

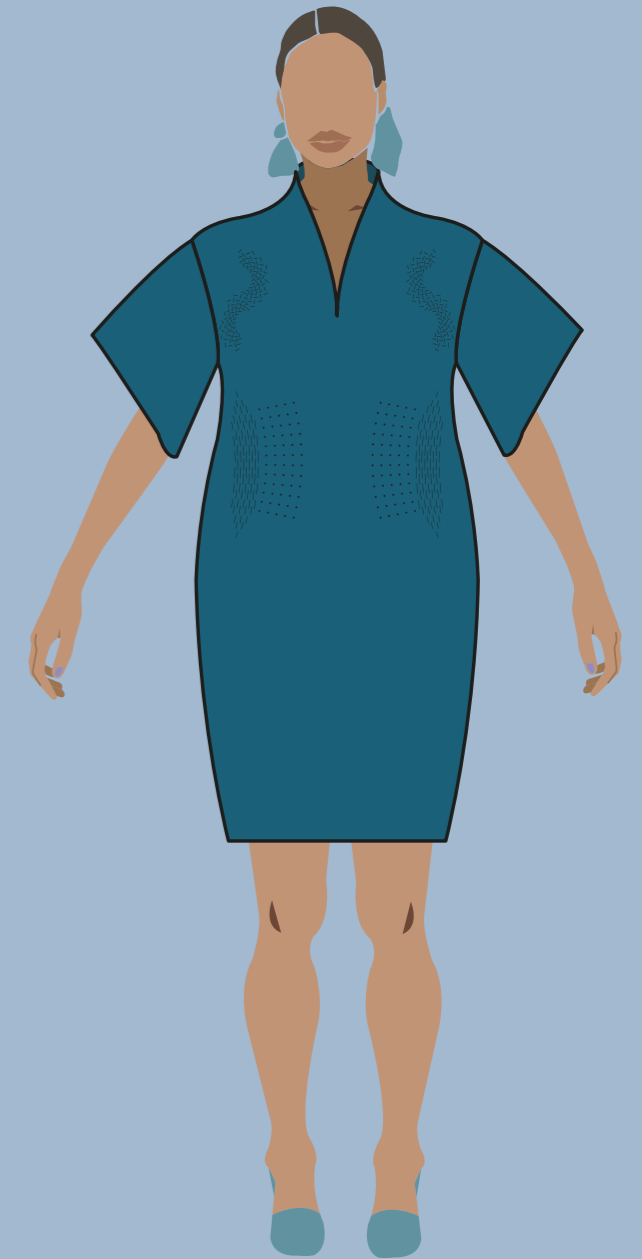
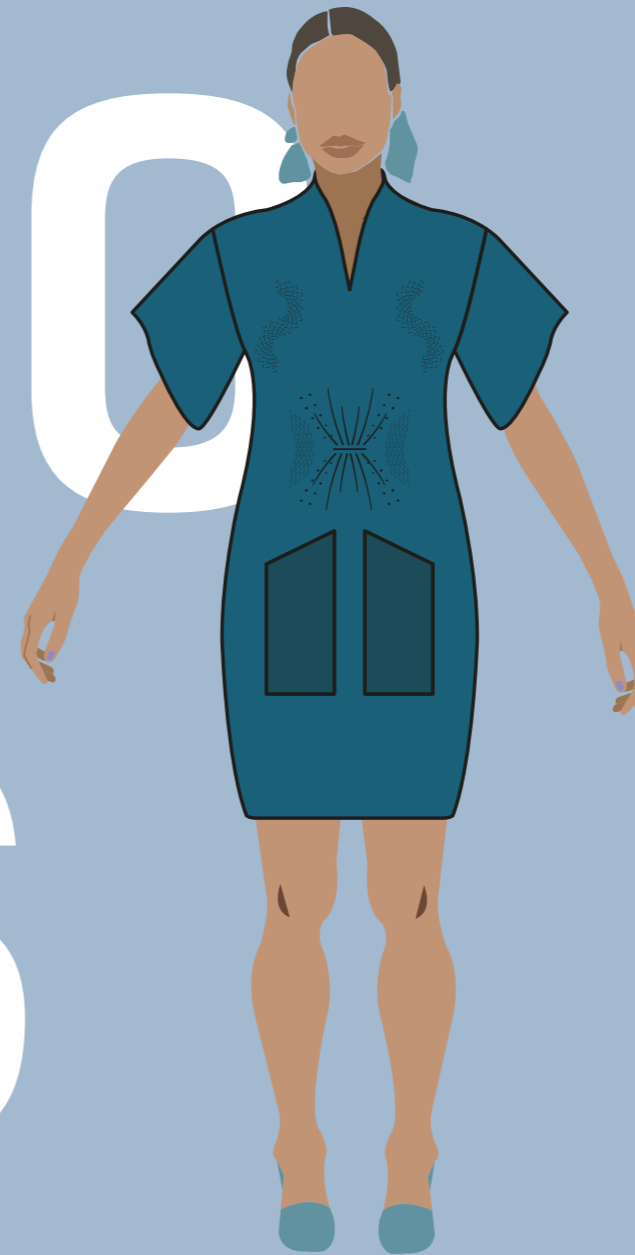
Once all the alterations of the designs were established the **final dresses were adjusted, the auxetics figures and lacing mechanism were applied**. The lacing mechanism was implemented in both dresses in the central part of the abdomen, in the back, and the lateral areas of the belly. The mechanism was put on these areas because they suffer the most changes during pregnancy; clothes need to be adjusted with frequency on these zones. Lacing mechanism was also applied there, because aesthetically it helps to define the belly and the waist. Two elements that women interpret as beautiful (chapter two and three). The auxetic figures were applied on the abdomen, on the mid back, and in the breast. They were employed on these areas because these regions increase during pregnancy forming a dome structure. Auxetic figures are excellent to permit the expandability of the materials, and they have the quality to adapt to curved surfaces. Adapt auxetic figures on the belly and breast will increase the clothes conform, because the garment will not obstruct the growth of these areas. Likewise, the auxetic figures are used as decorative elements, the intention is that the user could select the figures that best suit their style.

With the intervention of digital prototyping tool, it was possible at the end of the design process of the dresses obtain the different

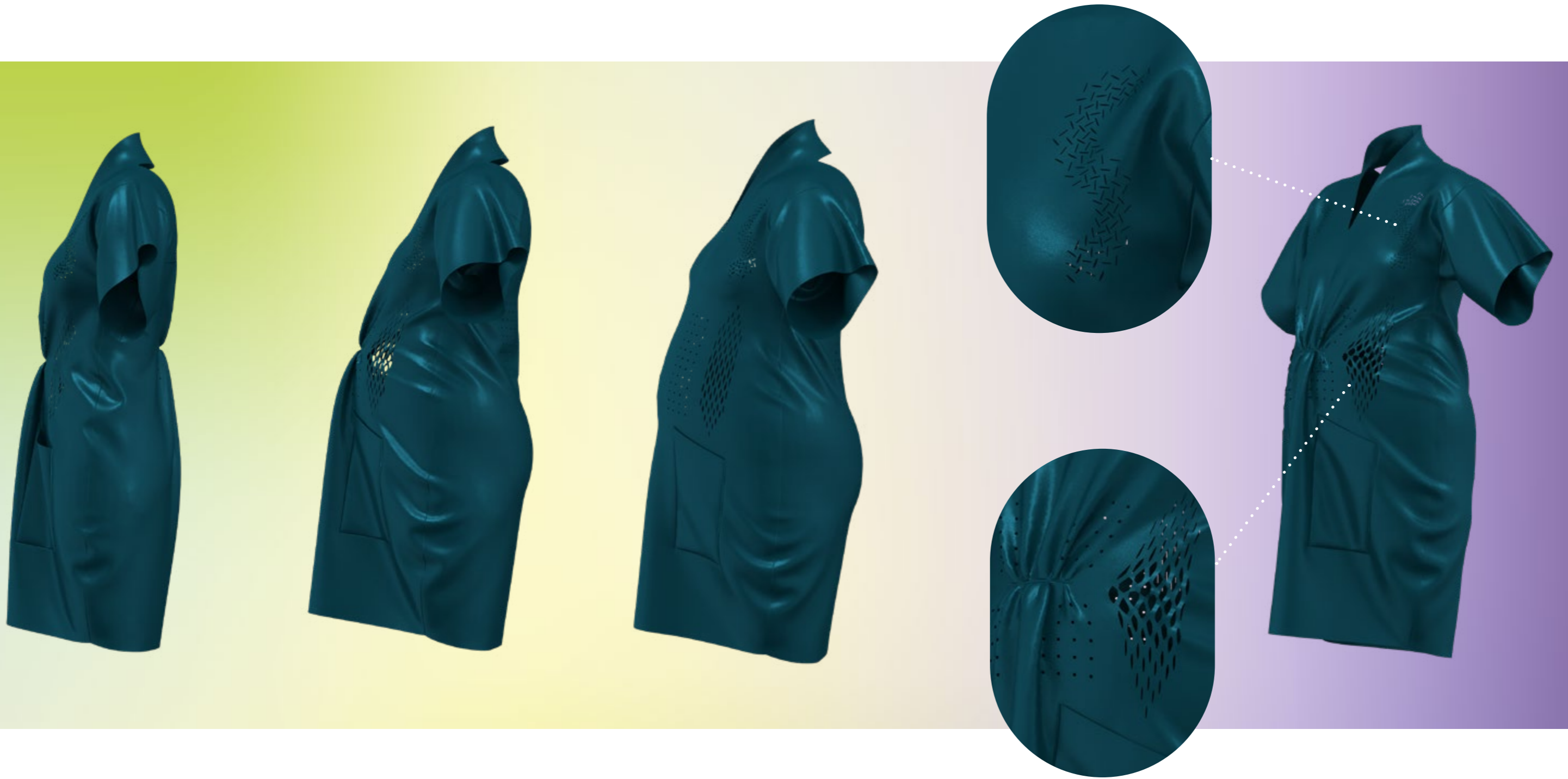
alterations of the garments and visualize the clothes on the different stages and different angles. This help the project to collect images and videos that will be showed to the user for future evaluation. **Work in Clo3d also allow to obtain the file on real size of the garment**. This file is compatible with laser cut technology. The intention is to export the file and produce the product on laser cut on traditional or networking production. The material selection for each of the dresses was based on the experiment realized on chapter six. Western dress was thinking to be produced on materials with similar characteristics that mollettoni fabric. While Kimono fabric is thinking to be produced in different fabrics, especially light fabrics to offers alternatives to the client.

As the intention of the of Nawale project is to give mothers the option of design their garments at their style also other personalization options were given to the dresses. People will have the option to choose the colour they like best on both dresses. For the Kimono dress, the option of placing a zipper in the neck was added to allow the opening of the garment in the chest area to permit the baby to be breastfed.

KIMONO DRESS



KIMONO DRESS CHANGE ADAPTATION AND DETAILS



KIMONO DRESS TECHNICAL DRAWINGS



FRONT



BACK

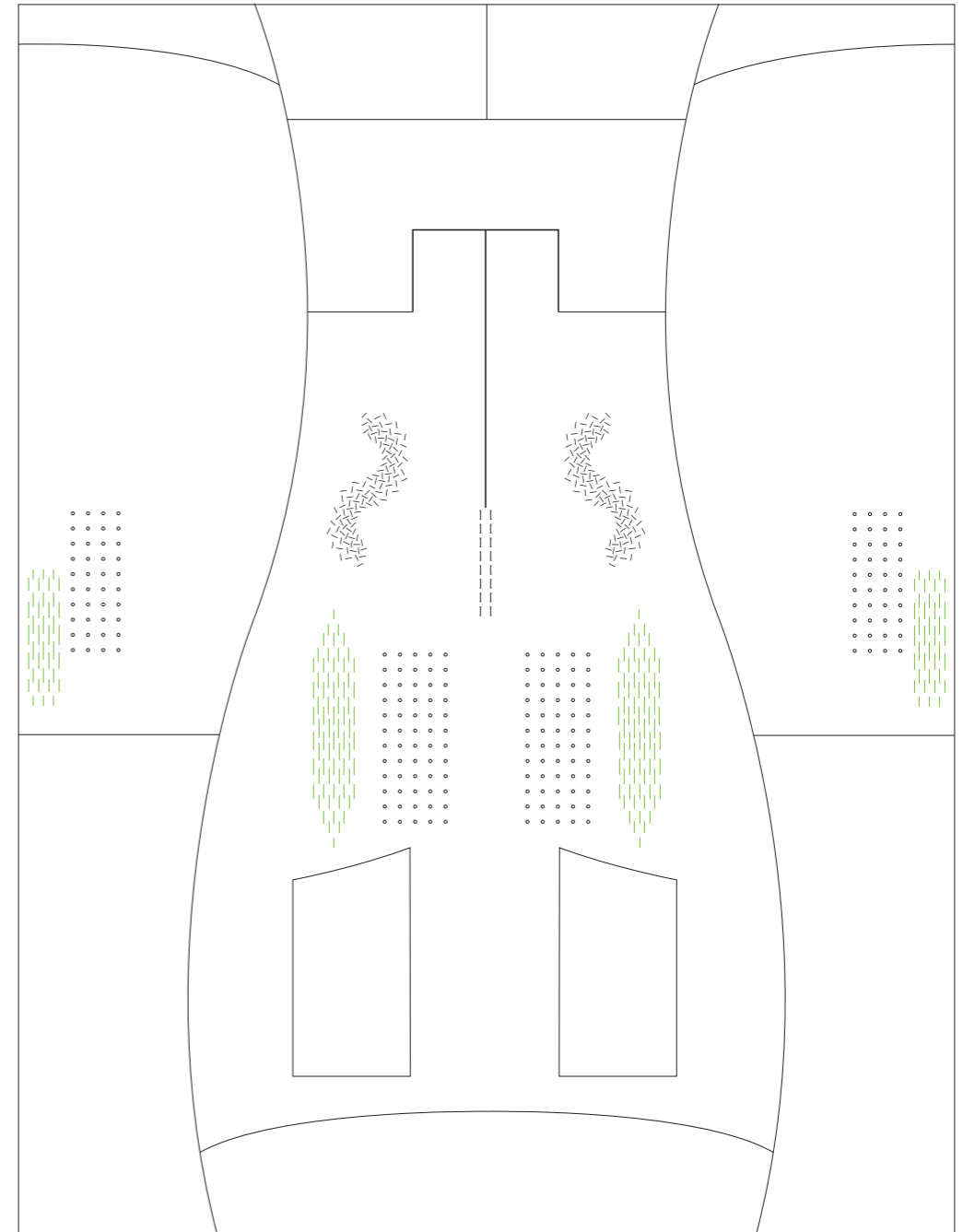
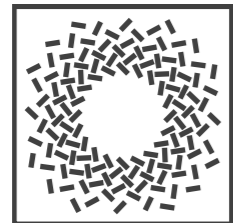
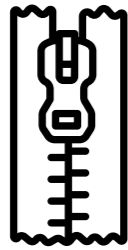


Figure 46: Zero -waste pattern, with baselines to create different pattern alterations

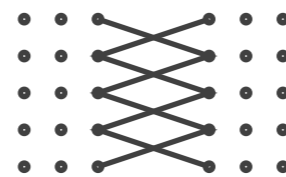
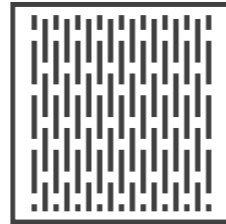
KIMONO DRESS TECHNICAL DRAWINGS

Auxetic figurines front and back. In the area of the abdomen and back where the dress is more fitted and where the parts of the body suffer more growth.

Lacing as adjustment mechanism on the back and front



Auxetic figures on the chest



Lacing as adjustment mechanism on the back and front



Produce in laser cut
minimum base of 93x120 cm

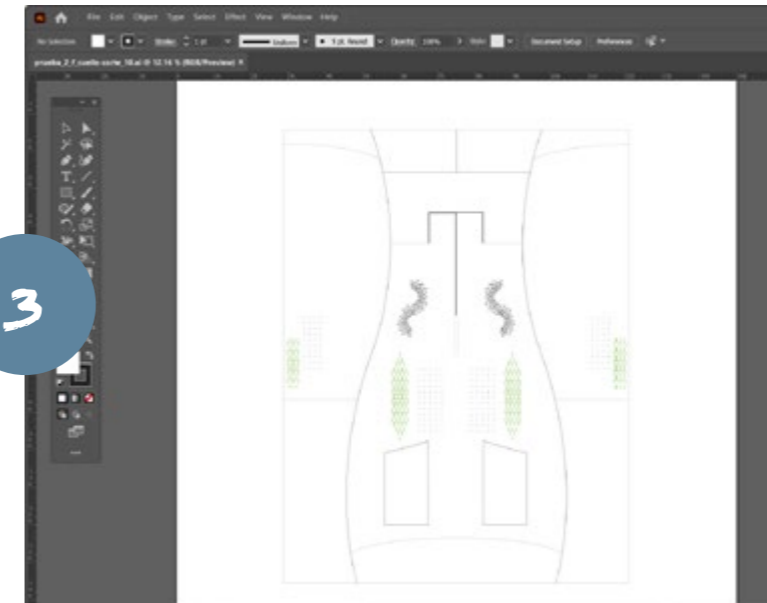
To be produced in light fabrics with characteristics similar to Rasone

MATERIAL
NAME
Rasone
CHARACTERISTICS
100% polyester Woven fabric Light, soft to the touch Fresh feeling
WEIGHT
0.0186 gr/cm2
SEASON
SS

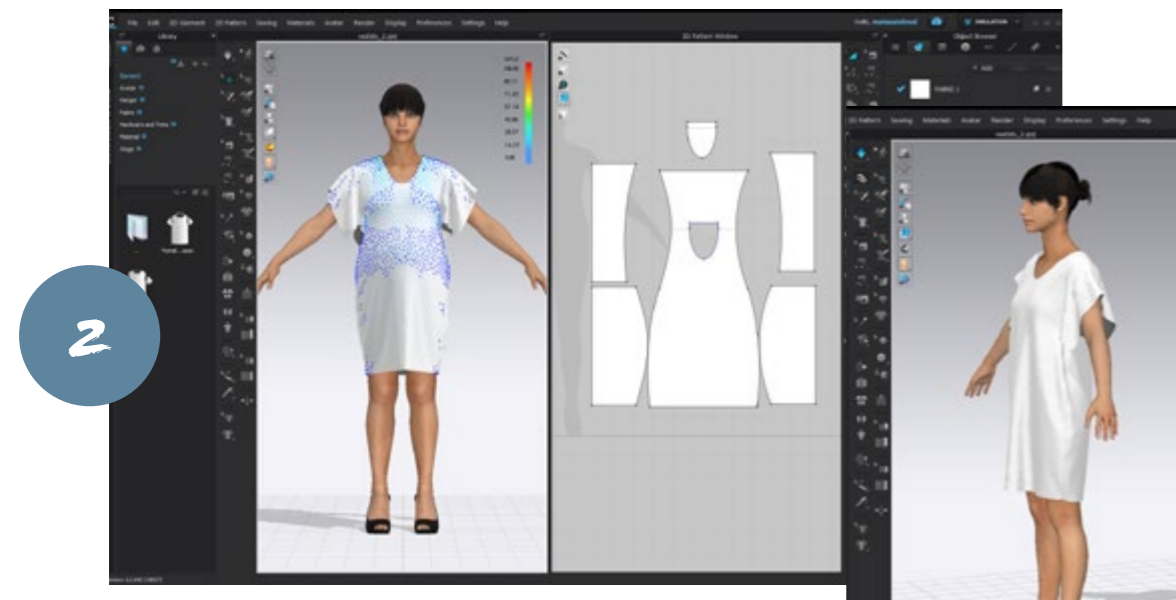
KIMONO DRESS DESIGN DEVELOPMENT



Exploration of the zero-waste technique. Since zero-waste design does not have established rules to generate designs, it is impossible to visualize the final product in the first stages. So, the beginning of the dresses design started with exploration on paper and scissors following the Make/Use tool. With the tool, it was possible to explore the garments alterations by cutting and attaching paper in different positions. With this process four alteration options were explored. Modification in the sleeves, the neck, the length, and the pockets.

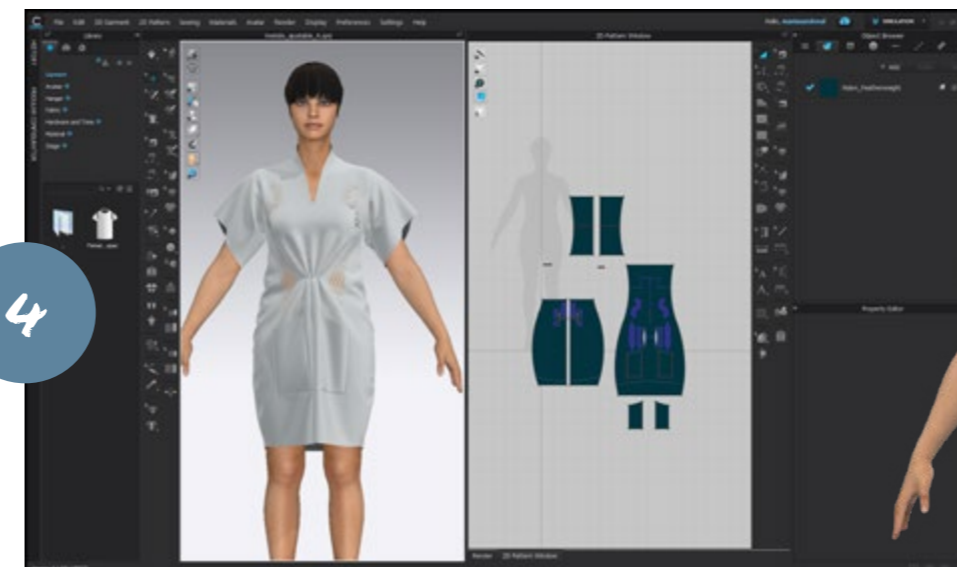


During the exploration of the dress in Clo3D, it was confirmed that to make the placement of the adjustment mechanism and the auxetic figures more agile and dynamic, it was better to translate the base pattern (already with all the baselines for the alterations) to illustration. The Clo3D pattern in real-scale, was opened on this program, and the options mentioned earlier were placed.



The designs were transformed on digital prototyping by using CLO3d software. With this tool was possible to see a more realistic behavior, the performance of the pattern on a body, the fabric texture and movement, and about everything the alteration that the dresses could have during pregnancy body changes.

Stress map and pressure points tools were used to confirm that women can feel comfortable wearing the dress during all pregnancy and post-pregnancy.



The pattern created in illustration was transferred to Clo3d where the simulation of the dress in the avatar was made. All its alterations and application of different auxetic figures were made. The material and colors were also applied.

Note to be able to apply the simulation of the adjustment mechanism, the cord had to be altered and made elastic. This will only apply to digital simulations.



PATTERN STYLE CUSTOMIZATION

Predeterminate alterations of the Kimono dress. Customers will be able to combine all these elements to create their designs. The Kimono dress includes three types of necks (collar, triangle, square), three sleeves options (with sleeves, open sleeves, and without sleeves), three types of length (to the knee, below the knee, and mullet), and finally, the option of have pockets or not have pockets. People will also be able to choose color, auxetic figures, and if they want a zipper on the neck.

COLOR



Green



Blue



Golden

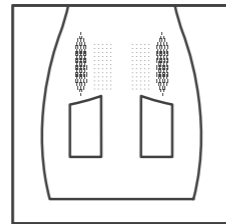


Gray

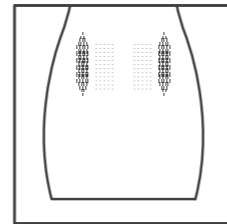


Aquamarine

POCKETS

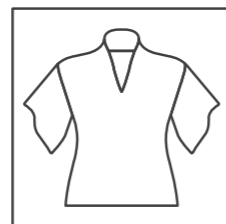


Pockets

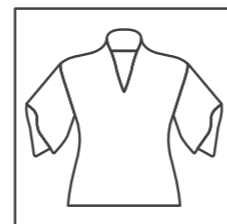


Without pockets

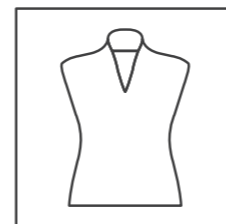
SLEEVES



With sleeves

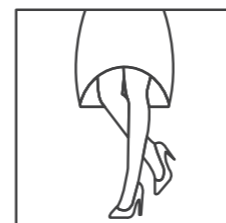
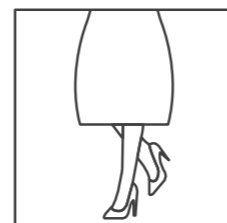
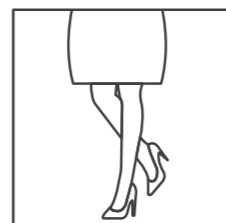


Open sleeves

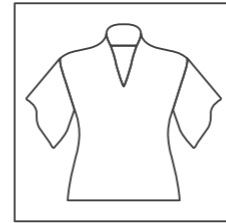


Without sleeves

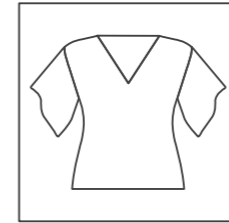
LENGTH



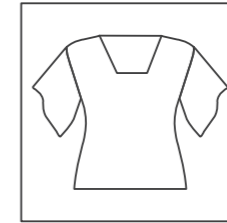
NECK



Collar

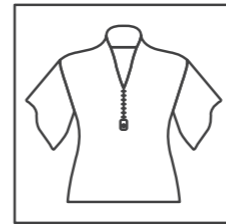


Triangle

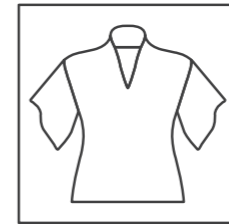


Square

ZIPPER

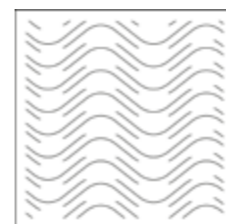


With zipper

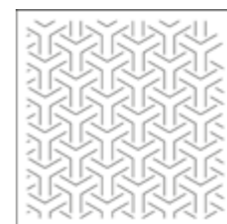


Without zipper

AUXETIC / BREATS / BODY FRONT AND BACK



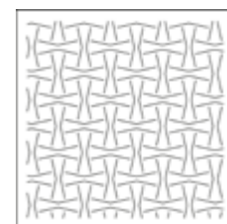
Waves



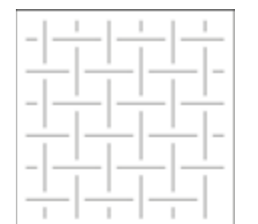
Y



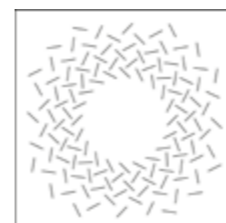
Triangle



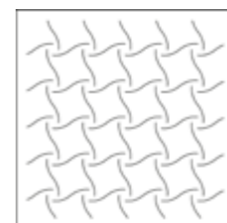
Bows



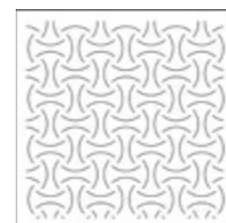
Square



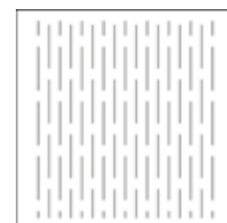
Swirl



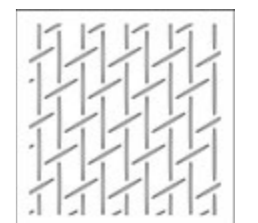
Pinwheel



Pinches



Lines



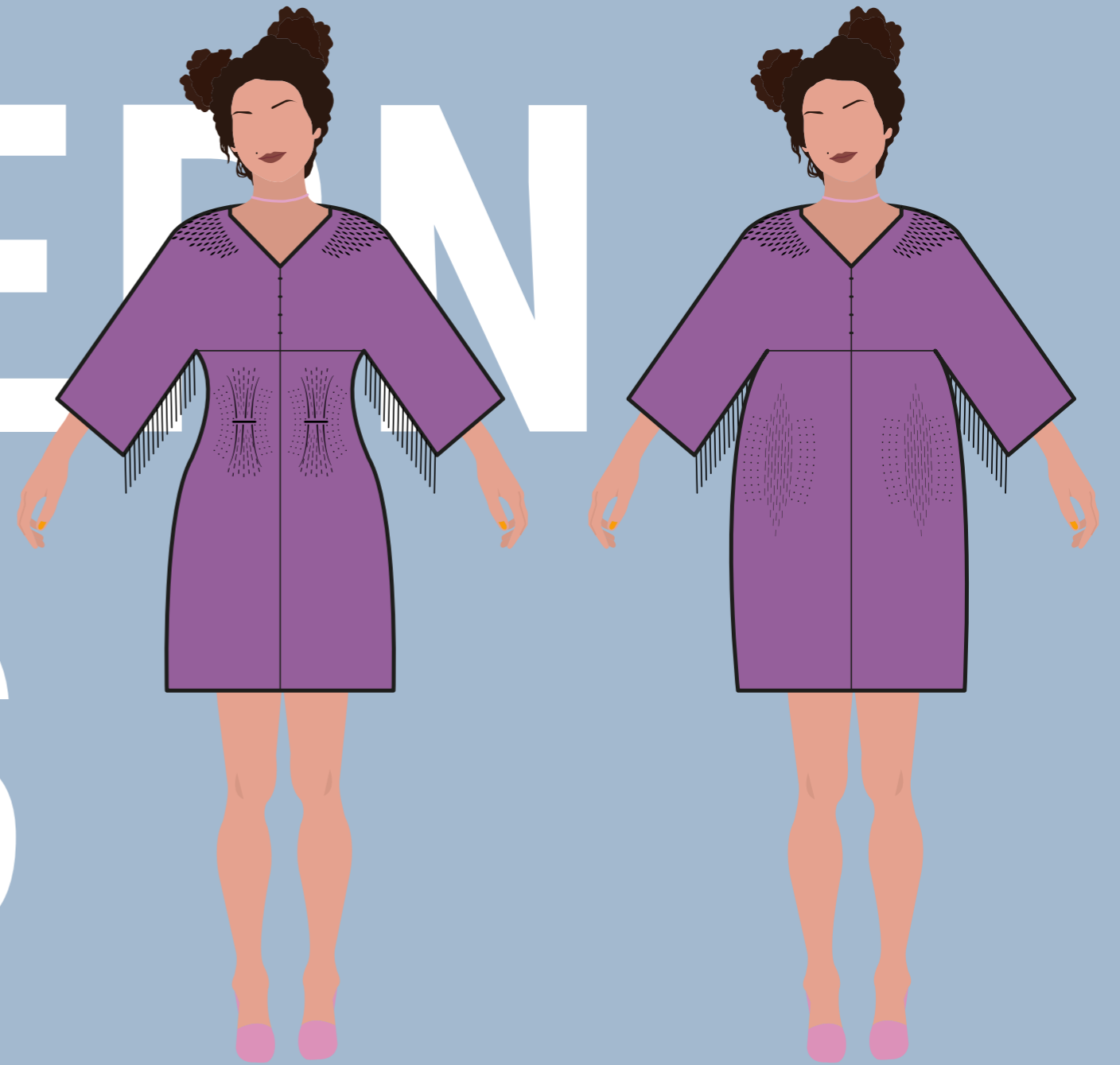
Rhombus

DESIGN ALTERATIONS



These are just some of the design variations that can be generated by combining elements and modifying the base pattern. It is important to emphasize that many more may arise, depending on the style and preference of the client.

WESTERN DRESS



WESTERN DRESS CHANGE ADAPTATION AND DETAILS



WESTERN DRESS TECHNICAL DRAWINGS



FRONT



BACK

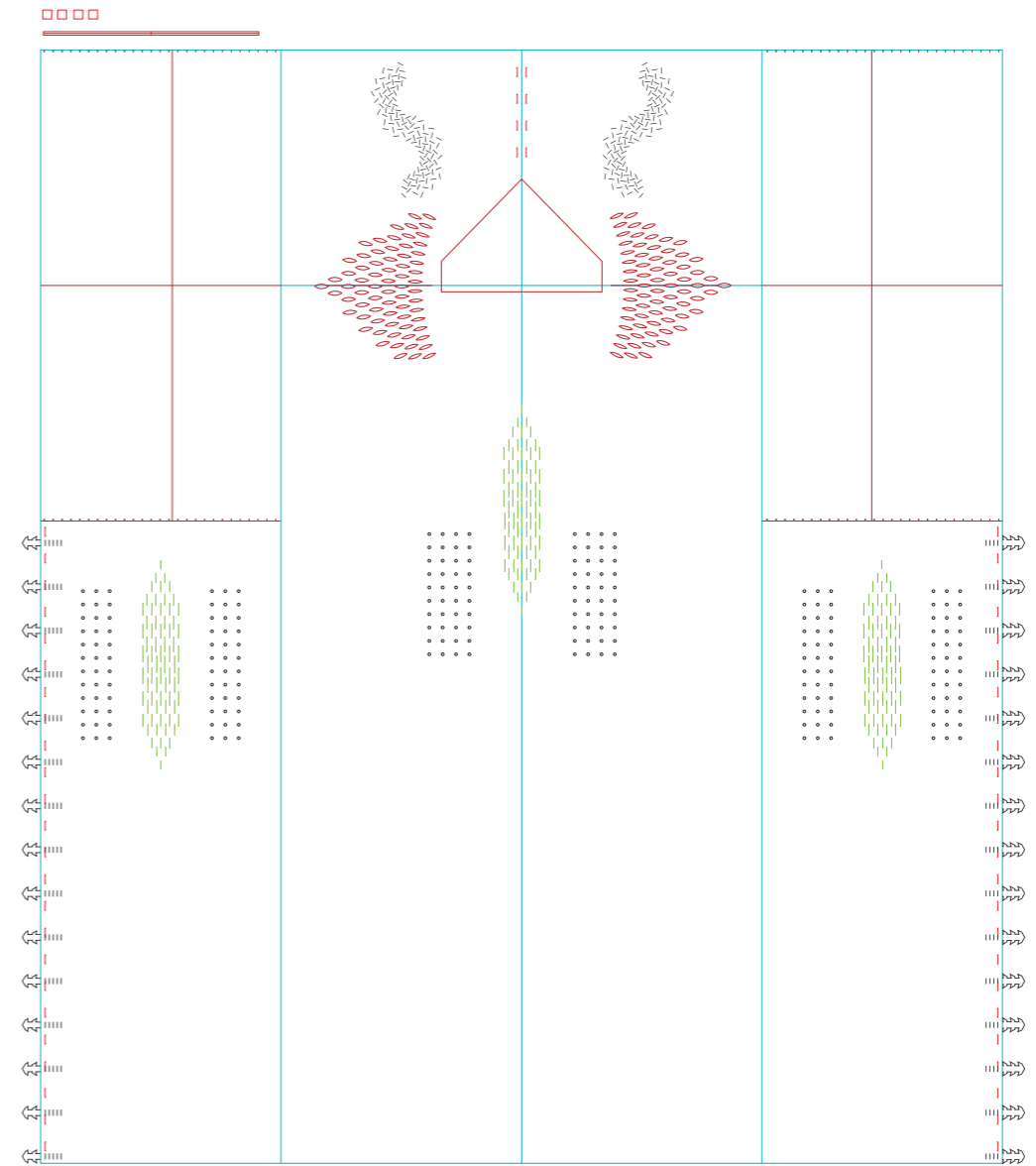
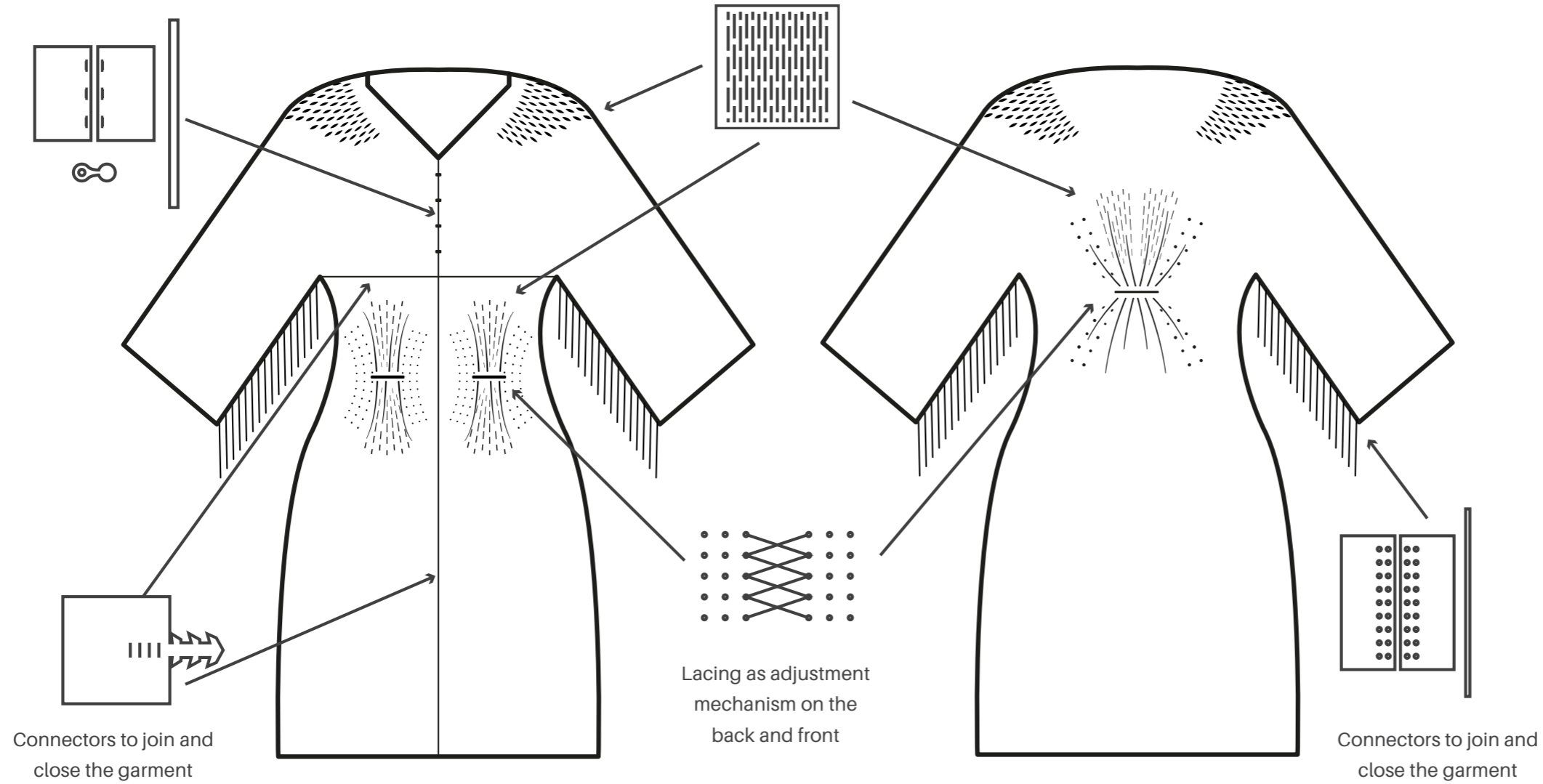


Figure 47: Zero-waste pattern, with baselines to create the different pattern alterations and connectors included for assembly at home.

WESTERN DRESS TECHNICAL DRAWINGS


Connectors that act as buttons, so that it allows you to open and close the area easily

Auxetic figurines front and back. In the area of the abdomen and back where the dress is more fitted and where the parts of the body suffer more growth.



Produce in laser cut
minimum base of
113 x125 cm

To be produced in fabrics
with characteristics similar
to Mollettoni

MATERIAL

NAME
Mollettoni
CHARACTERISTICS
65% polyester 35% viscose Non-woven fabric Texture, soft, smooth as felt, with resistance Warm feeling
WEIGHT
0.0329 gr/cm2
SEASON
FW

CONNECTOR ASSEMBLY INSTRUCTIONS

1

ASSEMBLY SYSTEM

Place A and B on top of each other, aligning the two holes you want to connect. Lace a string through and tie it into a knot

Repeat the action for all connectors and pull them tight

2

ASSEMBLY SYSTEM

The connector A has to go a slot A
The connector B has to go a slot B

Repeat the action for all connectors and pull them tight

3

ASSEMBLY SYSTEM

Place the fabrics on top of each other aligning the two slots. Then the connector A has to go a slot B. Then the connector A has to go through the a slot C

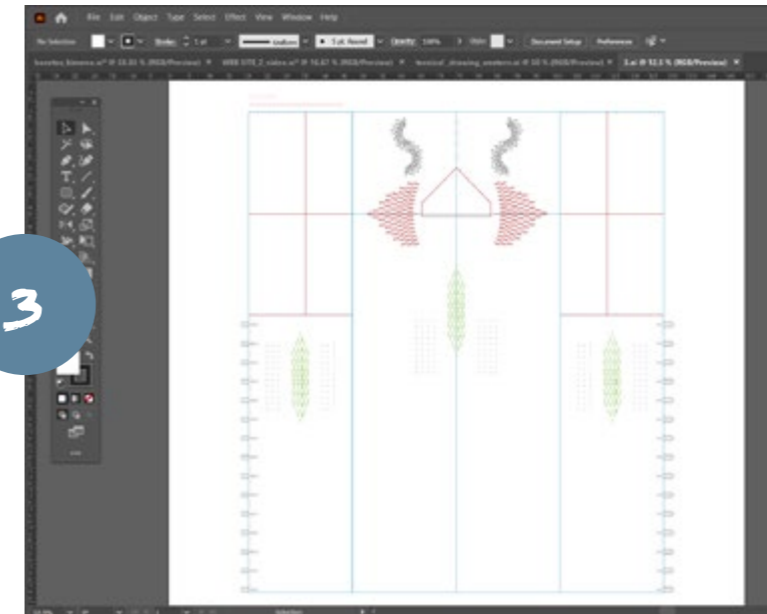
Repeat the action for all connectors and pull them tight

All products with connectors will come with manufacturing and assembly instructions, step by step it will be explained how to cut and join the pieces of the dress. The user will also be able to choose the type of connector she likes to choose depending on her style.

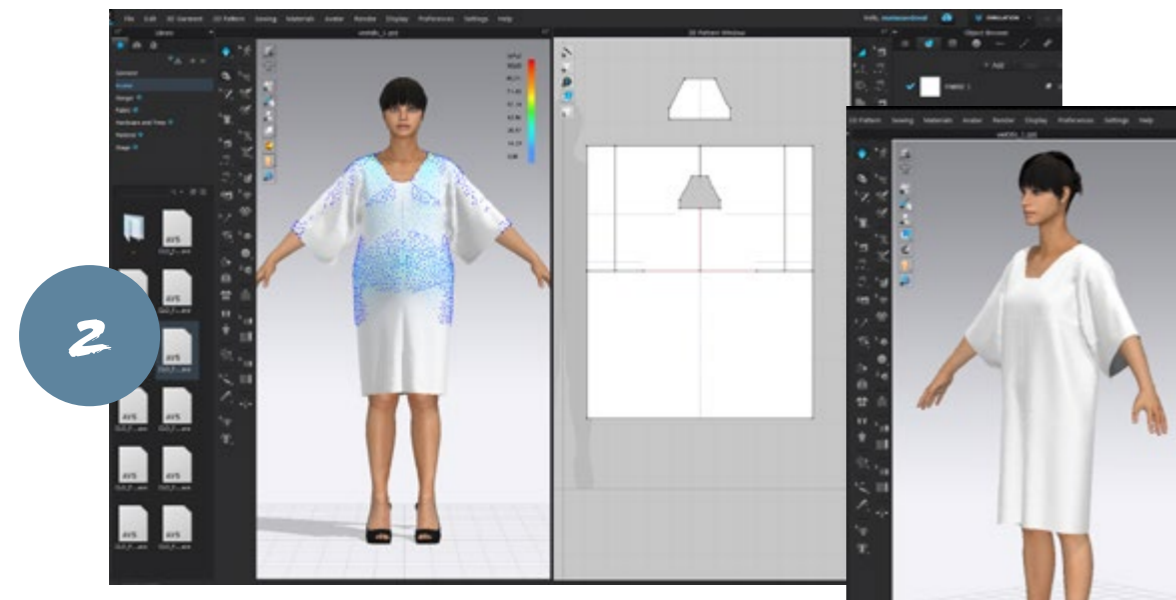
KIMONO DRESS DESIGN DEVELOPMENT



Exploration of the zero-waste technique. Since zero-waste design does not have established rules to generate designs, it is impossible to visualize the final product in the first stages. So, the beginning of the dresses design started with exploration on paper and scissors following the Make/Use tool. With the tool, it was possible to explore the garments alterations by cutting and attaching paper in different positions. With this process four alteration options were explored. Modification in the sleeves, the neck, the length, and the pockets.

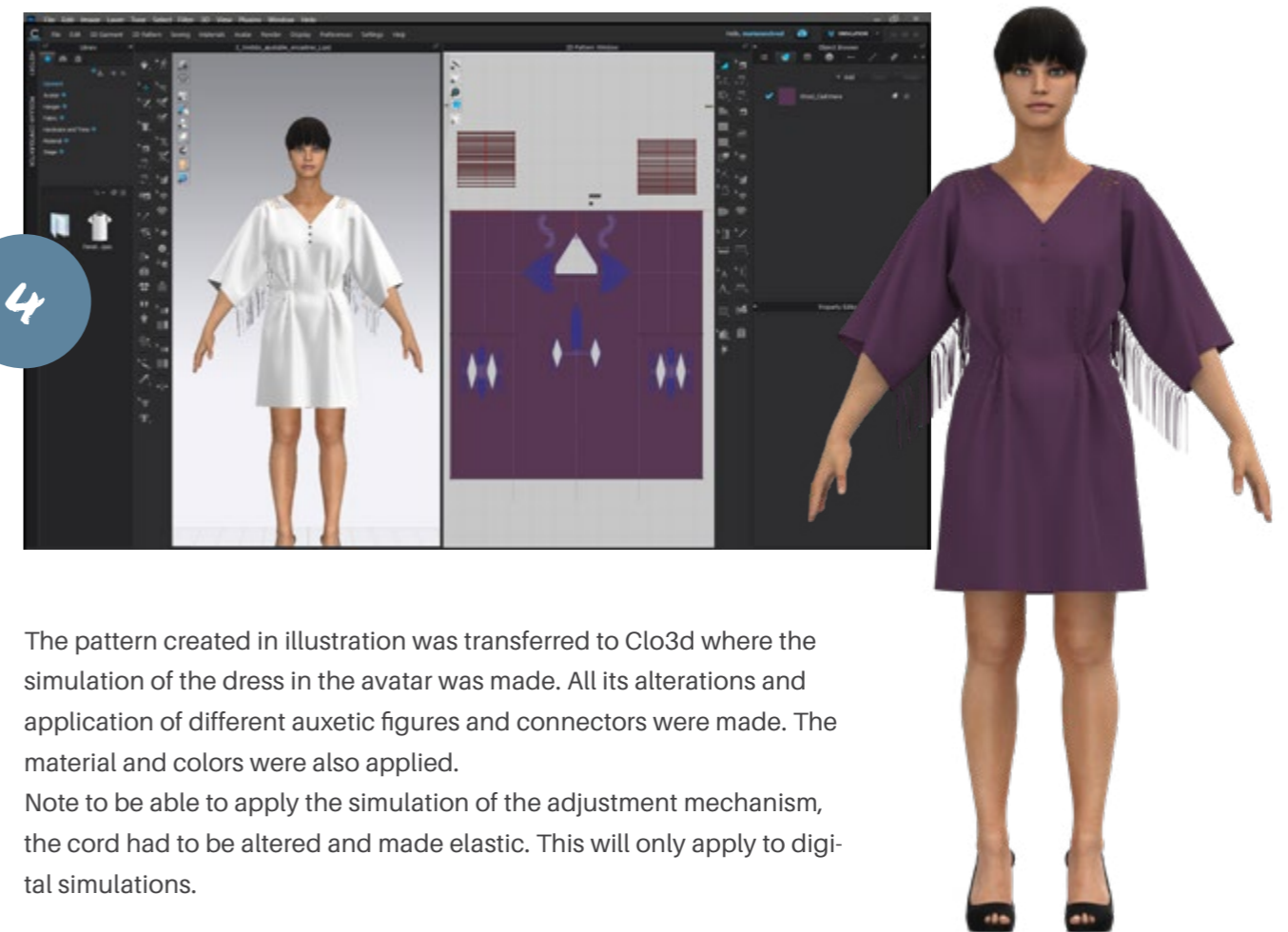


During the exploration of the dress in Clo3D, it was confirmed that to make the placement of the adjustment mechanism, auxetic figures and connectors more agile and dynamic, it was better to translate the base pattern (already with all the baselines for the alterations) to illustration. The Clo3D pattern in real-scale, was opened on this program, and the options mentioned earlier were placed.



The designs were transformed on digital prototyping by using CLO3d software. With this tool was possible to see a more realistic behavior, the performance of the pattern on a body, the fabric texture and movement, and about everything the alteration that the dresses could have during pregnancy body changes.

Stress map and pressure points tools were used to confirm that women can feel comfortable wearing the dress during all pregnancy and post-pregnancy.



The pattern created in illustration was transferred to Clo3d where the simulation of the dress in the avatar was made. All its alterations and application of different auxetic figures and connectors were made. The material and colors were also applied.

Note to be able to apply the simulation of the adjustment mechanism, the cord had to be altered and made elastic. This will only apply to digital simulations.

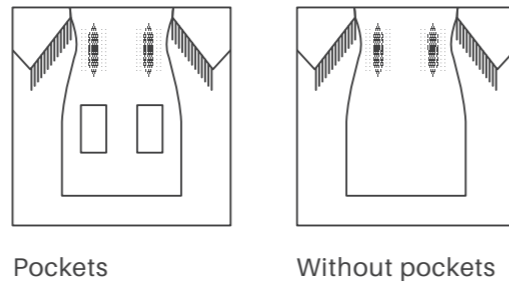
PATTERN STYLE CUSTOMIZATION

Predeterminate alterations of the Western dress. Customers will be able to combine all these elements to create their designs. The western dress includes two types of necks (square and triangle), three sleeves' options (long sleeves, short sleeves, and without sleeves), three types of length (below the knee, to the knee and above the knee) and the option of used it with pockets or without pockets. People will also be able to choose color, auxetic figures, and connectors.

COLOR



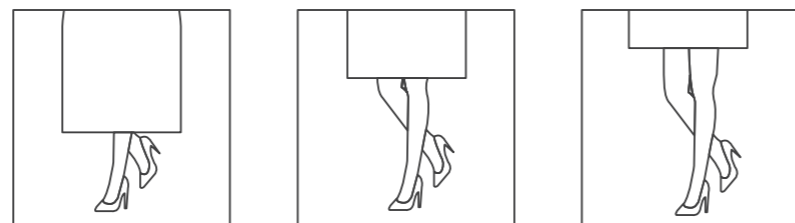
POCKETS



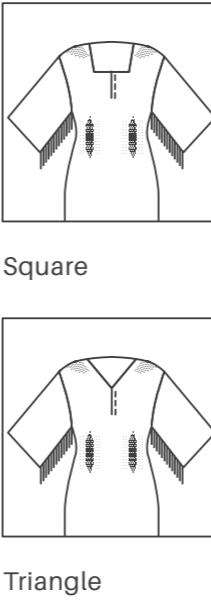
SLEEVES



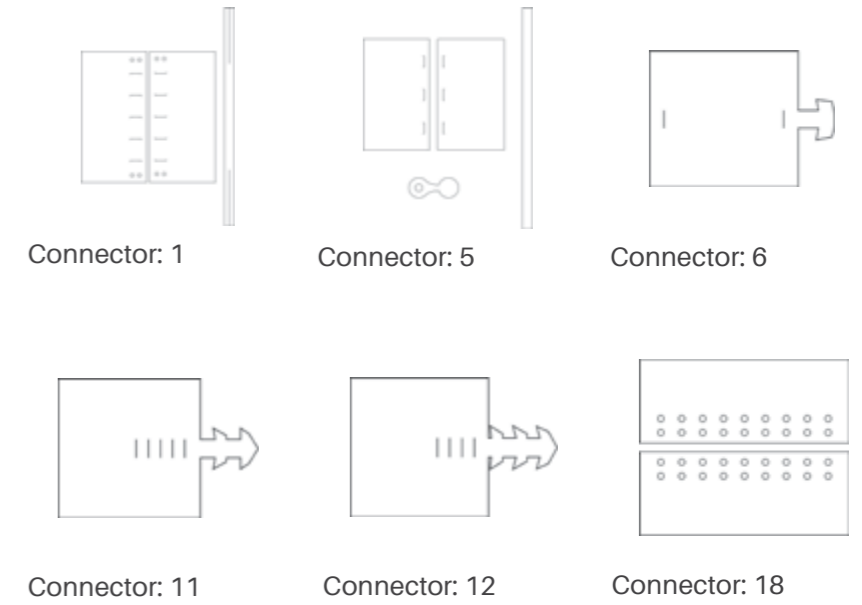
LENGTH



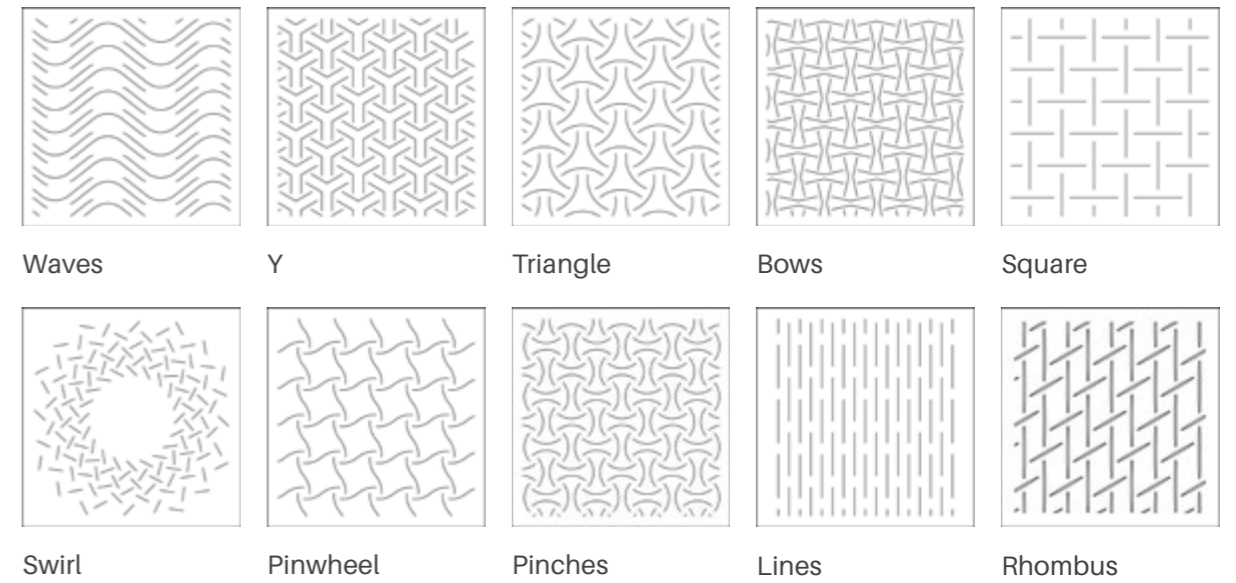
NECK



CONNECTORS



AUXETIC / BREATS / BODY FRONT AND BACK



DESIGN ALTERATIONS



These are just some of the design variations that can be generated by combining elements and modifying the base pattern. It is important to emphasize that many more may arise, depending on the style and preference of the client.

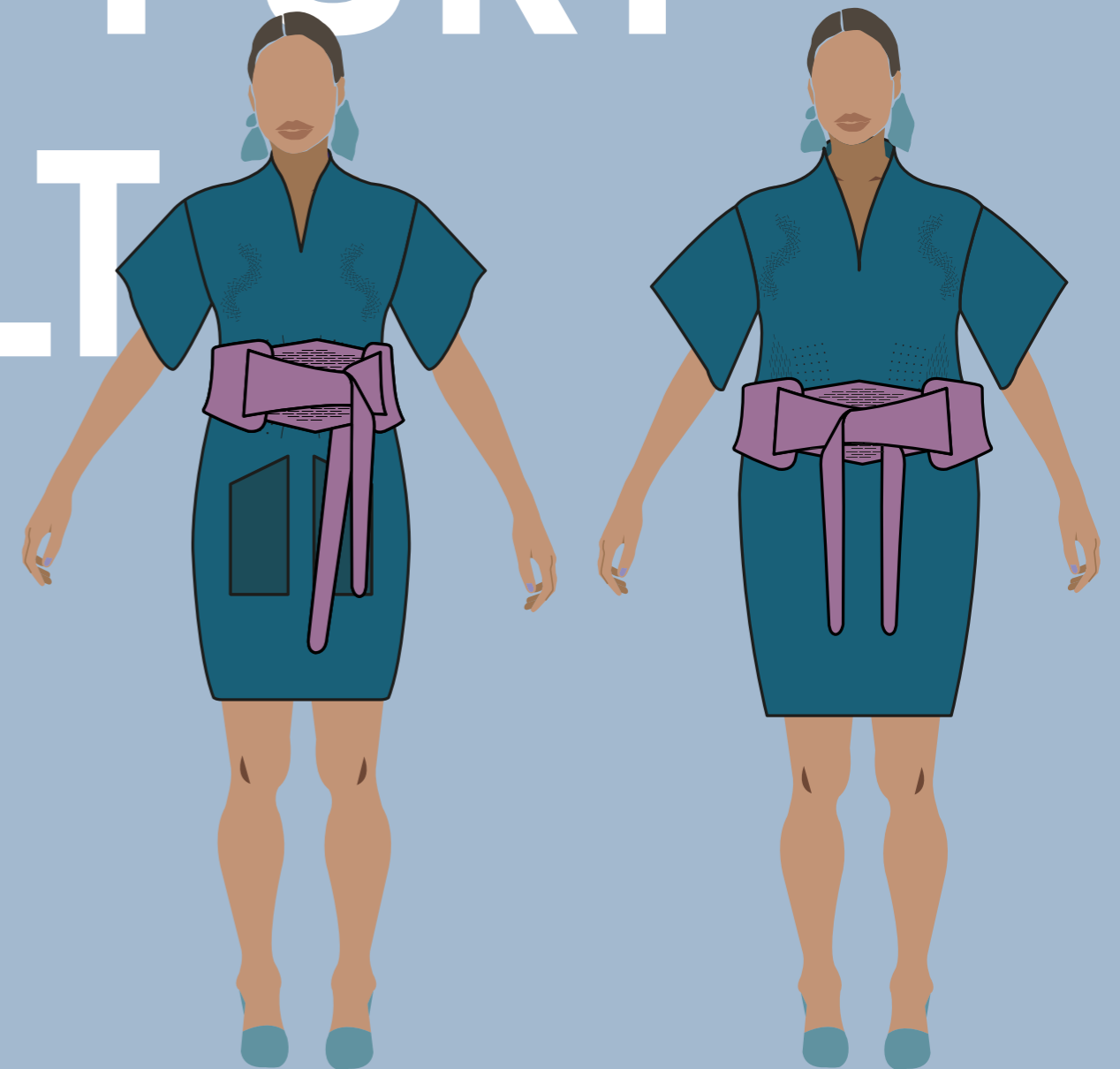
7.2.3 ACCESSORY BELT SUPPORT

The support belt was designed with the intention to relieve the lower back pain and relaxed the pelvic area of women during pregnancy. The aim was to design a complementary accessory that could work as support for the belly as well as a tool to give self-massages. The inspiration was taken from the rebozo (traditional Mexican garment). One of the requirements was that the belt had to be used during pregnancy and after pregnancy, to prolong the life of the product. That is why its aesthetic was thought of as a belt and not as inner girdle.

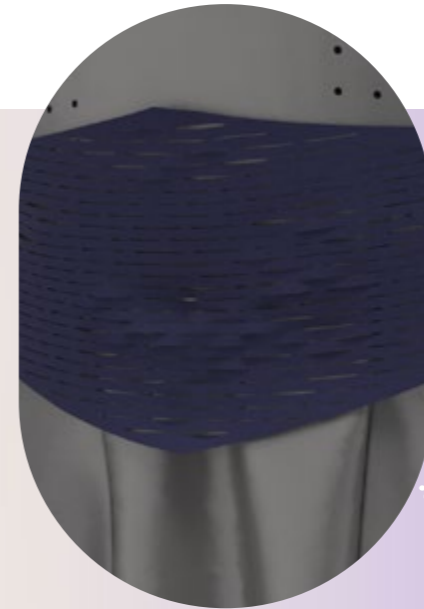
The belt is composed of two pieces, one that goes on the back (A), which function is give support in the lower back, and a second pieces that goes in the front (B), which will help to carry the belly weight. The piece B was designed to have a length that can involve the circumference of the stomach. This will allow the users to adjust the accessory as they like (front or back) as well as give massages on areas in which they cannot reach.

To provide comfort to the belly, auxetic figures were placed in the central part. The figures suggested for this area are the ones that proved to have greater flexibility on rounded surfaces. The adjustment mechanism was designed based on the sliding of part A in the lateral slots of part B. The user has the possibility to adjust it to the different sizes that require during pregnancy. The closure of the belt is done based on a knot, which the client can make on the sides, front or back, depending on their style. Furthermore, the support belt is thinking on be produced on laser cut machine and materials as mollettoni with the same fabric properties. The intention is that the accessory can be manufactured on traditional production as well as networking production, on materials with structure but and the same time comfortable. The belt pattern can also be personalized. Its width and the selection of the auxetic figures can be choose by the client.

SUPPORT BELT



WESTERN DRESS CHANGE ADAPTATION AND DETAILS



SUPPORT BELT TECHNICAL DRAWINGS

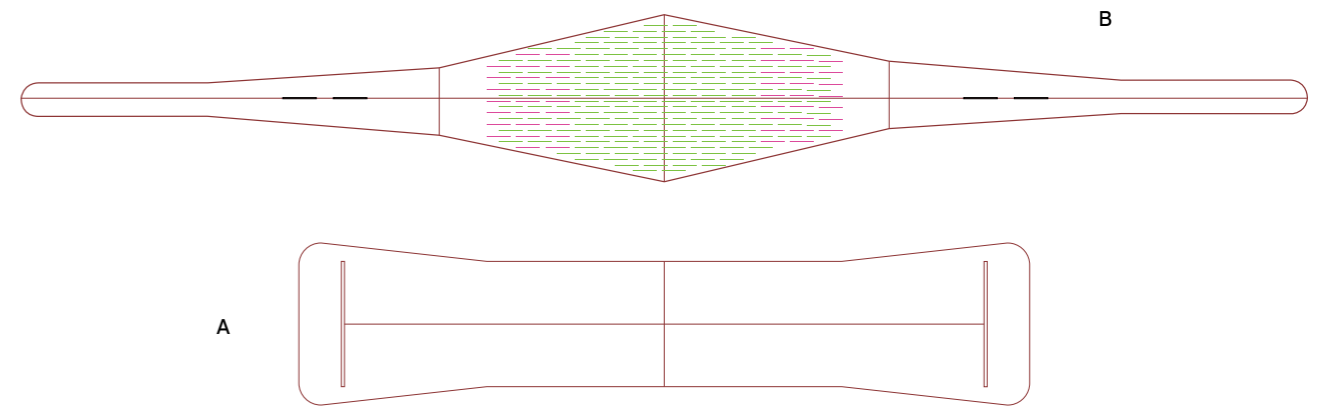
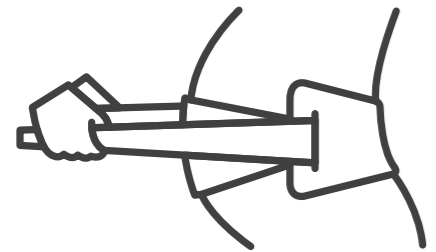
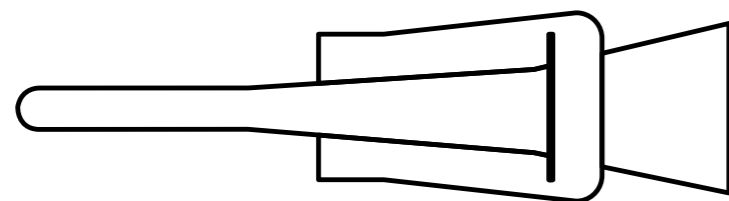
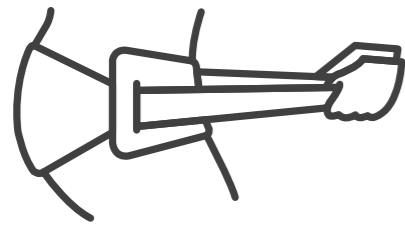


Figure 48: The belt is composed of two pieces, one that goes on the back (A), which function is give support in the lower back, and a second pieces that goes in the front (B), which will help to carry the belly weight. The piece B was designed to have a length that can involve the circumference of the stomach. This will allow the users to adjust the accessory as they like (front or back) as well as give massages on areas in which they cannot reach.

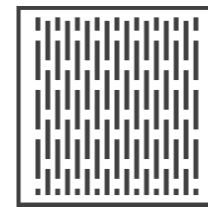
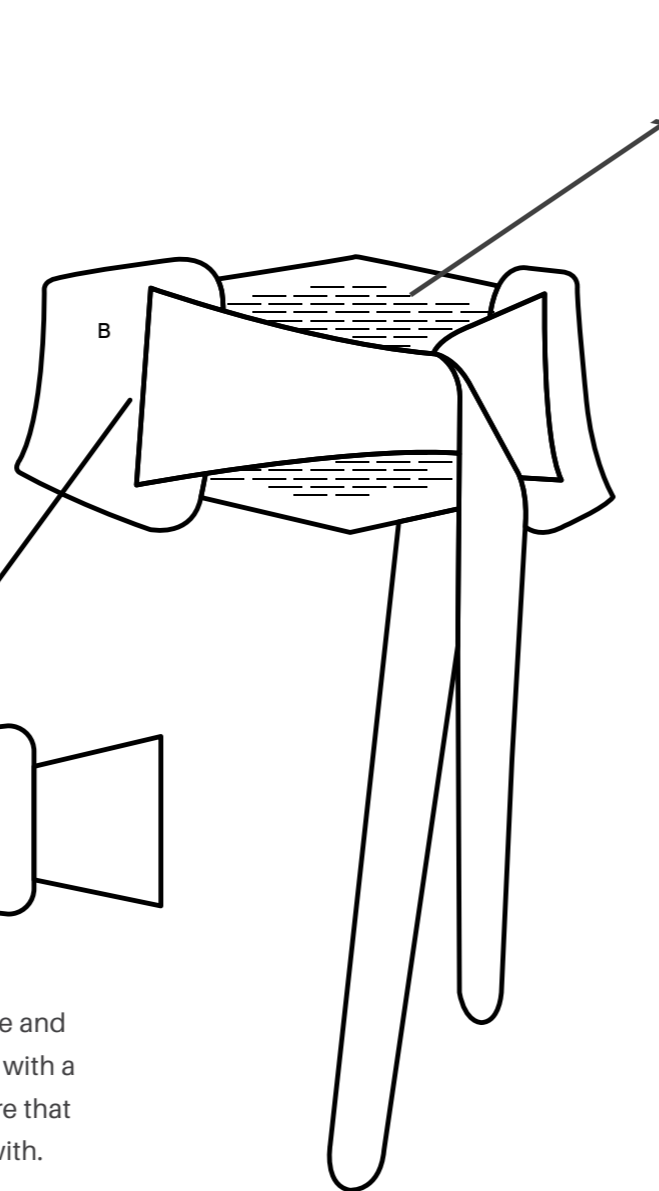
WESTERN DRESS TECHNICAL DRAWINGS



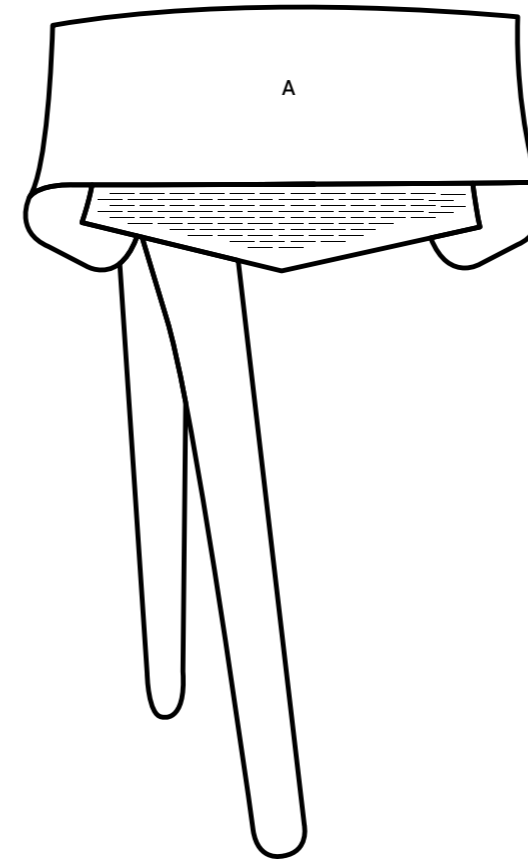
Support relaxes the pelvic area and relives



Lateral adjustment mechanism, easy to assemble and adjust to the user's figure, the mechanism closes with a knot. This will help the woman select the pressure that she likes best and that she feels comfortable with.




Auxetic figures in part B of the accessory to guarantee comfort in the part of the belly during its growth.

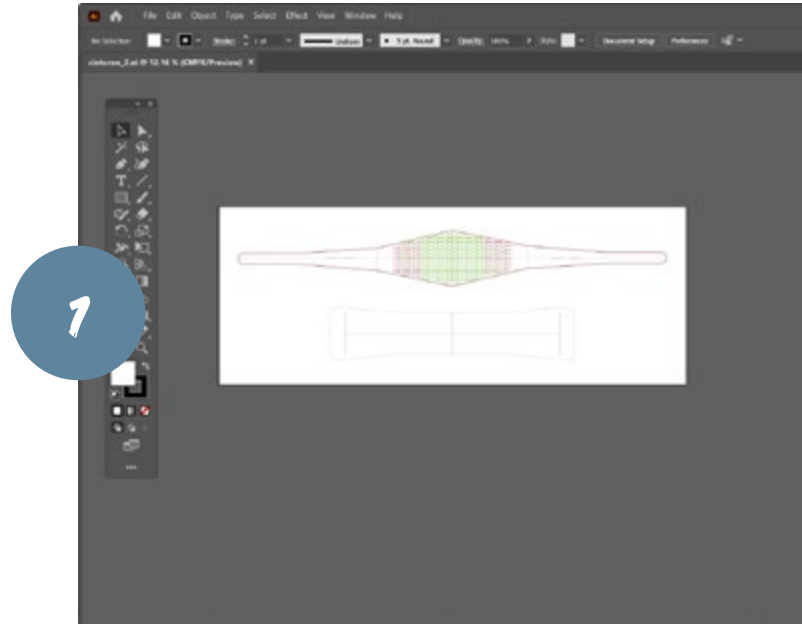


Produce in laser cut
28 x110 cm depending
user size

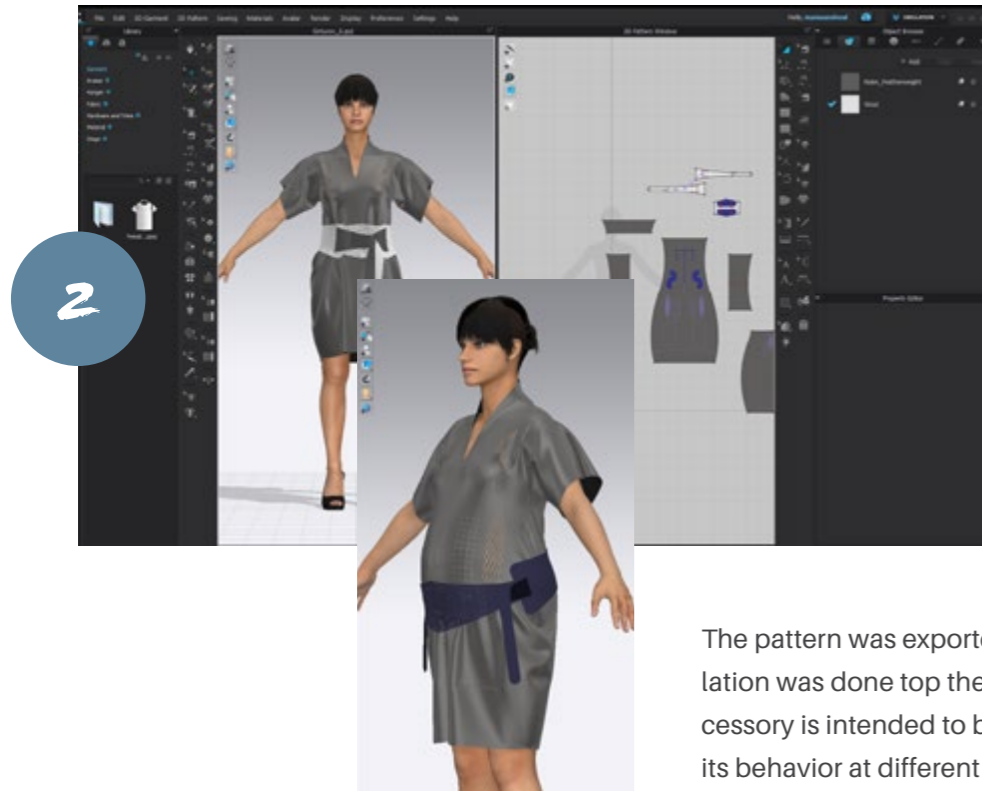
To be produced in fabrics
with characteristics similar
to Mollettoni

MATERIAL

NAME
Mollettoni
CHARACTERISTICS
65% polyester 35% viscose Non-woven fabric Texture, soft, smooth as felt, with resistance Warm feeling
WEIGHT
0.0329 gr/cm2
SEASON
FW

BELT SUPPORT DESIGN DEVELOPMENT



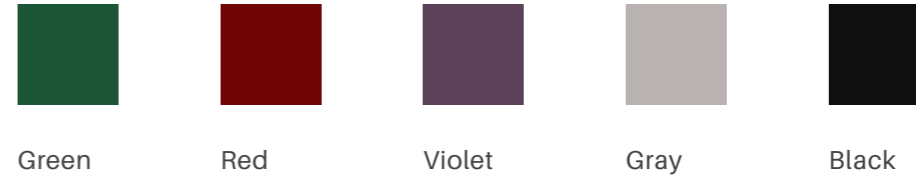
For the design of the belt, it was taken into account where women need more support, base measurements were taken and the pattern was created in Illustration, right there the auxetic figures were placed.



The pattern was exported to Clo3d where the simulation was done top the Kimono dress, since the accessory is intended to be worn on top of the clothes. its behavior at different stages of pregnancy was explored .The size was adjusted and the materials were applied.

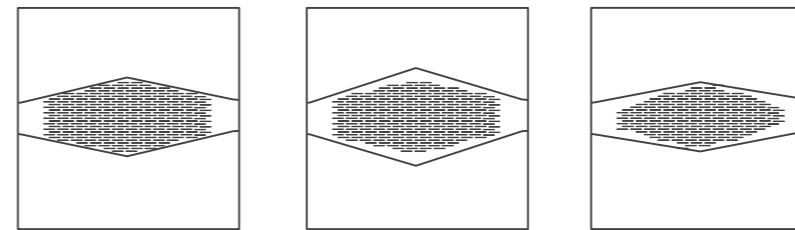
PATTERN STYLE CUSTOMIZATION

COLOR



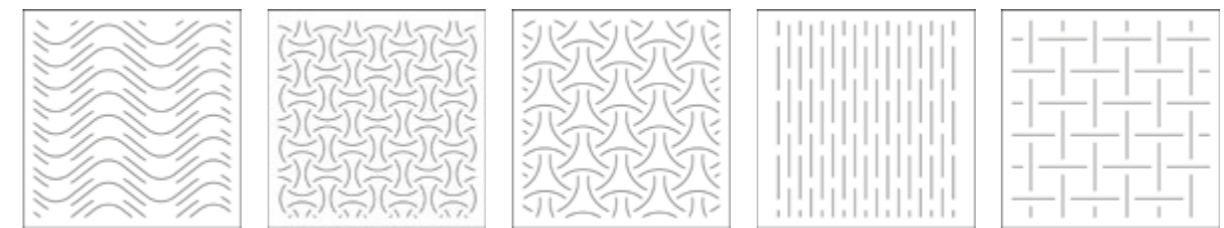
Green Red Violet Gray Black

SIZE



Normal Wide Thin

AUXETIC / BREATS / BODY FRONT AND BACK



Waves Pinches Triangle Lines Square

Women could adjust the belt to their style. They will have the option to select color, size, and auxetic figures.

7.3

SERVICE / PLATFORM

In this section will be show the Nawale service. The service is based on the implementation of a digital platform that contain Web 3.0 technologies. The user experience focuses on produce people's interaction with environmental cues. Based on this principal the system will allow fitting and customization. The aim is to create an inclusive service in which people can feel co-creator, to promote positive body image and customer engagement.

The service includes fit recommendation, fit visualization and code-sign technologies. These tools are combined to stimulate interactivity between people and the platform. With them it will be possible to design a 3D art customization area, where people can customize their products. In the case of fit recommendation technology, people will have the option of produce a garment with perfect fit during the difference stage of pregnancy. This option will be made through the implementation of a quiz in which women will leave their measurement and special notes about their bodies. The platform will also offer fit visualization through the implementation of a virtual fitting room. Where they will be able to observe their products on their avatars. They will see the behavior of the garment on their digital bodies, and how these change during the pregnancy and post pregnancy. It is important to point, that the project on this stage only focused on plan the service and translate it the design and analysis of the user experience interface.

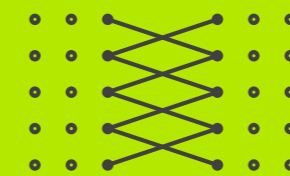
**ADAPTABLE,
FLEXIBLE,
AND TAILOR-MADE
GARMENTS AND
ACCESSORIES**

Nawale

Nawale is a brand that provides specialized maternity products that adapt to changes in the body during the pregnancy process. The goal is to make tailor-made products that offer freedom of movement, comfort, and personalized style.

The brand seeks to provide support and freedom to women during this transition stage where we know that feeling good about the body is of vital importance.

Nawale wants to break with the stereotypes of the perfect body and with the idea that women should conform to clothes and not clothes to the body. Likewise, the brand seeks to provide modern, contemporary, adaptable styles, generating the least possible waste.



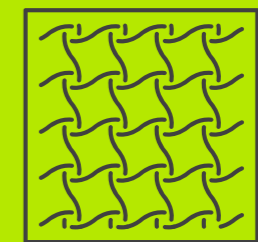
ADAPTABLE



SUSTAINABLE



CUSTOMIZABLE



FLEXIBLE

PRODUCTS



KIMONO DRESS



SUPPORT BELT



WESTERN DRESS

7.3.1 JOURNEY, HOW DOES IT WORK?

Nawale platform (figure 53 and 54) design is composed with 2.0 and 3.0 web technologies, which direct the customer to design, test, and produce their products. To start the platform has six main pages (1) **home**, (2) **how it works**, (3) **start to design**, (4) **community**, (5) **client area**, and (6) **contact**. Home is composed for the land page, in which people will have a general view about the brand topic and products. How it works, will be the area in which is explain the service, products special characteristics, brand sustainability. Start to design, is a 3D area in which people could choose and personalize their products. Community section will share contact information about certified perinatal physiologist, lactation experts, massage therapists, yoga teachers. In this section also people will have the information about Fablab laboratory contacts. The intention is to be able to offer a directory of experts to support and guide women during pregnancy and manufacture process. Client area is the 3D virtual fitting room. Customers could enter to this area to see their avatars and explore how the garments fit on their bodies. And finally contact sections dedicated to brand contact information, orientation about the service and sales policies.

The customer journey begins by selecting start to design section (figure 49). In this section people will be able to select the zero-waste product that they want to buy. It also will tell them which products can be produced with networking production and which products can be produced with traditional production. Then, they will be able to design their products by selecting predetermined alterations. The alteration on the products will be visible with the help of a 3D render image that is going to change its design with each client's preferences. Once the clients are satisfied with its design. They will be guided through a questionnaire, where they will record their measurements and special characteristics about their bodies. Completed the questionnaire. The clients will have finished their personalization and they will be able to continue with the payment. Paid the product, an email will be sent to the clients with the confirmation of their purchase, and the instructions to download an application to be able to scan their bodies. With this application, Nawale will obtain an accuracy on client's body measurements (It is important to point out that the 3D

scan was discarded in the final proposal since women perceived it as insecure, more will be discussed on chapter eight). When the client sends the scans, the Nawale will start working digitally on the product. When the products are ready, the client will receive another email with a username and password to enter the client's area to their virtual fitting session. In this room people will be able to see their product on 3D, on the avatar make with their measurements and physical characteristics. It is going to be possible to see how the clothes fit in their bodies on for different angles. Also in the virtual fitting session, it will be possible to observe how the garment changes during the different stages of pregnancy. If the users are satisfied with their products. they will have to approve it to send it to production.

As have been mentioned before the production stage can be done in two ways. By **traditional production (figure 50)** or by **networking production (figure 51)**. In the traditional production, the product will be manufactured and assembled on the company workshop and send it to the clients once it's finished. On the networking production (figure 52), the files of the pattern will be sent to the client to her mail. It is important to remember that these products are the ones made with connectors. That means that people will be able to assemble them at home without the necessity of a sewing machine. On the mail people will find a kit composed with the product file, instructions step by step of how to produce it and assemble it, and suggestions of Fablab laboratories on their community. The intention of the project is to recommend Fablabs as Fabricademy (page 329) . Specializes laboratories on fashion production. Nawale wants that over time, the customization options for homemade products can be enlarged. This type of laboratory has elements, in addition to the laser cutting machine, that would help to develop more attractive products for the user. However, as currently, this chain of factories is very limited. It will be recommended also Fablab laboratories that counts with 1200 x 900 mm dimension laser cut bed or larger. Once the client understands the process, he will be able to reproduce the garment as many times as he wants or needs.

Once the client receives his product, he will be motivated or tell her experience and join to the community, here they will find a directory of experts that could help them to solve and relive problems about pregnancy and body dissatisfaction. Furthermore, it will give as an option to keep their avatar animation to always remember the strength and functionality of their bodies.

PLATFORM DESIGN SECTIONS

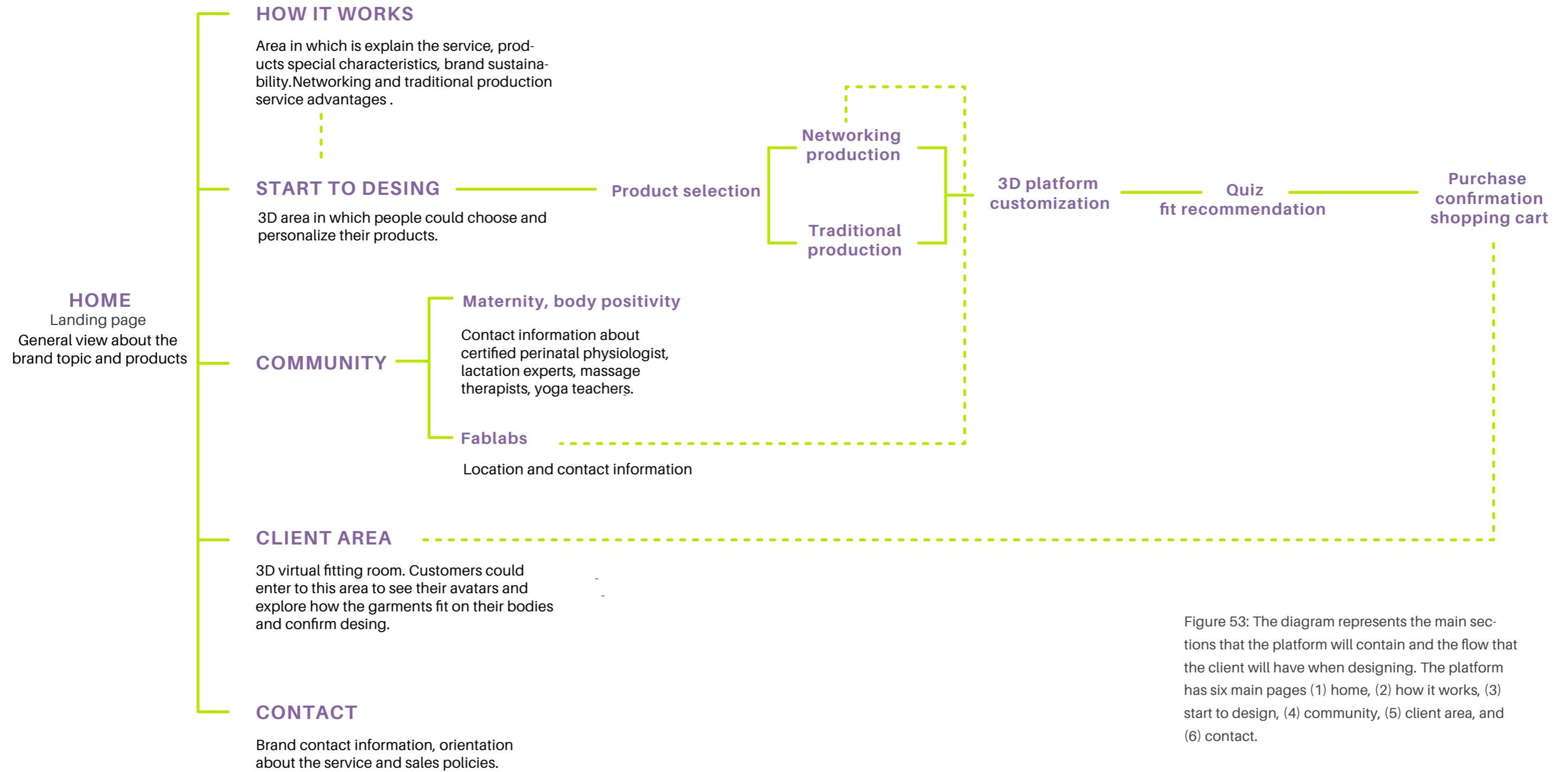


Figure 53: The diagram represents the main sections that the platform will contain and the flow that the client will have when designing. The platform has six main pages (1) home, (2) how it works, (3) start to design, (4) community, (5) client area, and (6) contact.

PLATFORM DESIGN

Figure 54: To know the acceptance of people towards the service and the project. An evaluation was carried out. To generate this evaluation, it was essential to show the design and purchase process that the user must follow in order to acquire a product. That is why it was decided to design the main windows of the user's purchase process. The home page, start designing, 3d platform design, fit quiz, 3d scan confirmation email, and virtual fitting session room were designed.

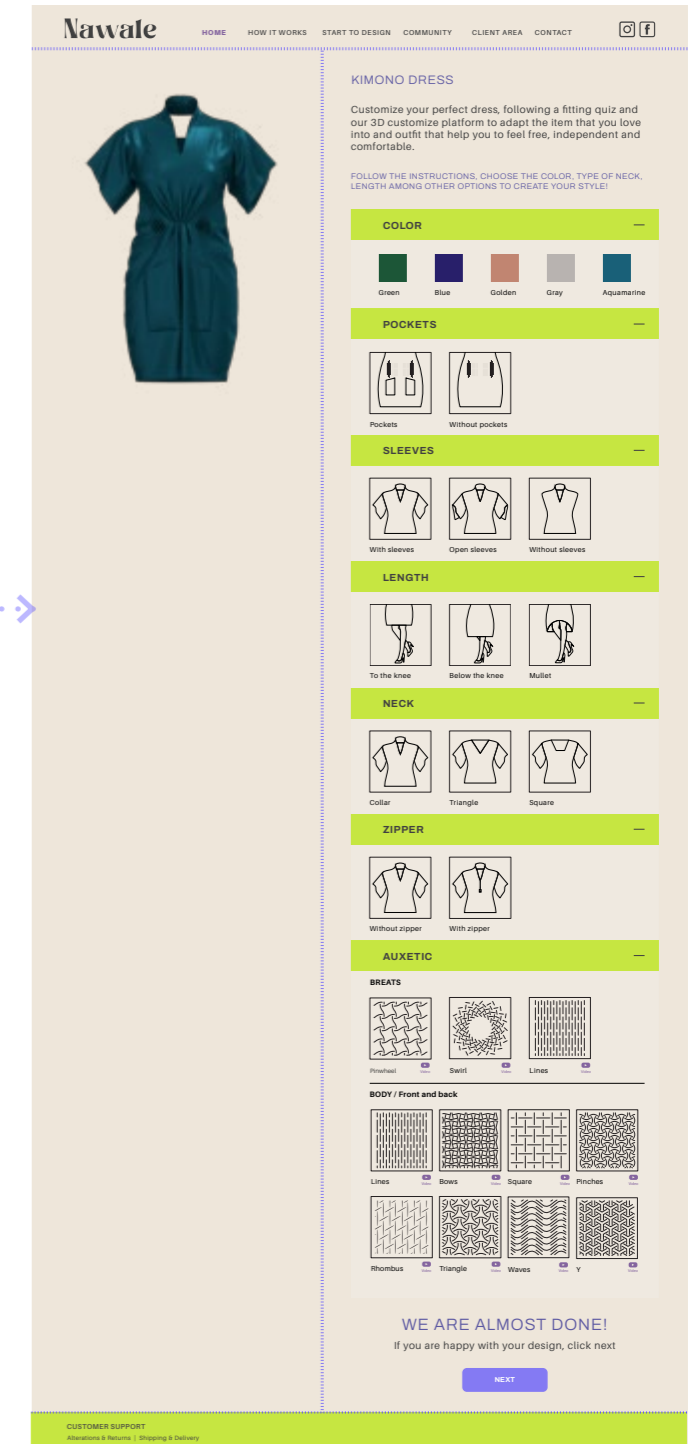
1) HOME



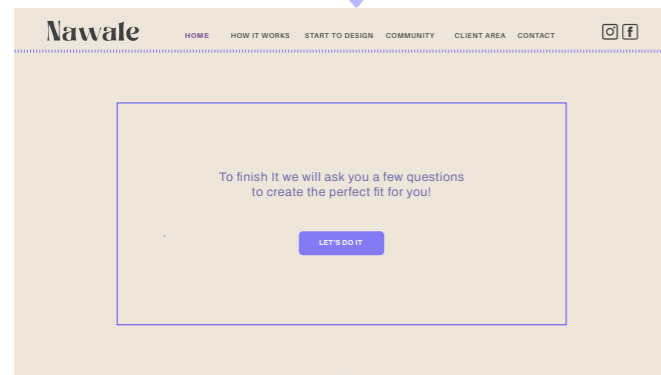
2) START TO DESIGN



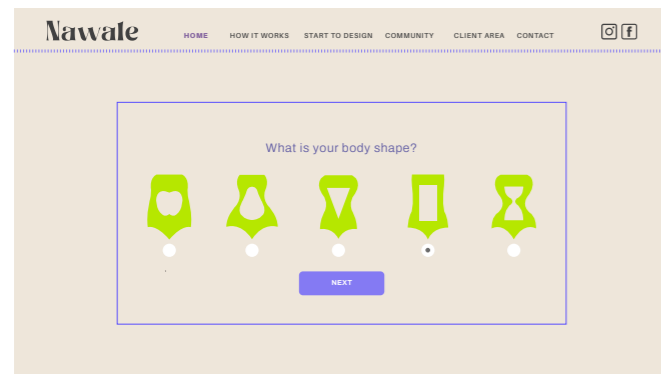
3) 3D PLATFORM DESIGN



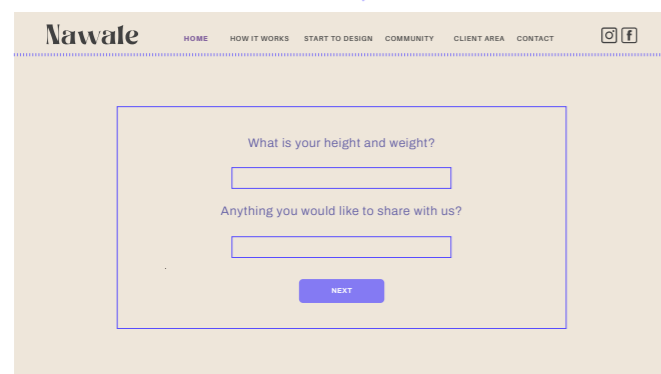
4) QUIZ A



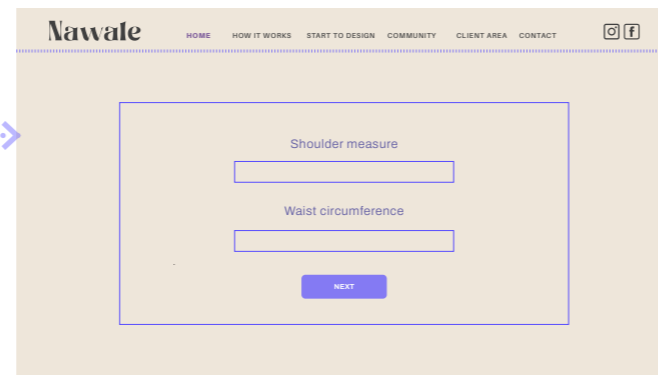
4) QUIZ B



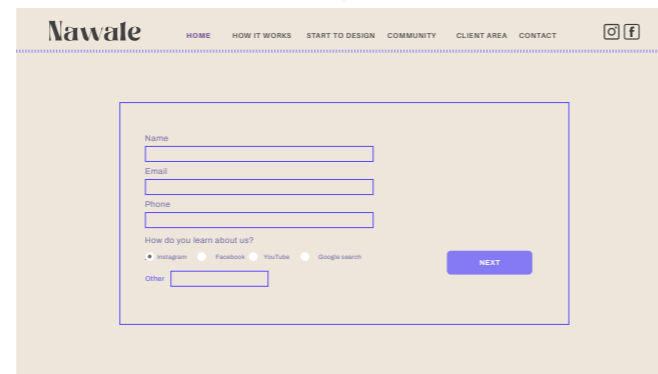
4) QUIZ C



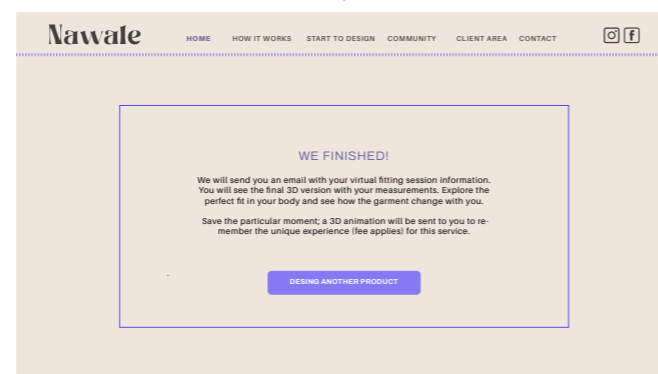
4) QUIZ D



4) QUIZ E



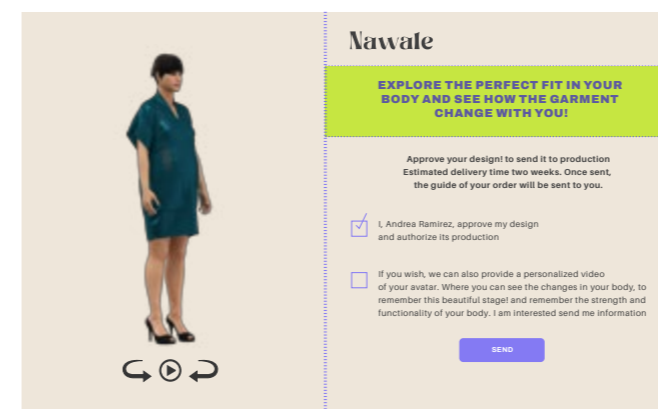
4) QUIZ F



5) 3D SCAN, CONFIRMATION EMAIL

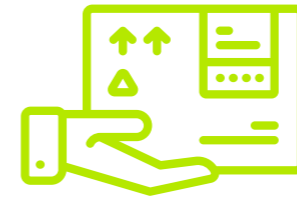


6) VIRTUAL FITTING SESSION



This video can show in a more interactive way how the platform works and ask people the changes that should be carried out to satisfy the client's needs. The results of the evaluation are shown in chapter eight.

HOW THE SERVICE WORKS?



1.- HELP US TO KNOW YOU BETTER

Tell us what you would like to design. You can order and customize your own clothes and accessory anywhere and any time, by taking a quiz, and following our 3D art customization you can transform your outfit in a piece that you will love.

Select start to design, select the product that you like to buy and then you will see options to change neck, color, sleeves between other characteristics.

2.- PERFECT FIT

Our service provides a perfect fit pattern. Following the quiz, you will give us a few simple measurements and special characteristics of your body. Then You can select the option of a virtual fitting session, in which we will ask you to download and app to scan your body taking some pictures with your cellphone.

3.- VIRTUAL FITTING SESSION

Once you finish our quiz, we will send you an email with the information about the fitting session. In which you will be able to see your own 3D avatar according to your body measurements. You will be able to see exactly how your clothes will look and fit during the different stages of the pregnancy thanks to 3D visualization.

4.- GET YOU YOUR CLOTHES TAILORED

Once the design is approved, we will tailor the clothes to your body measurements. Well will keep you update on the status of the production and process.

In the case of DIY products, it will send it to you by email the final pattern file and the manual to assemble it. You only need to download the file and produces the garment with the laser cut services in your community. Once it is cut you only need to assemble without the necessity of a sewing machine following the instructions. Your clothes will be ready to wear!

5.- DELIVERED TO YOUR DOOR

Once your garment is finished, we will send it to you to your door.

6.- RECEIVE YOUR GARMENT AND SHOW HER OFF!

Join to our community and tell us about your experience with our products. Be in touch with other customers who are experiencing the pregnancy process.

In the community you can also find list of contacts of experts in perinatal psychology, yoga teachers, midwives between other experts that could help you to solve your doubts.

MOMENTS TO REMEMBER

If you wish, we can also provide a personalized video of your avatar. Where you can see the changes in your body, to remember this beautiful stage! and remember the strength and functionality of your body.

Figure 49: Customer journey

TRADITIONAL PRODUCTION / PRODUCT LIFE

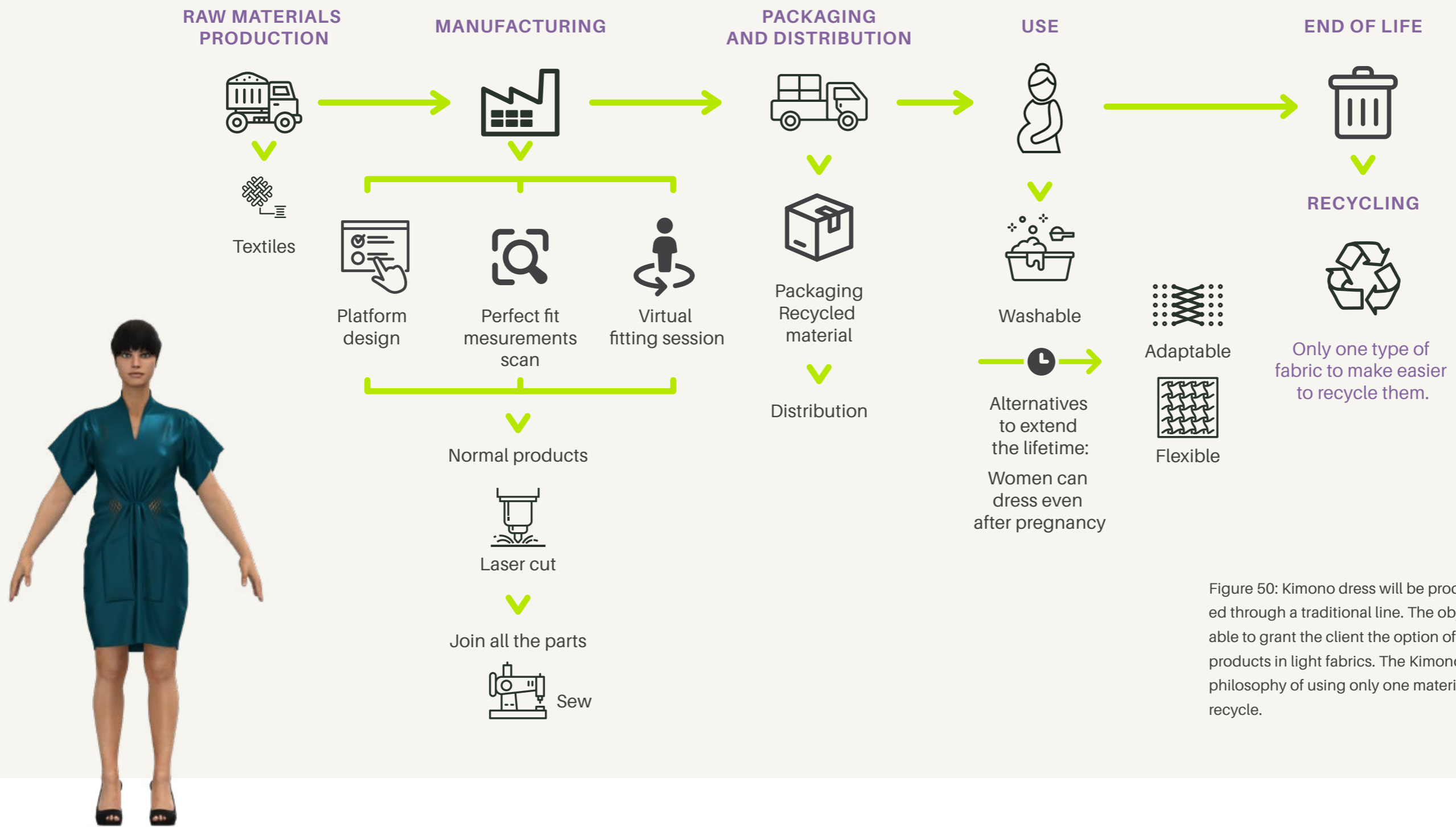


Figure 50: Kimono dress will be produced and distributed through a traditional line. The objective of this is to be able to grant the client the option of being able to design products in light fabrics. The Kimono dress will maintain the philosophy of using only one material to make it easier to recycle.

NETWORKING PRODUCTION / PRODUCT LIFE

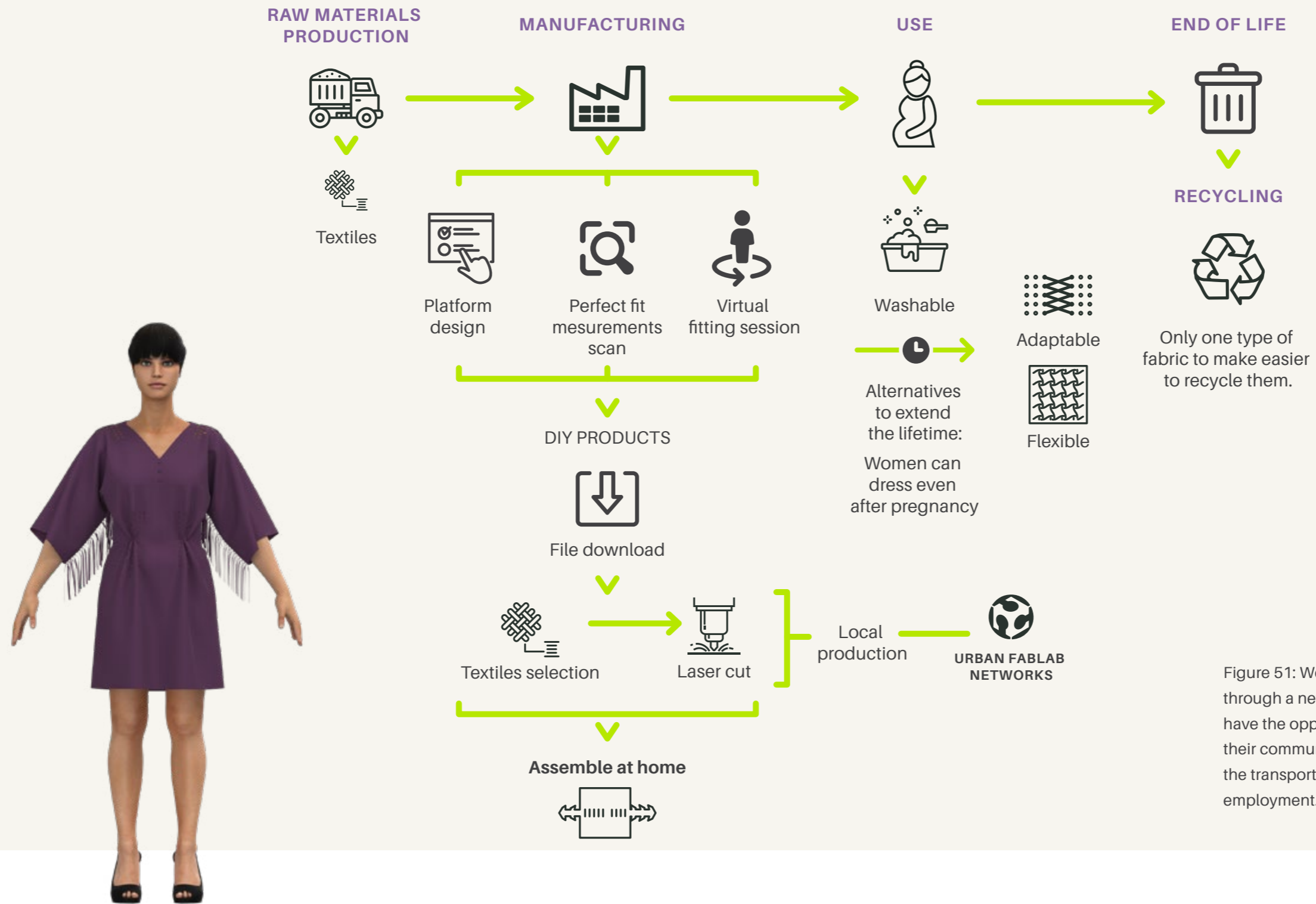
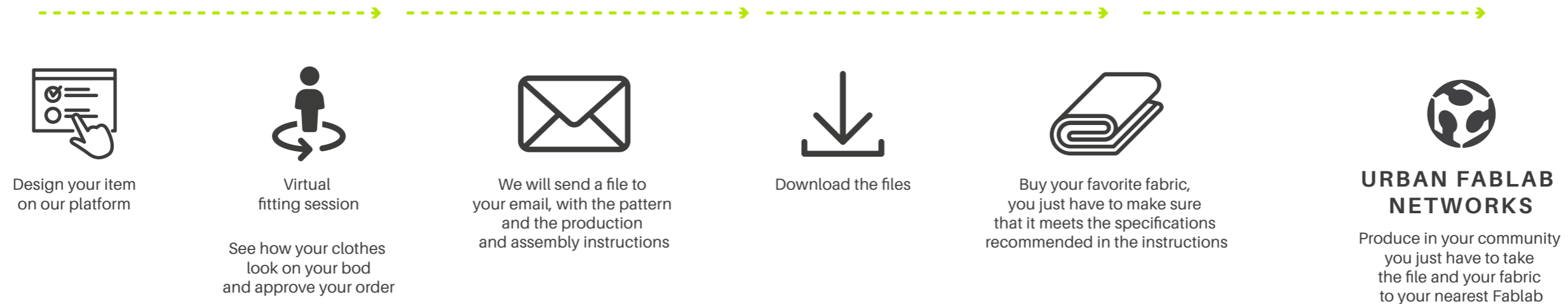


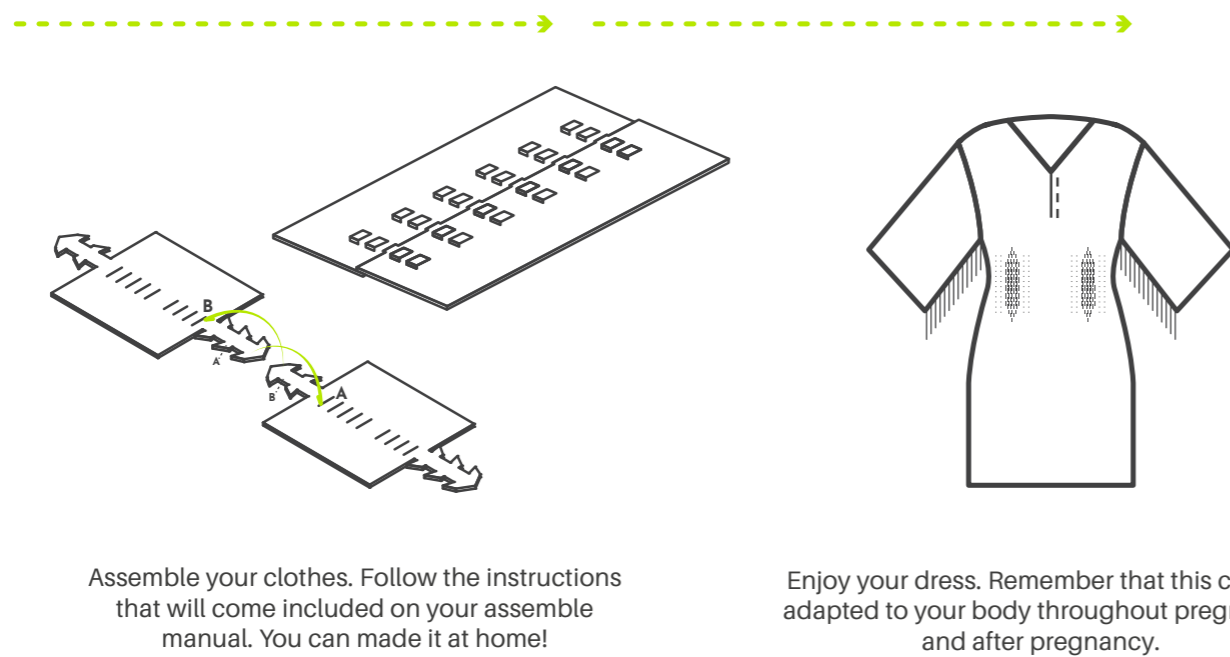
Figure 51: Western dress, will have been produced through a networking of laboratories. People will have the opportunity to produce the garment in their community, this reduces pollution due to the transport of raw material and generates local employment.

HOW DOES NETWORKED PRODUCTION WORK?



What is a Fablab?

They are digital fabrication laboratories. They provide the environment, skills, advanced materials and technology to make things cheaply and quickly anywhere in the world, and to make this available to anyone who wants to create something.



WHY CHOOSE THIS PROCESS?

Low shipping contamination. The emissions that are generated by the shipment are reduced. It can be produced in your community. This will generate local employment—production on demand. No more clothes are made than is needed; no excess garbage is generated. People can produce the dress as many times as they like with different fabrics. People can choose the fabric they like the most and that suits their needs. Easy to recycle

Figure 52: How networking works

FABLABS / FABRIACADEMY NODES 2022/23

● Asia

Fab lab O Shanghai, China
Tongji University, Shanghai
Contact: Saverio Silli

Fab Lab Kamakura, Japan
Contact: Jun Kawahara

● Europe

Fab lab Digiscope, Paris-Saclay, France
Paris-Saclay University
Contact: Romain Di Vozzo

Le Textile Lab, Lyon, France
Contact: Pauline Gamore

Fablab ULB + Green Fabric
Université libre de Bruxelles, Belgium
Contacts: Denis Terwagne, Valentine Fruchart

Basque Design Center, Bilbao, Spain
Contact: Adele Orcajada

Fab Lab Leon, Spain
Contact: Nuria Robles

Iaac, Fab Lab Barcelona, Spain
Fab Lab Barcelona / Institute for Advanced
Architecture of Catalonia
Contact: Santi Fuentimilla

TextileLab Amsterdam, The Netherlands
Fab Lab Amsterdam / Waag Society
Contact: Cecilia Raspanti

Icelandic Textile Center
Blondus, Iceland
Ziphouse Fashion Hub Moldova
Chişinău, Moldova

Fab Lab Lisboa, Portugal
Contact: Rafael Calado

Fondazione Mondo Digitale, Rome,
Italy. Contact: Matteo Viscogliosi

Onl'fait, Geneva, Switzerland
Contact: Cristina Olivotto

● North America

Echofab Fab Lab Montreal, Canada
Contact: Monique Chartrand

Fab Lab Maya, Quintana Roo, Mexico
Contact: Trinidad Gomez

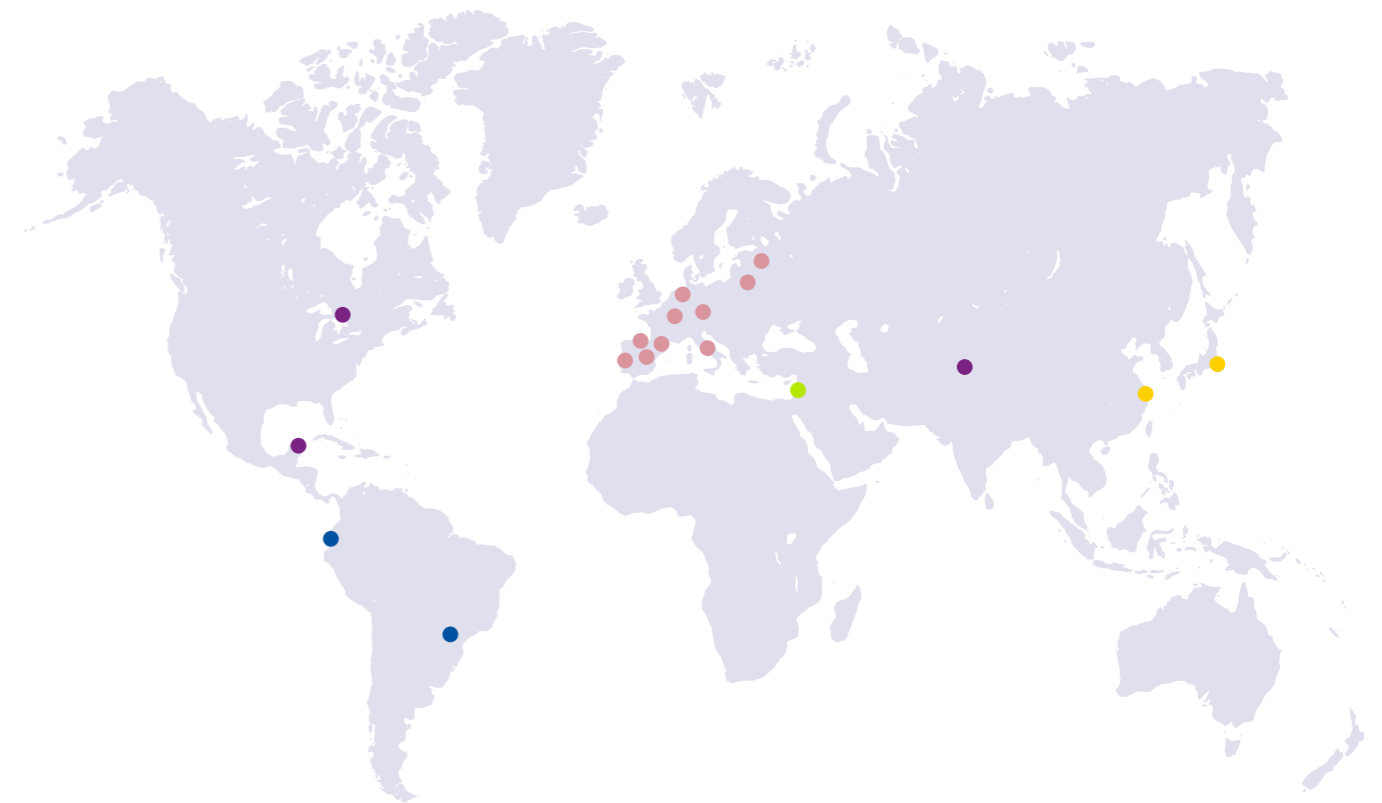
● South America

Fab Lab ZOI, Quito, Ecuador
Contact: Roberto Gallo

Ellora Ateliê, São Paulo, Brazil
Contact: Angela Barbour

● Middle East

Techworks, Amman, Jordan
Contact: Ismail Hakki

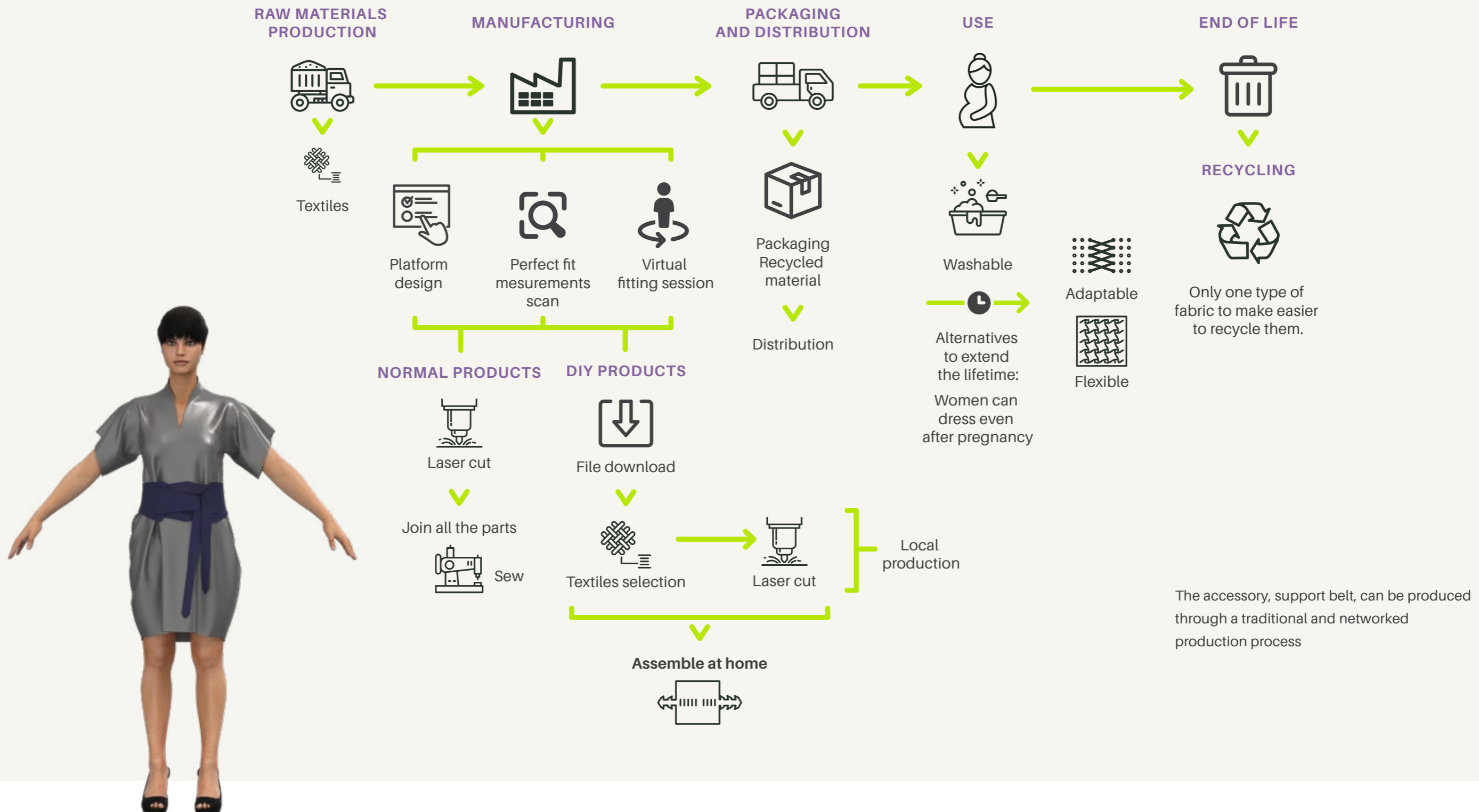


LAB EQUIPMENT

- 3D Printer
- Laser cutter
- CNC milling
- Vinyl cutter
- Molding, casting, composites
- electronics workbenches and components
- Big screen
- Sewing machine
- Sewing machine overlock
- Digital desktop Sewing machine
- Knitting machine
- Weaving machine
- Heat press
- Soft actuators - e-textiles (conductive threads, conductive fabrics, mini vibration motors...)
- Scissors, threads, yarns, natural and synthetic textiles
- Big working tables
- Roland Tex-art dye sublimation printer
- Kitchen tools, incubator, petridishes e.t.c

Nawale, wants to establish connection with Fabricademy nodes. The intention is to point out to people that they can go to these places to produce their clothes. The project wants to establish contact with this type of Fablabs specialized in textiles, because in this way Nawale can offer more personalized options for networking production and because people can receive personalized help from experts to make their experience more enriching.

PRODUCTION /LIFE



7.4

SUSTAINABILITY

Nawale wants to promote circular fashion system. Circular Fashion system is *“clothes, shoes or accessories that are designed, sourced, produces and provided with the intention to be used and circulate responsibly and effectively in society for as long as possible in their most valuable form, and hereafter return safely to the biosphere when no longer of huma use.”* Dr. Anna Brismar (The honest Consumer, 2022).

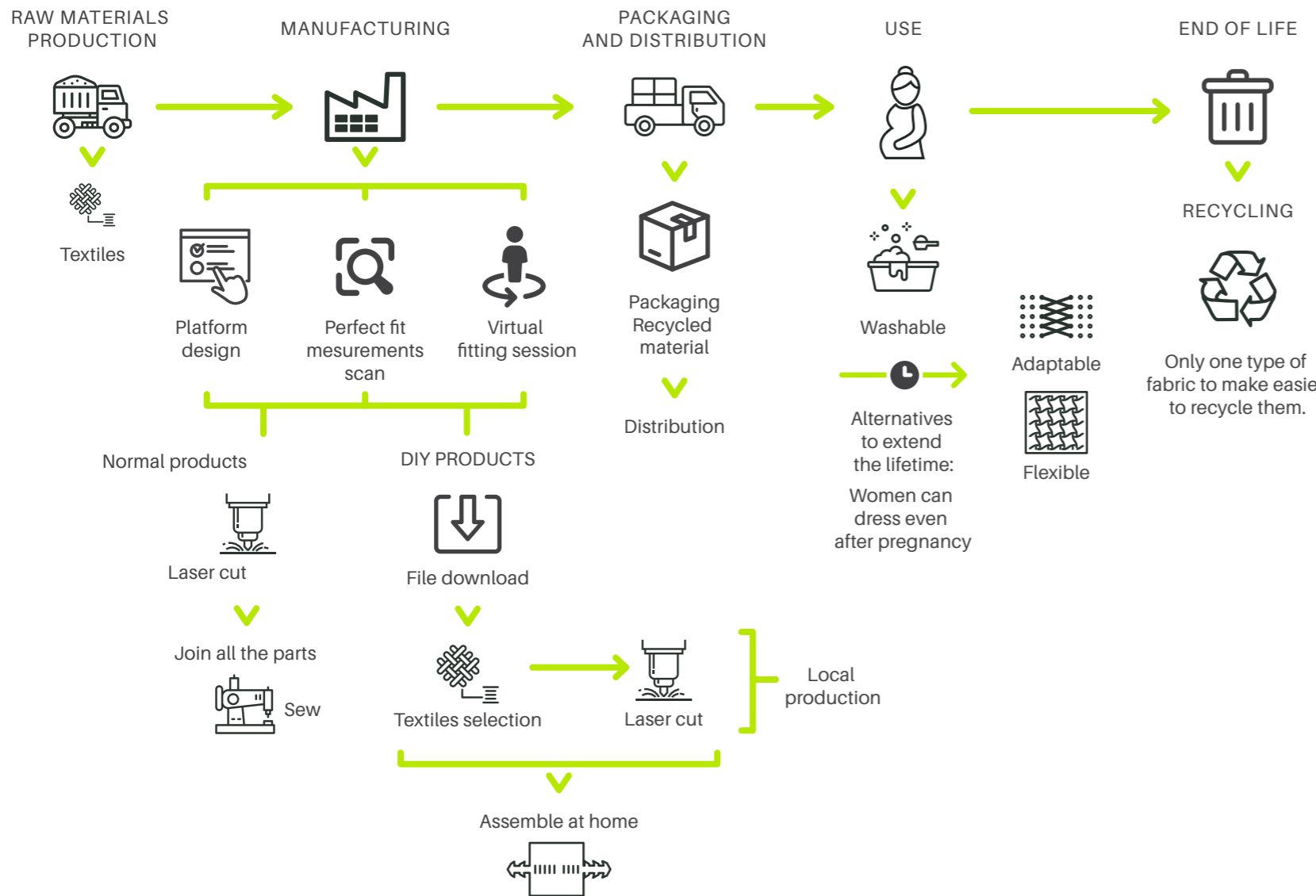
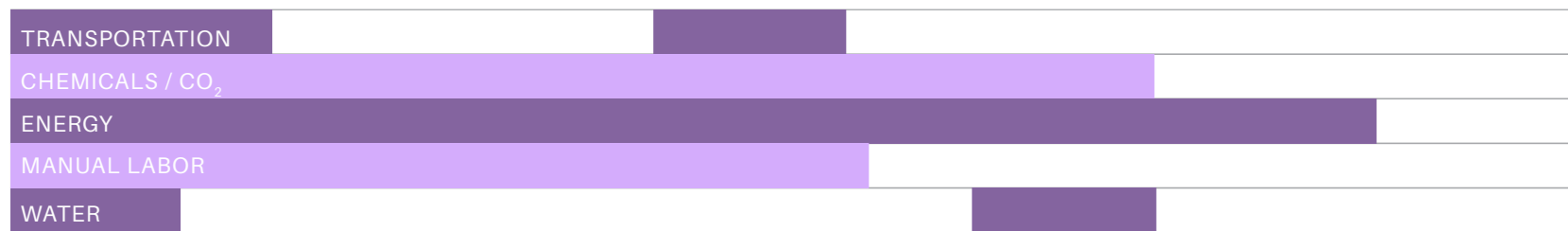
The strategy of this system is minimized waste through a **“take - make- reuse”** approach to apparel production and consumption, where a product, once ethically produced, does not leave the system until it has been reused or recycled to the point that it cannot be reused anymore. Nawale tray to follow the four ambitions of textile economy. For example, Nawale has selected to use recyclable materials. Although, these materials are based plastic. Their production requires 59% less energy and it reduces CO2 emissions by 32% in comparation with regular petroleum materials. They also increased awareness about overexploitation of raw materials and keep garbage from going to landfills and oceans. These fabrics can be recycled many times. The brand pretends to ensure that the material input used on their products, is safe and healthy to allow cycling and avoid negative impacts during production and dispose.

With the implementation of Make/Us tool, virtual prototyping, lacing, auxetics figures, connectors, and production networking elements, Nawale wants to transform the current fashion system. These tools and technologies help to create products that reduce waste during the manufacturing process. They also help to decrease the energy and chemicals consumption. The using of these elements prolongs the life product by giving adjustment and adaptation properties. Furthermore, design with connectors promotes the networking produc-

tion which reduces chipping caused by materials and product transportation. Nawale products intent to reduce the use of buttons and zippers. They will be designed by the thinking on only use one material. This will facilitate their mechanical disassemble, to reuse them in other products to extent the material life.

The Nawale service also promotes a sustainable consumption. The products will be made by demand. Only what is necessary will be produced. This reduces overstock, waste, and CO2 emissions caused due overproduction. Likewise, the service tries to reduce the returns produced for bad fitting. The fit recommendation and fit visualization tools will lead to make custom products that adapt well to the consumer. The implementation of these technologies on the service makes possible to integrate the user as a cocreator. Consumers in an active role can develop manual skill and make them more aware of the waste-related issues. It challenges values regarding fashion choices and develop a sentimental attachment between the product and the user. This provokes that consumer want to keep the product longer and look for ways to repair if it gets damaged.

As have been mentioned before, design with connectors limits the personalization of the products. For this reason, it was decided to implement two types of production, networking and traditional. This option has consequences on a sustainable level. It is for that reason that it was decided to make a comparation between the two processes across the Kimono and Western products to w=know their advantages and disadvantages. This will be presented on the nest section.



Responsible for products with the environment. Nawale wants to generate conscious consumption and production, designing functional, durable, and comfortable products for women.



Some products can be **produced locally**. Generating local commercial activity.



The brand uses **sustainable fabrics**.



Nawale tries to produce garments without adding buttons and zippers, and with only one type of fabric to make **easier to recycle** them.



The designs and patterns are designed to improve the efficiency of the use of the fabric and generate the least possible waste during production. **"zero waste"**



All the garments and accessories are **made on demand**. This reduces the over production.



Long life of products. The mission is that they could be useful to women even after pregnancy.

7.4.1 COMPARISON BETWEEN THE TWO DRESSES

As the project intends to offer the two-production manufacturing processes (traditional and networking). It is important to point out the advantages and disadvantages of each one. In this section a comparison between the kimono and western dress will be explore. The aim is to know their advantages and disadvantages of each garment. Four elements to compare are: design, production, services, and sustainability. In the table 3 will be appreciate the results.

In the design aspect the kimono dress has more advantages because it is not restricted for specifics requirements. It can be explored different materials, and pattern silhouettes. On the contrary the westerns dress is limited for the requirements that connectors need. It must be designed on specific materials and their pattern is restricted to straight lines. On the production side the two are very different from each other. One is produced by networking and the other on by traditional production. This means that one can be made at home and the other can be created on Fablab laboratories. The service of western dress is more enriching. People can learn new skills and have mindfulness experience. They control the situation, and an attachment between the clothes and user is created. This motivates the consumer to keep the clothes for more time. Furthermore, on the networking production, people can produce on their communities promoting local employment. On the sustainability part both dresses are pretended to be disassembled easily. They are designed with good quality and mechanism that prolong their functional life. However, the western dress production reduces the transportation of products and raw material, so the shipping pollution is less.

With this analysis it can be verified that although networking production limits more the design of the garment, it has much more benefits at an environmental and social level than traditional production. In a future more processes should be implemented to reduce the limitations of this manufacturing process to encourage users to select it.



ELEMENTS TO COMPARE	KIMONO	WESTERN
		
Design	<ul style="list-style-type: none"> • Accept different pattern silhouettes (straight lines and curved lines) • More customization options • Many materials with different characteristics can be used • Adaptable 	<ul style="list-style-type: none"> • The pattern works best with straight lines • Less customization options • It is limited in materials • Adaptable
Production	<ul style="list-style-type: none"> • Traditional • Without connectors • Cannot be produced at home 	<ul style="list-style-type: none"> • Networking • With connectors • Can be produced at home
Service	<ul style="list-style-type: none"> • The product is sent to the customer assembled. • The shopping experience ends with the shipment of the garment. • Less emotional attachment 	<ul style="list-style-type: none"> • The file is sent so that people can produce it in their communities. • People learn new skills • The experience ends until the client wants • Creates more attachment to the products
Sustainability	<ul style="list-style-type: none"> • Only one material (mechanical disassembly) • Long lasting 	<ul style="list-style-type: none"> • Only one material (mechanical disassembly) • Long lasting • Low shipping contamination • Local employment

Table 3: Dress comparison

7.5

CONCLUSION

In this section was presented the Nawale project development. **The integration of the components of chapter five and the results of chapter six were mixed to create a solution that could help women to reduce their body dissatisfaction during pregnancy.** With the integration of the elements a product service system was designed. The **product service system** is made up of custom zero-waste products, which adapt to the body during the different stages of pregnancy. Furthermore, by predeterminate design characteristics the user can modified their garments and adapt them to their style. The project is also composed by a digital interface in which customers will be able to interact with the products through web technologies 3.0. These technologies will help the client to customize their garment with their measurements to generate the perfect fit. Likewise, the platform will offer a 360-degree view of the product with a tailored avatar. Consumer will have the opportunity to see and try the products in a digital environment. This will help to generate confidence on the fitting and create and interactive engagement.

This product service system could help women to generate a positive body image. Nawale visual identity intents to bring and unexpected and less traditional view of what is be a mother. It wants to promote feminist values. **Exposure to feminist perspectives** increases women's body satisfaction through growing feminist identity. Furthermore, the **flexible adaptable zero-waste products intent to offer women freedom of movement, comfort, and personalized style.** Women expressed that during pregnancy they feel that they lose the control about their bodies, they describe this stage as a deformation. Women also expressed that it is very hard to find maternity clothes that fit well to their bodies in every stage of the pregnancy. Clothes can be a tool to practice control. Nawale will give women the possibility of **customizing their garments and adjust them as they want.** This will encourage positive thoughts because women could feel that they have the control about their bodies again. Furthermore, women refer to maternity clothes as ugly, made for old people, and that it symbolized someone that they did not want to be

associated. **By the personalization of the products the project will give women the power of express themselves by selecting the characteristics that more adjusted to their style.** Women does not need to lose their identity.

Nawale intent to implement a circular economy. This means that it searches for create a new fashion system in which social and environmental consequences are considered during the design, production and selling stage. The project search to implement new technologies and processes to reduce manufacture impacts on the planet. To start, their adaptable design will **extent maternity clothes functionality, preventing it from being discarded after a few uses.** Furthermore, the networking production will reduce pollution, by **reducing shipping caused for raw materials and final products delivery.** The material used on products will be recycled, reducing the CO2 emission. Nawale service also will help to reduce impact environments. It will help to reduce product returns due the bad fit. It will also create an attachment between the garment and the person, causing the wearer to want to keep the garment longer.

To sum up, Nawale is a brand that wants to provide specialized maternity products that adapt to body changes. The goal is to make tailor-made products to offer freedom of movement, comfort, and personalized style. The brand seeks to provide support with their products and service to mothers. Nawale want to break with the stereotype of the perfect body and perfect mother. The project is also committed to changing the traditional fashion system for a circular one. It wants to bring to the market sustainable maternity products.

Once presented the project solution, this was submitted to an evaluation. On the user survey (chapter three) at the end of the questionnaire, as an optional question, the respondents were asked to leave their email address to be contacted for the design evaluation, there were six positive responses. On the next chapter it will be presented the results of these evaluations. The project evaluation was composed of a survey. The survey was divided on two main areas products and services. The main of the survey was to obtain feedback about Nawale, to know what can of adjustment can be made on the future.

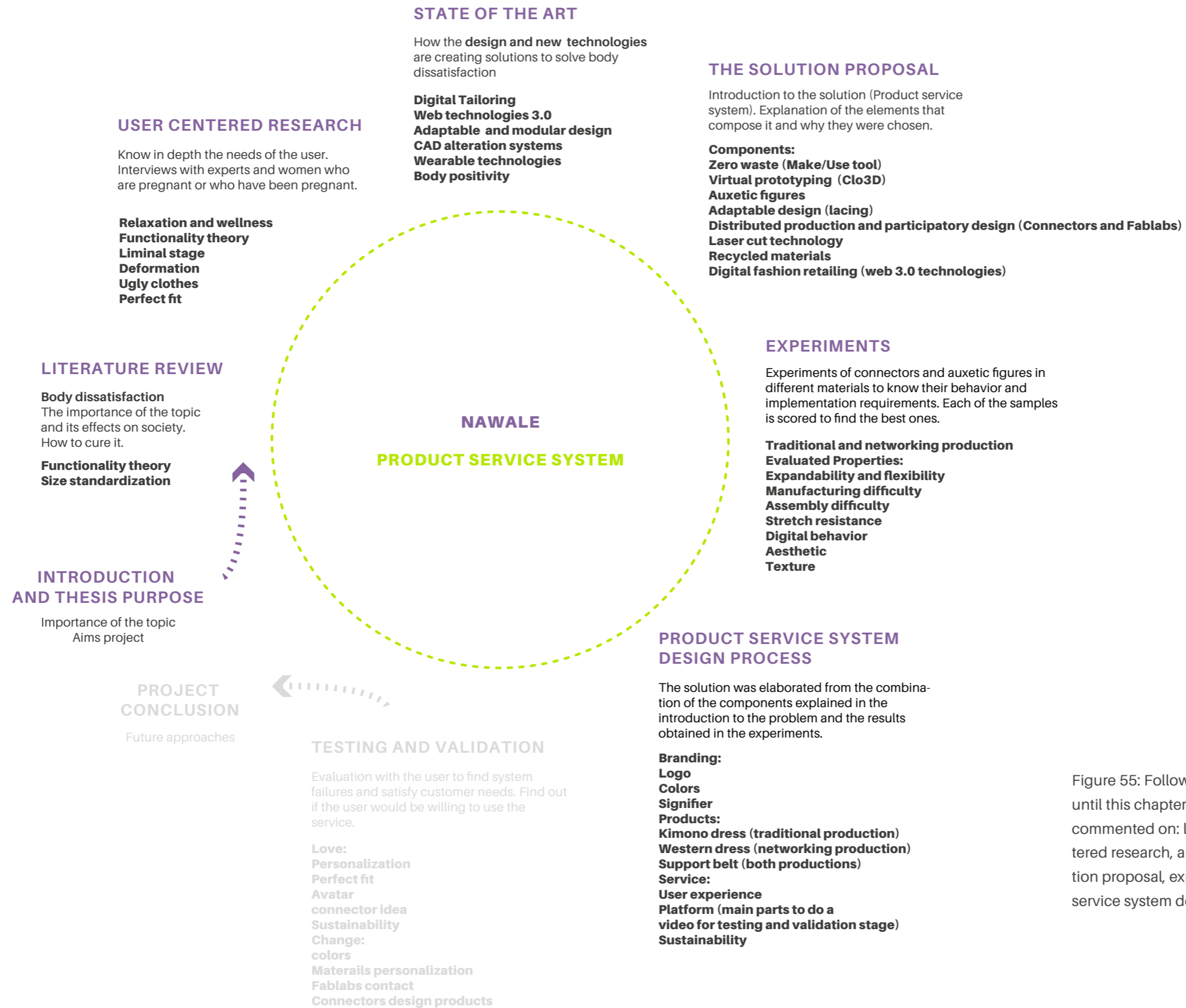


Figure 55: Follow-up of the design process, until this chapter, the sections have been commented on: literature review, user-centered research, and state of the art, the solution proposal, experiments, and product service system design process.

CHAPTER EIGHT TESTING AND VALIDATION

8



TESTING AND VALIDATION

The Nawale project underwent an evaluation. The objective was to know the user's opinion towards the product service system proposal. For this exercise, a survey was developed with 23 qualitative questions accompanied by images and a video. These materials explained the products, their characteristics, as well as the service. This chapter will show the development of the surveys and their results. At the end of the chapter based on the survey results, some additional modifications to the project will be presented and future developments will be established to improve the design proposal.

8.1

USER VALIDATION SURVEY

8.1.1 INTRODUCTION

It was developed a survey to know the opinion and feedback of the user about Nawale project. In this case the questionnaire was sent to mothers and pregnant women, who leave their email on the user-centered research. However, due to the lack of participation, it was decided to send the questionnaire to other mothers and pregnant women. The aim of the survey is to know women opinion about Nawale's service and products. To identify what are the faults and weaknesses of the project, and base on this improve the design proposal. Were asked question about the dresses and belt design and service characteristics. These questions were complemented with images and a video. The survey was completely confidential. Name was not required and was notified to the participants that the materials would be used for academic purpose, and that data would be used in an aggregated format.

8.1.2 PEOPLE

The questionnaire was sent to mothers and pregnant women, who leave their email on the user-centered research. However, due to the lack of participation, it was decided to send the questionnaire to other mothers and pregnant women. Eight online result survey were conducted between women in and age average between 25 to 45 years old.

8.1.3 MATERIAL

The survey has a total of 23 qualitative questions (see Appendix B for consult the questionnaire), distributed in four sections. Kimono dress, Western dress/DIY, Support belt and Service. Each section was focused on discover the user opinion about design and special characteristics. On the case of the products, it was asked about what other things they would like to customize, what things they like more and what things they like least. On the service was asked their opinions about technologies implemented such as fitting and Scan, virtual fitting etc.

8.1.4 STRUCTURED SURVEY QUESTIONS

To know the user opinion about Nawale project, there were made 23 questions about products and service. The questionnaire was divided in four sections, kimono dress, western dress, support belt and service. For the products was asked, what other things they would like to customize, what things they like more and what things they like least. For the service, it was asked their opinion about the technologies, the operation of the service and their willingness to order a product through the platform.

8.1.5 RESULTS

I. Kimono dress

The women referred to the dress as beautiful, comfortable, **ideal for going to work but also for use on other occasions**. They perceived it as versatile and elegant. They liked that the design was simple and indicated that it was **useful**. The most indicated adjective (five women) was comfort. Regarding what other options they would like to personalize. The women indicated that they would like to have the option to make it long and to include other types of sleeves (long and 3/4 sleeves). One of them suggested that more flight could be included in the lower part to make it more comfortable. Among the features that women liked the most about Kimono dresses was the **inclusion of the zipper in the dress**. They indicate that is indispensable for breastfeeding. They also like the idea of the adjustment, because removing and putting on clothing in a state of pregnancy can be tricky. They like their versatility and that can be used in pregnancy and postpartum. What they liked **least about the kimono dresses were the colors, and to do not know what kind of fabric it was**. In the entire kimono dress section. The women indicated that the color palette was very cold and very dark. They suggested that they would like to have more color options. Likewise, they would like to know the type of fabric from the beginning and, above all, include an image or video of the material. Likewise, one of the women surveyed commented that the adjustment in the back could become difficult in the final stages of pregnancy. Another indicated that it is an unusual garment and that it will be difficult to adapt at the beginning.

II. Western dress

For the western dress, the women said that they “liked” it, but the adjectives with which they described it were not very positive. The women indicated that they found the **dress very rough and very stiff**. They would like it to be loose, they perceived it as basic. **They like the idea of the connectors. They refer to it like interesting, useful, practical. They perceive it as origami or assembly on paper**. Only one person indicate that she did not like the idea, since it seemed complicated, and that it did not match her style. Regarding what other things they would like to customize, the women pointed that they would **like to use it as another garment**. One of them indicated that it could be good if it allowed to open it on the front to be able to use it as a coat or use it as a complement to her outfit or with the Kimono dress. Others indicated

that after pregnancy they would like to use it as a jacket, that could include the baby. They also revealed that it was not so obvious that the chest could be opened for breastfeeding, and they recommended using zippers since the buttons could be complicated with a baby. All the women also proposed to include **more color options and especially that the laces on the sleeves were optional**. The aspects that they liked the most about the Western dress were that it **could be produced locally, the connectors, and that it adjusted to the body**. Although the fabric seemed very thick to them, they perceived it as comfortable and soft to the touch. One of the women indicated that she liked the figures of the shoulders, the design of the neck and the long sleeves. What the women liked least were the color selection and laces connectors. They indicated that they would like to have light colors and not so cold, and that the laces seemed impractical and not very aesthetic.

III. Support belt

Women perceived Support belt as **useful and practical**. They like it, they said that it is nice. It is an auxiliary garment that combine very well with the proposal dresses. They argument that **it can be a good tool to help with the belly weight**. They would like to customize the color and the fabric, to choose the ones with a nice texture. What they love more about the belt was that it does not looks like a support belt. It looks different and with style. They also love that it could help to decrease the back pain. They argued that the support on the belly is important, although some women does not like to use nothing around the belly. Most of the women signaled that they liked everything about the belt, however, two of the women said that what they liked least about the accessory was that they did not know if it could be comfortable, and its aesthetics when the belly is bigger.

IV. Service

The service to women seemed practical. They like it a lot because, because it solves problems of excessive consumption (fast fashion), and because it is sustainable. **Regarding the tool of the perfect fit, the women loved it because they commented that each woman during pregnancy develops different bodies and that finding clothes that fit them well makes them feel happy**. For the technology of 3D scan the decision was divided, four of them argued that the application tool looks practical. It could help to reduce time and concern about the fitting. They find it interesting. The other four people said that that they perceive it as dangerous, that they would not like to share photos of their body on a platform they do not know about.

The customization for women was an excellent idea. They found it fascinating to be able to personalize their clothes and products. They love being able to portray their tastes and their personality. They see it as very viable to be applied in online shopping. They really liked the idea of the **virtual fitting room they consider that it generates buying confidence and that it can be fun.** The features that most caught their attention about the service were, that the products can be **produced on demand, the way in how all the customization elements assemble to design the garment.** They love the idea of select the dress characteristics (decision power) and to see to the garment adjust to their bodies. All of them liked the sustainability philosophy of the project. What they found less attractive about the project or what they saw as more difficult, **was to know in which place they could find a laser cut machine to cut the garment pattern. They demanded to have a directory of contacts near their community to carry out the process.** Furthermore, they do not perceive that the characteristics of the fabric are clear. They would like to see the type of fabric and its behavior with videos or images. Women indicated that they were willing to buy through the platform, but for some the price and quality of the fabric are determining factors to make the purchase.

8.1.6 DISCUSSION

The objective of this survey was to **get feedback about Nawale project products and service. Learn how they perceive the products design, new technologies, and networking production.** Findings indicated that pregnant women and new mothers perceive Kimono dresses as nice dress and versatile. They believe that this dress is good to go to work and for other casual activities. They like the idea of the zipper to make easier the breast feeding. They would like to have the possibility to make it a maxi dress and to include long and 3/4 sleeves. Some of the women indicated that maybe the back adjustment can be difficult in an advance pregnancy. Other women commented that it is an unusual garment and that could be difficult to adapt to it. These two last comments could be solved by teaching women how to use the garment. How they could adapt it during the different stages, to make easy the experience of wear it. **It also could be good idea to teach them**

the different occasion on how the dress could be wear, and how to make them see that it could adapt to their routines as a normal garment.

The findings on the **westerns dress were not so positives.** Women indicated that the **dress looks heavy, rough, and very stiff.** They would like it to be looser and not so basic. **They like the connectors idea and the adjustability. Women celebrate the sustainability concept behind these ideas.** They **loved the option of locally production.** However, they would like to use the dress as another garment (coats). A garment that could be a complement for the outfit, or to be used as a jacket that could include the baby comfort. They also revealed that it was not so obvious the chest opening, and that they prefer zippers because it makes easier to open and close. As mentioned before connectors only work fine with specific fabric characteristics. The fabric must generate friction to improve the lock of the connector. Frequently, these fabrics are heavy and with a stiff structure. **The solution to this problem could be to create a line of product based on garments with structure as coats, jackets, blazers, suits etc. Garment that are perceived as a little rigid to conserve their figure.** Other option is experimenting the connectors with other kind of fabric, with a looser sensation and with a light structure. It also can be good to implement the strings and slots connectors, who demonstrate have better performance with light fabrics. Six of the eight do not like the laces connector. To solve this case different connection will be implemented in the solution as a customization property for the client.

With reference to support **belt, women perceived it as useful, they like it.** Although not all women required it, women expressed that for women that enjoy using something on the abdominal area and need support on the back, the belt could be very practical. They expressed that it is a nice accessory to complement their outfits. They love the idea that it could help to relieve pain in the back and that it could help women to carry the belly weight. They love that it does not look like as belly band. However, two mothers indicate that they do not like its aesthetic appearance when the belly grows. In this case, solutions could be found to make it more aesthetic when the belly grows. Nevertheless, it is important to always follow the medical requirement to not lose its functionality.

For all products their adjustable property was celebrated. Women like the **idea of extent the product life. And be able to use it after pregnancy.** They also **underlined the importance of having the breast opening to be permit the breastfeed.** They confirmed that the products could be used to go to work and to be worn on casual occasions. However, **women did not like the product's palette colors.** They perceived as cold and dark. They would like

to have more bright colors. They also pointed that it is **important to know the fabric and material**. They suggest specifying the materials for each product and demonstrate their behavior with images and videos. In this case the project must increase the pallet color option and include more information about materials on the platform.

Women expressed that the service seems interesting. The women indicated that they really liked the idea of sustainability and **the concept of changing the mode of consumption**. They **love** the implementation of the **fitting and virtual fitting technology**. They commented that everybody is different and if a brand offers them a perfect fit and visualize their clothes on their body could make them feel happy and confident. They think that the experience can be fun. Women adore the idea of customization (the power to decide). **They believe that the system is easy to understand an easy to follow. They really want to transmit their personality on the garment. They expressed that this could also encourage them to buy more online.** What they found most difficult **was how to find laboratories where they can cut with laser cutting**. They demanded a directory of contacts near their community to carry out the process. They also indicate that the **service does not indicate the fabric of the products and materials**. For them it is important to see the materials behavior, so they suggest implementing a section or to make more visible which material products are using. Women would like to buy through the platform. Nevertheless, some women indicate that fabric quality and price are determinate factors to do it or not. The project must implement a directory of laboratories, which indicates to people where and with which laboratories they can carry out their production close to home. Likewise, it is important to reserve a section within the platform to explain the characteristics of the materials, and do it in a more visual way, so that people can perceive the behavior of the fabric without having it physically. In some cases, if the client is willing to pay for it, a sample kit with the materials could be sent by mail. In the case of production by networking, it is important to advised people in a more visible way what type of fabric they can buy.

8.1.7 CONCLUSION

The survey helps the project to visualize its flaws and faults. It was important to know the user opinion about Nawale concept to see **it is viable to be applied on the market**. The intention of this survey was to clarify the approach between the user products and service. It was important for Nawale to catch the information related with the design technologies and production proposals.

With the survey it was discovered that **women really search for services that permit them to express their personalities and taste on their garments**. They perceive these technologies as interactive fun and inclusive. They appreciate the way in how the clothes can be designed to measure. **This creates confidence and improve the service for pregnancy**. They believe that is important to generate alternative and new ways of fashion production, **most of them are willing to experience the process to reduce excessive consumption and pollution by the current fashion system**. Women perceive the products as functional, practical, and useful to go to work and casual activities. However there also exist flaws on the system.

Connector's technique to assemble seem to be well received for the user. Nevertheless, **western dress design was not liked for most of the participants**. They perceive the dress as very rigid, heavy, and basic. They do not enjoy the laces connectors on the sleeves, and they suggest improving the dress by using it as other garments for example a coat. **For these problems the project is suggesting for the future to improve the connector garment design**. Nawale realized that connector concept can work better with clothes that are perceived with more structure as coast, jackets, suits, blazers etc. Garments that need materials with structure to do not lose their silhouette. In the case of light materials, it is necessary to do more experiments with different connectors, to find the one that can offer a loose and smooth silhouette without breaking. It should also be explored how the strings and slots connectors can be applied to the clothes without generating concern on the user. These connectors proved to have a better performance in light materials, so it would be a good idea to explore different applications to cause people appreciation. In the case of connectors, the project is suggesting that **they can also be a custom option**. Women can choose the one they like best depending on their preference and the design of the garment.

Other flaw of the project is that **the platform does not show how the garments can be used.** Women indicate, that could be difficult to adjust the garment on the back in and advance pregnancy, and as the garment is unusual it could be difficult to adapt to wear it. **The brand understand that it is important to show women how the lace mechanism can work during the different stages of the pregnancy to make easier the user experience and clarify how woman can wear the garments.** For the support belt the only concern was that two women does not like how it looks in and advance pregnancy. It could be important to improve its aesthetics and design to make it more attractive when the belly is growing.

The two biggest flaws of **the project regarding the products were its color palette proposals and its lack of materials visualization.** Women perceive the color proposals as cold and dark. They would like to have more bring colors options. They also pointed that it is important for them visualize fabric characteristics for each product. **Nawale will change and implement different colors in the personalization area, and it will implement and specific section to speak about the materials characteristics in a more visual way, with images and videos.** Also, in each product it is going to be highlighted in which material the item is produced. In the case of networking production, it will teach people which materials are best to produce the garment to help them choose the best.

A concern for women about the **service was laser cutting. Women demand and area of contacts of suppliers that could help them with this task, a place close their home.** Nawale realize that this information was not clear on the proposal. For this reason, **the brand will have to specify an area, completely dedicated to the Fablabs, specifying their contact information, hours, the technologies they have and how to deliver the file to the laboratory.** Also as mentioned before (chapter 7) if women opt for the networking production, they will receive the same list of contacts in their package. However, this detail must be made clearer in the user's experience. On the service evaluation women again expressed the lack of information about the materials. This makes evident that materials are vital to satisfied user requirements, for that reason **in addition to implementing the exclusive area of materials on the platform. Nawale could offer a material kit.** Which could be send to the user to give them the opportunity of exploring a physical sample. As the project has seen that materials are important to users. The option to customize the fabric could also be offered. In the case of the Kimono dress there are no restrictions only need to be based plastic. In the case of clothing with connectors, only the fabrics that work with this assembly mechanism should be offered.

On the case of 3D scan technology, Nawale realize that it is not so easy to implement this technology if the system does not count with expertise that ensure the safety of customers. If this technology is implemented, great care must be taken with the protection of user data, guaranteeing the client anonymity and the correct use of their images. Nawale must research in depth which of the applications mentioned in chapter six have the regulations and security necessary to guarantee the protection of the client. It is for that reason that for the moment the project will limit this technology to futures improvement.

It can be concluded that Nawale project is attractive for the user, and that women believe that it can represent a tool to improve their self-esteem, because they can transmit their personality and taste, they will wear functional clothes and accessories, and because it offers an inclusive, nice, and custom shopping experience. Women are willing to try this new fashion system experience with the intention of reduce the environmental impact that fashion generates on the planet. However, to offers and improve the service and products Nawale must implement following upgrades on the future:

- Improve the connector garment design (western dress).
- For connectors line create a line of product based on garments with structure as coats, jackets, blazers, suits etc. Garment that are perceived as a little rigid to conserve their figure.
- Give more connector option to the clients to personalize their items.
- Clarify how the adaptable lacing mechanism works, show how the garment can be used.
- Improve belt design to make it more aesthetic when the belly is growing
- Change color personalization on the products, offer bright colors.
- Create a section that show materials characteristics, also highlight in each item option.
- Create a laser cuts suppliers contact section. Highlight the information. In the service
- Offer fabrics a customization property for each product
- Create a kit sample of fabrics to send to the clients

8.2

NAWALE IMPROVEMENTS

Based on the results obtained in the evaluation survey with the user, the following modifications were made:

- Added more color alternatives to products (figure 56).
- In terms of western dress design, it was opened at the front to allow the dress to be worn as a coat or jacket (Figure 57).
- The incorporation of a section only dedicated to the presentation of materials was contemplated in the flowchart of the platform. Likewise, the Fablabs module, previously incorporated in the community section, was moved to the main menu. A division dedicated to explaining the characteristics of the auxetic figures, connectors products, and the mechanism of how to use and adjust the garment was also established within the "How it works" section. This will help users become familiar with the designs (figure 58).
- In terms of technologies in the service. It was decided to eliminate the 3D scan step since women considered it dangerous. They believe that the tool is intrusive to their privacy, and they do not want to share images of their bodies. This technology may be used in the future once the client's security is guaranteed (figure 59).

More significant changes, such as designing a new collection with the connectors and others mentioned in section 8.1, are contemplated for future approaches.

COLORS



Figure 56: Different palette colors

WESTERN DRESS TECHNICAL DRAWINGS CHANGES

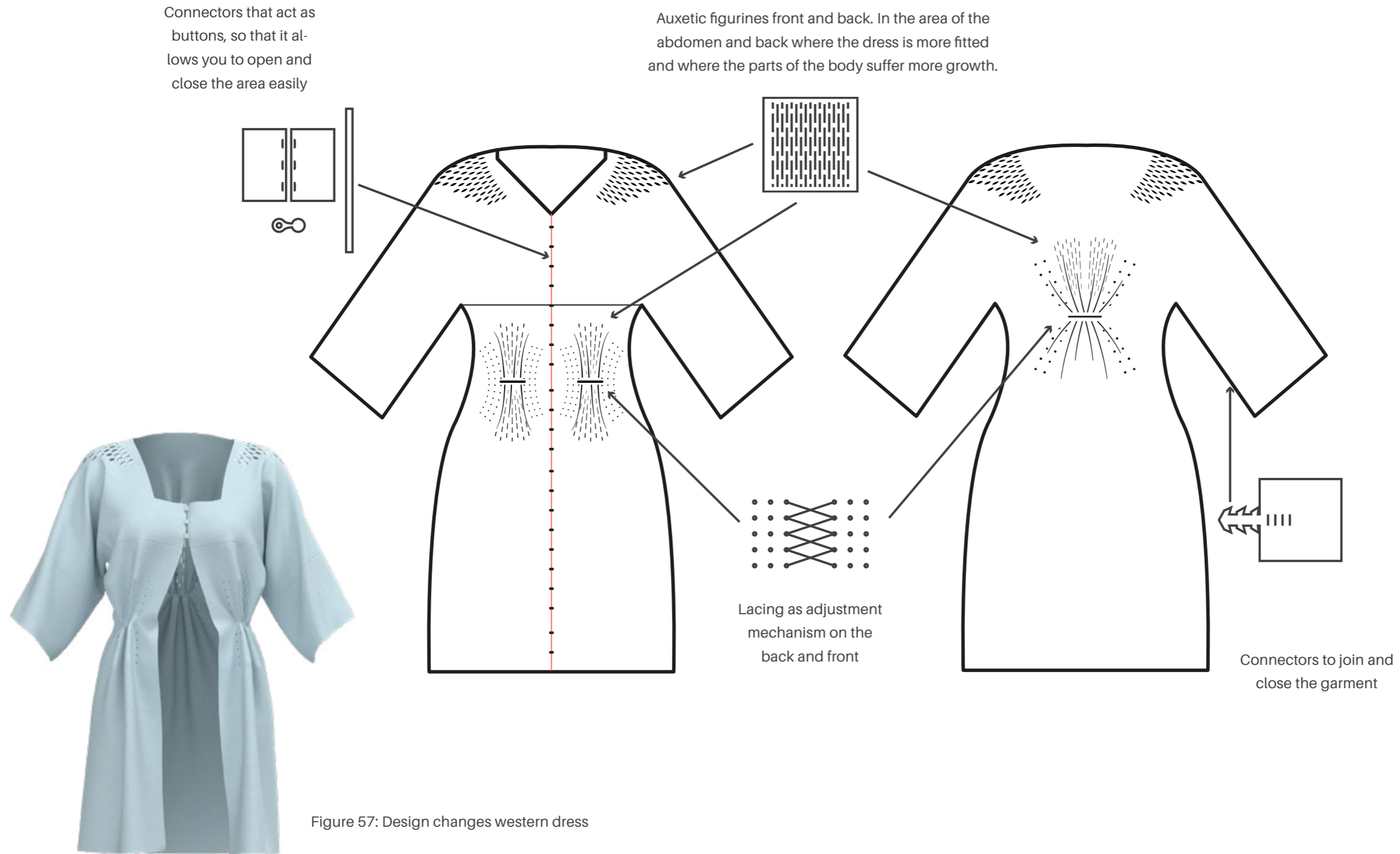



Figure 57: Design changes western dress



Produce in laser cut
minimum base of
113 x125 cm

To be produced in fabrics
with characteristics similar
to Mollettoni

MATERIAL

NAME
Mollettoni
CHARACTERISTICS
65% polyester 35% viscose Non-woven fabric Texture, soft, smooth as felt, with resistance Warm feeling
WEIGHT
0.0329 gr/cm2
SEASON
FW

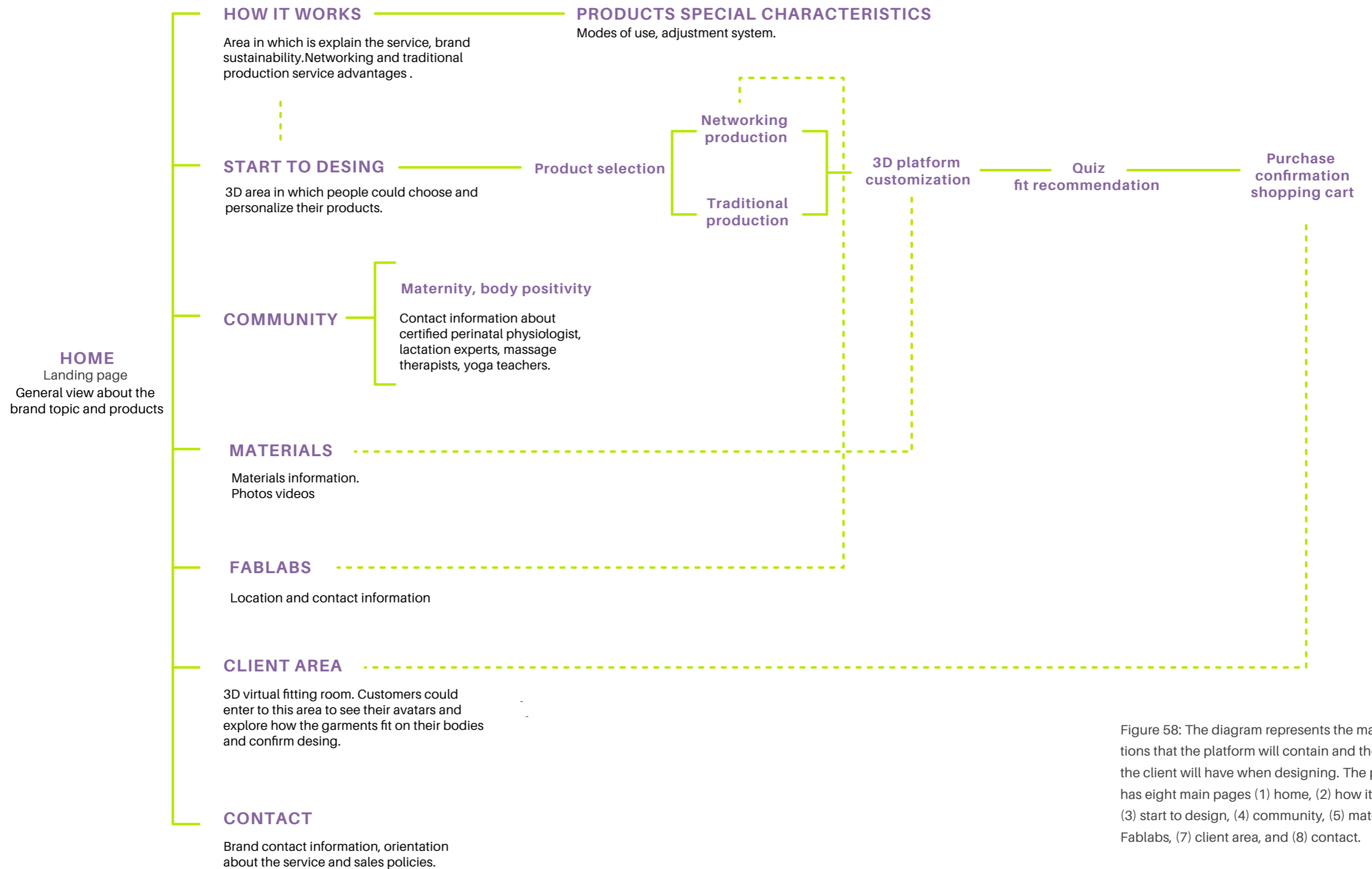


Figure 58: The diagram represents the main sections that the platform will contain and the flow that the client will have when designing. The platform has eight main pages (1) home, (2) how it works, (3) start to design, (4) community, (5) materials, (6) Fablabs, (7) client area, and (8) contact.

HOW THE SERVICE WORKS?



1.- HELP US TO KNOW YOU BETTER

Tell us what you would like to design. You can order and customize your own clothes and accessory anywhere and any time, by taking a quiz, and following our 3D art customization you can transform your outfit in a piece that you will love.

Select start to design, select the product that you like to buy and then you will see options to change neck, color, sleeves between other characteristics.

2.- QUIZ PERFECT FIT

Our service provides a perfect fit pattern. Following the quiz, you will give us a few simple measurements and special characteristics of your body. Then You can select the option of a virtual fitting session.

3.- VIRTUAL FITTING SESSION

Once you finish our quiz, we will send you an email with the information about the fitting session. In which you will be able to see your own 3D avatar according to your body measurements. You will be able to see exactly how your clothes will look and fit during the different stages of the pregnancy thanks to 3D visualization.

4.- GET YOU YOUR CLOTHES TAILORED

Once the design is approved, we will tailor the clothes to your body measurements. Well will keep you update on the status of the production and process.

In the case of DIY products, it will send it to you by email the final pattern file and the manual to assemble it. You only need to download the file and produces the garment with the laser cut services in your community. Once it is cut you only need to assemble without the necessity of a sewing machine following the instructions. Your clothes will be ready to wear!

5.- DELIVERED TO YOUR DOOR

Once your garment is finished, we will send it to you to your door.

6.- RECEIVE YOUR GARMENT AND SHOW HER OFF!

Join to our community and tell us about your experience with our products. Be in touch with other customers who are experiencing the pregnancy process.

In the community you can also find list of contacts of experts in perinatal psychology, yoga teachers, midwives between other experts that could help you to solve your doubts.

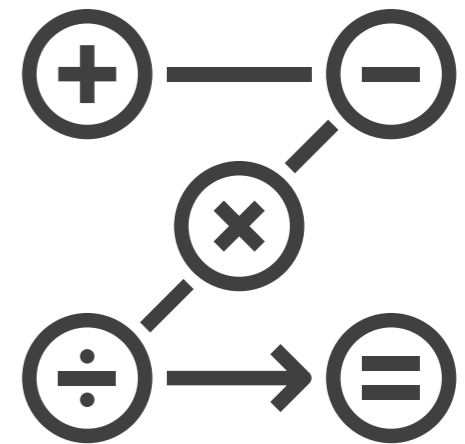
MOMENTS TO REMEMBER

If you wish, we can also provide a personalized video of your avatar. Where you can see the changes in your body, to remember this beautiful stage! and remember the strength and functionality of your body.

Figure 59: Final customer journey, without the 3D scan step.

CHAPTER NINE CONCLUSION OF NAWALE PROJECT

9



PROJECT CONCLUSION

9.1

PROJECT CONCLUSION

The concept of beauty has been reduced to an image lack of meaning. Currently, there exists the idea that the body must be “perfect.” When people do not achieve this perfection, they started to have problem with their appearance generating serious mental and physical health problems. Women are the most affected by this phenomenon. Fashion and media tend to promote the women’s bodies as object of desire. Even during pregnancy, women suffer stigmatization for their body’s changes. Their bodies are despised, and they are pressure to come back to their pre-pregnancy bodies as soon as possible. Pregnant women suffer rejection, since it is difficult to find in the market clothes that fit them well during the different stages of pregnancy and postpartum and find clothes that adapt to their styles. In this thesis we aimed to tackle the issue of body dissatisfaction in pregnant women in the fashion industry. The intention was to develop a solution that could help to reduce anxiety on women caused for the currents fashion system in a circular way.

It was investigated various theories and methodologies related to body dissatisfaction, presented in section 2.12 such as cognitive-behavioural theory, feminist theory, physical self-efficacy, and body functionality. However, for the research it was concluded that the most suited one to tackle body dissatisfaction in fashion industry was functionality theory. In terms of body dissatisfaction, functionality theory aims to provide appreciation for one’s own body focusing on what it can do rather than the appearance. It was validated the use of this theory through the instruments presented in chapter 3. On one hand it was conducted interviews and surveys with experts on the perinatal psychology and body experts. It was found that functional theory is used. Body functionality is composed of two phases the emotional, where women feel in a secure space to express their feelings, and the body phase, where they do physical and relaxation activities. In addition to this, it was also found that specialists also include feminist values in their therapies. This surveys

and interviews help the project to conclude that body functionality is a good option to be included in the creation of fashion products that pretend to reduce body dissatisfaction during pregnancy. On the other it was conducted a survey with potential users (i.e., pregnant women) to evaluate 3 main aspects: 1) the existence of body dissatisfaction during pregnancy and its possible reasons, 2) what activities women do to reduce body dissatisfaction, and 3) their opinion about maternity products on the market and functional and taste characteristics that they would like the products to have. The results presented in section 3.2 showed that mothers also use functionality theory to tackle body dissatisfaction. Women felt better about themselves through physical activity (i.e., using their bodies) and because the capability of being able to host life. Furthermore, the survey showed that the use of a garment that could allow mobility, adaptability and provide help with the discomfort related to pregnancy would be a potentially successful solution.

With the results from the evaluation instruments presented in Chapter 3, it was proceeded to investigate possible alternatives in terms of design and new technologies that could aim to tackle body dissatisfaction during pregnancy through body revalorization, body relaxation, body movement, functionality theory application (physical activity and support), media portrait, adaptability, digital services, and wellbeing. The results from the research performed prior to starting the design process are presented in chapter 4. It was reviewed 20 case studies, which showed that body positivity and technology driven solutions were strong candidate solutions. Additionally, it became clear that a concern in fashion industry nowadays is sustainability. Not only in terms of the global context (environmental and economic), but also directly related to women, who must buy clothes that can only be used during pregnancy and are disposed of immediately afterwards. From the research presented in chapter 3 and 4 it was concluded that the requirements for the solution were: adaptability, sustainability (circular fashion), comfortable, permit free movement, perfect fit, customization, long lasting life, easy to wear, help to relax the body, permit breast feeding, help to relief pain, permit physical activity, design focus on trend and young styles, and nice and soft texture (breathable, stretchable).

In order to be able to create a solution that meets the aforementioned requirements, different technologies and processes were integrated into the design solution. The solution is composed for zero waste concept and Make/Use tool, who create zero waste pattern design and permit garment personalization. Virtual prototyping and Clo3D software, which allow to see the prototype, tested, and modified the product in a quick and easy way. Auxetic figures, that make clothes more flexible and comfortable by expanding the figures.

Experiments were done to verify which auxetic figures had greater flexibility, aesthetics, texture, and best digital behavior (they were tested also on Clo3D) to select the best ones for its application on maternity products. The experiments showed that the figures with the best performance were figure eight pinches, figure two Y, and figure five square. It possible to observe the results on chapter 6. Other technologies and processes applied on the design solution are adaptable design and lacing as adjustable method, which allow the garment to adapt to the body during the different stages of pregnancy and postpartum. Distributed production and participatory design, connectors and Fablabs, methods that allow clothing to be assembled without the need for a sewing machine and that allow the garment to be produced around the world through a network of laboratories. Experiments were made with connectors to test their stretch resistant, aesthetic, and assembly difficulty. The aim was to select the best ones to be applied on maternity products. The connectors with best performance were connectors one, five, eight, eleven, eighteen and nineteen. It is important to mention that based on connectors results, traditional and networking production were implemented on the final proposal. The results can be seeing on chapter 6. Other elements that are part of the solution are laser cut technology, who allows to produce the garment in a faster, more efficient way, tailored and with less waste. Recycled materials, materials that reduce CO2 emissions and that can be recycled constantly. And digital fashion retailing (web 3.0 technologies) tools that allow the creation of a more inclusive digital platform, which can generate customizable and tailor-made products. The detail description and why of their selection of each element that compose the final solution can be seen on chapter 5.

The integration of all these elements allowed the creation of a product service system name Nawale. Nawale is a project that intent to create personalized and tailor-made products for pregnant women to help them to reduce body dissatisfaction caused for the current fashion industry. It intends to give women perfect fit, freedom of movement, comfort, and personalized style through a digital service. Nawale want to implement circular fashion to offer sustainable maternity alternatives to mothers. The project is composed of two adaptable and flexible dresses, an accessory, and a digital platform. The products are designed to not generate waste during their manufacture, to adapt to women bodies during the different stages of pregnancy and post pregnancy, and to be able to customize their pattern in an easy way. The service is a digital platform that offers digital tailor service. From the platform women can personalize their products by selecting pre-determined items alterations, and in which people can see who the garment and their bodies change, and how they match during all the stage of pregnancy. With the objective to attach the project with the circular fashion values, the service offers two different ways

of production traditional and networking. Both designs proposal products and service ca be consulted on chapter 7. The aim was to create a space in which mothers can feel secure and integrated. Make them feel like they are in control of the situation.

To assess whether the system can help women reduce their body dissatisfaction and whether the system meets the above requirements, the design proposal underwent through an evaluation. It was conducted a survey with potential users (i.e., pregnant women) to evaluate 5 main aspects: 1) product design (characteristic, performance, alterations, functionality), 2) service design (user experience, functionality), 4) acceptance of system technologies (comfort and if women would be willing to use them.), 5) if they believe that the project could help improve their self-esteem during pregnancy. The results presented on 8.1.5 showed than women love the idea of the personalization and tailor products. They also point out that the sustainable method is attractive for them, and that the service can help them to feel happy and improve their self-esteem. However, to be able to fulfil the objective of the project, it is necessary to improve connectors product designs, explores more connectors on light materials, clarify how the adjustable product mechanism work, implements more personalization options on the service as fabrics and bright colours, and show better material characteristics and laser cut suppliers (Fablabs). The results exposed on chapter 8 will help the project to improve its design to guaranty the reduction of body dissatisfaction on women during pregnancy related with the fashion system.

I strongly believe that the contributions of this dissertation constitute a step forward to create inclusive products service systems. In which people can feel integrate, and in which body can be revalorized. It is an example that can wide designers to think in new ways in how mix the new technologies and methods to create solutions that can help industry to design democratic, sustainable, and inclusive products and services for people that feel segregated for the current fashion system.

9.2

FUTURE APPROACHES

It was identified specific areas and methods that can be improved in the future. Below the thesis provide a summary of these improvements.

Include the two phases of functionality theory. Functionality theory has two phases. The one where women have contact with their emotions and reconcile their being, and phase of the body function, where women search for activities and things to relax their bodies as physical activity and functional items. In this moment the project is focused on solve functionality problems that women have during pregnancy, the second phase of the theory. To have a better result on body positivity on pregnant women the project must search for innovations to be able to implement the first stage of the therapy.

Fablabs collaboration. The project must search in detail more Fablabs contact suppliers to promote the project on different world zones. In this case it is necessary to search specialized laboratories as Fabricademy to be able to include more personalization options on the networking production.

More personalization options. The implementation of more customization options should be implemented such as fabric selection, prints, and bright colors. This will guarantee that women can express themselves in deep, and diversity on designs among them, generating expectation of something new every time the customer makes the purchase.

Review 3.0 technologies. The project only focused on designing the user experience on the digital platform. However, to carry out the real prototype of the platform, a deep investigation should be done about implementation of web 3.0 technologies.

Improve connectors design products. Base on the result obtained on the testing and evaluation of the proposal, chapter 8, a new collection of products with connectors must be done, taking in consideration design of garments that require more structure as jackets, blazer, or suits.

Physical prototype. It must be made a physical prototype of the products to tasted and see the product behavior on real materials and on a human body.

Experts' evaluation. An evaluation should be carried out with the experts to know if the design solution adheres to the criteria that they use to reduce body dissatisfaction in pregnant women.

Connector with light materials and curves. It is necessary to develop more experiments to find connectors that can work on light materials. This will help the project to have more options to be produced by networking laboratories.

Teach people about connectors and adjustable mechanism. It is necessary to clarify how the adjustability mechanism and connectors works, how they create a sustainable product, in order to impulse the selection of this products by the consumer.

10

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11

APPENDIX

11.1

APPENDIX A INTERVIEW AND SURVEY QUESTIONNAIRES: USER-CENTERED RESEARCH

11.1.1 A.1 INTERVIEW: EXPERTS

PREGNANCY / POSTPARTUM BODY IMAGE

The following questions are related to the perception of body image during pregnancy and postpartum. The objective is to deepen the knowledge of the treatments used during gestation and postnatal regarding the dissatisfaction of the body, caused by the objectification of women in society and media, to generate a design proposal that serves as a tool to solve this problem. The information provided will be analyzed and used for academic purposes. Data would be used in an aggregated format.

1. How common is it for a woman to feel dissatisfied with her body during postpartum pregnancy?
2. In your experience, what are the reasons why women during pregnancy and postpartum suffer dissatisfaction with her body?
3. What type of therapy or treatment do you think is best to treat body dissatisfaction during pregnancy and postpartum? Why?
4. What type of exercises do you use and propose to women during pregnancy and postpartum in relation to the changes in their bodies?
5. What do you think of cognitive behavioral therapy during pregnancy and postpartum?
6. Do you think that cognitive-behavioral therapy can help women to be happy with the changes in their body during pregnancy and postpartum? How do these types of therapies work or are used?
7. The theory of functionality helps people to appreciate their body for what they can do and not so much for their appearance. Have you ever used exercises related to this theory? What type of exercises have you used?
8. Have you felt the need to require some support material to help you give therapy focused on the appreciation of the body? If so, what type of material?
9. What kind of elements do you think are necessary for women to develop body satisfaction during pregnancy and postpartum?
10. Do you think clothing can help generate a positive image of the body during pregnancy and postpartum?
11. What requirements or mechanisms do you think clothing should have to generate a positive image of the body during pregnancy and postpartum?
12. Do you think that body exploration helps pregnant women reduce their body dissatisfaction?
13. Do you think that self-massage can help women appreciate their body and relax?
14. Do you think that yoga exercises can help women to become aware of their body and appreciate it more?

11.1.2 A.2 SURVEY: USER

BODY IMAGE

Greetings,

I am doing my degree project about body image during pregnancy. The following questions are related to the processes of body changes during pregnancy to find the feelings and situations that women experiment during this period to find a solution that help them to improve its self-esteem and confident during this phase. The results will be used to guide the design of a modular / flexible systems of garments.

This survey contains 28 questions. It is completely confidential; name is not required. The information collected will be used for academic purposes and data are going to be used in an aggregated format.

Thank you for helping me!

1. Are you pregnant or have you been pregnant?

- I am pregnant
- I have been pregnant

2. What is your age?

- 15-20
- 20-25
- 25-30
- 30-35
- 35-40
- 45-50
- 50-60
- 60 - More

3. Where are you from?

4. During the pregnancy and post-partum period, have you/did you feel self-conscious about the physical changes in your body?

- Yes
- No

5. What kinds of feelings have you had during pregnancy and post-partum regarding the changes in your body? (e.g., insecurity, joy, fear, motivation) Why?

6. What parts of your body are the ones that make/made you feel insecure during pregnancy and post-partum period? (You can choose more than one)

- Abdomen
- Chest
- Waist
- Hips
- Legs
- Face
- Arms
- Feet
- None, I did not feel insecure about my body.

7. During pregnancy, have you/did you considered/consider that the changes in your body were okay because you related them to the health of your baby and yours?

- Yes, this helped / helps me to accept the changes and make me feel good
- No, I did /do not consider it

8. Have you ever taken therapy to help you in the adaptation process of your body during pregnancy or after pregnancy?

- Yes, I have
- No, but I would like to
- No, I never considered it or have considered it necessary
- Yes, I have considered it, but there is never time to do it

9. During pregnancy what activity did / do you do that helped /helps you to feel good with your body and relax? (e.g., walking, yoga, massages, stretching)

10. Have you ever admired your body for what you can do with it? For example, breathing, thinking, smell, feel emotion, physical activity. How do you realize these functions? (e.g., Yes, I realize because, I dance, and I feel and touch my body during the practice)

11. Have you tried to hide the imperfections of your body caused by pregnancy and childbirth, such as scars, stretch marks, skin marks? Why and how do you hide them?

12. What beauty rituals have people suggested you during pregnancy and after pregnancy? And how did / do this make you feel? (e.g., people suggested me to wear a girdle, and this made me feel uncomfortable because it limited my movement)

13. What things or activities help you feel good about the changes in your body during pregnancy and postpartum?

14. Do you think that maternity clothes affect your perception about your body? Why?

15. During pregnancy which kind of garments did / do you prefer to dress? (e.g., comfortable large t-shirts, pre-maman trousers, super large dress, etc.)

16. Do you think that pregnancy clothes are expensive?

- Yes
- No

17. Where did / do you buy most of your clothes during pregnancy?

- Specialized department stores
- Supermarkets
- Second-hand or borrowed clothing
- Normal stores
- Fast-fashion maternity stores
- I made my own clothes
- Other, which ones?

18. Why did / do you buy in these stores?

19. Did /do you limit yourself to buying essential clothes during this period?

- Yes
- No

20. Did / do you wear clothes borrowed from your husband or boyfriend during pregnancy? If it is positive, why did / do you use it? and how did / do you wear it?

21. Did / do you feel that you could express your personality with the pregnancy clothes that you have or had?

- Yes, I feel/felt complete
- No, I feel/felt that my wardrobe was very limited
- No, I feel/felt that I cannot express myself

22. Do you consider that current maternity clothes are? (You can choose more than one)

- Ugly
- Reliable
- Not very attractive
- Pretty
- Comfortable
- Uncomfortable
- Does not good for work
- With old design
- Disposable
- Pleasant
- Refreshed
- Others, which ones?

23. What essential needs do you consider that maternity clothes should cover? (e.g., allows freedom movement, comfortable, adaptable to the body, different style options)

24. What essential needs do you think maternal clothing should meet after pregnancy? (e.g., that allow breastfeeding, allow to collect breast milk, to permit easy movement)

25. Did you buy or adapted your clothes for different stages of the pregnancy?

- Yes
- No

26. If you are adapting / adapted your clothes for different stages of the pregnancy, how do / did you adapt it?

27. After your pregnancy, did you wear your pregnancy clothes again?

- Yes
- No

28. What did you do with the maternity clothes that you used?

- I threw them away
- I donated them
- I gave them away to friends
- I kept them in my closet
- Other, which ones?

Optional: Thanks for helping me! If you are interested in this project and would like to participate in the design stage and know the final result of the design proposal, please leave your email.

11.1.3 A.3 SURVEY: EXPERTS FOCUS ON BODY

PREGNANCY / POSTPARTUM BODY EXPLORATION

The following questions are made to know more about your experience with body exploration on pregnant women. To know more about type of exercises used on the practices and support/touch points that can help women to feel better with their bodies. The information provided will be analyzed and used for academic purposes. Data would be used in an aggregated format.

1. As an expert, do you consider that physical activity such as yoga can help reduce women's anxieties caused by dissatisfaction with her body? Why?
2. Do you think that self-massage and body exploration can help women reduce their anxiety levels and appreciate their body more for what it can do and not so much for its aesthetics? Why?
3. What types of exercises do you think pregnant and postpartum women should do to feel more comfortable with their body?
4. What are the points at which a woman could self-massage during the pregnancy stages?
5. What are the points that the woman could self-massage after giving birth?
6. How and in what direction should the pregnant woman self-massage?
7. What other type of body exploration would you recommend to pregnant women? Why?

11.2

APPENDIX SURVEY QUESTIONNAIRES USER VALIDATION SURVEY

11.2.1 APPENDIX B SURVEY QUESTIONNAIRE: TESTING AND VALIDATION

NAWALE

Greetings,
I am doing my degree project about body image during pregnancy. The following questions are related to Nawale project, which provides specialized maternity products that adapt to changes in the body during pregnancy. The goal is to make tailor-made products that offer freedom of movement, comfort, and personalized style.

The brand seeks to provide support and freedom to women during this transition stage where we know that feeling good about the body is of vital importance. Nawale wants to break with the stereotypes of the perfect body and with the idea that women should conform to clothes and not clothes to the body. Likewise, the brand seeks to provide modern, contemporary, adaptable styles, generating the least possible waste.

The results will be used to know your opinion about the service and products that offer the brand. Before to answer please see the images, and video included on the questionnaire.

KIMONO DRESS

Kimono dress is a garment perfect to work and daily life, it is thinking to be produced on thin light weight recycled fabrics. Its design provides comfort and perfect fitting. The dress has a mechanism that help you to adjust it to your body during the different stages of the pregnancy. Furthermore, it contains special personalized cuts that makes the garment flexible and comfortable and aesthetically appealing.

The dress can be customized to match with your style. You can change colour, pockets, sleeves, length, neck, auxetic figures and zipper (to provide breasts feeding).

1. What do you think about the Kimono dress?
2. What else would you like to be able to customize on the kimono dress?
3. What did you like the most about the kimono dress?
4. What did you like least about the kimono dress?

WESTERN DRESS /DIY

Western dress is a garment perfect to work and daily life, it is thinking to be produced on thick recycled fabrics. Its design provides comfort and perfect fitting. The dress has a mechanism that help you to adjust it to your body during the different stages of the pregnancy. It contains special personalized cuts that makes the garment flexible and comfortable and aesthetically appealing.

The dress is meant to be produced locally without sending it physically from far distance. It is using Fablab places where it is possible to laser cut the pattern. People (user) will receive the instruction plus the parts to be assembled through special and tested connectors. These connectors were tested to resist the flexibility of the dress, and they will enable a better disassembly at the end of life of the garment since there are not different materials accessories to be disassembled.

Furthermore, the dress can be customized to match with your style. You can change colour, pockets, sleeves, length, neck, auxetic figures and connectors.

5. What do you think about the western dress?
6. Do you like the idea that you could produce it an ensemble at home? What do you think about the connectors?
7. What else would you like to be able to customize on the western dress?

8. What did you like the most about the western dress?
9. What did you like least about the western dress?

SUPPORT BELT

The support belt is an accessory perfect to work and daily life, it is thinking to be produced on thick recycled fabrics. Its designs provide comfort and perfect fitting. The belt has a mechanism that helps you to adjust it to your body during the different stages of the pregnancy. It contains special personalized cuts that make it flexible and comfortable and aesthetically appealing.

It is designed to help you to prevent lower back pain. It also can be used to provide massage and relief during pregnancy. For its design it can be easier attached and can be used even after childbirth.

The accessory can be produced by us, or you also can select to be manufactured at home! (DIY). Furthermore, the belt can be customized to match with your style. You can change colour, width, and auxetic figures.

10. What do you think about the support belt?
11. What else would you like to be able to customize in the support belt?
12. What did you like the most about the support belt?
13. What did you like least about the support belt?

SERVICE

Nawale provides specialized maternity products that adapt to changes in the body during pregnancy. The goal is to make tailor-made products that offer freedom of movement, comfort, and personalized style.

Through our 3D platform, the customers can customize their product, see their own 3D avatar according to their body measurements. They will be able to see exactly how their clothes will look and fit during the different stages of the pregnancy. Women also will be in direct contact with our tailors, the product is not manufactured until the customer is satisfied.

Our method allows us to produce on demand. This means that only the amount of clothes that is needed is produced, reducing pollution of processes and materials.

14. What do you think about our service?
15. Do you like the idea of perfect fitting garment?
16. What do you think of the 3D scan? Do you like?

17. What do you think about the customization system?
18. Do you like the idea of the virtual fitting session?
19. What is the feature that caught your attention the most?
20. What feature did you not like you? And why?
21. Would you like to buy through our platform?
22. What would you change or add to our custom process?
23. What do you think about our alternate production system?