

[Original Article]

Example of iterative process in upcycled clothing design: Unused neckties and upholstery scraps

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Abstract

This study proposed a base framework for creating sustainable designs with textile production waste and unused neckties with the “design thinking” approach, which is an iterative process. It aimed to set an example of how fashion designers can plan and manage their clothing design processes in a more sustainable way by recycling textile production scraps and unused neckties into unique clothing pieces with the upcycling method. Unused neckties and upholstery scraps were turned into skirts, blouses, and dresses by using creative techniques in line with current fashion trends. In addition, the five-stage iterative design process followed was explained, and the way in which the waste textile materials gained value by being converted into unique garments was discussed in terms of the user and the designer. Through the study, it was observed that the smallest amount of textile waste can be transformed into upcycled clothing via the iterative process, and original, value-added products enjoyed by consumers can be created. In addition, it was observed that the design thinking approach improves the understanding of the context of the problem, creativity in the generation of insights and solutions, skills to materialize those solutions through iterative prototyping, and the ability to combine these factors. Promising ideas to help designers develop recycling strategies were also provided.

Keywords: upcycling, design thinking, iterative process, textile wastes, unused neckties

I. Introduction

The fashion industry has undergone considerable change over the years. It has expanded and will continue to expand. Nowadays due to increasing demands for fashion items accelerated by population growth and economic development, a significant volume of apparel products are sold. Fashion industry needs to quickly respond to the consumer demand and the severe competition, apparel companies need to keep the production cost low and the variation of products few. For this reason, it can be said that the fashion industry relies on the constant change of products, correlating with the consumers’ need for change, the changes in their lifestyle and their wish for difference.

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The trend for consumption patterns has rapidly evolved over the last 20 years. The changing demands and behavior of the consumer are the most prominent differences in today's fashion world. Mass communication leads the consumers to an extensive access to the flow of information around the latest trends which are moving around the globe at speeds never seen before. Consequently, consumers became more sensitive to style and are demanding variety, originality, sincerity, spirit, and environment-friendly characteristics in designs more than ever. Therefore, the current consumption trend has promoted the production of low durability clothes in large quantities at low unit prices (Fletcher, 2008; Hawley, 2008; Hethorn & Ulasewicz, 2008). Thus, fast fashion emerged in the fashion industry from the consumers' perspective.

In recent years, designers from fast fashion retailers started to attend numerous fashion shows and to get inspirations from the new designs and styles; and later merge the latest trends in their own designs in a rapid and cost-effective way. Some fast fashion retailers collaborate with fashion designers. Because consumer needs are changing at a fast pace, and the women of today are revising their wardrobes far more often, than in previous years. Retailers such as Zara, H&M and Mango, have distinguished themselves for their ability to react almost instantly to current trends, and have expanded throughout the world with exceptional success.

Consumer behavior and perception towards fast fashion has changed. From conservative consumers' perspective, fast fashion is viewed as a 'waste', because rather than buying one high quality item to satisfy a wardrobe need, consumers buy multiple items that are lower quality and then throw old merchandise away as quickly as they bring in new ones. Young people, however, would prefer a higher number of low-quality, cheap and fashionable clothes (Sydney, 2008). Fast fashion depends on continued marketing of new products and disposal of old ones that are thrown away simply because new styles promote their

obsolescence (Claudio, 2007). These are the characteristics of fast fashion and encourage consumers toward overconsumption. Thus, the purchase rate of clothing and disposal has dramatically increased and the path that a clothing travels from the shops to the landfill has become shorter.

Because clothing is a highly symbolic product and a sign of high social status, consumers want to buy clothing at a much more frequent pace. The fast fashion trends provide low quality and low-cost clothes with a new value. As a result of lower prices people may buy more clothes. Consumers constantly throw away clothing not because they are worn out but because they are outdated. Seasonal and fast changes in fashion mean that clothes can become outdated very quickly, and this encourages the replacement and disposal of outdated, yet good quality garments. This means that clothes can become outdated very quickly and this causes the replacement and disposal of outdated clothing. They are sometimes given to charities or sold second hand, but more typically are disposed of and end up in municipal landfills. As a result, textile waste is generated. Therefore, clothing has been identified as the fastest increasing stream of household waste, growing more rapidly than even plastic and glass waste.

The culture of transience, newness and perceived obsolescence is so prevalent in the fashion industry; it has led to growing over-consumption and consequentially high volumes of waste (Han, Tyler, & Apeagyei, 2015). But the journey of a piece of clothing should not always end at the landfill. Nowadays, designers are taking greater responsibility for the problems presented by the inefficient and unsustainable systems used to create new fashion items. Innovative eco-designers are developing designs at different levels of the fashion spectrum, from casual clothing to haute couture; and these designs are presented to consumers.

Today, sustainable design and business strategies include ethical and value-based thinking. While true

sustainable thinking is rather wide and needs a holistic understanding and approach on many levels, it is more common to focus on one narrower approach to eco-design and sustainability (Niinimäki, 2013). Although environment is an important component for achieving sustainability, literature suggests that leftover fabric scraps in apparel manufacture or old garments thrown into trash are not generally addressed. Since garment production depends on natural resource availability and labor; unethical treatment of the manufacturers could lead to the loss of natural resources and environmental degradation. Therefore, sustainability in design -as a principle for manufacturers and designers- should continue strongly, by ensuring, protecting and enhancing.

With the “fast fashion” practices in recent years, the contradiction between fashion and sustainability has gained even more importance; which has caused an effort to create different approaches to fashion in order to raise awareness (Koca, 2019). Many environmental benefits can be derived from an emphasis on the efficient use of resources, whether through specifying less harmful materials or processes, or thorough recycling. In order to increase reuse and recycling activity there is a need to explore other methods of recycling and new sustainable strategies such as new added value products. As part of this strategy, designers should develop a ‘clothing roadmap’ which will propose sustainable solutions for clothing and textile waste arisings. The journey of a piece of clothing or textile production scraps may not always end at the landfill. Even the smallest textile waste can be converted into a value. These can be used for the manufacturing of new clothing designs that cost less, are original end eco-friendly without chemical or mechanical processes. The properties of used clothing such as size, material, color or pattern are not important for this. With appropriate design methods and creativity of the designer, it is possible to transform every piece of clothing into new and unique designs. Practices and academic studies on this subject reveal

that the method used in design is important for sustainability. For this reason, the application of an iterative design process, which is based on a design-oriented research that is tested by producing insights through constant experimentation with materials and forms, makes this work different from others. Every phase of design thinking is explained and analyzed together with insights on navigating through the process. Also, since it is a user-centered approach focused on early customer orientation, it makes ideas tangible at an early stage so that prototypes are created as quickly as possible. Thus, sustainable design practices can be given a different perspective.

Based on the question “Can the smallest waste be a great value?”, the necktie-to-clothing journey of the necktie, which is the most important complement to men’s clothing, is thought to be interesting as an example. Awareness on the evaluation of textile wastes can be increased by converting one of the small pieces of clothing, such as a tie, into a unique wearable design. Because the necktie is found in most men’s wardrobes and is often thrown away when it is outdated. A small piece of clothing that is worthless as a post-consumer waste will be able to attract consumers’ attention when it turns into an original clothing design with high added value and low cost. In terms of design, upholstery fabric scraps were used with neckties, because they are suitable for the fabric, texture and pattern properties of neckties. Thus, it was shown that even the smallest textile wastes can be converted into a value in line with the consumer’s expectations.

There is a need for a new narrative in which waste recycling is not only about economic concerns, but is primarily about social justice, materials, and people. It is believed that the designs of clothes with increased design values can contribute to this narrative. Apart from industries’ by-products, one of the other factors responsible for polluting the environment is the ignorance about disposal of waste amongst the public. They also do not have adequate facilities for

dealing with waste. Upcycling clothing designs can encourage people to think about using clothing with increased design value instead of buying new clothing. Also, these designs can be popular both manufacturers and designers because they are fashionable, photogenic and take little time to produce. In this respect, this study will increase the awareness of consumers towards the evaluation of textile wastes. Thus, designers can spread awareness not only to other designers, but also to others in their near environment or the social world in which they function. With its design thinking approach, this study also proposes a base framework to create fashionable and sustainable designs with textile production scraps and unused neckties in terms of sustainable fashion. Thus, it will, we hope, be made evident that in order to clarify the essential method and style of inquiry encompassed by design thinking.

II. Background

1. Design thinking

In recent years, “design thinking” has been used as one of the approaches for innovation, which has an increased importance in every field. Design thinking is a method of innovation using the human-centered approach with a designer’s sensibility and creative problem-solving skills. It also refers to how the designer thinks and the designer’s reasoning.

By challenging patterns of thought, behavior and feeling, “Design Thinkers” produce solutions that generate new meanings and activate diverse elements - cognitive, emotional and sensory - that are involved in the human experience (Vianna, Vianna, Adler, Lucena, & Russo, 2013). Therefore, design thinking is a powerful process that facilitates understanding and framing problems, enables creative solutions, and provides fresh perspectives. Curedale (2013) mentions 3P of design thinking: People (the human being), process (the problem solving process) and place (the working spaces) must be considered for successful

idea development. A fourth P can be partnerships, since a large number of partners must be involved in the development and implementation of ideas (Roterberg, 2018).

The notion of design thinking has been largely popularized by design firms such as IDEO that have been working on new product developments for decades. Currently, application of design thinking is done in various forms. According to Plattner, Meinel, and Weinberg (2009), the design thinking process consists of six process steps with iteration loops: understanding, observing, defining problems, finding ideas, developing prototypes and testing. Woolery (2019) states that the design thinking process is not necessarily linear, nor is there one canonical way to approach it; it is an iterative system with many variations and consists of five phases: empathy, definition, idea, prototype and test. According to Verganti (2008), design thinking includes a series of iterative activities: an initial exploratory set of activities focused on data gathering to identify user needs, design criteria and problem definition, followed by the generation of ideas, which are then prototyped and tested.

The design thinking process goes through a cycle of generative flaring and selective focusing. Empathy is the central element, which is to put oneself in the position of the customer/user and to observe them in detail (Roterberg, 2018). The define phase aims to define the problem along the extracted insight, the unique approach, design goal with originality to the solution (Sakama, Mori, & Iba, 2018). In the ideate phase, a multitude of ideas and selected promising solutions are generated for prototyping. Prototyping helps to see and solve problems in design and test ideas quickly. Test is the final phase. At this stage, ideas are further developed and tested through further experiments and customer feedback. Each step along the process adds an opportunity to rethink, relearn, and reboot as needed. Design thinking creates team-oriented, creative working spaces and consists of frequent iteration loops between the process phases.

Therefore, design process is rarely linear.

2. Textile wastes and sustainability

The EPA, under the Resource Conservation and Recovery Act, considers many textile manufacturing facilities to be hazardous waste generators (Claudio, 2007). Textile recycling material can be classified as pre- or post-consumer waste. Pre-consumer waste is defined as waste that during the manufacture of a product while post-consumer waste is “any type of garment or household article made from manufactured textiles that the owner no longer needs and decides to discard”. Every step from the production process of the clothing to the end of their life cycle has the potential for environmental impact. Textile recycling, on the other hand, most often refers to the reprocessing of pre- or post-consumer textile waste for use in new textile or non-textile products (Sandin & Peters, 2018).

Fast fashion has made it possible to produce clothing at increasingly lower prices; prices so low that many consumers consider this clothing to be disposable. As a result of lower prices people may buy more clothing that is less recyclable. Production process of new clothing often involves energy intensive processes which generate a considerable amount of greenhouse gas emissions. Accelerated production and the trend for fast fashion lead to excessive consumption and sustainability problems caused by mass production, including air pollution, water contamination, waste treatment etc. Since the current energy generation is mostly from non-renewable sources, its contribution to climate change is also unavoidable. As a result, the apparel industry continues to create challenges to sustainability both at regional and global level. Yet fast fashion leaves a pollution footprint, with each step of the clothing life cycle generating potential environmental and occupational hazards. Because of the previously mentioned environmental hazards, there is an interest in regulating the textile reuse and recycling in the fashion industry.

The environmental impacts of apparel production vary depending on the raw material and how items are made. For example, the manufacture of polyester and other synthetic fabrics, which are the most widely used materials in the fashion industry, is an energy-intensive process requiring large amounts of crude oil while also releasing emissions. Conventionally grown cotton, one of the most popular clothing fibers, is also one of the most water- and pesticide-dependent crops in the world. In addition to this, extensive water and chemical use during production can be considered to have one of the most significant environmental impacts. Dyeing and bleaching of textiles also generates highly toxic wastewaters. Wet treatment processes (dyeing, finishing, printing, etc.) are major sources of toxic emission (Roos, Sandin, Zamani, & Peters, 2015).

In addition to wearing clothing pollute soil and ground water when disposed. Textile waste in landfill contributes to the formation of leachate as it decomposes, which has the potential to contaminate both surface and groundwater sources. Another product of decomposition in landfill is methane gas, which is a major greenhouse gas and a significant contributor to global warming. A particular problem of synthetic products in landfill as is that synthetic products will not decompose, while woolen garments do decompose and produce methane, which contributes to global warming. The decomposition of organic fibers and yarn such as wool produces large amounts of ammonia as well as methane (Blackburn, 2005; Cupit, 1996). Clothing scraps and used clothing are also incinerated in large quantities. Incinerators emit organic substances which are all potentially harmful to both humans and the environment. It is difficult to estimate how many tons of garments end up in global landfills or incinerators annually. For all these reasons the whole process in clothing causes environmental degradation, though the impacts are not visible when clothes are purchased.

Pre-consumer waste is easier to recycle than post-

consumer waste. Manufacturing residues (pre-consumer waste) can be collected in the factory and re-spun with the help of virgin materials into new yarn, this practice is more common than using post-consumer waste. But the amount of post-consumer waste is excessive and keeps increasing, so this waste stream should also be recycled (Hvass, 2016). The Council for Textile Recycling (2020) is trying to raise public awareness about the importance of textile recycling and the need to reduce the amount of used clothing and other post-consumer textile waste. The Council's goal is to have no textile waste going to landfills by 2037. The recycling of textile waste is not only an important means of solving numerous environmental problems but also a means of socioeconomic and environmental sustainability (Cuc & Vidovic, 2011). Today, the textile industry must assume a prominent role in the sustainability movement and find ways to stop its enormous generation of waste and pollution (Savageau, 2011). Therefore, designers need to 'build in' the possibility of re-using, re-styling, redesigning, and re-manufacturing to the design of all products; in other words, they need to create sustainable designs.

3. Textile recycling

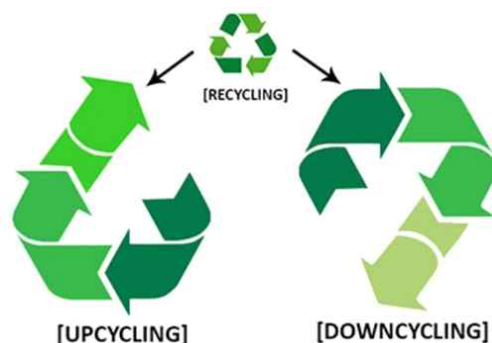
Today, the globalized, highly competitive fashion industry has reduced prices to a level so low that clothing has become almost a disposable commodity (Claudio, 2007). Sometimes even not so worn clothes are discarded as they become unfashionable or undesirable. There is also post-industrial waste produced in yarn, fabric and garment manufacturing processes. Therefore, "The textile and apparel recycling effort is concerned with recycling, recycle-ability, and source reduction of both pre-consumer and post-consumer waste" (Hawley, 2006). For economic and environmental reasons, it is necessary that as much of this waste as possible is recycled instead of being disposed of in landfill sites.

Recycling is the method of reusing or reprocessing used clothing, fibrous material and clothing scraps

from the manufacturing process (Cuc & Vidovic, 2011). In terms of textiles, recycling can cover many different areas. Clothing and materials can be recycled. There is the recycling of materials in a more industrial context. This include the production of recycled yarn where textiles are unravelled and re-spun into new fibres. While upcycling and downcycling are both examples of recycling, not all types recycling are considered equal. Upcycling, downcycling and recycling are various ways to reuse waste materials (Fig. 1). There is a clear distinction between them. What is the difference between upcycling, downcycling and recycling?

4. Downcycling

Downcycling recycles the material into a lower quality substance, which is then used to create a lower-grade product. This is often because the nature of the material prevents it from retaining its former durability once re-processed. When plastic bottles and materials are recycled by mechanical methods, the plastic gets weaker. However, downcycling makes it possible to still put the recycled materials to good use. Common example of the downcycling process includes transforming plastic bottles into carpeting or fleece fibers and lower quality products such as doormat. Used clothing recycled into non-woven textiles, building insulation, rags, or carpet underlay are also examples of textile downcycling. Plastic bottles



<Fig. 1> Upcycling, downcycling vs. recycling

are also upcycled into goods of a higher quality, such as textiles.

5. Upcycling

Upcycling refers to reusing an object in a new way without degrading the material it is made from (Goldsmith, 2009). The goal of upcycling is to prevent the wasting of potentially useful materials by making use of the existing ones (Teli, Valia, Kadu, & Dahale, 2015). Upcycling is the opposite of down-cycling. Upcycling reuses materials that may otherwise end up in the landfill in creative and innovative ways, but it is first and foremost the story of the re-design process. In other words, it produces original and often one-of-a-kind items from what many consider to be waste. The process is related to the recreation of used materials also known as waste materials- and giving them another function without having to spend much to get new materials. Upcycling is also related to re-assessing and recreating which pave the way to innovation and value.

As a design based on waste solution, upcycled fashion production utilizes textile waste to create products with a higher retail value than traditionally recycled goods. It seeks to provide a transitional solution to the textile waste problem (Han et al., 2015). Upcycling can be done using either pre-consumer or post-consumer waste or a combination of the two. It is a way for companies and designers to be more efficient with leftover materials such as upholstery scraps or vintage textiles, and to give them a new purpose. Upcycling is not just a design approach. The upcycling processes and upcycled products demonstrate the interrelation between old and new, and even reflect the designer's general understanding of creativity on 'old' and 'new'.

Called the "trashionable fashion movement" in recent years, upcycling has been shaping the design world ever since it appeared. Kallio which is kid's wear brand, whose clothes are know to be fun and functional with a green heart. Kallio recrafts men's

dress shirts into stylish, modern classics for kids aged infants to 8 years old. The garments developed by Kallio are recreated from used vintage clothing, which are popular for their unique colour, pattern and design. Reformation is fashion company and aims creating sexy and sleek styles for women. Raw materials at reformation include new sustainable textiles, repurposed vintage clothing and rescued dead stock fabric from fashion houses that over- ordered (Muthu, 2017). There is a plethora of inspirational design in this facet of eco-fashion. Many brands such as Sword & Plough, Looptworks, Boom Shankar, Bottletop Fashion, Triarchy Atelier, Elvis & Kresse, The R Collective, Reformation, and designers like Vivienne Westwood, Christopher Raeburn, Charlotte Bialas, Duro Olowu have been effectively upcycling for years.

Holm and Holm (2010) argue that fashion helps to create identity, personality and meaning, which is what consumers seek in fashion consumption. In this context, worthless materials being valued as, new and unique clothing with the upcycling process will be meaningful for the consumers. But most importantly, it illustrates and encourages responsible design ethics by acknowledging the wider environmental issue of waste. This in turn also raises consumer awareness on the subject of sustainability. The benefits of upcycling include using waste as a source material, diverting it from landfill and in doing so reducing carbon emissions as well as other negative environmental impacts.

III. Material and Method

1. Material

In this study, it is aimed to set an example of how fashion designers can design and manage their clothing design processes in a more sustainable way by recycling textile production scraps and unused neckties into unique clothing designs with the upcycling method. The materials used in this study are unused neckties and upholstery scraps. Unused neckties and

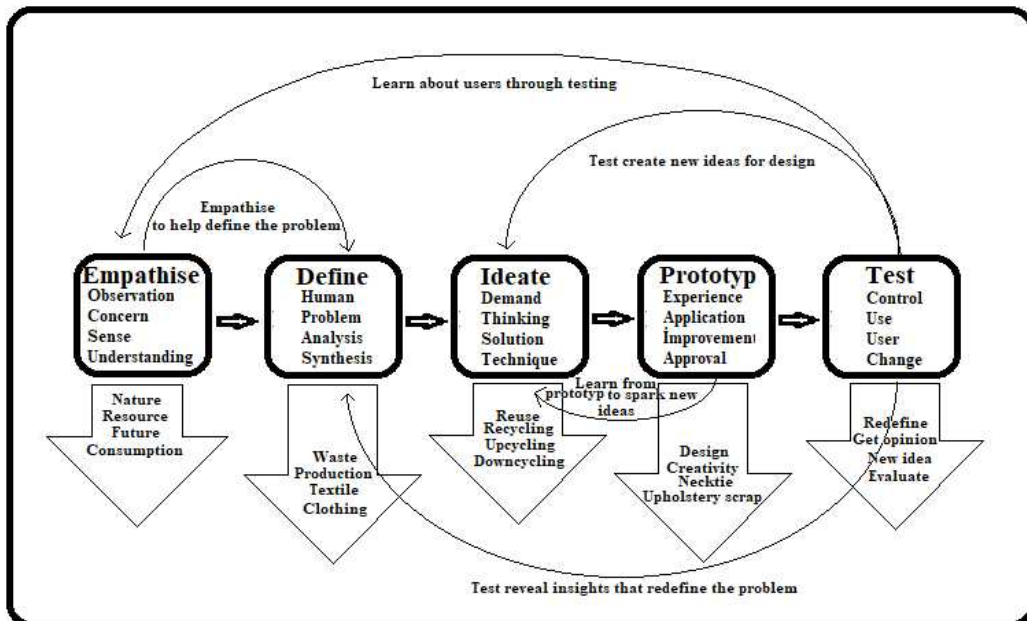
upholstery scraps were turned into skirt, blouse and dress designs by using creative techniques in line with current fashion trends.

2. Method

In this application and action research, “design thinking” approach, which is an iterative process, has been adopted. Design thinking is an iterative design methodology that provides a solution-based approach to solving problems. Iterative design is the key part of action research (Allen, 2020). It’s extremely useful in tackling complex problems that are ill-defined or unknown by understanding the human needs involved, re-framing the problem in human-centric ways, creating many ideas in brainstorming sessions, and adopting a hands-on approach in prototyping and testing. Design thinking model involves 5 phases that feed into one another; empathize, define, ideate, prototype and test (Dam & Siang, 2020). In this study, the process of converting old ties and upholstery pieces into clothing was based on the 5-stage iterative

design model (Design thinking: A nonlinear process) of Teo Yu Siang and the Interaction Design Foundation (Fig. 2). In this action research, the researchers worked directly with users as co-researchers, on an iterative cycle of learning, reflection and action. The designers know that to identify the real problems and solve them most effectively, it is necessary to approach them from different perspectives. For this reason, the researchers have worked as a team in a collaborative effort that offers diverse viewpoints and a variety of interpretations on the subject at hand, which will yield innovative solutions. In addition, the iterative design process followed was explained, and how the waste textile materials gained value and were converted into unique clothing designs were discussed in terms of user and designer.

Iterative design process moves from design to evaluation, to redesign and reevaluation, then back to design again, and so on (Xie & Matusiak, 2016). As the first step of working in this direction, a substantial amount of information was gathered at “empathi-



<Fig. 2> Iterative process of transformation of old neckties and upholstery scraps into creative clothing designs

zing” stage, to use during the next “defining” stage and to develop the best possible understanding of the users, their needs, and the problems that underlie the development of that particular design. In line with the information about the environmental hazard of the textile and fashion industry, pre-consumer and post-consumer textile wastes have been identified as problems (define stage). Consumers’ sensitivity to problems and their expectations from upcycling clothing designs have been determined.

In the next stage (ideate), it was adopted that converting these wastes into clothing designs could be a solution to the problem. Considering majority of textile waste consists of household sources, generally thrown out as old clothes, it was thought that unused neckties and fabric scraps generated a significant amount of waste. It was decided to design original clothing with the upcycling approach that turns these worthless textile wastes into valuable products. Within the scope of the problem, many skirts, blouses and dress sketches were drawn. During this stage, by testing the previous phases, an iterative process typical to grounded research was followed. Sketches were tested with the data collected during the empathise stage and models were developed according to user opinions. It was decided to produce prototypes of models, which are considered the best solution to the design problem.

In prototype stage, skirt, blouse and dress designs were prepared using old neckties and upholstery scraps in line with current fashion trends by using creative techniques. In the final phase, all designs were rigorously tested by designers using the best solutions identified in the prototyping process. During the testing process, the accuracy of the data, determinations, solutions and applications in the previous stages were checked with users participation. Alterations and refinements were made in order to rule out problem solutions and derive as deep an understanding of the designs as possible.

The researchers’ own professional practices for

creating clothing designs with textile production scraps and unused ties have been documented to gain a deeper understanding of the upcycling process. This study also offers promising ideas to designers for developing recycling strategies. Designers recreated stylish and valuable clothes from discarded materials, and the benefits of this process are explained in this study.

IV. Upcycling Clothing Designs with Unused Neckties and Upholstery Scraps

Every day, ecological awareness increases more and more as many new techniques and approaches are considered to find solutions to the environmental problems in the fashion industry. New approaches developed by designers are based on efficient use of resources that are often perceived to be the central issue of design for sustainability. According to the principle of sustainability, designs are related to the designers’ need to conserve and reuse the Earth’s finite resources. For this, what the designer needs to know is how to design products with features that encourage consumers to adopt a more responsible behavior to the environment. Designers must create new strategies for sustainable designing with the clothes’ quality and life cycles in mind. They have to be able to design for several life cycles and focus on creating something more meaningful and special to the end user.

Design involves purposeful behaviour that is targeted toward certain goals and the creation of solutions. The goal of design may be to solve a problem that affects one or many people. In the design field, design is not seen as the prerogative of a select few. On the contrary, “we all can, and do, design and that we can learn to design better (Lawson, 2006). There are many models and techniques for fashion designers to adapt in their quest for sustainability. The important part is for designers to apply their knowledge, creativity, and experience on the study to a

suitable model with up-to-date trends and show examples of sustainability in fashion (Koca, 2019). Design-centered studies look for ways with which new functional and aesthetic solutions can be developed. One of the most appropriate sustainable design processes is upcycling; with it, waste textile products are converted into new clothing designs of better quality and higher environmental value. The designer can add value to these clothes -which are considered worthless- by combining the existing or self-developed different methods with creativity. Old or unused clothing can inspire designers to make new designs. Then, if we do not need to use anything new, why should we? So, we can take the first step by picking up unused neckties, clothing and fabric scraps in our own homes and the homes of the people around us. Afterwards, it is not hard to see “the transformation of the smallest waste into a great value” and experience the happiness by following the five stages of the iterative design process.

1. Empathise

In this stage, in order to increase the reproduction of discovery in this phase, observers need to focus not only the act of using the product but also observe the living environment, and speculative potential needs that may arise (Sakama et al., 2018). Accordingly, an analysis was made by separating complex concepts and problems into smaller, easier-to-understand components. The researchers started the process by looking for answers to the questions of “What do we know about the problem?”, “What does the consumer know about the problem?”, “Is the consumer aware of the problem?”, “Is design a solution proposal for the problem?” and conducted research to develop an understanding of the problems created by textile waste and the requirement. It has been clarified who will be integrated in the process. Detailed research and on-site observations have been made to define who will be integrated into the process and their needs and expectations in concrete terms. The researchers have

created an empathy map that includes four main titles (said, did, thought and felt) to record their observations.

The focus was concentrated on 10 users who have the same needs and expectations and are looking for suitable solutions. The participants in the research task were encouraged to gain new knowledge together with the researchers. Dialogue-based conversations were conducted with the users. First focus was the definition of the problem, which led to the emergence of new solutions. The target group was defined as 20-30-year-old girls and their needs and expectations were comprehensively understood. It was determined that the users expect the upcycling clothing to have elegance, originality and innovation that reflect the current trends, as well as comfort of movement. In short, at the empathize stage of the iterative process, required insights were provided to solve the problems. No matter the methods, a good empathy study will give the designer new perspectives on the lives of the users. This stage of the process can be seen as a way of becoming intimately familiar with an area of concern.

2. Define

In this stage the problem was defined along the extracted insight and the unique approach and design goal with originality to the solution. This step seems to have an important role to determine what problem they eager to solve in the system (Sakama et al., 2018). In the define stage the researchers have synthesized the observations on the users from the first phase, the empathize stage. In the empathy findings and free thinking environment, researchers approached the problem with the question “How can we do this?”. While two issues emphasized by consumers and researchers give the answer to this question, they have also been effective in determining the definition and design goal of the problem. The first is that recycling textile waste is seen as a responsibility for both the consumer and the designer, but both sides

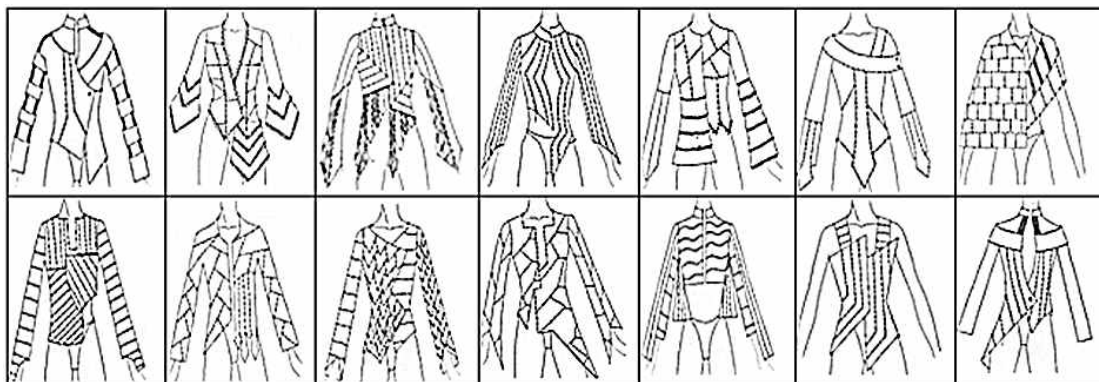
are not sufficiently implemented. The second is that pre-consumer and post-consumer textile wastes are considered a major problem by the majority of consumers, but recycling clothing is not preferred because of their simple and ordinary appearance. In the light of these findings, it was decided that the conversion of textile wastes into single and unique clothing designs with a design thinking approach would be a unique solution to the problem.

In this second (define) stage, where the economic, ecological and social effects of textile wastes are defined as problems, the conversion of unused neckties and upholstery scraps into unique clothing designs with an upcycling approach is seen as an example of sustainable design. The process of upcycling requires a blend of factors such as environmental awareness, creativity, innovation and hard work, and results in a unique, sustainable and handmade product. This is effective in selecting research materials. Converting used neckties and upholstery scraps into clothing requires intensive hand workmanship. In addition, the fact that both materials that will be converted into designs are among the smallest wastes has been found interesting for users, and prototypes have been eagerly awaited. In this context, the researchers decided to design blouse, skirt and dress with unused neckties and upholstery scraps that they have collected over a long period of time. In this stage, the findings were

condensed to a single prototypical user whose need is clearly defined.

3. Ideate

The main aim of the Ideation stage is to use creativity and innovation in order to develop solutions. It provides both the fuel and also the source material for building prototypes and getting innovative solutions into the hands of users (Dam & Siang, 2020). It is thought that this step is an act of forming an autopoietic system with elements of discovery about problem awareness. The idea for solving the problem requires the chain of “discovery”, which depends on individual creative system (Iba, 2011). Although insight is for users because problem exists around their environment, design goal should be defined in this phase are those of practitioners who solve the problem, and it is necessary to have originality (Sakama et al., 2018). In the ideate stage when the actual brainstorming process takes place, a large number of ideas and more creative solutions are created for the prototyping. In this direction, user demands, material, technical and thought-oriented design solutions have been developed. The researchers made many blouse (Fig. 3), skirt (Fig. 4) and dress (Fig. 5) sketches that can meet the expectations of users for fashion, innovation, originality and comfort by using their creativity skills.



<Fig. 3> Blouse sketches

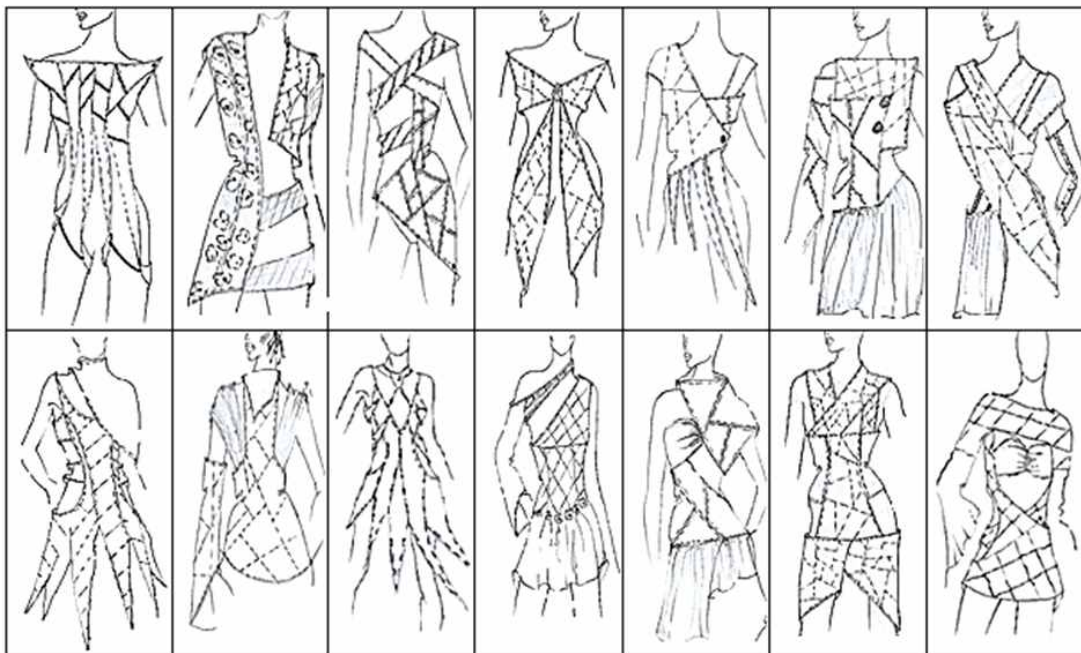
Brainstorming is a method that design teams use to generate ideas to solve clearly defined design problems. Sketches to which this method is applied should not be seen as the ultimate solution. By giving them a large amount of creative ideas quickly, seeds

of possible solutions are sown. Sketches have helped researchers go beyond obvious solutions and harness the collective creativity of the team.

In the sketches, besides the fashion trends, the small dimensions of neckties and upholstery scraps



<Fig. 4> Skirt sketches



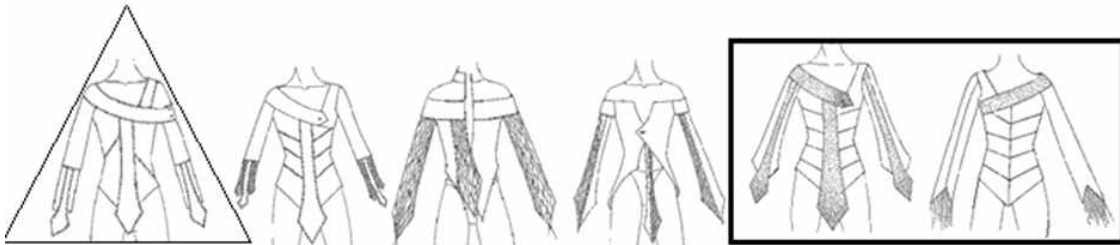
<Fig. 5> Dress sketches

were the determining factors. In all blouse, skirt and dress sketches, this factor has been transformed into a design feature as small cuts and cups. For this reason, the sketches are seen as a tool that can trigger inspiration and imagination and lead to innovative ideas that meet the expectations of the users.

In order to reflect the current silhouette trends, the silhouette form that fits the body is used in all of the sketches. Then the sketches were analyzed in a

customer-oriented manner in order to identify weak points, and a selection was made on the basis of an idea evaluation. Alternative model suggestions were developed for the selected blouse (Fig. 6), skirt (Fig. 7) and dress (Fig. 8) models by feeding weak points in line with user expectations and divergent thought.

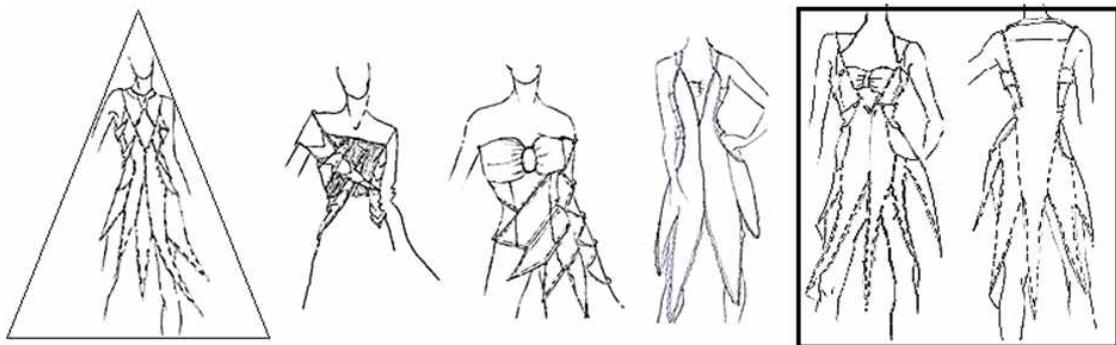
By expanding the solution space, the design team will be able to look beyond the usual methods of solving problems in order to find better, more



<Fig. 6> Alternative blouse sketches and prototype sketches



<Fig. 7> Alternative skirt sketches and prototype sketches



<Fig. 8> Alternative dress sketches and prototype sketches

elegant, and more satisfying solutions to problems that affect a user's experience of a product (Dam & Siang, 2020). With this understanding the answer to the question, "Are the existing solutions sufficient?" was sought. For this, the following sub questions were created by using the empathy map and the problem's condition which was defined in the previous stage. "Have user demands been met?", "Have current trends been reflected?", "Will the user feel stylish with this dress?", "Will the user feel comfortable with this dress?" Three alternative sketches were developed from the sketch selected (sketch in triangle) to answer these questions. Here, the iterative process was followed by returning to the first sketches and the empathy map. Among the alternative sketches, a sketch that best represents the user's needs and expectations and the problem has been selected for the prototype (sketch in square).

Ideate stage represents a process of "going wide" in terms of concepts and outcomes in a mental context. Developments can thus be better aligned with the customers and, if necessary, prioritize to what extent they can satisfy the needs and wishes of these customers. With this approach, mental repetition and creativity were used together in alternative the sket-

ches that were detected.

The characteristic feature of the iterative process of the design thinking approach in the ideate stage can be clearly seen in both the figures and the stage itself. Knowledge, problems and solutions create a loop that nourish and repeat each other during this process. Prototype sketches that were to be produced from blouse, skirt and dress alternative sketches developed in this cycle were selected.

4. Prototype

Prototyping is an integral part of design thinking and user experience design in general because it allows us to test our ideas quickly and improve on them in an equally timely fashion (Dam & Siang, 2020). The researchers developed different illustrations by presenting their own creative ideas -specific for each design- and it was decided to produce the prototype of the model, which was seen as the best solution to the problem described. All phases of prototype production have been supported by a hierarchy emphasizing the priority of designing for sustainability, trendiness, functionality and reuse, then for recyclability, and finally to promote awareness that textile waste can be valuable. But the basic idea behind



<Fig. 9> The blouse designed with unused neckties and upholstery scraps

each stage remains the same. Although the colors and patterns of ties are an important limiting factor in the choice of colors of prototypes, a selection was made for each prototype while taking current trends into account.

As seen in the blouse design in (Fig. 9), asymmetrical forms, aesthetic cuts and cups, sparkling, fringed ornaments are among the 2019/2020 spring and summer trends. Asymmetrical forms, aesthetic cuts and cups, sparkly, fringed ornaments are among the 2019/2020 spring and summer trends. Especially the collections of famous designers (i.e., Alexander Mc Queen, MSGM, Tom Ford, Valentino, etc.) have attracted attention by mixing a pink or red color with another color for a bold contrast.

Unused neckties were used on the body and sleeves of the blouse design. The band around the collar and the necktie-shaped part in the middle front of the blouse were prepared by using upholstery red satin fabric scraps. When choosing a material for clothing, the material's attributes and how it suits those particular wearing practices needs to be considered carefully. It is important to evaluate the material's type (i.e., wool, silk, cotton), color, texture and aging process. Especially in combinations made to add new value to old materials, this importance increases even more. Thus, functional and aesthetic value of the design is increased. For this reason, upholstery satin scraps have been chosen, as they are most suitable

for the texture and type of neckties. The asymmetrical neckline that leaves the shoulders exposed and the long necktie form in the middle of the front is the distinctive design feature of the blouse. In addition, the integrity of the blouse design has been ensured with a straight and narrow sleeve form that expands towards the sleeve tip. Due to the narrow dimensions of the neckties, equal-sized pieces were assembled, and body width was provided. While doing this, the pieces were placed with a tilt on the body of blouse to provide aesthetic appearance (Fig. 10).

In order to increase the value of the blouse, different techniques were experimented with for the combining of necktie pieces; and the most appropriate and most aesthetic technique was decided for the texture of the material. In order to protect the essence of the neckties and to emphasize the different pattern features, attention was paid to the color and pattern features during the arrangement of the pieces. Red satin piping was placed between the assemble stitches of the necktie pieces (a). Since the necktie pieces were converted into design features of the blouse and the aesthetic value of the blouse was increased. At this stage, the information at the ideate stage was returned to the user expectations and the techniques to be applied were tested Since the neckties have a bias cut, they increase the flexing tolerance in the body. Thus, the comfort expectation of the user was fulfilled. But it has been observed that



<Fig. 10> Details of adornment assembly seams (a); sleeve (b); and front piece (c) of the blouse design

the pipings between the assemble stitches of the necktie pieces that make up the body reduce the flexing tolerance of the body and do not give the intended result. The problem was solved by using flexible satin pipings as a new solution. Thus, reoccurrence of previous errors were prevented in the final prototype by testing the applications at every stage of the iterative process.

The long necktie-shaped red part at the front of the blouse was adorned with gray beads, they get more sparse towards the upper side of the piece, making it look as if the beads were sprinkled on top of the clothing (c). The sleeve ends have a long triangular and are harmonic with the tilted cuts on the body of the blouse. The long red satin piece in the middle of the sleeve and the front piece are other features that ensure harmony in the blouse design with the same form, color and bead ornaments. The fringes formed with beads swinging from the short part of the sleeve ends are the ornament details that make the difference of the sleeve (b).

⟨Fig. 11⟩ shows 7 unused neckties used in the skirt design were combined with chamois-like upholstery scraps. Upholstery fabric pieces were placed

between the neckties, expanding towards the hem. Plain upholstery scraps were used between the neckties to emphasize the pattern features. The hemline shape was inspired by the form of the necktie. The waist of the skirt was draped with organza fabric to give it a corsage appearance. The skirt is worn by tying the two strips of long organza fabrics together. The skirt reflects the current fashion trends, with a voluminous, flowing, layered and corsaged look.

The researches made many iterations to try and make the previous blouse design the best and to improve the product to suit the user, and this was a guide to the skirt design. It has been observed that using ornament techniques that have a visual effect rather than just stitching adds value to the clothing. While intensive hand workmanship added value to the clothing, it was observed that it also increased the production cost and prolonged the production process. It is thought that the best designs should focus on utilization and satisfaction, rather than easy profit via a single sale.

As seen in the skirt's details in ⟨Fig. 12⟩, the assembly stitches of necktie and upholstery scraps are embellished with shirred organza strips. Double layer



⟨Fig. 11⟩ The skirt designed with unused neckties and upholstery scraps



<Fig. 12> Details of adornment and piece of skirt design

organza strips are placed on the stitching lines and all around the skirt. Upcycling requires creativity to envision the potential of existing materials to create new and beautiful designs. If the old material is used with appropriate technique and creativity, fabric scraps can have a strong influence on the aesthetics of the new clothing. Moreover, it is always nice to know that the user owns a piece of clothing that is one of a kind. Therefore, designers should reconsider their own collective imagination on a different basis in the upcycling process and think ambitiously. It should not be forgotten that every upcycling clothing is special and has a beautiful history behind it. While this is an inspiration for the designer, it is a special sentiment for the user. It is clearly seen in the examples that one of the main factors in ensuring this is the method that was applied.

<Fig. 13> shows that the all of the dress is created by giving the necktie and upholstery scraps a model feature. While combining the parts, attention was paid to color harmony as well as fabric texture. Mobility was provided to the skirt of the dress with the triangular organza pieces placed between the cuts after the knee line. Thus, a different visual effect was created with the fluttering of the organza pieces while the user is walking. The deep decollete of the dress and wide organza bands placed in the openings on both sides are the interesting design details of the

dress. The functional value of the dress was increased with these bands, which can be adjusted according to the size of the body. Thus, the current trends were reflected in the dress prototype with lovely and light tiers that manage to offer volume, high drama, and maximum twirl-ability. The comfort expectation of the user was fulfilled, while the functional value of the dress was increased with bands, which can be adjusted according to the size of the body.

It's important to test prototypes early in the design process, so that if product hypotheses are incorrect, mistakes can quickly be corrected (Fig. 14). After several experiments it was decided to clean the edges of the organza pieces on the skirt of the dress; the decision was made taking the lifetime of the dress into account (a). Because the original design needs to take several life cycles into account. Between the deep collar opening of the dress, a wide band made of double organza was placed. The middle portion of this band was shaped with pleats and ornamented with beads (b). As a result of the researchers' different ideas, the middle portion of this band was shaped with pleats and ornamented with beads. Also, the shoulder straps, collar and hemline of the dress are ornamented with strips prepared by shrinking double layer organza. This ornament type, which had positive results in the skirt prototype process, was applied to the dress. The two pieces were added to each



<Fig. 13> The dress designed with unused neckties and upholstery scraps



<Fig. 14> Details of hemline (a); front body, collar (b); and assembly seams (c) of the dress design

other as the length of the upholstery scraps placed between the neckties are shorter than the length of the dress. The assembly seams were hidden by embellishing them with beads in the color of the upholstery scraps (c). In addition, beads were sewn by hand on all surfaces of the piece, which makes the beads look as if they were sprinkled on the dress.

At this stage, it was determined that prototyping is an important way to engage with the end users. Prototyping reveals deeper insight and more valuable experiences to help with design decisions going for-

ward. Although the prototypes have various forms, the one thing they have in common is that they are all tangible forms of researchers' ideas.

5. Test

Testing is an iterative process that provides evaluation and feedback. This process can be said to be most critical process in design thinking in terms of human-centered design, because the developers can not see whether their ideas and designs or targets are appropriate without feedback on the idea from the



<Fig. 15> Testing the blouse design on the user in iterative process

end users (Sakama et al., 2018). “Prototype as if you know you’re right, but test as if you know you’re wrong” (Woolery, 2019).

The blouse, skirt and dress designs have been rigorously tested by researchers with the best solutions identified at the prototyping stage. Through this stage, they received user’s feedback on what is effective and what is not valid for the ideas. Since the applications made in the previous stages of the prototypes were frequently confirmed, there were few problems at this stage. According to user opinions, minor corrections such as clothing length and collar depth were made, and notes were taken for subsequent designs. Therefore, user opinions regarding the aesthetics and functionality of the prototypes were received.

The prototypes were tested and the following questions were asked to the users from the notes on the empathy map (Fig. 15). “What did you think-What happened - What do you feel?” The user answered: “I wasn’t expecting it to be this perfect, these designs went beyond what I thought was possible”. She also stated that these upcycling clothings made of unused neckties are important for consumers, since they are so unique. The user stated that with these designs, her opinion on fabric waste had changed and

that old clothes carried a new meaning for her.

At this stage, prototypes were determined to be critical in understanding a problem better and picking apart what makes them work or fail. As said at IDEO “If a picture is worth a thousand words, then a prototype is worth a thousand meetings” (Dam & Siang, 2020). It should be remembered that the process of redesigning is very delicate and requires sophisticated design choices. In this creative and innovative process, the usage of more unique pieces and techniques within design should be encouraged. The intensive hand workmanship techniques and the adornment of the upcycling clothing not only increase its designs value but also give them a unique appearance. In this context, it can be said that creating a new and valuable product from the old and worthless fabric scraps has a positive effect not only on the designer but also on the user.

V. Conclusions

In this study, upholstery scraps and unused neckties were converted into upcycling clothing designs with the Design thinking approach, which is an iterative process. According to the results of the study, it is

possible to say that upcycling is one of the ways to propose a solution to the textile waste problem, and upcycling clothing can be designed by following the iterative design process with the design thinking approach. The researchers understood the users and their needs in the Empathise stage; they analysed and synthesised their observations in the Define stage, and ended up with a human-centered problem statement. With empathy findings and free thinking environment, researchers approached the problem with the question “How Can We?”. They generated ideas to solve the design problem defined in the idea stage. Numerous feedbacks were given on the previous stage (empathy) while sketching blouses, skirts and dresses. In the prototype stage, the solutions were implemented within the prototypes; they were investigated, improved and re-examined, based on the wearers’ experiences. There was no obvious problem in the testing of the prototypes, since information that redefined the problem was provided by feedback from all previous stages. Therefore, minor improvements were made to all prototypes. It was observed that very efficient results can be obtained by following the iterative process with the design thinking. This process minimizes the problems that may be encountered in subsequent designs. One of the important results of the research is that repeated cycles and concrete ideas between development stages ensure that prototypes are created as fast as possible and low in probability of error. According to this process, it can be said that designers can use their creativity in many ways to discover new directions that responsibly address environmental and socio-cultural vital issues. Because design thinking is a tool that can trigger inspiration and imagination, to lead to innovative ideas that are responsive to the needs and issues of stakeholders.

The upcycling clothes that emerged at the end of this process had a low cost but high value, unique designs and they encouraged a creativity that benefits both the environment and society. As seen in the three prototypes, upcycling clothing instead of discar-

ding them is a simple way for designers to reduce the environmental impact of textile waste and be more responsible. As a design-based waste solution, it is clear that upcycled clothing production utilizes textile waste to create products with a higher retail value than traditionally recycled goods. These garments have high design values and are unique. Moreover, it was also found that unused neckties and upholstery scraps had a strong effect on the aesthetics of the new clothing. If designers decide to make items from reclaimed materials, this can drastically reduce their manufacturing costs.

Such design practices will enable the multiplication of more intentional designs and can also cause a change in behavior and social transformation towards the reuse of textile wastes in the society. In other words, awareness of the subject can be increased. Thus, it will be possible not only to minimize the volume of pre-consumer and post-consumer textile wastes sent to the waste storage area every year, but also to reduce the need for new raw materials. In this respect, redesigning textile wastes and products for cyclical use can also be seen as one of the basic requirements of the economy. This approach does not need a big investment in technology but can challenge the current way of designing and manufacturing on a mass-industrial scale. In line with the common upcycling designs of designers and the conscious demands of consumers, it is believed that companies will adopt this method as a production strategy and will be able to produce quality items. This will not only utilize textile wastes, it will also provide new jobs and employment opportunities in the fashion sector.

Clothing and textiles should be recycled on different levels to guarantee optimum material use. All textile products should be seen as valuable materials for recycling and should be recovered after their useful period has expired. With a process focused on design thinking and its outcomes this work can encourage readers to design upcycling clothing. We encourage everyone to have a go at upcycling. Why buy

new clothing when you can learn to make things yourself?

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