Upcycling Design Process and Classification of Upcycling Method as Innovation to Extend Product Lifecycle

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Abstract

Fashion industry is one of the biggest and most successful industries, but also at the same time it contributes the biggest pollution in the world. Discarded clothing and garment factories result in massive garment and textile waste. This keeps happening because of the consumers' consumptive behavior and lack of knowledge in repurposing clothes. To solve this problem, customers need to be educated in repurposing clothes and adding value to the product. This way, it can extend fashion products' life cycle, and decrease the consumption of massive fashion products. This research aims to identify the upcycling design process in fashion and also classify the methods and techniques in repurposing clothes (especially upcycling), such as 1) subtraction which includes cutting, cropping, slashing of fabrics and garments, 2) deconstruction which includes division and reassembling clothes and other textile materials, 3) addition which includes embellishment assembling, patchworking, etc. and 4) refunctioning which is reusing old products for new purpose. This way, not only upcycling methods are more structured and accessible to everyone, also the upcycling methods and techniques can be employed in the design development of old garments to extend the garments' lifecycle.

Keywords

Upcycling, fashion, design process, methods, technique

1. Introduction

Fast-fashion industry has evolved dramatically nowadays, especially over the last twenty years. This phenomenon has changed the behavior of consumers in buying and disposing of fashion products. Nowadays, fashion products have a shorter lifespan, and consumers tend to buy and discard their clothes more often. In developing countries like Indonesia, Vietnam, and Cambodia, *fast-fashion* products are sold affordably, and the products are produced massively, making it possible for the customers to buy more products in a very short time (Chang et al 2016). However, this phenomenon has significant implications in environmental, social, and economic (Bhardwaj and Fairhurst 2010). Although the garment factories are able to fulfill the consumers' demand, many destructive effects on the environment remain a major concern. There is a big reason why textile / garment factories (especially in Indonesia and China) are

built near big rivers. Factories need water power to process textile, garment, and yarn, such as bleaching process, dyeing process, etc. which result in polluting the river with hazardous substances (Chen and Burns 2006). The great impact of fast-fashion massive productions does not leave behind the social and economic issues. To produce cheap products and increase the sales, many fast-fashion companies create a profit-oriented business model that puts the lives of the employees at risk (Bick et al. 2018).

Circular business models are believed to be one of solutions to lower the impact of use and production rate of garments. Circular business models include renting, sharing clothes, and also repurposing clothes (EEA 2020). There are some ways to repurpose clothes, such as recycling and upcycling which has started to become an emerging trend. However, the recycling process has its limitations. The process of 'melting' down and reconstruction that needs to be done still results in carbon dioxide (CO2) that is harmful for the environment. Comparatively, upcycling processes use less energy than recycling processes. (T.Szaky 2014). Therefore, upcycling is considered the most effective way to repurpose old clothings. According to Sung et al. (2014), upcycling is a process of creating new products from used materials with added value and higher quality. Upcycling process is a form of repurposing products (reusing, repairing, and remanufacturing) without recycling the materials. It can extend product life cycle, as well as the components and materials as well. As upcycling creates a longer life span of products and enables future lives of old products (Bridgens et al 2018), upcycling supports sustainability. The process of upcycling allows people to connect with the materials of the products, therefore it is important that upcycling enables multiple product life cycles.

Seeing this as an opportunity, solution, and innovation to create a longer product life cycle and support sustainability, upcycling technique needs to be spread and observed more. However, there is not much research regarding technique and methods used in upcycling, whereas to develop and spread awareness about upcycling, technique and methods need to be introduced to a bigger audience.

This study aims to identify the upcycling design process and classify methods and techniques used in upcycling production for clothing and the application on the products to be upcycled.

1.1 Objectives

The objectives of this research are:

1. To identify the upcycling design process for design inspiration
2. To classify the methods used in upcycling production process in clothing
3. To categorize the techniques used in upcycling production process in clothing

2. Literature Review

2.1 Upcycling as Product Innovation

Upcycling is a well-known term especially in design fields nowadays. It is a process of transforming discarded / disposable products/ materials into a product with higher value and quality using creative inputs. With creating 'new' products out of old materials, upcycling is indeed an innovative way to achieve a more ethical consumption and production process of fashion products (McDonough and Braungart 2002). Upcycling is the product of a design thinking model that involves 5 stages, they are Empathize, Define, Ideate, Prototype, and Test (Dam and Siang 2020). Upcycling involves combinations of people, knowledge, ideas, needs, creativity, etc. That is why there is no identical upcycling process and result for each product produced. Every upcycled product is unique. In the process, the combination is very special in that it is changing and developing organically depending on the people, resources, creativity, skills, and needs. Upcycled can be done and applied to used products by combining 2 or more products and changing the shape of the clothing. It does not require any special formula; hence the process flows organically. This opens an opportunity for upcycle to evolve to a better direction. As a growing trend, upcycling takes a very important role in representing innovation - delivering a new product and introducing the process of new and fresh ideas in solving problems (Conway and Steward 2009).

Systematic Inventive Thinking (SIT) is a theory of inventive problem solvings that create innovation and solution for a problem. According to Boyd and Goldenberg (2014) ; Heo et al. (2016), SIT process includes this following 5 tools :

a) Subtraction (problem solving based on removal of objects) ,
b) Multiplication (problem solving by adding modified copy to an object),

c) Division (problem solving by dividing objects and reorganizing them),
d) Task Unification (problem solving by changing the role of object), and
e) Attribute Dependency Change, which is addition/removal

We modified SIT theory to create a classification of methods for upcycling processes that can be useful for further development of upcycling processes.

2.2 Techniques in Creating Surface Design for Fashion Products

Once a fabric is constructed, it can be enhanced with many types of surface treatments to create texture. Texture includes the look and feel of a material which is divided into two characteristics: appearance and performance (Brannon and 2011). Depending on the type of texture the designers want, the fabric surfaces can be treated in many ways. Creation of surface textures and patterns are a never-ending process of innovation which consist of many techniques and methods. According to Sorger and Udale (2017), the surfaces are treated in various ways, such as printing (including digital printing, stamp printing, eco-printing, etc.), dyeing (with natural and synthetic dyes), embellishment addition (such as hand & machine embroidery, applique, cutwork) , or creating fabric manipulation such as gathering, shirring, pleating, tucking, smocking, etc. As these techniques can turn garments into exceptional objects by reshaping the surface of the material, we can use them in creating upcycled products as innovation as well. The products can be made using the combination of techniques of surface treatments.

3. Methods

This study is qualitative-based and practice-based research. Firstly, we interviewed 4 local designers to gain information about their design process. These local designers are 2 designers from regular womenswear brands, and the other 2 are the upcycling brand owners. Interviews are done to gain information relating to the design process. We will compare the design process of regular garments and upcycled ones. Next, we tried to incorporate our creative practice by creating upcycled products with existing techniques to create surface appearance and performance and give the old clothes ‘a new life’. We used several used garments for our upcycling materials. We picked 6 random garments to work on, and we did concept-making and produced the products. After the products are made, we list the techniques used during the upcycled process and classify them based on the modified method of SIT (Systematic Inventive Thinking). SIT method was picked since it was derived from theory of inventive problem solving, and upcycling is an invention that acts as a problem solver for massive consumption and production. The SIT method was modified to adjust the inventive thinking to upcycling processes and existing techniques.

The Research Question-How is the upcycling design process undertaken?
What are the methods and techniques used in upcycling production for clothing and the application on the products?

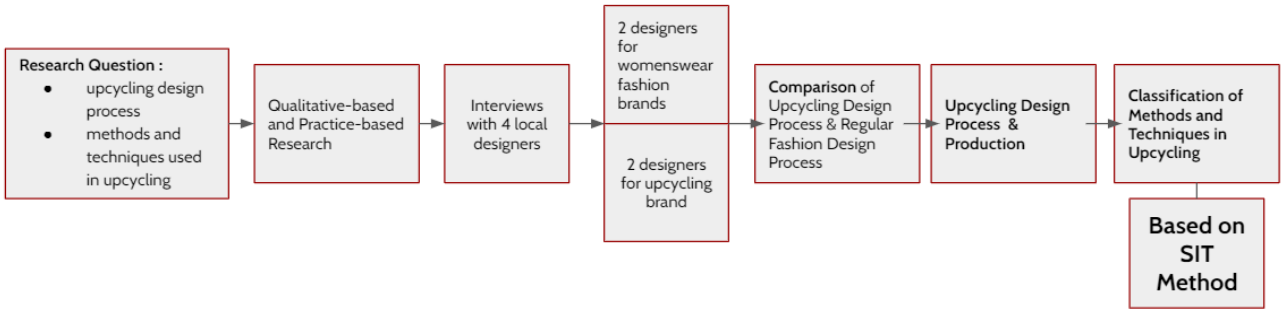


Figure 1. Research methods diagram

Figure 1 shows the research method of this study, starting with the research questions, followed by the data collections to the results of the study which includes the comparison of upcycling design process, production, and the classification of methods and techniques used in upcycling.

4.Data Collection

Data collection is conducted through literature and interview to 4 local designers. These 4 local designers consisted of 2 designers for womenswear brand and 2 designers who own their own upcycling brands. The interview questions involve:

a. The process of designing
b. The challenge and opportunities in designing

By gaining these data, we can map and compare two design process of regular garment and upcycled clothes.

5. Results and Discussion

5.1 The Upcycling Design Process

Upcycling process varies for every product. The most important thing was the re-designing process after the used products were picked. The diversification of the redesign can vary, from adding small details to big transformation, for example a dress can be 're-designed' and turned into a shirt, an outer, or even other products like hat, bag, etc. The upcycling process is different from the standard fashion designing process. In the upcycling process, we need to use the available materials to create 'new' garments and add value to the used ones. This is not an easy process, to create a collection, designers need to pick old / used garments that are attuned to be combined.

Based on the interviews with 2 local designers of upcycling brands, we found similarity in the design process. The designers of upcycling brands start their design process with "empathy", by looking at the problems in fashion industries. From the interview results, we put the upcycling design process into Dam & Siang's design thinking model which includes Empathize, Define, Ideate, Prototype, and Test. In this study, the process of upcycling old garments was in accordance with 5 stages of the Design Thinking process as shown in Figure 2.

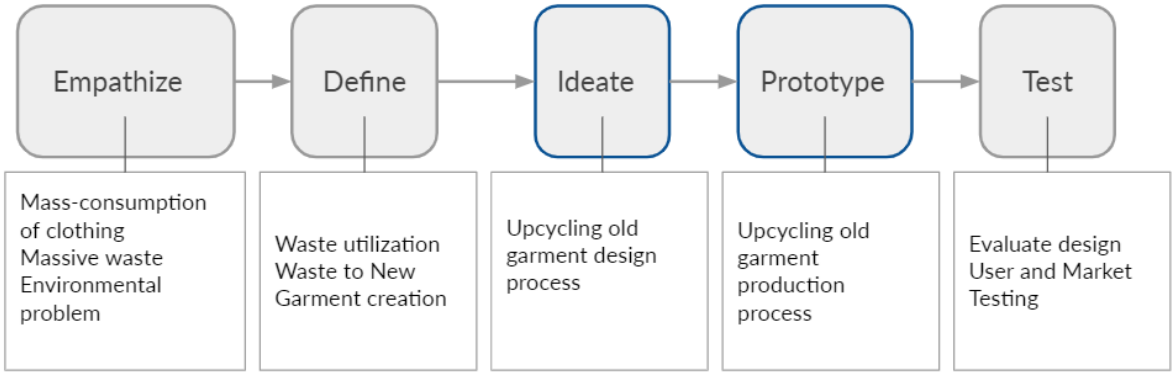


Figure 2. Process of upcycling based on design thinking stages

Figure 2 shows the process of upcycling based on Design Thinking stages by Dam & Siang (2020). As the first stage of design thinking, a significant amount of information related to massive consumption and production of clothing is gathered in the "Empathize" stage, to be used during the next stage - "Define" to state the problems which in this study, is how we do the waste utilization. The next stage, "Ideate", we upcycle old garments to new garments as the solution of the problem. This process includes the small steps as illustrated in Table 1 below. In the "Prototype" stage, the upcycling production process is done, and this includes pattern-making, sewing, and other creative techniques. Finally, the upcycled garments are tested and evaluated by users during the "Test" stage. However, the process does not end there. Designing upcycle products is an iterative process that requires 'trial and error'. Therefore, "Prototype" and "Test" stages can be done several times to get astonishing results.

Table 1. The Comparison of Upcycling Design Process and Standard Fashion Design Process

No	Upcycling Design Process (2 Upcycle Fashion Designers/Brand)		Standard Design Process (2 Local Designers/Brand)	
	Process	**Description**	**Process**	**Description**
1	**Collecting used garments (random)**	The garments are collected from variable resources (families and friends' discarded clothing and secondhand-shop / thrift shop)	**Creative inspiration search**	Creating inspirations from the trend research, market testing, and any other inspiration sources.
2	**Sourcing materials and textiles**	Checking the type of materials available from upcycled clothes to create a concept	**Moodboard creation**	From the inspiration, designers need to make a moodboard containing color plan, mood, texture, and inspiration/theme pictures
3	**Creative inspiration search**	Creating inspirations from the materials that are available.	**Raw sketches, Details and Fabric planning**	This process includes the creation of fashion sketches of collection planning, including the details and fabrics to use.
4	**Moodboard creation**	From the materials available, designers need to make a moodboard containing color plan, mood, texture, and inspiration/theme pictures.	**Materials and textile sourcing**	Materials and textile are set based on the garment types, designer preferences, and the inspiration.
5	**Collection creation (sketches)**	From the materials and the type of the garments, designers create a 'brand new' design that has the elements of the used material.	**Collection creation**	The detailed collection is made based on the inspiration and mood board.
6	**Production process**	The production process of the garment.	**Production process**	The production process of the garment (Can be mass produced or limited product)

Table 1 shows the comparison of upcycling design process and standard fashion design process in general. While the standard fashion designing process usually starts by creating creative inspiration and mood boards before determining the textile materials used, the upcycling process is done otherwise. The materials used for upcycling are old garments, with all their defects, so the designers need to adjust their design with the materials available. In terms of production process, the upcycled garment is one of a kind, and it is impossible to create the exact same clothes. On the other hands, the production in regular / standard design process can be mass produced or limited aswe

Table 2. Production process of Upcycled Garment

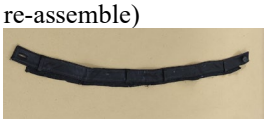
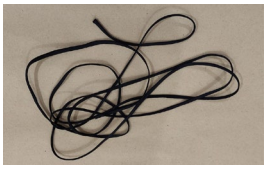
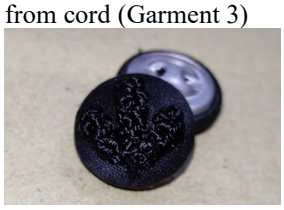
No	Raw Clothing (Old Garments)	Upcycling Part	Process	Final Upcycled Garment
1	 Garment 1 : Knit Long Sleeves Top (condition : fabric pilling in some parts)  Garment 2 : Faux leather pants (condition : faded colour and some scratches in some parts)  Garment 3: Corset (with defects and faded colour)	 Front bodice cut from knit top (division and re-assemble)  Faux leather waistband from pants (defected)   cord on the back of corset	 Pattern deconstruction and reassembly (Garment 1)  Cutting Waistband (Garment 2)  Painting defected waistband (Garment 2)  Creating macrame string from cord (Garment 3)  Leftover button, decorated with cord from Garment 3	   Final Garment: Halter Knit Tank

Table 2 shows the production process of an upcycled garment that is made of old clothing's. For Halter Knit Tank, we picked 3 old garments with a similar color (Black). The method used in this process was a) subtraction by cutting the sleeves of garment (Garment 1) b) deconstruction of garment pattern (Knit Long Sleeves Top / Garment 1 to Halter Neck Knit Top), c) Addition of cording on leftover button and addition of macrame string, resulting a totally different garment. We also make use of leftover buttons from other garments and decorate them to add value.

5.2 Upcycling Methods and Techniques

Upcycling Methods Classification

From the upcycling process we did, we categorized the methods used in the upcycling process. This method is inspired by the SIT method (Systematic Inventive Thinking), a theory of inventive problem solving.

We classified the upcycling process into 4 methods:

1. Subtraction

Subtraction involves reducing some parts of the product, such as cutting, slashing, laser cutting, etc. (shown in Figure 3)

Figure 3. Subtraction method in upcycling process (Cutting sleeve of knit top and fabric manipulation)

There are lots of ways to create new products by subtraction methods. For example, a regular T-shirt can be turned into different products, such as sleeveless T-shirt (by cutting the sleeves off), tank tops, crop shirt, one shoulder shirt (by cutting one of the sleeves and a bit of collar part) as shown in Figure 4.

Figure 4. Examples of T-shirt subtraction into tank top, crop top, and one shoulder top

2. Deconstruction

Deconstruction method is used to change the shape of a product, and in the upcycling process it involves division and re-assembling of the garment. For example, a shirt can be modified and turned into a dress, or any other garment, by reconstructing the pattern of the garment.

3. Addition

Addition in upcycling involves adding and attaching any details on the garment, such as :

a) Embellishment addition : Beading addition , embroidery addition, fringe addition , patchwork addition , etc.

Figure 5. Examples of beadings embellishment addition in upcycled garment

Figure 5 shows the garment before and after the upcycling process. The used garment was cut using laser cut to create a repeated pattern, and then beading embellishment was applied. The addition of embellishment creates a different vibe and also adds value to the garment.

b) Surface design: Painting on garment/textile, stamp- printing on garment/textile, screen-printing on garment/textile as shown in figure 6

Figure 6. Examples of stamp-printing

c) Textile manipulation:

Pleats, smocking, pintucks etc.

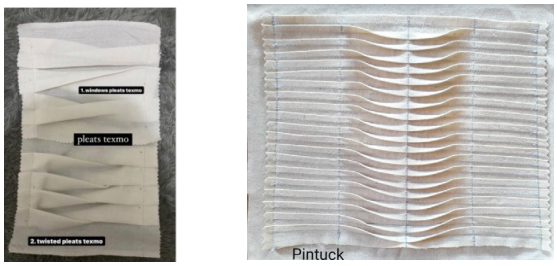


Figure 7

Figure 7. Examples of textile manipulation that can be added to garment (left to right: twisted pleats and pintuck)

4. Refunction

Refunction in upcycling means refunctioning one product / multiple products and changing it into another product. For example, unused caps can be assembled into a tank top, or the glasses' temples can be formed into accessories like a necklace, as shown in figure 8.

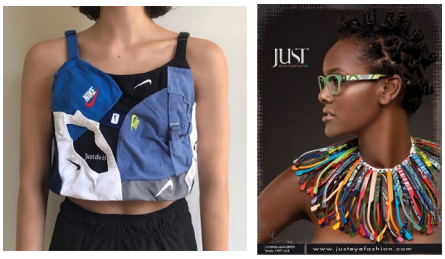


Figure 8. Refunction of old products example

Upcycling Techniques Classification

The technique used in upcycling can be classified into 5 categories, they are cutting, folding, patches, weaving, and coloring. All these techniques can be combined to make a new product with methods that are already explained in the previous subsection. These techniques can be used in the "Addition" method of upcycling.

Table 3. Table of Techniques used in Upcycling

No	Technique Category	Technique
1	CUT	laser cutting, cutting, slashing, fringe trim.
2	FOLD	pleats, tucks, smocking,

3	PATCH and JOIN	stitching, assemble patchwork, quilting,
4	WEAVE	Fabric weaving, yarn weaving, knitting
5	COLOUR	tie dye, shibori , fabric painting, screen printing,
6	ADD	Addition of beadings, embroidery

Table 3 shows the techniques used in upcycling and the category of technique. We categorized several techniques into 6 categories based on the actions done to the fabric/garment. For example, the "CUT" category includes laser cutting, manual cutting, fabric slashing, fringe trim, and other actions that involve cutting parts of the fabric / garment. Another example, in the "FOLD" category, we put techniques that require to bend/fold fabric/garment into a certain shape, like pleats, tucks, and smocks.

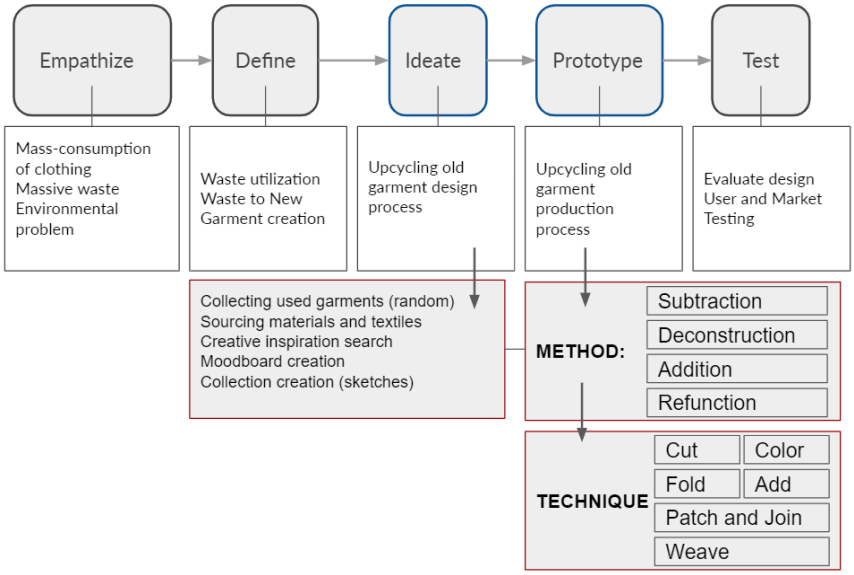


Figure 9. Diagram of upcycling design process, including methods and technique used

Figure 9 shows the whole process of upcycling, including the steps by steps of the design process and methods and techniques used in creating upcycled products. Methods and techniques can be combined freely to get unpredictable and exceptional results. The most crucial part of the process is the 'Prototype' process, which is the production process of the garments. From the examples of the garment, we created in Table 2, it is shown that the functional and aesthetic value of the old garments have increased. The old garments were very worn out, with defects and pilling in some parts of the garment, and we managed to give them a new life by turning them into something else. We created 3 new garments with the method shown in Figure 8, and we found out that discarded clothing, old garments, can be transformed into new products with added value. We used 3 methods: subtraction method, deconstruction method, and addition method in creating the new garment, and we also used several techniques like laser cutting, fabric painting, embroidery, and bead sewing as variations. By mapping the design process, methods, and techniques used in upcycling, the study can contribute to involvement of craftsmanship in garment production, especially upcycled ones.

The limitation of this study is that we did not manage to test the product on users. However, product testing is very important. At the "Test" stage, the prototypes we made are tested to gain users' feedback on what works and what does not on the product.

6. Conclusion

Design thinking is an iterative process, and in designing, we need to use our empathy to connect with the problem occurred. Upcycling is a product of the 'Empathize' step of design thinking process, and it is meant to be one of the solutions to overcome the massive production of clothing and textile waste problem. Upcycling design process involves collecting used garments/textile, sourcing and analyzing materials collected, followed by the process of finding creative inspiration, moldboard creation, sketching, and production process. Unlike the standard/regular fashion designing process, upcycling processes create inspiration based on the materials and textiles available. It was observed that by following the design process, an efficient result can be achieved.

Methods in upcycling the production process also play a crucial part. There are lots of ways to rework clothing, and we classify them into 4 methods, namely Subtraction method, Deconstruction method, Addition method, and Refunction method. From these 4 methods, subtraction is the easiest method to be used since it does not require any special tools (except laser cutting). Addition method is the richest method since it can be used by applying many creative techniques to the garment. There is a wide-ranging category of techniques that can be used in the upcycling process, such as cut, fold, patch and join, weave, color, and add. These various choices of techniques prove that the lifecycle of a garment can be lengthened by adding variations or deconstructing them. With upcycling, we can develop fashion industries with provision of upcycling methods and techniques skills training. Future research in the upcycling area can involve the consumers' willingness to pay towards the upcycled garments, new methods and techniques, and the perceptions of the consumers towards the technique used in upcycling garment.

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Biography

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