Sustainability Fashion: Exploration of Modular Concepts & Material Recycling

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Abstract

Public awareness of the sustainability of fashion recycling has become an important concern in the fashion industry in recent years. This is due to the environmental issue of increasing global garment waste due to the "fast fashion" business concept. This awareness encourages artists and designers to continue to develop creativity by considering environmental impacts and aspects of sustainability in their fashion work through, exploration of manufacturing techniques, processing of environmentally friendly raw materials, sustainable production processes, and the resulting economic value. This paper discusses the concept of sustainability through the exploration and creative development of modular techniques and recycled materials in fashion. Modular in fashion is the concept of dividing the system into small parts that can then be changed, combined and adjusted independently. Recycling of materials involves crushing clothing into fibres which are then remade into materials using a felt technique.. Modular techniques have great potential to be further explored in design in collaboration with recycled materials by designers and the fashion industry. This research uses a qualitative methodology carried out by means of library observation, exploration and experimental techniques. The aim of this research is to create sustainable fashion design works which can ultimately increase public awareness of environmental issues, as well as demonstrate creative and innovative techniques in fashion design that minimize the environmental impact of the fashion industry itself. The results of this research are expected to make a valuable contribution to the development of the sustainable fashion industry, as well as increasing public awareness of sustainable fashion products as part of a lifestyle.

Keywords; Sustainability, Creativity, Modular, Recycling

Introduction

The development of fashion has encourages people to be consumptive. The reason is the rapid turnover and change of fashion products along with the trends offered in each season. According to Rashmila Maiti's article on earth.org, the time it takes for a product to pass through the supply chain, from design to purchase, is called 'lead time'. Maiti also noted in the article that in 2012, Zara was able to design, produce and deliver new clothes within two weeks; Forever 21 within six weeks and H&M within eight weeks (Maiti, 2024). This results in the fashion industry generating a huge amount of waste from garment production.

Fashion waste is not only from leftover production, but also from clothes that are no longer worn by their owners. This continues for decades, causing pollution and negative impacts on environmental ecosystems. Other environmental issues include excessive water usage and environmental pollution. According to an analysis by Business Insider, fashion production accounts for 10% of total global carbon emissions, the same amount as the European Union. It drains water sources and pollutes rivers and streams, while 85% of all textiles go to landfill each year. Even washing clothes releases 500,000 tonnes of microfibres into the ocean each year, equivalent to 50 billion plastic bottles (Maiti, 2024). This indicates that there are still many textile industries that pay little attention to recycling water from fabric washing and dyeing.

Another impact of the concept of fast fashion relates to social issues, the payment of wages for workers directly involved in the fashion industry, especially in developing countries. The issue of minimum wage and long working hours due to the high market demand for cheap products. This does not only happen in small-scale industries but also in large-scale industries. According to the non-profit organisation Remake, 80% of clothing is made by young women between the ages of 18 and 24.

A 2018 US Department of Labour report found evidence of forced and child labour in the fashion industry in Argentina, Bangladesh, Brazil, China, India, Indonesia, Philippines, Turkey, Vietnam and more. Rapid production means sales and profits trump human welfare. (Maiti, 2024)

It is important to realise that social and environmental exploitation has resulted in ecosystem imbalances that we can feel today. Unstable climate change and environmental degradation in recent years have prompted public concern, especially the big fashion industry to immediately change the concept of fashion business towards sustainability in its fashion products.

According to the UN Climate Change news article on 22 January 2018, the United Nations held a meeting to draft the UN Framework Agreement on Climate Change. They developed a framework agreement for a new fashion business model as an effort to advance sustainability business in the fashion and textile industry. Conduct various initiatives and explorations that support the concept of sustainability and environmental balance. The meeting was attended by environmental experts and business people from the fashion industry to find the best way to reduce greenhouse gas emissions (United Nation Climate Change, 2018). At the UN Climate Change 2018 meeting, 38 representatives from leading brands of the fashion industry, such as; Hugo Boss, Adidas, Puma, Kering VF Corporation, C&A, and H&M, along with yarn producers, recyclers, and representatives of associations working on environmental sustainability in the fashion sector.

The new business model of sustainable fashion is being pursued by both small and large fashion industries. Large industries focus on developing raw materials, such as organic fibres and recycled fibres from fabric waste. The application of the concept of zero waste & internal upcycling in the retail fashion industry such as; H&M, Ganni, and others is carried out as an effort to use material efficiency. The start-up fashion industry develops its sustainable products to produce innovative products through the creative process; exploration and experimentation of design and materials.

The creative process is carried out by striving for the effectiveness and efficiency of the design and production process. The application of fashion patterns without any fabric left over (zero waste). Optimal design making refers to sustainable design, such as making designs that are not limited by size (all sizes). Making designs that prioritise function and aesthetics to answer the public's need for fashion.

Considering the function and aesthetics of fashion design. The modular fashion concept of the label "Multiples" became a breakthrough point in the fashion industry. In 1980, Sandra Garret, an American fashion designer, presented the modular concept of the "Multiples" label in her fashion products. The collection offers "one-size-fits-all" adaptive fashion products; layered, wrapped, tied, creased, stretched and modified to create a variety of looks. Motifs are kept to a minimum so as not to prevent the garment from being worn in multiple directions. The concept of turbular patterns using flexible fabrics makes it possible to serve multiple functions. This "Multiples" product can be worn for different sizes and ages. (Serva, 2019).

The phenomenal Modular concept is back. Japanese Fashion Designer Jun Takahashi presented his first collection under the label "Undercover" at Japan Fashion Week 1994. His first collection was titled "Small Parts"; where almost all parts of the clothes in his collection could be removed and exchanged with other parts of the clothes.

Removing the sleeves on a jacket becomes a vest, and other parts can be swapped to get different colours and patterns (Christianto, 2021). Takahashi's concept is to combine streetwear with experimental concepts, creating a creative blend of street, chaos, fragility, peace, drama and humour. His unique take on streetwear made Undercover one of the fastest growing streetwear brands in Japan in the 1990s (Rees, 2019).

The modular design concepts of the two fashion designers mentioned above became a reference for designers in other parts of the world to explore the latest modular techniques to answer the needs of the fashion community. Designers are experimenting with versatility, multi-detail sewn products, garments that can be disassembled into sections or modules, and reassembled according to the wearer's wishes, alternative fastenings; from buttons, zips to press studs and Velcro, then there is a more flexible version - geometric modularity where a product can be folded into different sizes or shapes (Vaid, 2021).

According to Li, Chen, & Wang, the modular concept is divided into three; Component modular, Geometric modular, and Fusion modular. Component Modular divides a garment component into two or three parts that can be single or multi-functional. Geometric Modular; triangle, rectangle, circle, or polygon pattern components are sized to suit the design; large or small. This modular geometry design can be applied to more than one type of geometry in one garment. The joining can be flat or three-dimensional. Fusion Modular Design; A combination of component modular design and geometric modular design. (Li, Chen, & Wang, 2018)

In 2021, trend forecaster WGSN identified modular fashion as one of their top five trends for the year, reporting that "This trend marks new ways to purchase and build value into items, sometimes simply updating or refreshing them, other times allowing garments or items to cross seasons or to provide functionality" (street, 2023).

According to Hebee street Modular fashion in 2023, further developed, researched and studied, has even more impressive potential to change the way we design, shop and wear clothes. It seems plausible that if pieces of clothing can endlessly adapt, transition and be personalised, the need to buy will be significantly reduced. In this way, the industry will be able to reduce production without limiting creativity (street, 2023).

Based on the explanation above, the modular fashion concept is important to be researched and explored because the modular principle is flexible; multifunctional, easy to disassemble, recycle, renovate or repair as desired without reducing the beauty value. In this research, the author makes sustainable fashion works through the exploration of geometric modular concepts of flat splicing and three-dimensional splicing using recycled materials from the garment industry.

Research Methods

This research uses qualitative methodology to gain depth in the concept of research-based work creation, then steps are taken including methods and techniques as follows:

1. Literature Review: Collecting and analysing relevant literature on sustainability; modular and recycling techniques in the fashion industry. This data was obtained from books, journals, and the internet.
2. Exploration of Modular Techniques: Applying the results of research analysis and testing modular concepts in fashion design with modular techniques, which divide systems into small parts that can be changed, combined and adjusted independently..

3. Recycled Material Experimentation: Crushing fabric scraps into fibres and reprocessing them into new materials using felt techniques.

Results

Exploration and Experimentation

In this stage, the author explored modular geometry and experimented with recycling fabric waste from the garment industry. The exploration stage is divided into three stages; initial exploration, advanced exploration, and selected exploration.

1. **Exploration of Modular Techniques**

   Create geometric modular explorations with flat joining and three-dimensional joining.

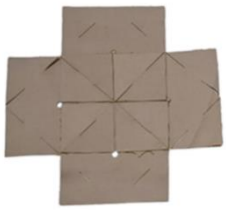
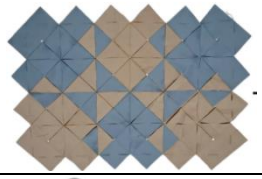
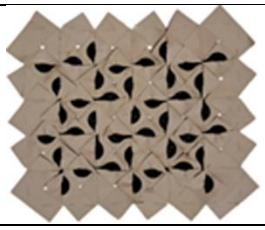
   - Modular exploration of flat joining geometry

   In this exploration, the author made an exploration by using calico material as a toile, for the hook using a snap button.

Pictures	Description
Early Exploration	
	Make a long square geometric pattern measuring 17.5 x 32.5 cm. This geometric pattern is then applied to calico material.
	Using Snap buttons that function as hooks between modules
Advanced Exploration	
	These geometric modules are then combined and arranged to form tops and bottoms. These geometric modules can be applied to various forms and functions as desired..
Selected Explorations	
	

   - Modular exploration of three-dimensional geometrics.

   Exploration of three-dimensional geometry using the interlock technique, a two-component geometry pattern that has a hook and lock function.

Pictures	Descriptions
Early Exploration	
	Make a pair of 10 x 10 cm rectangular pattern components. The first rectangular pattern has a diagonally cut section on the outside towards the inside. These cuts are found on the four sides of the rectangle, acting as a hook.
	The second quadrangle pattern has a diagonally cut section of the section. These cuts are found on the four sides of the inner rectangle, acting as a lock.
	These two pieces are combined by hooking on one side into a pair of components. These two pairs of components are combined into one small panel.
	These small panels are then combined into a large panel. To get the large panel in the image beside, 8 small panels are required.
	To strengthen the modular hooks, a hook pattern is required. For that, make a hook component with a width of 3 cm and a length of 9 cm.
Advanced Exploration	
	A large panel that has been given a crocheted reinforcement. It takes several large panels to make an outfit, be it a top, bottom or dress.
Selected Exploration	
	

2. Recycled Materials Experiment

Pictures	Descriptions
Early Exploration	
	Using leftover fabric scraps from the garment industry.
	Removing the weft and warp threads from the leftover piece of fabric by pulling the weft and warp threads.
	Using vliselin with double-sided glue. Vliselin is a glue cloth commonly used in garment production.
	The first experiment made fabric from recycled fabric fibres.
Advanced Explorations	
	Arrange the remaining yarn fibres on the pattern. yarn fibres are placed evenly trying not to leave empty gaps in the pattern.
	Place the vliselin on the fibres
	Arrange the remaining yarn fibres on top of the pattern evenly, leaving no gaps in the pattern.
	Press the fibre arrangement on top of the pattern using a hot iron until the fibres stick to the vliselin..
	The result of the arrangement of yarn fibres back into fabric by means of felting
Selected Exploration	
The recycled yarn fibre fabric was then applied to clothing using a modular flat splicing technique. Using snap buttons as a hook between modules. The snap buttons are placed around the edge of the fabric and arranged intermittently.	

Pictures	Descriptions
Early Exploration	
	
	

Results and Discussion

The findings obtained from the exploration of the flat modular technique and the three-dimensional modular technique are:

Description	Modular exploration of flat joining geometry	Modular exploration of three-dimensional geometrics
Strength	• The use of auxiliary materials such as snap buttons allows the connections between modules not to come apart easily.	• The interlock technique applied to the modular does not latch firmly. This is because the material is not rigid, so the links between modules do not lock. • The addition of other components serves as reinforcement enough to increase the strength of the links. It's just not strong enough to withstand the weight of modular components when applied to dress..
Material	• The recycled material of fabric fibres can be adjusted to the desired thickness. • The strength of the fabric is obtained from the glue on the vliselin and the laying of the fibres randomly and crosswise. • In this experiment, the author increased the thickness of the fabric by adding layers of fibres to increase fibre strength. However, the fabric became stiff and less flexible. • This recycled material has not been further tested for the washing process.	• In this study using neoprene material with medium thickness and flexible fabric, • The modular interlock technique can only be applied to medium, rigid and non-heavy materials..

Description	Modular exploration of flat joining geometry	Modular exploration of three-dimensional geometrics
Production	• This expoloration does not go through the sewing process. • The use of snap buttons is an effective and efficient way of making clothing.	• Cutting the module pattern using laser cut technique. • The fashion production process is carried out by hooking between modules without the help of a sewing machine.
Fleksibility	• Exploration of changes in fashion design and function can be done independently and quickly.	• Exploration of changes in design and changes in function of clothing can be done independently and quickly.

The findings obtained from the experimentation of recycled materials are :

Description	The first experimental flat connect modular	Second experimental flat connect modular
	• The use of snap buttons allows the connection between modules not to come apart easily..	• Using 9mm buttons. • The buttons were placed around the edge of the fabric and arranged in a criss-cross pattern with a distance of +- 1 cm. • In this experiment, the felting process using textile glue was done only once. • Fabric thickness is medium, tends to be perforated, textured. • The fabric handfeel is soft, not rough. • The fall of the fabric is not stiff.
	• The recycled material of fabric fibres can be adjusted to the desired thickness. • The strength of the fabric is obtained from the glue on the vliselin and the laying of the fibres randomly and crossing each other. • In this experiment, the author increased the thickness of the fabric by adding layers of fibres to increase fibre strength. However, the fabric became stiff and less flexible. • This recycled material has not been further tested for repeated washing. • The resulting fabric is thicker, textured and slightly stiff.	• In this experiment, the felting process using textile glue was done only once. • Fabric thickness is medium, tends to be perforated, textured.. • The fabric handfeel is soft, not rough. • The fall of the fabric is not stiff.

Description	The first experimental flat connect modular	Second experimental flat connect modular
	• This exploration does not go through the sewing process.	• To increase the strength of the fabric; irregular stitches on the top of the fabric. • Sewing loop laces for buttons..
	• Exploration of changes in design and function of clothing can be done independently, and can be done anywhere. However, design exploration is still limited due to the spaced position of the snap button and the fabric is a little thick and stiff.	• Exploration of changes in fashion design and function can be done independently, quickly, and anywhere.·

The final result of the research work

Figure 1, First design of sleeveless top, personal documentation

Figure 2, Second design of sleeveless top, personal documentation

Figure 3 Third design of sleeveless top, personal documentation

Figure 4, Work of The Fourth Design Top, Personal Documentation

Figure 5, Work of the fifth design top, personal documentation

Figure 6, First design subordinate work, personal documentation

Figure 7, Subordinate works of the second design, personal documentation

Conclusion

The results show that modular techniques and the use of recycled materials have great potential in creating sustainable fashion designs. The creation of geometric modular fashion works of flat splicing and three-dimensional splicing is the author's exploration to explore the advantages and disadvantages of this technique. Similarly, the experimentation of recycled fabric from garment industry scraps is an effort to customise materials without generating new waste.

The exploration of modular techniques and the experimentation of recycling are expected to create novelty in sustainable fashion works and reduce the complicated sewing production process. This research has not achieved the expected results, but these results can be a guide for further research. Therefore, it is important to conduct further research to achieve the modular concept; flexible in design and wearability, and customisation to the user without compromising beauty.

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