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A Zero-Waste Concept of Multifunctional Clothing Design

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ABSTRACT

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In the rapid development of technology and infrastructure, fashion has moved forward in producing the current style and trend known as fast fashion. The accessible and affordable fashion enables consumers to have varieties of choices that turn into over-consumption. The clothing industry is known as the second-highest polluting industry in the use of materials, and this has given a negative impact on the environment. The research aims to design a range of multifunctional clothing that has both added and creative values, which can be transformed into multiple usages, styles, and looks. Elements such as flexibility, functionality, and user-friendliness are applied to convert clothes into different types of garments that are suitable to be worn in different situations and purposes. The research found that the application of the zero-waste concept would improve the functional features, which could sustain the garment worn for a long period. The final product fulfilled the elements and characteristics of multifunctional clothing with the design projected to achieve the objective of the zero-waste concept based on recovery, reuse and recycle. The convertible designs are suitable for daily wear activities that have an evergreen look that follows the current trend and style.

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1. INTRODUCTION

The zero-waste concept has been used in most parts of the world and it is looking into different ways of implementing new models of waste management. The philosophy of zero waste is to encourage the idea of redesigning resource life cycles so that all products and materials can be reused or recovered besides guiding people in changing their lifestyles while practising a sustainable environment (Hogland, Kaczala, Jani, Hogland & Bhatnagar, 2017). Sustainability ideas are strongly defined in the careful use of resources and ideas to demonstrate the practice of reusing clothes in fashion. The dynamics of reusing clothing can

change the rising levels of consumption and disposal with the cheap market value. Designers utilise their creativity to do techniques of re-shaping, re-cutting, re-stitching or paneling of the garments together with off-cuts are used to produce unique pieces (Fletcher & Grose, 2012).

Multifunctional clothing was developed to solve the short usage of clothes because of the fast trend changes. It is caused by different situations or even weather conditions. Moreover, multifunctional clothing will have different functional features, such as the characteristics of the garments, where it is defined by the specific market needs, and creating the concepts that meet those requirements (Cunha & Broega, 2009).

1.1 Zero Waste Concept

The zero-waste concept is defined as a process to guide people in changing their lifestyles and practices to emulate sustainable natural cycles to achieve ethical, economical, efficient, and visionary goals. In making the goals successful, the process of designing and managing products can avoid and eliminate the volume of waste and materials, conserve and recover all resources, and not dump them (Hogland et al., 2017). The zero-waste concept will eliminate all discharges to land, water or air that threaten the planetary, human, animal and health (Hogland et al., 2017).

1.2 Concept of Multifunctional Clothing

Multifunctional clothing is being developed to solve the short usage of clothes because of the fast trend changes. Multifunctional clothing is defined as clothing that allows consumers to use during different occasions and functions. Besides that, it is also caused by different situations or weather conditions (Cunha & Broega, 2009). Moreover, multifunctional clothing will have different functional features, such as the characteristics of the garments, the definition by the specific market needs, and the creation of concepts that meet those requirements (Cunha & Broega, 2009).

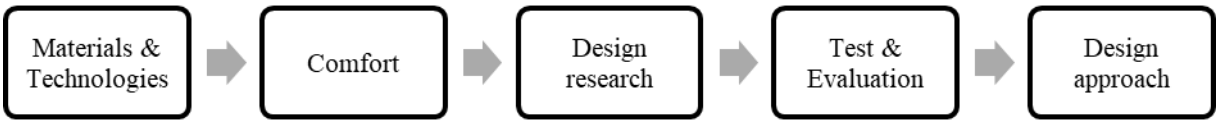


Figure 1: The stage of developing multifunctional clothing

Figure 1 shows the stage of developing multifunctional clothing by determining the materials and technology used. The concept comes from certain products that can transform a specific function into a new system by producing various or similar functions. The clothing can be dismantled into a subsystem, in which each part of the clothes can be disassembled to restructure with others to become a completely new product with multiple functions. Therefore, total comfort is a requirement to design clothing that can play a great role between humans and the ergonomic aspect (Cunha & Broega, 2009).

1.3 Value of Multifunctional Clothing

The value of multifunctional clothing is determined by the technical aspects of the product. The clothing does not just have a single product design but also series of different functions that can even be practical across several seasons and create a unique production marketing chain. It consists of three main features, namely diversity, flexibility, and continuity (Li, Chen & Wang, 2018).

i. Diversity - The design is involved with the wearer's choice and assembly.

ii. Flexibility - All the clothing products have to undergo five processes including design, production, sales, use and discard use.

iii. Continuity - The usage applies for long-term use; it can be reused from season to season.

1.4 Characteristics of Multifunctional Clothing

Multifunctional clothing is focused on how to disassemble and reassemble different parts of the clothes to have different functions. The structure of the basic form of clothing has to be disassembled into two or more parts. According to Li et al., (2018), there are 5 characteristics in producing multifunctional clothing:

i. Single Function - A single function that can only disassemble for a fixed function. The decomposition of a single function design needs to be taken apart from the complete garment, where it is the simplest and the most widely used in the market.

ii. Multi-function - The characteristics of multi-function design include having two or more functions. Each part of the garment can be simply disassembleded to achieve a multi-function design.

iii. Geometric - The geometric characteristics are the way of dismantling the clothing out of basic form, and the dismantled parts come from a form of geometric shapes such as triangle, quadrangle, polygon and so on.

iv. Compounded - Compound can be defined as a thing that is composed of two or more separate elements or in a general mixture. The basic form of clothing can be transformed into decorations and trimmings, while the use of fasteners or zippers can transform the clothing into different types of clothes.

v. Splicing - Splicing technique is applied into two kinds of expressions: namely recessive and explicit. Recessive is the attempt to use the same colour, reduce the volume of splicing tools, and reduce the sense of presence. Explicit is the preference to match colours, amplify splicing tools, and emphasize the sense of presence.

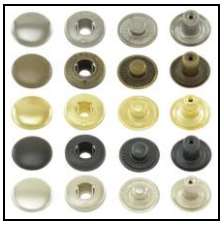
1.5 Techniques of Multifunctional Clothing

Multifunctional clothing is a way to make clothes that can be used in different situations or scenarios. The assembling or disassembling features are the systems to provide total comfort to the wearer in making their own choices of functions. Therefore, it is important to understand the techniques of multifunctional clothing by using different types of closures such as zippers, buttons, or fasteners. Closures are devices that are used to secure garments strongly. They are designed for a variety of purposes and can be decorative as well as functional. The type of closure selected depends on the design and use of the garment as well as its care, weight, and fabric use (Crawford, 2006). Picture 1 shows the types of techniques use in multifunctional clothing.

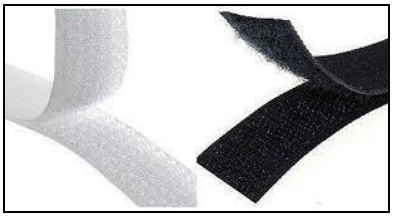
i. Zipper

ii. Buttons

iii. Snap fasteners



iv. Velcro



v. Knot

vi. Embedded

Picture 1. Types of Techniques Use in Multifunctional Clothing

2. PROBLEM STATEMENT

From year 2000 to 2014, the number of garments production has increased to 100 billion garments every year, which is 13 times the global population (Nadia Rosli, 2018). The quality of craftsmanship is also being considered because of the sense of urgency in creating short-life clothing that encourages frequent and impulsive purchases by the consumers (Gordon & Hill, 2015). Apparel industries and designers work according to the seasonal fashion collection (LeBlanc, 2012). Women's wear companies usually produce four to six lines per year. Otherwise, men's wear companies present two to four lines a year. This influences the selection of fabrics, colours and styles that reflect the weather conditions and consumer needs (Keiser & Garner, 2003). The availability of updated looks with greater variety and selling at reasonable prices makes fashion more accessible to many consumers, which can cause over-consumption (Ertekin & Atik, 2014). In addition, the fashion industry has become the second-largest industrial polluter of the high usage of materials that give an impact on the environment (Nadia Rosli, 2018).

Indeed, the fashion revolution has influenced the way people shop. Consumers are more likely to throw away clothes due to trend changes, and they easily feel bored after wearing them.

This research attempts to conceptualize a multifunctional clothing using zero-waste concept. Such clothing concept could lead to maximum usage of clothes for a longer period than would decrease the volumes of product dumping. Specifically, the study aims:

i. To identify the elements of multifunctional clothing using the zero-waste concept for millennial consumers.

ii. To determine the suitable design for multifunctional clothing by emphasising functionality, flexibility, and user-friendliness.

iii. To design a range of multifunctional clothing for millennial consumers.

3. METHOD

The study employed quantitative method to develop a deeper knowledge of multifunctional clothing using the zero-waste concept. This included the usage of appropriate data collection and analyses methods that match the research objectives. This contributes to a greater understanding of the zero-waste concept from the respondents' perspectives, the needs of multifunctional clothing in the current fashion trend and determining the elements of multifunctional clothing. The researchers used several types of methods for the data collection that involved primary and secondary data. The data provided design exploration as a step towards making the final product.

Based on several observations on the existing product, there was a lack of multifunctional clothing sold in the market. The existing designs are mostly not suitable to be worn for daily activities and the functionality of the product is also limited. The data collection was gathered by a series of product reviews. The observation took place at selected shopping malls and retailers in Klang Valley, Malaysia. This study examined the usability, aesthetics, and technical features of the existing product. The study on the existing product included several designs retrieved from the internet to analyses the elements of multifunctional clothing and enhancement on the product to fulfill consumers' needs. It is important to study the existing product from other brands and to find gaps between the products that can help towards developing new designs.

In the survey, the researcher developed questionnaires to identify the knowledge about multifunctional clothing from the respondents' points of view and to meet the objectives of this study. A total of 50 respondents participated in the online survey. A random approach was used to select the respondents. The items used were mainly multiple-choice questions in which the aim was to get feedback from the respondents about their perceptions and views towards the zero-waste concept in fashion. The survey results enabled the researchers to determine the market needs and acceptance of the projected design besides providing more design options. The survey was divided into three sections, which included demographic information, the understanding of zero waste, and the best design characteristics.

In developing the final product, several methods were applied for product making, which included sketch development, prototypes, and experimentation. These processes showed the development of ideas about multifunctional clothing that can transform clothes into different types of clothes by using the zero-waste concept.

4. DATA ANALYSIS AND RESULTS

Data from the surveys and observation were analyses. Based on the observation, the researcher found that there was a lack of multifunctional clothing sold in the market. Furthermore, most of the products were designed for sports and outdoor activities. The result found that the existing designs were mostly not suitable to be used for daily wear, and the functionality of the product was also limited. Many respondents were females, aged between 26-36 years old and employed. The age was examined based on the number of consumers. Most respondents were millennials who also contributed towards the highest percentage in buying clothes.

4.1 Preferred Multifunctional Clothing

The understanding of the zero-waste concept and multifunctional clothing showed that the respondents acknowledged the understanding of zero waste from different sources such as through reading, the internet, and designers. Respondents also agreed that the zero-waste concept can be applied to multifunctional clothing, in which it can encourage people to recover, reuse and recycle. The fashion category is important to determine the final design collection. Most respondents preferred casual attire for their daily outfits. The survey also required respondents to select the types of clothes that can be transformed to achieve the flexibility, functionality, and user-friendliness of the product (Figure 2).

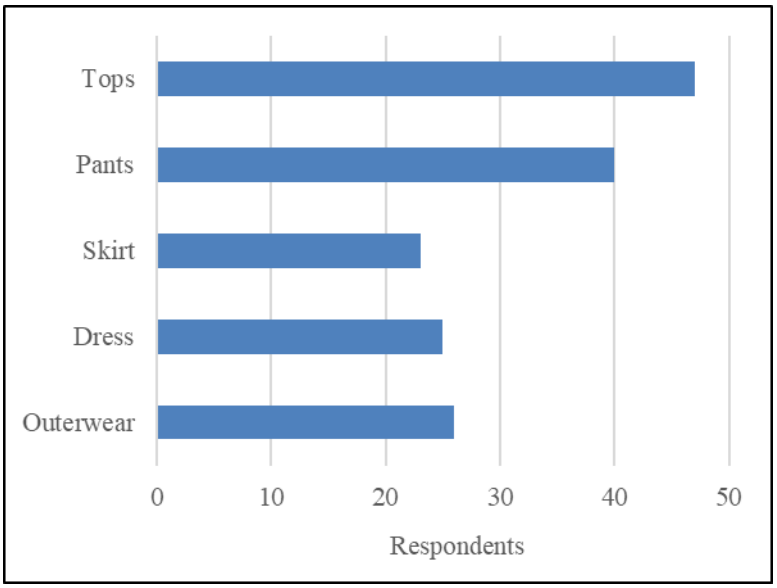


Figure 2. Preferred Multifunctional Clothing (percentage of respondent)

The researcher constructed a set of questionnaires that involved two types of designs. Table 1 shows, Design A – a convertible jacket and Design B – a Convertible skirt. Each of these designs has different characteristics. The survey was conducted to identify the best design to describe the multifunctional clothing based on the respondents' feedback.

Table 1. The Description of Design Used: Usability, Characteristics and Technique

Design	**A - Convertible Jacket**	**B - Convertible skirt**
Image		
Functionality	Transformed into a top, a crop top, and a jacket.	Transformed into a skirt and a dress
Usability	Daily activities	Day-to-night outfit
Techniques	Zip and buttons	Drape and fold

The results from the respondents showed the best criteria to develop the final product. The results demonstrated different elements of multifunctional clothing encompassed functionality, flexibility, and usability. Followed by the design attributes, this design can be transformed into different types of clothes, which are timeless and evergreen, suitable for daily use activities. The design is based on the zero-waste approach with the concept of recovery, reuse and recycle for economical and sustainable purposes.

4.2 Design Process

The data collection was analysed to determine the issues that need to be considered during the design process. The process involved transferring ideas into a compilation of sketches, prototypes, sample experimentation, and final product.

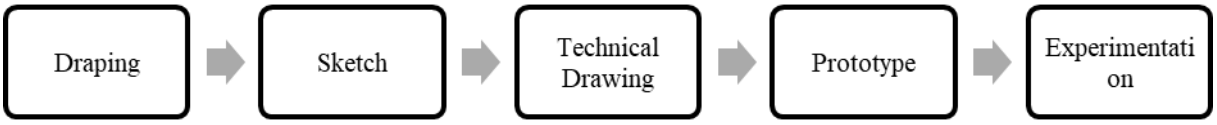
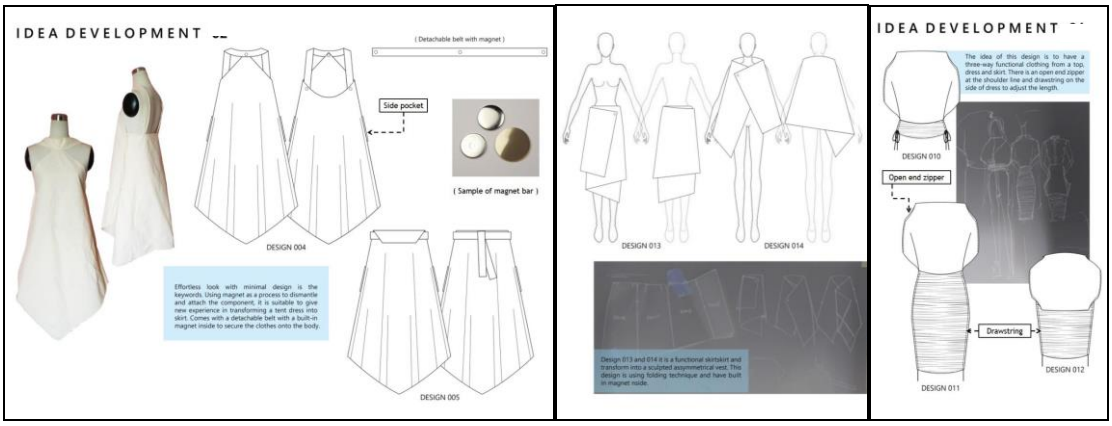


Figure 3. Development of Idea Using Draping Techniques

As shown in Figure 3, the first process was generating the idea by doing the draping technique to explore how the silhouette can be transformed into different shapes to achieve different types of clothes from a piece of fabric. It is followed by idea development that comes from the draping process and is turned into fabric sketches. The process is continued by doing the technical drawing of the finalised design. Picture 2 displays the technical drawing used to illustrate the design with a front and back view that included other detailed properties of the product.



Picture 2. Sample of Technical Drawing

Prototype involved the process of identifying and resolving the problem for each design. Hence, the final design varies from the initial idea developed as a result of the researcher's design experimentation which can achieve all the required features based on the findings and research collected. The experimentation included pattern making and fabric cutting that are aligned with the concept of zero waste.

4.3 Final Design

From design one until design four, each prototype was developed with different types of elements and characteristics to propose a new range of multifunctional clothing. Each of the designs was transformed into three types of clothes. Picture 3 shows the final design of the multifunctional dress (01). Picture 4 shows the second design of multifunctional pants (02). Picture 5 shows the third design of multifunctional top (03) and lastly, the final design for multifunctional outer is shown in Picture 6 (04). Table 3 shows the summary of each design characteristic.

Table 3. Summary of Design Used: Usability, Characteristics and Technique

Design	**01**	**02**	**03**	**04**
Usability	Multifunctional dress	Multifunctional pants	Multifunctional top	Multifunctional outer
Characteristics	Transformable into a dress, a skirt, and tops. Suitable for day-to-night outfits. Using drape and fold elements. Additional side pockets and belts.	Transformable into pants, a skirt, and tops. Suitable for daily wear. Using elements of paneling and gathers. Additional detachable pocket.	Transformable into tops, a dress, and a skirt. Suitable for any occasion. Using elements of paneling and gathers. Infinity style can be functional.	Transformable into a cape, a vest, and a skirt. Using drape and fold elements.
Techniques	Buttons and knot	Buttons and drawstring	Open-end zipper and drawstring	Invisible zip and magnets

Picture 3. Final Design of Multifunctional Dress (01)

The outcome from the first design can be transformed into three-way multifunctional clothing, dress, skirt, and tops. This design was chosen based on the analysis from the respondents that focused on draping and folding elements, which are considered as the best elements to characterise the element of flexibility. There are other functional properties such as side pockets and belts to emphasise the characteristics of the design. The use of buttons as a technique of closure as an insert in the design makes it easy to operate and to be transformed into different types of clothes.

Picture 4. Final Design of Multifunctional Pants (02)

The second design was one of the most challenging parts of the process to have an idea of transforming pants into other functional types of clothing. This design produced three types of clothes, which were pants, a skirt and a top. The elements of panelling and gathers were used to transform the clothes. The use of buttons and drawstrings are parts of the techniques in multifunctional clothing. Besides, this design included features such as a detachable pocket to enhance the functionality of the product, and at the same time adding values to the garment.

Picture 5. Final Design of Multifunctional Top (03)

The top is the most basic item that people usually wear as a daily outfit. The multifunctional top is designed to have a day-to-night outfit that can be transformed into three types of clothes, such as a top, a dress, and a skirt. The top can also be worn in two different styles; either to wear it with sleeves or sleeveless. This gives flexibility and different functionalities to the wearer to decide which style to be mixed and matched. Elements of paneling and gathers were used with the techniques of open-end zipper and drawstring, made the transformation easy and user-friendly.

Picture 6. Final Design of Multifunctional Outer (04)

The fourth design was multifunctional outerwear that can be transformed into a cape, a vest, and a skirt. Outerwear is the third-highest clothes that are normally worn by wearers based on the analysis. This is because outerwear can be matched with any type of clothes, which are suitable for a daily outfit. The reversible elements were included in the design to give a little bit more variety to consumers who wear the multifunctional outer. The use of magnets as a new technique of closure and invisible zip to achieve multifunctional clothing.

5. CONCLUSION

The study aims to explore a range of multifunctional clothing by transforming them into different types of clothes with different properties and functions. The use of different elements and techniques has given versatility to the design and flexibility of design conversion. The outcome has reached the zero-waste concept to encourage people to recover, reuse and recycle garments for economical flexibility. To achieve research objective one, the elements of draping, folding, paneling, and gathering were applied as these elements can enhance the flexibility of the product, and consumers can easily manage the functionality of the clothes. The zero-waste concept was achieved as a whole process to overcome the problem of wasted garments and enhance consumers' advantages in following current trends and styles.

In relation to research objective two, the aim was to enhance the functionality, flexibility, and user-friendly features of the product. From the research observation, it was found that there was difficulty in finding multifunctional clothing that is suitable for daily wear activities. With the development of ideas to find suitable designs, the clothes can be suitably used for any occasion or situation. The most important is the final design has the evergreen design which can fit with current fashion trend.

With regards to research objective three, the final design of multifunctional clothing offered wearers comfort and flexibility in clothing design. The variation of clothing that can be convertible into different types of clothes gave wearers an option to stylise their garments based on the functionality property. Millennial consumers were the target group because it was found that this market contributed to the highest proportion in buying clothes. A range of multifunctional clothing can overcome the problem of wastage and the wearer can mix and match the clothes with various styles.

For future research, further studies could focus on the enhancement of detailing of the product and material that suit best for different seasons. This is because seasonal fashion collections can be taken into consideration when designing multifunctional clothing that can be used from season to season. In addition, the study can focus on the concept of zero waste to manipulate different types of pattern making to reduce waste material as close to zero. The pattern making can be fitted into different types of body or sizes. Additionally, fast-fashion companies should focus on producing multifunctional clothing in their yearly collection to give awareness to consumers about a sustainable issue as well as to educate consumers towards practicing a sustainable environment.

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