

# Could Punk Style be the New Solution for Up-Cycling Fashion?

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**Abstract** This study examines the integration of punk fashion within the context of Industry 5.0 and its combination with up-cycling fashion design to address the negative environmental impacts of the fashion industry. By analyzing the expression techniques of punk fashion, the research explores their application in creating new, innovative fashion styles. The study employs the CPAM model of creativity evaluation by Besemer and Treffinger (1981) and Dacey (1989). During the design and development process, punk style expression skills were merged with up-cycling design concepts. Designs were adjusted and prototyped using CLO 3D software, culminating in the development of a series of high-end fashion products. Evaluation results indicated that these designs achieved notable success in terms of innovation and sustainability. The findings suggest that punk fashion not only has the potential to inspire new fashion trends but also offers valuable insights and practices for sustainable fashion design.

**Keywords** Punk style, Up-cycling design, Sustainable fashion, Industry 5.0, CPAM

**Citation** Li, D., & Lee, Y. K. (2024). Could punk style be the new solution for up-cycling fashion?. *International Journal of Costume and Fashion*, 24(2), 13-26.

## Introduction

The European Commission describes Industry 5.0 as having three fundamental pillars: a human-centered approach, sustainability, and resilience (European Commission, 2020). Unlike Industry 4.0, which focused on automation, Industry 5.0 emphasizes synergies between humans and autonomous machines (Nahavandi, 2019). The term Industry 5.0 emerged from the growing recognition that Industry 4.0 is insufficient to meet the increasing demands for personalization (Akundi et al., 2022). Sustainability, the second pillar of Industry 5.0, aligns with the definition provided by the World Commission on Environment and Development in 1987, which stated that sustainability is economic development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

In recent years, the importance of sustainability has

been increasingly emphasized in the fashion industry (Black, 2011), with sustainable fashion becoming a central topic in both professional and academic circles. Sustainable fashion considers the entire lifecycle of a garment, including design, manufacturing, logistics, retail, use, and disposal. As consumer tastes become more customized and demand for personalized fashion rises (Gazzola et al., 2020), the personalization models under Industry 5.0 may provide new opportunities for upcycled design. The future fashion industry should prioritize developing more sustainable and personalized designs.

Horbach (2005) argues that sustainable development success can be realized through sustainable innovation. One such innovation in the fashion industry is the upcycling of fashion products. Upcycling design involves adding aesthetic

Received August 06, 2024; Revised September 23, 2024; Accepted October 24, 2024

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value to waste by reusing it through recycling, reorganization, and closed-loop manufacturing systems. Recently, successful upcycled design products have gained popularity not only for their environmental benefits but also for their originality and design. However, upcycling design faces limitations and often resembles ordinary design products (Cassidy & Han, 2017; Cha & Han, 2016; Han & Kim, 2019; Lee, 2023). Despite recognizing the limitations of upcycling design, research to date has rarely found solutions in the historical changes in fashion and the emergence of new styles. Most of the researches (Cassidy & Han, 2017; Chen et al., 2021; Koch, 2019; Kwan, 2012) on upcycling that has been conducted until recently has focused on finding ways to mass-produce upcycling designs and presenting various examples of upcycling designs. Accordingly, this study focused on changes in fashion and the emergence of new trends at a time when the importance of sustainability is becoming more emphasized as we move into a new era, and focused on punk, which pursues newness from the past among various fashion styles.

Sklar (2013) mentioned punk fashion is characterized by exaggerated, shabby, and DIY elements. This style not only expresses resistance to commercialized and homogenized fashion, but also emphasizes resource reuse and waste minimization through a strong DIY ethos and practices. Punk enthusiasts often alter old clothes and create their own accessories, reducing the demand for new clothes and reusing waste (Sklar, 2013). In the early 1970s, punk expressed a very unconventional and explicit sexual style, such as the Sex Pistols. This unconventional and aggressive appearance spread mainly among some young people, and as the 1980s and 1990s progressed, overly bold or flashy decorations, hairstyles, and fashion styles became common and changed as characteristic elements of punk. The correlation between punk and sustainability is such that punk fashion draws inspiration from a variety of materials, deconstructs and discards traditional design approaches to create a unique style, and creates infinite style variations through a unique DIY spirit. This creative design technique is very similar to the way upcycling fashion products are recreated. The unconventional DIY work techniques shown by the punk fashion style are particularly enjoyed by

world-renowned fashion designer Vivienne Westwood in her collections. Inspired by punk, she uses her unique fashion to express topics such as hatred, blasphemy, and political statements through provocative punk fashion. Focusing on this unique and individualized tastes of punk fashion, this study aims to explore how punk style fashion design techniques can be applied to sustainable fashion design and develop new upcycled fashion designs.

The objectives of this study are as follow. First, analyze the design expression techniques of punk fashion and their potential for developing new upcycled designs. Second, explore whether punk fashion techniques can provide a unique and innovative path for upcycling fashion design in sustainable fashion, particularly in terms of creativity in design. Third, propose a creative upcycling punk fashion design based on these findings.

## Up-Cycling Design as Sustainable Fashion in Industry 5.0

With the advent of Industry 5.0, the fashion industry is undergoing significant transformations (Donmezer et al., 2023). The core values of Industry 5.0—people-centeredness, resilience, and environmental sustainability—urge the apparel industry to align with higher value concepts (Safavi Jahromi & Ghazinoory, 2024). As defined by the European Commission (2021), “Industry 5.0 attempts to capture the value of new technologies, providing prosperity beyond jobs and growth, while respecting planetary boundaries, and placing the wellbeing of the industry worker at the centre of the production process” (p. 46). Sustainable fashion aims to maximize positive impacts and minimize negative environmental, social, and economic impacts throughout the supply chain and value chain, effectively striving to achieve the practical goals of Industry 5.0. However, realizing these goals is complex and requires balancing short-, medium-, and long-term improvements across various contributing factors (Niinimäki, 2013).

Sandy Black outlines guidelines for sustainable fashion designers, including reuse, recycle, repurpose, garment repair and reconstruction, re-engineering, and downsizing and

reduction (Black, S., 2011). The upcycling movement, which involves creatively recycling discarded items to enhance their value, is gaining traction, particularly with the rise of environmental and social movements advocating for green practices. The concept of upcycling was first introduced by Lena Pilz in 1994 and later popularized by William McDonough and Michael Braungart in their book *Cradle to Cradle*. Upcycling design involves converting waste or useless products into higher quality or higher value products, thus adding value to the material through design (Choi et al., 2014; Niinimäki, 2013). The upcycling process can renovate broken, damaged, and surplus products by employing decorative textile techniques such as printing and embroidery (Gwilt & Rissanen, 2012).

Despite its promise, upcycling design faces many limitations in actual fashion products and designs. Cha and Han (2016) note that materials used in upcycling are limited and that the techniques are often restricted to handmade methods such as patchwork, pasting, electroplating, crochet, and knitting. They argue that the development of diverse production techniques beyond traditional handmade methods is essential for advancing upcycling (Cha & Han, 2016). Han and Kim (2019) also highlight that upcycled product designs often rely on simple methods, such as gluing pieces together, resulting in similar-looking products (Han & Kim, 2019). Therefore, innovative approaches to upcycling are necessary to enhance its effectiveness in sustainable design development.

This study investigates the expressive techniques of punk fashion, drawing on the similarities between punk and upcycling in their approach to creating something new. By exploring how punk fashion techniques can be applied to sustainable fashion design, this research aims to develop novel upcycled fashion designs that embody the principles of Industry 5.0.

## Punk Style as a Solution of Up-Cycling Design

Punk as a word was initially a mocking term, often used in movies, especially film noir from the 1940s, to describe

criminals or juvenile offenders. On March 22, 1970, the "Chicago Tribune" first used the term "punk rock" to refer to music or bands. It was not in the late 1970s that punk was used as a positive description (Stewart, 2017). Punk is formed in the mid-1970s, punk culture spread in the United States, the United Kingdom and Austria, and by the 2000s it had become a subculture of fashion. Punk fashion aimed to express resistance and disobedience to mainstream culture (Sklar, 2013). The main elements of punk style include black, heavy accessories, leather for boots or jackets, worn and manipulated clothing, unbalanced clothing, piercings, tattoos, unnatural hair color, band logos, jeans, T-shirts, hooded sweatshirts, vintage, overalls, sportswear, and fetish clothing (Sklar, 2013). Punk emerged from youth culture, reflecting the angst of young people in the 1970s (Moran, 2021). However, there is no universally accepted definition of punk, even among those who identify as punk (Hannon, 2009). The core of punk's early ideas has been termed as "calculated anger," encompassing anger at the system, the hippie counterculture, and the commercialization of rock music (Cullen, 1996). Early punk themes included fashion, music, politics, soccer hooliganism, youth culture, avant-garde artists, intellectuals, the socially disadvantaged, and the disenfranchised (Sklar, 2013).

Punk fashion is characterized by exaggerated, shabby, and DIY elements. This style not only expresses resistance to commercialized and homogenized fashion but also emphasizes resource reuse and waste minimization through its strong DIY spirit and practice (Sklar, 2013). Punk enthusiasts often alter old clothes and create their own accessories, reducing the demand for new clothes and reusing waste materials (Sklar, 2013). The relationship between punk and environmental protection is not coincidental: recycled fashion started in the late 1960s as rural hippie style, evolved into punk fashion in the 1970s, and continued with the recycling of old clothes in the 80s and 90s (Sklar, 2013). Rasson (2021) also suggests a link between punk and ecologically friendly DIY practices. Punk's DIY and eco-friendly approach is associated with anti-capitalism, as punks slow down consumption and continually reflect on the necessity of their purchases.

Vivienne Westwood, the mother of punk, is also a

staunch advocate of environmental protection. In 2003, she stated, “If I had it to do over again, I would be an eco-warrior,” and her runway clothes often featured signs and patterns drawing attention to environmental issues (Fury & Westwood, 2021). In 2020, she remarked, “By reducing and reusing we can have real impact. One of the most important things I have probably ever said is: Buy less, choose well, make it last” (Westwood, 2020, December 5). Through her designs, Westwood has strongly expressed that punk and sustainable fashion share a common root: resisting the stimuli of the fashion system to create an alternative lifestyle.

Today’s punk style draws inspiration from a variety of sources to create unique styles by deconstructing and discarding traditional approaches, resulting in infinite stylistic variations through the DIY spirit of punk. Additionally, upcycling fashion products have become increasingly popular for their environmental benefits and unique designs. These upcycling designs align with the ideology of punk fashion, which challenges traditional aesthetic values, opposes materialism, and expresses the desire for freedom through the recycling of old clothes. Therefore, exploring the relationship between different styles of punk fashion and upcycling fashion can provide new solutions for expanding production systems and advancing sustainable fashion design through a creative perspective on sustainable design (See Figure 1).

## Methodology

### Research Design

The research design of this study follows these steps. First, analysis of design processes. This study begins by analyzing the differences between the general design process and the upcycling design process, drawing on previous design research.

Second, examination of punk fashion techniques. Based on original design techniques of punk fashion from the 1960s to the present, this study examines the expressive techniques of material design in punk fashion and analyzes those utilized in contemporary punk fashion.

Third, classification of textile techniques: The study classifies textile techniques of punk style that incorporate upcycling, based on the expressive techniques analyzed from punk fashion.

Fourth, development of punk style designs. Ten high-end fashion designs with punk style concepts are developed using the analyzed textile techniques. Their creativity is evaluated using the CPAM model by Besemer and Treffinger (1981) and Dacey’s (1989) creativity evaluation criteria. Representative designs are realized as CLO 3D prototypes.

Finally, derivation of upcycling design process. Based on the design development process that utilizes punk style expression techniques, the study derives an upcycling design process differentiated from the general design process. This

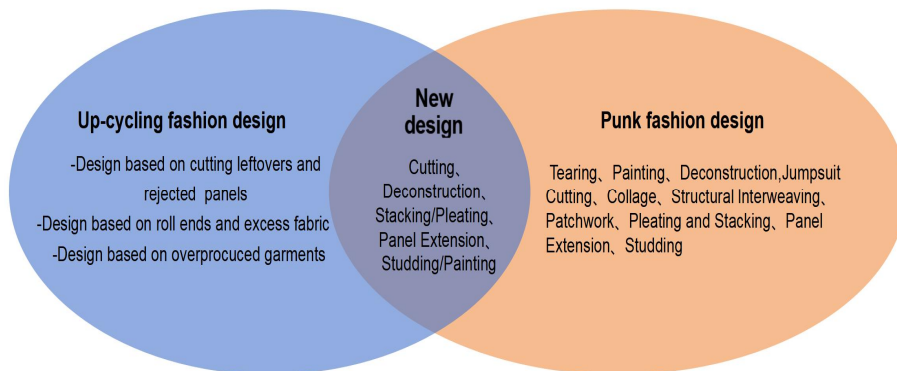


Figure 1. up-cycling and punk fashion design framework

structured approach aims to explore and innovate within sustainable fashion design by leveraging the unique, expressive techniques of punk fashion.

### Analysis of Punk Technique and Evaluation

To analyze the upcycled textile techniques utilized in contemporary punk fashion, this study selected Vivienne Westwood as a representative designer of punk style fashion. An analysis was conducted on 300 punk designs from Vivienne Westwood's collections spanning 2012 to 2022. The expressive techniques of punk fashion were classified and analyzed based on these designs.

The study aims to evaluate whether combining punk style with upcycling design demonstrates innovation and explores its potential applications in sustainable fashion. The evaluation method combines Besemer and Treffinger's (1981) CPAM model with Dacey's (1989) creativity evaluation criteria, resulting in three main evaluation standards and several sub-factors for assessing design creativity.

For the design evaluation, 12 participants were involved: six Master's students and six PhD students specializing in fashion design. The four main evaluation criteria are based on the CPAM model's categories of novelty, resolution, sophistication, and comprehensiveness. The sub-criteria include originality, surprise, quirkiness, value, logic, usefulness, organicity, elegance, complexity, and comprehensibility. Creativity was assessed using a 5-point Likert scale (1 very low to 5 very high) across the following 10 evaluation items: 1) The experimental, novel, and creative nature of the design. 2) The design's ability to fulfill a previously unmet need. 3) The usefulness of the design as a solution. 4) The clarity with which the design addresses a need. 5) The feasibility and potential for the design to evolve in the future. 6) The purposefulness and goal alignment of the design. 7) The natural flow of details within the design. 8) The visual appeal of the design. 9) The completeness and practical applicability of the design. 10) The degree of impact and innovation of the design.

Through this structured evaluation approach, the study seeks to validate the innovative potential of punk-inspired upcycled designs and their contribution to sustainable fashion.

## Results

### Analysis of Punk Fashion Design Techniques

This study reviewed punk style from the 1960s to the present and focuses on works that best express its material expression techniques in modern fashion style. Specifically, it analyzes the textile designs and fashion design structures used in Vivienne Westwood's collections from 2012 to 2022 to highlight the characteristics of punk fashion in contemporary fashion design. The analysis encompasses 300 designs that utilized upcycling techniques.







The punk-style designs in Westwood's collections are characterized by the use of fabrics with special technical treatments, the addition of decorative details, and printing techniques. In some instances, the designs retained hems in their original state, augmented with three-dimensional techniques. Simple applications of solid fabrics to flat designs were rarely observed. This analysis reveals how punk style, defined by the reuse of materials and recycling of used clothing to create new looks through unique shapes and techniques, is expressed diversely and why it is so distinctive.

The results of this analysis categorize the material expressions in punk style as follows: 1) Splicing, 2) Gluing, 3) Perforating, 4) Tearing, 5) Painting, 6) Studding, 7) Folding. The structural features of fashion designs are categorized as: 1) Asymmetry, 2) Layering, 3) Deconstruction, 4) Functional Design (see Table 1).


In terms of expressive techniques, punk fashion develops new materials by transforming existing shapes or connecting disparate elements. It also creates unique materials by painting or adding various details. In addition to seeking uniqueness through these material techniques, design differentiation is achieved by modifying the compositional form or utilizing functional elements, especially when using common or non-distinctive materials.

This structured approach to analyzing punk fashion's material and structural techniques provides insight into how the punk aesthetic is maintained and innovated in contemporary fashion design, particularly through the lens of sustainability and upcycling.

Table 1. Expression techniques in the prototype punk fashion design

Types	Techniques	Image	Image source
Textiles designs	Splicing: Collage multiple fabrics together, giving aesthetic value		Westwood (2017)
	Pasting: Paste metal sheets on the clothing, or buttons, rags		Westwood (2016a)
	Perforation: Make holes in the fabric		Westwood (2021)
	Tearing: Tear the fabric open		Westwood (2013)
	Painting: Doodle paintings on the fabric or write slogans		Westwood (2019)
	Studding: Attaching studs to the garment		Westwood (2016b)



	Folding	Enrich the visual layers of the fabric and reduce the generation of clothing waste.		Westwood (2012a)
	Asymmetric	Different designs on the left and right sides or variations in length and shape.		Westwood (2012b)
Fashion design	Layering	Adding depth and complexity to the garment through multiple layers of fabric and layered design.		Westwood (2020)
	Deconstruction	Breaking traditional garment structures and reassembling different parts of the garment.		Westwood (2016c)
	Function	Incorporating practical and decorative elements such as pockets and zippers		Westwood (2016d)

### Outcomes with Punk Techniques in Up-cycling Design

Using the seven textile design techniques (splicing, gluing, perforating, tearing, painting, studding, and folding) and four garment structure design techniques (asymmetry, layering, deconstruction, and functional design), We used upcycled fabrics in basically all of our designs to develop a collection

of upcycled fashion with a creative punk style. Initially, 20 sketch designs were created, from which 10 were selected for further development. We refined our upcycling-based punk approach to enhance the aesthetics and details of the designs. The final collection includes 15 garments, 6 pairs of shoes, and accessories such as 4 bags, 4 hats, 2 shawls, 3 rings, 2 gloves, and several bracelets. The following four designs out of the 10 generated designs are shown in Table 2. Each

Table 2. Derived upcycling design (4 out of 10)

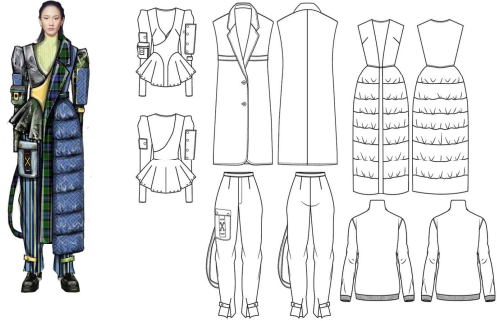
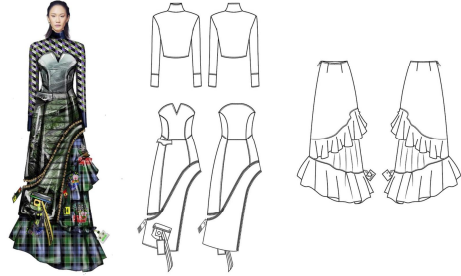

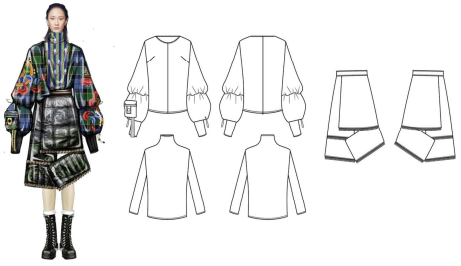
No. design	Textiles techniques	Material use	Structural techniques
<p>C1</p> 	<p>Studding</p>	<p>Padding, Denim</p>	<p>Functional pockets, Deconstruction</p>
<p>C2</p> 	<p>Perforation, Digital Printing</p>	<p>Tartan plaid patterns, Labels</p>	<p>Asymmetry, Functional zippers, and pockets</p>
<p>C3</p> 	<p>Studding, Patchwork</p>	<p>Various reused fabrics</p>	<p>Layering</p>
<p>C4</p> 	<p>Tartan plaid patterned printing, Asymmetrical patchwork</p>	<p>Tartan plaid patterns, Various reused fabrics</p>	<p>Deconstruction, Functional zippers, and pockets</p>



Table 3. Evaluations results of the developed design

No	Design	C1	C2	C3	C4
1	Originality	4.30	4.23	3.92	3.76
2	Surprise	3.84	4.07	3.38	3.92
3	Quirkiness	3.61	3.92	3.61	3.92
4	Value	3.76	4.15	3.61	3.92
5	Logic	3.92	3.84	3.92	4.00
6	Usefulness	3.84	4.23	4.15	4.07
7	Organicity	3.92	4.53	4.30	4.38
8	Elegance	4.07	4.00	4.15	3.61
9	Complexity	4.30	4.15	4.61	4.46
10	Comprehensibility	4.07	4.23	3.92	4.00
	Total (Mean)	3.96	4.13	3.96	4.00

design is characterized by distinct features:

The following four designs out of the 10 generated designs are shown in Table 3. Each design is characterized by the following features. First, C1 design mainly used stud elements among the textile design techniques of punk fashion and utilized mix and match of disparate materials of padding and denim. It also added functional pockets and deconstructive elements as structural features of fashion design. In the C2 design, we used labels on the fabric as decoration, added perforations to the fabric, and introduced retro patterns such as tartan plaid patterns using digital printing instead of painting to enhance the funky aesthetic of the fabric. The garment structure is characterized by an asymmetrical skirt design with functional zippers and pockets. The C3 design utilized studs and patchwork on the fabric in a funky way, with a multi-layered layering technique. C4 design was designed to create a deconstructive structure using tartan plaid patterned printing, asymmetrical patchwork, and functional zippers and pockets.

### Creativity Results of Punk Techniques in Up-cycling Design

Through the above analysis of creative upcycling design development using the funk method, the potential of the funk method as a solution to upcycling design development can be

summarized as follows (see Table 3). First, as shown in Design C2, the DIY approach of punk to aesthetic transformation of materials can be utilized very effectively in upcycling design. This highlights the importance of infusing new aesthetic value into recycled fabrics, as redesigning them can enhance the effectiveness of upcycling designs. Second, overly complex structural designs such as C1 and overly simple designs such as C3 scored relatively low in the creativity evaluation. This shows that it is necessary to balance the complexity of the structural design in the development of upcycling designs. Overly complex designs are difficult to understand and appeal to users or consumers, while overly simple designs can look bland and therefore have limited appeal to consumers. Therefore, the results confirm that moderate structural designs can better meet the aesthetic and functional needs of consumers. In addition, the functional zippers and pockets utilized in C1, C2, and C4 designs were evaluated as greatly enhancing the practicality and popularity of these designs. This shows that functional elements that increase the practical value of a product are also important in upcycled designs. Finally, C2 and C4 designs that utilized retro patterns scored relatively higher, indicating that retro elements also have a strong appeal in upcycling.

These scoring results suggest that the way punk design

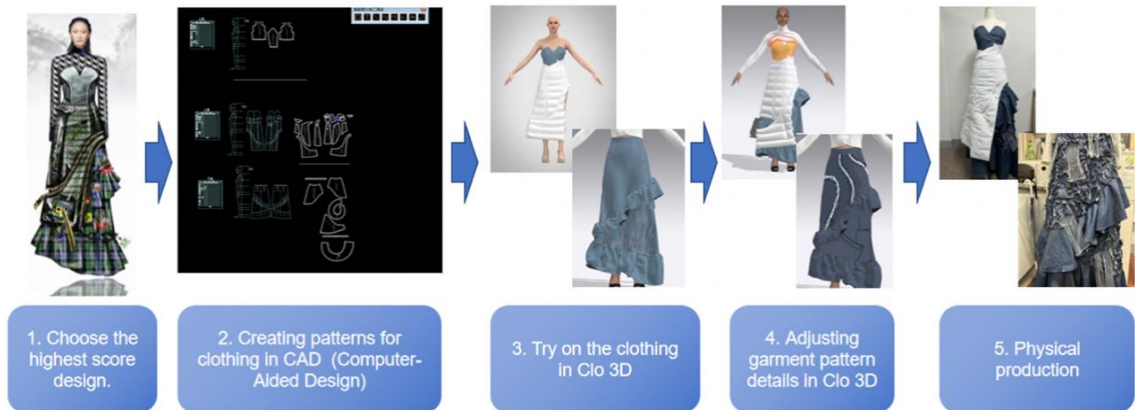


Figure 2. Representation process with CLO 3D

combines asymmetrical design, functional design, and aesthetic variations of materials can be a solution that can greatly enhance creativity and originality when developing creative and innovative upcycling designs.

### 3D Representations

The purpose of this study was to investigate whether punk design techniques can be a solution for upcycling design development, and to evaluate the creativity of upcycling designs using punk design techniques. As a result, the utilization of various material techniques (such as 1) splicing, 2) gluing, 3) perforating, 4) tearing, 5) painting, 6) studding, and 7) folding) and structural forms (such as 1) asymmetry, 2) layering, 3) deconstruction, and 4) functional design) of appropriate punk design techniques obtained high creative evaluations, confirming that the utilization of punk fashion design techniques in upcycling design development is very effective.

We developed the upcycling design using CLO 3D through the following process. First, we set the goal of conducting upcycling fashion design by utilizing punk technique. Second, we source fabrics by securing waste from garment factories and recycling clothing from local communities. Third, we conduct a research process to gather examples of punk designs that illustrate the concept of upcycling fashion design through literature review and case studies. During this phase, we organize the textile design and



Figure 3. CLO 3D(a and b) and actual garment(c and d)

structural design methods shown in various design works. Fourth, in the design phase, we create a color palette and mood board based on the fabrics and materials we collected,

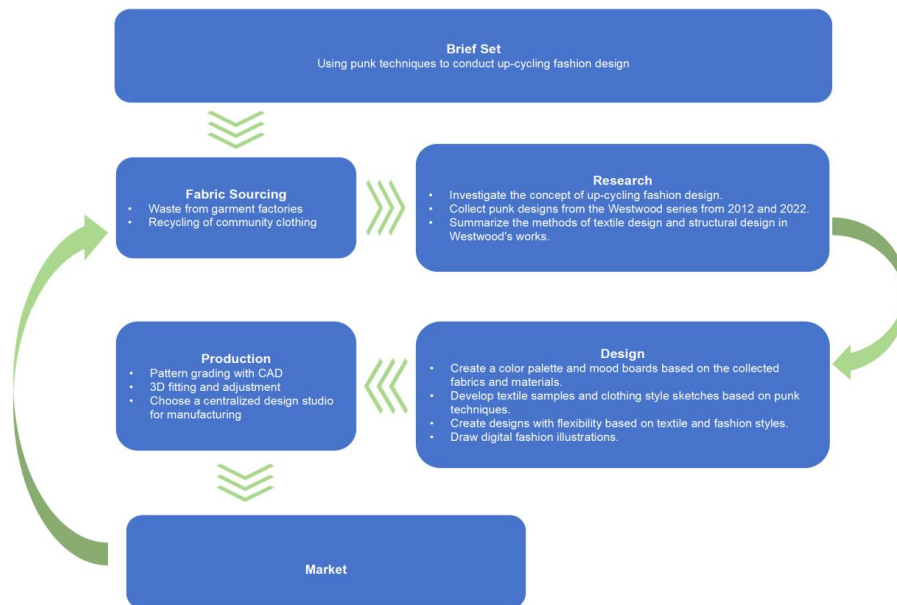


Figure 4. Upcycled design process model

and proceed with textile samples and garment style sketches. Fifth, we finalize the design and create digital fashion illustrations. Finally, in the production phase, we use CAD to grade the pattern, make any necessary adjustments, and sew and mount the pattern on a CLO 3D (see Figure 3 and 4). Final production is done in a centralized design studio.

## Discussions

The emergence of Industry 5.0 means a shift from mass production to mass customization and a greater emphasis on environmental protection and resource reuse. This concept underpins the core principles of upgrading circular fashion and punk fashion. This study verifies how the design techniques of punk fashion can be an effective solution for the development of upcycled fashion design, which has been criticized for its design limitations.

This study also confirms that material utilization is a very important factor in upcycling design development, and that the upcycling design development process should be somewhat different from the general design development

process. Han et al. (2017) mentioned the difference between the standard design process and the upcycling process. While the standard design process proceeds in the order of brief set-research-design-promotion-fabric purchased, the upcycled fashion design process proceeds in the order of brief set-fabric sourcing-research-design, so material development precedes research and design development. However, Han et al. (2017) upcycling fashion design model has a one-way structure rather than a circular structure, so it is limited to be used as a sustainable fashion design development model. Based on the results of this study, the upcycling design process for sustainable fashion design development was derived as shown in Figure 4.

In this study, the following meanings were derived through the development of upcycling design using punk style design techniques.

First, upcycling design is the process of converting waste or useless products into higher quality or higher value. However, in actual fashion products and designs, upcycling design has many limitations, such as simple splicing of pieces in the design process, and it is limited to using decorative textile techniques. Therefore, through various academic research and creative design approaches, it is very

important for us to address the limitations of circular fashion technology and explore more innovative and sustainable design methods.

Secondly, the subversive punk style of the 1970s was characterized by a desire for anti-hegemony, freedom of thought, and individual power to separate from mainstream culture. However, over time, these characteristics have largely lost their meaning in contemporary punk style and are only expressed in an unconventional and diverse combination of elements, which are expressed through a variety of creative techniques in punk fashion. We found that punk fashion design is represented by material techniques such as splicing, gluing, perforating, tearing, painting, and studding, which are consistent with the design concept of upcycling design. Thus, by deconstructing and reconstructing existing fashion forms, these techniques are expressed as new and unique design features, which can be utilized as creative and innovative design solutions. This process of deconstruction and reassembly is at the core of upcycling design, which gives new life and value to existing materials through reprocessing and reuse.

Finally, in the process of upcycling design, it is very important for designers to pay attention to the aesthetic transformation of materials, balance the complexity and simplicity of design, increase the design of functional elements, and combine retro style with modern technology to develop more attractive and practical fashion products.

## Conclusion

This study explores the integration of punk style with up-cycling fashion design in the context of Industry 5.0, validating its creativity in the realm of sustainable fashion. Through an analysis of Vivienne Westwood's designs, seven unique textile techniques and four structural design elements are summarized, providing rich inspiration and practical foundations for up-cycled fashion design. The findings indicate that the distinctive expressive techniques and DIY spirit of punk fashion can effectively enhance design creativity and originality, thus offering new solutions for the sustainable fashion industry. By applying the CPAM model

to evaluate the designs, we found that innovative punk style designs possess significant advantages in both functionality and aesthetics.

The results of this research not only inspire up-cycling designers to incorporate personalized elements of punk into their sustainable creations but also create a model for up-cycling fashion design using 3D digital technology in the context of Industry 5.0, aiming to inspire up-cycling fashion designers in their design processes. Furthermore, this study demonstrates how recycling and reusing materials can enhance the aesthetic value and market appeal of old garments.

Future research could further explore the application of punk style in different cultures and markets, as well as how to promote up-cycling fashion concepts on a broader scale. Additionally, this study reveals that secondary design development of recycled garment materials plays a crucial role in fostering innovation in up-cycling design; future research could consider how to integrate secondary development design of garment materials into up-cycling fashion design. Finally, given the rapid advancement of technology, exploring the application of digital tools in up-cycling design will also be a worthwhile research direction.

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