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Advanced Knitwear: A Sustainable Journey Towards Couture Innovation

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ABSTRACT

This paper focuses on the dynamic relationship between knitwear, technology, and sustainability and their application in the creation of a couture collection. With the ever-evolving fashion landscape, designers are increasingly seeking innovative approaches to address both aesthetic and environmental concerns. Knitwear, with its inherent versatility and adaptability, has witnessed significant advancements in recent years due to technological innovations. This study investigates the potential of integrating advanced knitting techniques and sustainable practices to develop a couture collection that showcases the symbiosis of artistry and responsible fashion. This paper underscores the potential for knitted garments to become key contributors to a more sustainable and responsible fashion industry. An effort was made to create a couture collection on Shima Seiki knitting machines using different knitting structures and environmentally friendly organic yarns. The panels of each silhouette were knitted as per the knitting specification and later knitted panels were linked on a linking machine.This research discusses the creative process of developing a zero waste couture collection to promote circular fashion.

Key Words : Knitwear, Sustainability, Couture Collection, Shimaseiki

INTRODUCTION

The textile, apparel, and fashion (TAF) industries are the second most polluting industries, contributing significantly to global environmental pollution at every point of the supply chain. They are accountable for 10% of the annual global emissions of greenhouse gases and play a significant role in climate change. According to the Environmental Protection Agency's data, 17 million tons of textile waste were dumped in landfills in 2018 which may demand more than 200 years to decompose completely. Textiles release toxic chemicals and dyes into our soil and groundwater as they decompose, releasing harmful greenhouse gas methane. Plastic is also used a lot in the apparel industry, which uses 342 million barrels of petroleum to make the synthetic fibres in clothes. An estimation of 8,000 engineered synthetic compounds are utilised during garment manufacturing, which incorporates cancer-causing agents and chemical disruptors. Therefore, stakeholders are becoming more aware of the impact that the fashion, textile, and apparel industries have on climate change and human rights, which is encouraging businesses to reduce the damage they cause to the environment.

Sustainability, today, is very essential to the apparel industries for saving our mother earth from the danger of environmental pollution. It has been discovered that looms used to weave fabric use more energy and release more carbon dioxide into the atmosphere. The machine knitting process, on the other hand, is better for the environment than weaving because a single knitting machine is sufficient to make a complete piece of fabric. The hand knitting process is a zero-waste producing, zero carbon-discharging, minimal expense business, and manufacturing process for making fully fashioned knitwear. The advancement of 3D knitting, seamless

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knitting, has shown a viable impact in further taking out waste.

One of the leading fully- fashioned knitting machine producers is Shima Seiki Mfg. Ltd. (Wakayama, Japan). Using computer-aided design, the knitting pattern can be easily modified during fully fashioned knitting, facilitating mass customization and knit-on-demand business models. Thus, computerised flat knitting is a medium to support the dire need for sustainable fashion.

In this study, an attempt has been made to design and develop a knitted couture collection using the Japanese machine, Shima Seiki: SSR-112 (a computerised flat knitting machine of gauge-12) and programming the fabrics on the supporting software Apex 4. The main aim of this collection is to eliminate or limit the waste caused during the production of couture garments.

METHODOLOGY

This study follows an exploratory research technique, with Stage 1- Secondary Research, involving understanding previous literatures and articles to assist in assessing the status of textile waste and the contribution of knitwear to resolving this issue. In the stage 2-Primary research, the process of exploring different yarns, swatches and silhouettes, and developing a zero waste knitted couture collection to promote sustainable practices in the TAF industries.

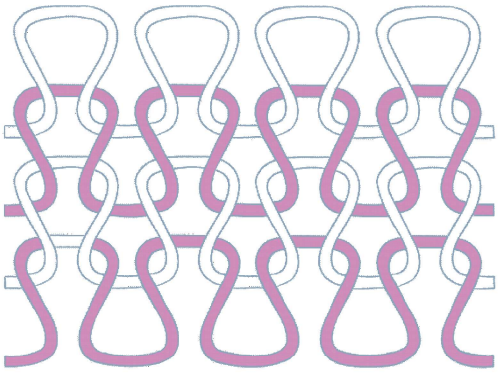


Fig. 1 : All knitted structures are based on the formation of such pattern of interloping yarns

Fig. 2 : The Shima Seiki SSR-112.
Ref: https://www.shimaseiki.com/product/knit/ssr/

Stage 2:

Yarns used :

The Yarns chosen for the collection were well researched to make sure their production criterias are sustainable in nature. The prime sustainable choices that were readily available and sustainable were Tencel- *(2/30 Nm)*, and Organic cotton- *(2/30 Nm)*. Tencel is a brand of lyocell fibre manufactured from eucalyptus tree wood pulp, a sustainable resource. Tencel yarn production utilises less water and energy. Tencel yarn is biodegradable and compostable at the end of its life, making it an eco-friendly alternative.

Development Of Silhouettes:

The process of developing the collection began with silhouette finalisation. A thorough research on trends and forecasts for the upcoming seasons was conducted. The silhouettes were created keeping the research and aesthetic in mind, as well as the freshness and uniqueness of the story represented in the collection. The majority of the designs developed were based on ensuring that the seamless knitting could generate the desired panels. Before settling on the final five designs (Fig. 3) for the collection, a total of 15–18 designs were explored.

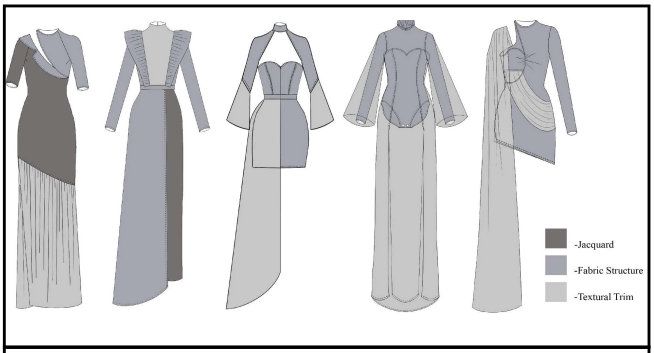


Fig. 3 : The final 5 designs with highlighted panels. Left to Right: Silhouette 1 to 5, respectively

Development of Fabrics:

The sample development of fabric structures including jacquard patterns for the selected designs was

curated on the Japanese software of Shima Seiki- Apex 4. The APEX series provides full assistance for all stages of the flat knitting supply chain, including knit planning, pattern development, and colour evaluation, as well as manufacturing and sales marketing. Flat knitting designs such as structural patterns, intarsia patterns, and jacquard patterns can potentially be created using the APEX series. It also has the ability to simulate yarns such astancel, slub, and shiny yarn in a realistic manner.

For a total of 5 ensembles, 20 swatches, including 5 jacquard patterns were developed. The uniqueness and relevance of the concept were taken into consideration while designing the jacquard patterns too. Before any samples were further processed into knitting, they were all originally developed on the computer programme and virtually simulated on Apex 4.

Client Determination:

A woman aged between 25 to 33 years, belonging to the upper class and residing in tier 1/metropolitan cities of India is assumed. She's passionate, outspoken, mature and independent. Her interest lies in music, travel, literature and social cause. She highlights her presence on events like Award ceremonies, Fashion shows, Red carpets and Motivational talk shows.

Evaluation of the Designs:

A group of 30 judges, consisting of professors, label owners, knitwear manufacturers, stylists, and students, first reviewed the developed silhouettes and assisted in deciding the five final designs (displayed in Fig. 3). They were then responsible for reviewing the jacquard designs before choosing the two most outstanding design for application in two separate ensembles. Visual Appeal, Colour combination, Appropriateness of Jacquard motif for couture, and Overall Appearance with respect to the resultant design were the criteria for evaluating jacquard swatches. For this, a 5-point ranking proforma was applied. The designs were scored as 1, 2, 3, 4, and 5, respectively, denoting bad, fair, good, very good and excellent designs.

Post that, a total of 15 structures with a variety of cables stitches, pointelle variations, front and back bed variation along with tucks were presented to the panel. They were asked to choose between different structures of fabric textures for each of the desired silhouette as per their opinion. A rating proforma of most to least accurate structure for a particular design was considered.

Fig. 1 : Jacquard swatches enhanced with Handwork. (Design 3 and 5, respectively)

RESULTS AND DISCUSSION

The developed jacquard patterns were evaluated visually by the panel for the selection of the two most preferred jacquard designs for two individual pieces as displayed in Fig. 3. Table 1 displays the record of the evaluation. It is observed that, for the Jacquard fabric, Design 3 and Design 5 were scored the highest due their visual appeal, motif appropriateness and overall look with respect to the design. The Design 3 was selected for silhouette 2 while the Design 5 was selected for silhouette 1. The selected jacquards, Design 3 and 5 were further embellished with *katdanas, and glass beads* to enhance and elevate the look of the fabric (shown in Fig. 4).

The evaluation record for the fabric structures is presented in Table 2. (For better understanding, please refer to the highlighted panels of the fabric structures in Fig. 3). A total of 15 swatches, each containing distinct elements of the cable, pointelle, and tuck variations were presented to jury.

Fig. 5 displays the 15 swatches which were developed. Table 2 provides clear understanding of the most preferred fabric structures for each silhouette. The evaluation record for the fabric structures is presented in Table 2 (For better understanding, please refer to the highlighted panels of the fabric structures in Fig. 3). A total of 15 swatches, each containing distinct elements of the cable, pointelle, and tuck variations were presented to jury.

Fig. 5 displays the 15 swatches which were developed. Table 2 provides clear understanding of the most preferred fabric structures for each silhouette.

Out of 15 swatches, 6 of them stood out the most and the distribution of all 6 swatches came to a conclusion and each silhouette was made unique with detailed structures appointed to them by the panel. It can be observed that Design 7 is the most relevant amongst the other swatches for Silhouette 1. Design 10 received the highest score of all the samples and was selected most relevant for both Silhouette 3 and Silhouette 5. Design

Table 1: Visual Display of Evaluation Report of Jacquard Designs

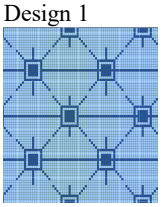
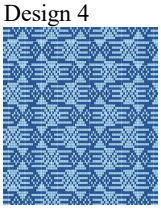
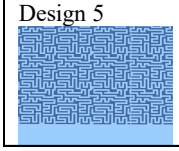
Design Number	Visual Appeal	Colour Combination	Appropriateness of Motif for Couture	Overall Appearance	Avg. Score
Design 1 	4	4.5	3.6	3.5	3.9
Design 2 	4.3	4.2	4	3.8*	4.1*
Design 3 	4.8	4.5	4.6	4.9*	4.7
Design 4 	3.9	4	3.7	4.2	4*
Design 5 	4.2	4.6	4.3	4.8*	4.5*

Table 2 : Visual Display of Evaluation Report of Fabric Structure Exploration

Design number	Silhouette 1	Silhouette 2	Silhouette 3	Silhouette 4	Silhouette 5
Design 1	3.5	3.2	3.7	3.1	2.8
Design 2	2.6	2.4*	2.2	3	3.1*
Design 3	3.4	3.2	3.3*	3.1	2
Design 4	2.9	3.4	3.1	3.4*	2.8
Design 5	2	2.5	3.2	2.6	2.1
Design 6	2.7*	2.1	2.6	2.8	2.2
Design 7	4.4	3.6*	4.1	3.4*	3.7
Design 8	3.8	2.7	2.9	3.5	3.4
Design 9	3.4	2.2	3.5	3.3	2.6
Design 10	4.1	4*	4.8	3.8	4.5
Design 11	3.8	3.7	3.5	2.8*	3.1*
Design 12	4.1	3.8	4.2	4.7	4.2
Design 13	3.9*	4.6	3.5	3.7	4.6
Design 14	4.2	3.2	3.7*	4.4	4.2
Design 15	3.7	3.6	4.6	3.4	3.7

Fig. 5 : 15 structure swatches evaluated by the jury, containing variations of tuck, cable, pointelle

12 was determined to be the most applicable to Silhouette 4, while Design 13 was applicable to both Silhouette 2 and Silhouette 5. Design 14 was also rated to be significant for Silhouette 4, whereas Design 15 received the highest score for Silhouette 3.

Taking along the selected 6 designs and 2 jacquards, the pattern making for each panel on the Apex system was initiated. Corresponding CPI (courses per inch), and WPI (wales per inch) to the desired measurements -of the finalised silhouettes were taken out, before creating the final panels with the allotted structures. The length of the panels were recorded by adding up the wales per inch and the number of courses represented the width of a panel (Fig. 6 represents the virtual representation of the final collection).

Range Plan Execution:

Taking along the selected 6 designs and 2 jacquards, the pattern making for each panel on the Apex system was initiated. Corresponding CPI (courses per inch), and WPI (wales per inch) to the desired measurements of the finalised silhouettes were taken out, before creating the final panels with the allotted structures. The length of the panels were recorded by adding up the wales per inch and the number of courses represented the width of a panel. The recorded measurements backed the pattern making on the Apex system and using the 'narrowing and widening' method of knitting, the patterns were then processed and updated into the Shima Seiki system. Being an absolute machine, it has the power to read throughout the processed file, and identify errors. When the file prompts no errors, the machine then starts knitting the pattern programmed. All the panels of the ensembles were knitting and embellished with handwork in order to create statement couture pieces. The embellished panels were then assembled by the technique of linking and the

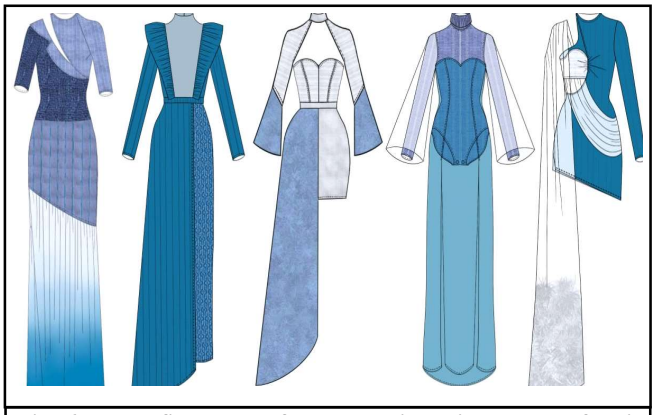


Fig. 6 : The final look of the collection with allotted fabric structures and Jacquard details

final collection was completed. The final range was showcased to the Jury panel and the same was highly appreciated by them. The collection also was showcased in the NIFT fashion show held by the Knitwear Department (Fig. 6 represents the virtual representation of the final collection).

Conclusion:

The study concluded that the textile, apparel and fashion industry's contribution to global pollution can be remedied by considering the use of advanced technology. The use of biodegradable, organic, natural, and recyclable raw materials is equally effective in reducing pollution levels in the environment. This study serves as a first step towards creating a safe environment that is accessible to all. The use of advanced technology also encourages designers to meet the ever-evolving needs of consumers, particularly those who are looking for a more sustainable and eco-friendly future but still expect statement and high-fashion attire. Since couture fashion is primarily bespoke and does not require large-scale production. The continuous development in the knitting industry is envisioned to be sustainable and feasible for all.

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