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The Role of Knit Structures for Unisex Clothing

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Abstract

This research analyses the knit structures used in unisex clothing, focusing on their suitability for achieving aesthetic requirements in line with current fashion trends. As the demand for unisex apparel continues to grow, understanding how different knit structures contribute to visual and stylistic appeal becomes essential for designers and manufacturers. The study adopts a qualitative research approach, integrating a comprehensive literature review with content analysis of contemporary market products to identify commonly used knit patterns in unisex fashion. In addition, experimental sampling is undertaken to develop fabric swatches representing selected knit structures, which are then assessed through expert evaluation to determine their aesthetic suitability. The findings aim to provide insights into which knit structures effectively meet the aesthetic expectations associated with unisex clothing, thereby supporting informed decision-making in knitwear design and development.

Keywords

Unisex Clothing, Knitwear, Fashion Trends, Knit Structure Development, Digital Garment Simulation

1. Introduction

Unisex clothing is becoming a significant trend in the fashion industry, which is currently undergoing a significant transformation. Unisex apparel has become increasingly popular due to its versatility, comfort, and allure to a wide range of individuals, transcending traditional gender norms. The significance of fabric innovation, particularly in knit structures, is at the core of this movement. These structures serve as the foundation for the development of garments that are visually distinctive, comfortable, and malleable.

Knit structures are ideally adapted for unisex fashion because of their inherent stretch, drape, and texture, which enable them to accommodate a variety of body

shapes and sizes. Diverse knit patterns and techniques, including Tuck, Pointelle, and a combination of structures, provide varying degrees of visual appeal, thickness, and elasticity, rendering them suitable for garments that cater to a wide range of preferences. Furthermore, the increasing consumer demand for ethical and environmentally responsible fashion is in line with the incorporation of sustainable materials such as organic cotton in knitwear.

Objective:

1) To thoroughly understand the Market insights for unisex clothing through secondary research.

2) To develop fifteen Flat Knit structures for a unisex pullover following a design process.

3) To evaluate the fabric swatches based on the tech pack received from the client.

4) To identify one knit structure for manufacturing a unisex pullover.

5) To digitally design a unisex pullover for an international brand based on the client's requirements.

2. Review of Literature

2.1. Unisex Clothing

Unisex clothing, designed to be worn by any gender, has grown in popularity, reflecting evolving views on gender and inclusivity in fashion. Unisex fashion resonates with both designers and consumers for varied reasons. Designers approach unisex clothing as a response to cultural shifts, aiming to broaden market appeal and challenge traditional gender norms in style. Consumers, however, are often attracted to the versatility and aesthetic value of these pieces, viewing unisex clothing primarily as a style choice rather than a gender statement. This trend underscores a broader cultural embrace of inclusivity and individuality in fashion [1]. The concept of unisex clothing emphasises gender equality and self-expression, originating from the mid-20th-century movements against traditional gender norms. Influenced by cultural icons and movements like the Peacock Revolution, unisex clothing became a medium to blur gender boundaries, combining masculine and feminine design elements. This style prioritises comfort, simplicity, and freedom from gender-specific constraints, making it appealing to younger generations who value individuality over traditional roles [2].

Gender-inclusive clothing fashion prioritises comfort and adaptability by using versatile, breathable materials that fit various body types. Key elements include relaxed, non-restrictive silhouettes that enhance freedom of movement and flexible, lightweight fabrics like organic cotton and linen, known for their breathability and comfort. These choices align with the practical and aesthetic goals of gender-inclusive clothing design, which often adopts minimalist styles free from heavy embellishments, thus ensuring a lighter wear experience. Additionally, natural fibres not only offer a comfortable fit but also cater to the eco-conscious consumer base, emphasising sustainable and environmentally friendly materials in unisex fashion [3].

The study investigated the relationship between friction and tactile properties of woven and knitted fabrics, emphasising that clothing comfort is closely linked to fabric properties like bending, thickness, and compressibility. It was found that knitted fabrics exhibit a stronger correlation between friction and subjective tactile assessments compared to woven fabrics, due to their looped and more irregular surfaces, which enhance the tactile differentiation. The type of fiber used in knitted fabrics significantly affects their physical properties, including strength, moisture management, and durability [4]. Cotton, a widely used natural fiber, provides excellent comfort and moisture absorption but tends to have lower mechanical strength compared to synthetic options. Organic cotton, specifically, offers the same benefits as conventional cotton but is cultivated without synthetic pesticides or fertilizers, making it more environmentally sustainable [5].

2.2. Knitted Unisex Clothing

Knitwear has recently been floated as high-value-added fashion products preferred for having both functionality and fashionability by the international casual tendency of clothing [6]. Knitwear design involves creating garments by interlacing yarns into fabrics known for flexibility, texture, and warmth [7]. Innovations like fully fashioned knitting integrate traditional skills with sustainable practices by shaping garments directly on machines, eliminating fabric waste, and allowing complex design capabilities [8]. Knitwear plays a vital role in unisex fashion, blending functionality and aesthetics to transcend traditional gender boundaries. As a medium, knitwear is celebrated for its versatility, offering neutral designs that accommodate diverse body types and preferences. The inherent flexibility of knitted fabrics allows for creative structures and seamless adaptability, making them ideal for gender-neutral collections. By avoiding overtly masculine or feminine motifs, knitwear creates a blank canvas that focuses on comfort and individual expression rather than conforming to societal norms. Unisex knitwear emphasizes clean lines, simple patterns, and soft textures, which cater to universal preferences, reinforcing its appeal across genders. Its adoption reflects broader societal trends toward gender fluidity, with consumers—particularly millennials and Generation Z—valuing inclusivity and individuality in their fashion choices. Moreover, the sustainability of knitwear aligns with contemporary ethical concerns, as durable and timeless designs reduce waste and encourage longer usage cycles. Despite its potential, barriers such as entrenched cultural stereotypes and varying global perceptions of gender fluidity impact its mainstream acceptance, particularly in regions with conservative norms. However, as more individuals and designers embrace knitwear as a neutral, functional, and expressive medium, its role in advancing unisex fashion is set to grow, reflecting a shift toward more inclusive and equitable clothing practices [9].

2.3. Fashion Trends for Unisex Clothing

Unisex fashion is gaining traction for its practicality and inclusivity, although cul-

tural norms and comfort challenges hinder broader acceptance. Unisex fashion trends emphasize versatility, sustainability, and minimalistic design, appealing to fashion-conscious consumers seeking adaptable, gender-neutral options [10]. Unisex brands prioritize simple, smooth textures and avoid overly gendered embellishments, like lace or intricate embroidery, which are traditionally associated with specific genders. This approach helps garments feel approachable for everyone, emphasizing functional and minimalist textures that add to their versatility and ease of wear across various contexts and personal styles [11].

Unisex fashion has evolved significantly in recent years, reflecting changing societal attitudes towards gender expression and identity. Designers are increasingly focusing on creating clothing that can be worn by individuals regardless of their gender identity [1]. This trend is particularly prominent among younger consumers in Western countries like the United States, where gender fluidity is more widely accepted due to a long history of fighting for gender equality. Interestingly, there are notable differences in how unisex fashion is perceived and practiced across cultures. While it has become a more routinized practice in the United States, Chinese consumers demonstrate a more deliberate and reflexive attitude towards unisex clothing, still influenced by traditional gender ideologies [12]. This highlights the impact of socio-cultural values and political ideologies on the adoption of unisex fashion trends.

In conclusion, unisex fashion continues to challenge traditional gender norms in clothing design and consumption. The industry is moving towards more inclusive and diverse approaches, with designers emphasizing the characteristics of "unisex" rather than adhering to strict gender-based categories [13]. As the concept of unisex fashion matures, it is likely to develop further in the direction of diversification and equalization of clothing, reflecting broader societal shifts towards gender inclusivity and individual expression [13] [14].

2.4. Trend Forecast

Fashion seasons, such as Spring/Summer (SS) and Autumn/Winter (AW), divide the global fashion calendar into structured periods that guide the development of colours, materials, textures, and silhouettes for each cycle. These seasonal trend directions are created by forecasting agencies and research bodies that analyse cultural shifts, consumer behaviour, climatic requirements, and market demands. For export-oriented knitwear, understanding trend seasons is essential, as international buyers rely on season-specific requirements to ensure commercial relevance and alignment with global retail timelines. Trend seasons help export houses plan yarn selection, fabric structures, colour palettes, and garment silhouettes that suit both the climate and the consumer preferences of the target market [15].

WGSN (Worth Global Style Network) is one of the world's leading fashion forecasting platforms, providing data-driven insights into upcoming seasonal trends, including colour direction, fabric innovation, consumer behaviour, and key prod-

uct themes [16]. Their forecasts play a crucial role in shaping design decisions for international brands and export houses, ensuring that products align with future retail expectations.

According to WGSN's Spring/Summer 2025 forecast, the season focuses on calm, tactile minimalism rooted in comfort, longevity, and subtle expressions of texture. The colour palette for SS25 emphasises neutral tones, soft pastels, and nature-inspired mid-tones, supporting the global shift toward gender-inclusive and versatile design. Textures remain an important direction for the season, with a preference for delicate surface interest, lightweight structures, and breathable fabric behaviour suitable for warmer climates [16]. These insights guided the swatch development in this study, ensuring alignment with both client expectations and international market directions for SS25.

2.5. Knit Structures Used in Unisex Clothing

As previously discussed, versatility is one of the important criteria in developing unisex clothing. One of the ways to achieve versatility can be through constructing fabric that is universally accepted for all-gender clothing. Knitted fabric structures, particularly weft-knitted fabrics like plain jersey, single lacoste, and double lacoste, significantly influence physical properties such as density, dimensional stability, and resistance to pilling.

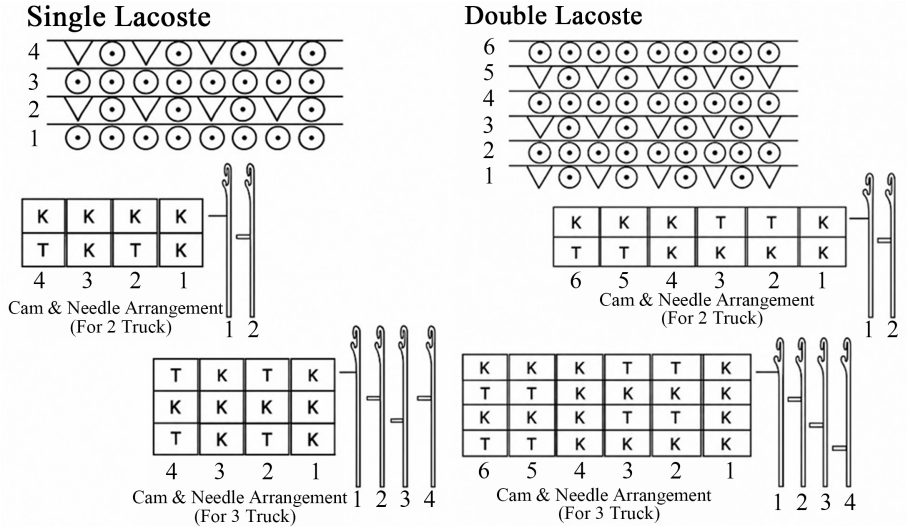


Figure 1. (a) Knit notation of single lacoste; (b) Knit notation of double lacoste (textile floor).

As shown in **Figure 1(a)** and **Figure 1(b)**, the knit notations illustrate the structural differences between single lacoste and double lacoste (textile floor), highlighting the variation in stitch arrangement and surface formation.

Structures with more tuck stitches, for example, tend to increase areal density, fabric width, and pilling resistance due to added yarn accumulation at tucking points. Additionally, knitted structures with tuck stitches display higher width shrinkage but lower length shrinkage, which stabilizes the fabric. Spirality—a ten-

dency for the fabric to twist or distort—also decreases with increased tuck stitches, enhancing fabric stability. However, knit structures minimally affect colour fastness if dyeing and finishing parameters remain consistent.

These properties highlight that changes in knit structure directly impact fabric performance, appearance, and durability, which is why specific structures are chosen based on end-use requirements in apparel and textile applications [17].

Weft-knitted fabrics offer high stretch, often up to 100%, due to their loop structure, making them more elastic and comfortable than woven fabrics. Rib structures enhance stretch with a "concertina" effect, ideal for cuffs and waistbands. However, knitted fabrics have lower dimensional stability and may shrink or pill over time [18]. Knit fabrics with tuck stitches exhibit higher porosity, weight, and thickness, enhancing stability, shape retention, and pilling resistance, making them ideal for durable casualwear and sportswear [19].

2.6. Consumer Preferences

Unisex knitwear consumer preferences vary by demographics. Older and career-oriented consumers prioritize quality and practicality, especially low-frequency buyers, who emphasize durability and ease of care [6]. According to a survey result, 80% of participants wanted more unisex clothing in stores, with over 60% expressing high interest in such options [20]. Additionally, unisex styles support sustainability by broadening reuse potential across genders, offering a stable wardrobe choice that can reduce excessive consumption [20]-[22].

In unisex fashion, silhouettes are meticulously crafted to create a gender-neutral aesthetic, often using specific elements that achieve both inclusivity and functionality. Key features include straight cuts, which lend a balanced appearance that doesn't emphasize curves or broad shoulders, making garments feel accessible across body types. Oversized fits are particularly popular in unisex collections, as they offer ease of movement and a sense of comfort without adhering to body shapes; this is commonly seen in pieces like boxy T-shirts, loose trousers, and hoodies [14].

Designers frequently adopt drop shoulders and extended hemlines, which add to the relaxed fit and contribute to a minimalistic, slightly androgynous style. Unisex outerwear, such as trench coats and bomber jackets, often incorporates such design elements, using straighter, elongated lines that avoid traditional waist cinching or shaping. Additionally, cropped lengths—like cropped jackets or ankle-length trousers—are selectively used to maintain visual interest without fitting too closely to the body.

Unisex silhouettes also rely heavily on layering potential, with designs like longline shirts, tunics, and straight-leg pants that can be combined effortlessly. The lack of excessive detailing, such as darts or tapering seams, means these garments fit more loosely and adapt well to layering, enhancing their versatility. Colour block-

ing and neutral shades further complement these silhouettes, allowing the garment structure to stand out without gendered colour associations. This approach reflects the unisex style's core principle of offering adaptable, inclusive clothing suitable for all genders.

2.7. Revolutionizing Garment Designing Using Digital Technology

Digital technology has revolutionized the garment design process, offering innovative tools and methods for creating and visualizing clothing. Computer-aided design (CAD) systems play a crucial role in modern garment engineering, enabling designers to create virtual prototypes and simulate fabric behaviour [23]. These systems allow for the integration of textile and apparel design processes, improving efficiency and enabling simultaneous development [24] [25].

3D modeling and simulation technologies are at the forefront of digital fashion, allowing for the creation of virtual clothing and digital representations of garments [26]. This includes 3D human modeling, 3D garment modeling, and garment virtual display techniques. Additionally, digital printing technology has emerged as an alternative to traditional offset printing methods, offering new possibilities for garment production [27].

Interestingly, there are two main approaches to designing virtual garments: "2D to 3D" and "3D to 2D" [28]. The former involves draping flat digital pattern pieces on a virtual mannequin, while the latter focuses on developing clothing designs on a realistic body and then flattening them into 2D pattern pieces. Although several CAD systems for garment visualization from flat patterns are available in the industry, the pattern flattening technique is yet to see widespread industrial application.

Digital technology has significantly transformed the garment design process, offering tools for 3D modeling, simulation, and visualization. CAD systems, digital printing, and virtual prototyping have become essential in the modern apparel industry, enabling more efficient and flexible production processes. As technology continues to advance, we can expect further innovations in digital fashion and garment engineering, potentially revolutionizing the way we design, produce, and interact with clothing in both physical and virtual spaces.

CLO3D software technology has emerged as a powerful tool in the fashion industry for digital simulation and design, particularly in the realm of unisex fashion. This technology offers unique economic and technological advantages over traditional artificial clothing design methods [29].

The use of CLO3D for unisex fashion design allows for clearer and more intuitive content presentation, with convenient modifications that can effectively reduce costs [29]. It enables designers to visualize how clothing will potentially look without creating physical samples, making the design process more efficient and cost-effective [30]. This is particularly beneficial for unisex fashion, where designers can easily adapt various textiles and patterns to 3D dynamic virtual mannequins before making clothes.

Interestingly, while CLO3D offers numerous advantages for unisex fashion design, it's worth noting that the continuous decision-making process involved in digital simulation can be subjective, potentially affecting the final results. Additionally, the technology's application extends beyond just design; it can be used to digitize historic costumes for permanent online display and access, increasing audience engagement and serving as a marketing tool [30].

In conclusion, CLO3D technology provides a versatile platform for unisex fashion design, offering benefits such as cost reduction, increased efficiency, and enhanced visualization. Its application in the fashion industry represents a shift towards digital transformation, enabling leapfrog development with the help of networking and intelligent technology [31]. As the fashion industry continues to embrace digital solutions, CLO3D and similar technologies are likely to play an increasingly important role in shaping the future of unisex fashion design and production.

Current research on knitwear and unisex clothing delves into areas like fabric aesthetics, functionality, and market trends. However, there is a significant gap in studies that comprehensively combine client requirements, the design process, production feasibility, and commercial viability within a unified framework. Most existing research tends to focus either on the technical aspects of fabric development or on the creative dimensions of design, with limited exploration of how these elements interact under manufacturing and market constraints.

This gap emphasizes the need for a more integrated approach that examines the influence of client expectations on design choices, validates these decisions through production capabilities, and ensures the final product meets commercial demands. Filling this void could offer valuable insights into creating an efficient workflow that bridges the gap between concept and finished product. Such a holistic framework would benefit not only designers but also manufacturers and brands looking to meet the growing demand for unisex clothing. Future research could prioritize developing standardized methodologies to support this integration, providing a clear guide for export-oriented processes and aligning with the evolving trends in the fashion industry.

3. Methodology

As seen in **Figure 2**, A qualitative approach was used to design and develop unisex clothing for an international clothing brand. This methodology uses a design process to explore theme-based concepts, knitting textures in fabric swatches and to manufacture unisex garments. To fulfil the aim of this study, many decision-making processes across several stages were taken in line with the client's requirements and global standards. Hence, this study is categorised into five phases.

3.1. Phase I: Understanding Client Requirements

The first step was to dive deep into understanding the client's requirements re-

ceived through a tech pack. A thorough understanding of the brand's design specification is the key aspect. In this phase, the study focused on developing fabric swatches as per the specifications given.

In order to understand the current market trends and trends in unisex clothing, a thorough literature review was conducted. Industry reports and fabric and colour trend reports were studied to actualize the concepts. Diverse knit structures were emphasised to increase the versatility, comfort, and aesthetics of unisex clothing. This step helped in understanding current market trends in comparison to the academic literature review. This approach was considered an excellent way to know about the current trend of unisex clothing in the market.

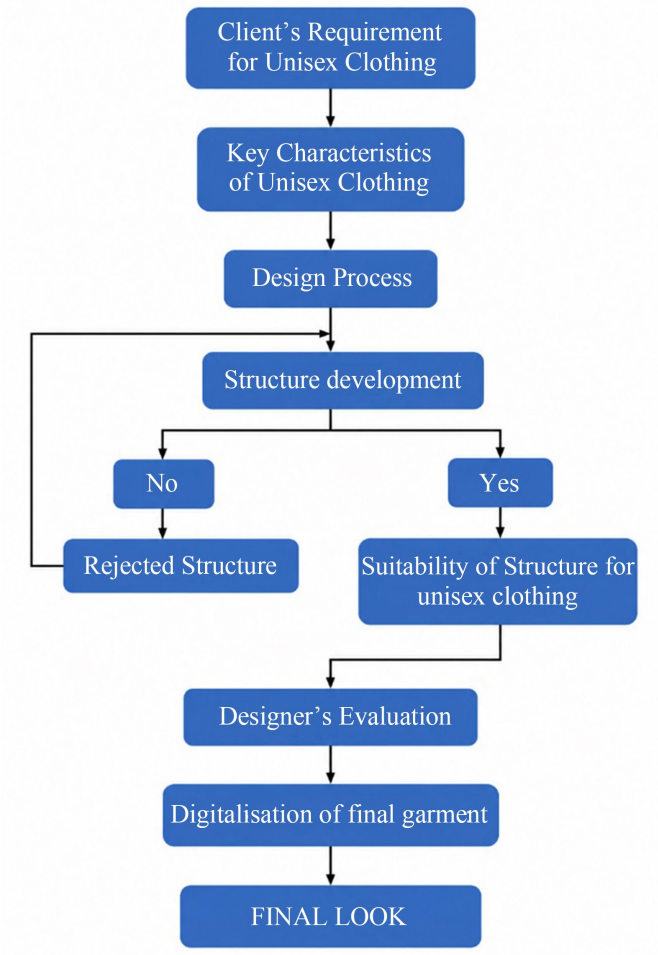


Figure 2. Phases of methodology.

3.2. Phase II: Design Process and Knit Swatches Development

Proceeding with the next step is the Design Process. At every stage in this phase, there is continuous iteration with client requirements to ensure that there is no deviation.

This process was initiated with the selection of two themes—Illusion and Texture. Based on the theme, textures were inspired by various organic elements such

as leaves, honeycombs, and feathers. These were chosen, and approval was sought from both the merchandiser and the client for a smooth and continuous design process. The design brief was to replicate or represent the basic structure of these elements in the fabric swatch, emphasising simplicity and gender neutrality in order to accommodate unisex clothing designs.

With consideration of the client's preference, the texture theme was finalised, and the fabric swatch explorations continued. Following this, swatches were designed and manufactured as per the specifications. Some of the textures that were designed could not be developed due to the limitations of the machine. This caused a considerable amount of yarn breakage during the knitting process. Hence, a few texture designs were rejected.

The experimental phase involves creating fabric swatches based on the above design process. Fabric swatches were developed based on the following criteria:

Yarn: 100% organic cotton with S twist.

Yarn Count: 2/32 s.

Texture: 3D texture.

Gauge used: 12 gg.

Knit Structures: Variations of cable Knit, variations of tuck stitches, needle transfer technique.

Software: SDS One Apex was used to program the structure for computerised flat knitting.

Machine used: Shima Seiki (Model No.: SSR112).

The swatches developed were evaluated and cross-verified against the client's specification sheet. This process was repeated until its commercial viability and suitability for large-scale production were ensured.

3.3. Phase III: Designer's Evaluation

The designer plays a crucial role in the decision-making process. The designer emphasizes the following steps, referring to the client's requirements.

1) Design and aesthetic alignment with the client's design vision.

2) Practical feasibility of fabric structure manufacturing.

3) In correspondence with Market fashion trends.

The designer's input is important to balance smoothness along with the design, aesthetic, knit structure development and its relevance in the overall fabric selection process.

3.4. Phase IV: Merchandiser's Feedback

With a one-to-one discussion between the merchandiser and the designer, the approval and acceptability of the designs are finalized. This feedback provides a detailed understanding and finalization as per the client requirement, current market trends and the practical implications of the export house. This is a critical stage of the decision-making process. This phase will either accept or reject the designs based on the above-mentioned combined criteria discussed. This ap-

proach practiced in the export house provides a thorough as well as a collaborative methodology to integrate the client's expectations with the designer's creative skills.

3.5. Phase V: Designer's Evaluation

The design process involves integrating the merchandiser's feedback to ensure the fabric and garment designs align with client standards, production feasibility, and market trends. Designers review and adjust swatches and garments to meet client specifications, refining aesthetics while ensuring practicality for production. Alterations may include changes in shape, texture, or colour to enhance unisex appeal, maintain aesthetic value, and align with the company's infrastructure.

3.6. Phase VI: Digitalization of Final Garment

This approach practiced in the export house provides a thorough as well as a collaborative methodology to integrate the client's expectations with the designer's creative skills.

Once the fabric was evaluated by the designer, CLO3D software was used to develop a simulated garment design.

This digital visualisation tool helps to view the garment digitally. This stage improves the efficiency of quick prototyping and repeating the process if there are any changes/variations to be made. This iteration process gives designers a chance to explore patterns/textures/colour possibilities/garment fit in the best possible way. This is also a cost-effective process.

4. Thematic Analysis and Observations

4.1. Phase I: Client's Requirements Analysis

The design brief given by the client was to develop unique and comfortable unisex clothing made up of 100% organic cotton fiber for summer wear. The client suggested using neutral-coloured yarns. The unique selling point (USP)of the European client's brand is its comfortable unisex apparel that promotes eco-friendliness. The data about the current market trends, consumer preferences, etc. were collected from trend and market reports as well as from the latest consumer studies. Based on these requirements, the designer interpreted the following parameters, keeping in mind the USP of the brand, client requirements, and the company's production capacity.

According to Table 1, the designer's interpretation of the client's requirements aligns closely with the project's sustainability and inclusivity goals. For example, the selection of 100% organic cotton and neutral colours ensures eco-friendliness while appealing to diverse consumer groups. The detailed specification of the knitting machine and gauge demonstrates a deliberate approach to balancing comfort and durability.

Table 1. Designer's interpretation of the client's requirements.

Design Parameter	Designer's Interpretation
Material	The designer chose to work on 100% organic cotton fabric as suggested by the client. The designer emphasized using high-quality, durable, and certified yarns to ensure that the yarns are 100% organic cotton. The specification of the raw material reflects their strong commitment to eco-friendly practices.
Colour	Colour is the first aesthetic attraction to the human eye. The client suggested using Neutral colours. These tones are considered timeless, classy, and never go out of style. This makes them ideal for unisex clothing. Also, neutral colours are not associated with cultural stereotypes or traditional affiliations. Black and white are colours that are elegant, adaptable by age or gender and seamlessly complement any style, preferences or purposes.
Knitting Machine	Based on the client's rapid production request, the designer suggested using the computerized flat knitting machine (Shima Seiki). The advantage of using this machine is its unique feature of constructing garment panels as the fabric is being constructed.
Machine Gauge	Gauge is an important parameter in knitting machines. Though flat knitting machines are known for construction of sweaters and heavy clothing for winter, the finer gauges provide soft, comfortable fabrics, suitable for summer wear. Hence, 12 gg was chosen by the designer to explore on the swatches. Also the client required a durable yet comfortable fabric for summer wear. Hence, this gauge is ideal for construction of fabric swatches.
Overall Approach	Keeping in mind the infrastructure of the company and the requirement for quick production from the client, advanced knitting technology was chosen by the designer. The Shima Seiki machine works on the software SDS One Apex to construct unique structures.

4.2. Phase II: Analysis of the Design Process and Knit Swatches Development

4.2.1. Theme and Inspiration

As the creative process started, the designer chose two themes—Illusion and Texture—for the whole range of designs. Inspired by these themes, textured designs were created based on natural elements like leaves, honeycombs, and feathers. This was done after approval from the merchandiser. The natural forms were chosen to make aesthetically pleasing swatches focusing on simplicity and gender neutrality, which goes with the unisex clothing concept. Consultation with the merchandiser and customer was involved in the approval process to streamline and keep the design flow consistently moving.



Figure 3. Theme board for the theme—"Textures".

As seen in Figure 3, the theme board illustrates the concept of "Illusion," focusing on abstract patterns and visual play. It reflects experimental textures and intricate designs intended to represent optical effects, which align with unisex clothing's goal of combining aesthetics and simplicity.

4.2.2. Theme—Illusion & Texture

The theme board illustrates the concept of "Illusion" (Figure 4), focusing on abstract patterns and visual play. It reflects experimental textures and intricate designs intended to represent optical effects, which align with unisex clothing's goal of combining aesthetics and simplicity. Depicting the "Textures" theme, the board incorporates inspiration from organic elements like leaves, honeycombs, and feathers. The emphasis on natural patterns conveys the idea of simplicity and gender neutrality, providing a foundation for the fabric's design direction.

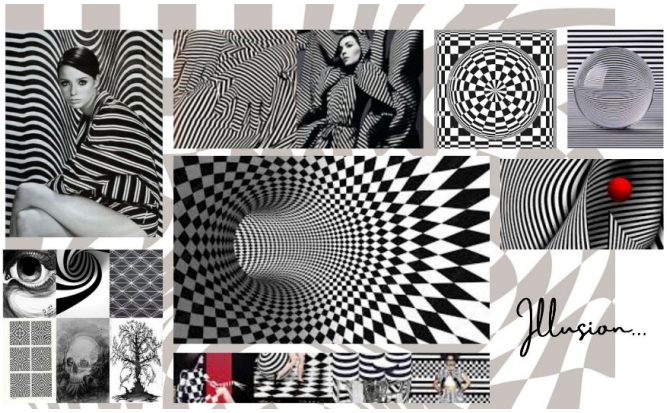


Figure 4. Theme board for the theme—"Illusion".



Figure 5. Inspiration board for the theme—"Textures".

As seen in Figure 5, the board visualizes key inspirations derived from organic textures for the "Textures" theme. It shows detailed images of natural forms, showcasing the aesthetic elements that are translated into the knit structures.

The theme "Textures" draws inspiration from organic elements such as leaves, honeycombs, and feathers, emphasizing natural patterns and structures. These textures were chosen to reflect simplicity and gender neutrality, aligning with the

concept of unisex clothing. By translating the intrinsic details of these elements into knit structures, the theme captures their aesthetic and tactile essence. The use of textures adds depth and character to the fabric, creating a visual and sensory appeal that enhances the garment's uniqueness.

Current Market Trend Report:

Market Focus: International brands in Spain, Belgium, and Denmark were the target market. Understanding the previous five years trend reports, there were pastel colours used for unisex clothing. But the latest reports predict that there will be a preference for solid & neutral colours. This insight was acquired considering consumer preferences for Spring/Summer 2025.

Consumer Preferences: In the last five years, several consumer studies have mentioned that men and women consumers are opting for fabrics that have subtle texture instead of plain designs. This change in preference emphasizes the need for textiles that combine aesthetic quality and practicality, especially for unisex apparel styles. Timeless, versatile, and enduring, neutral tones are perfect for sustainable and long-lasting designs. Always characterized as graceful and versatile, these colours suit any style, taste and reason. The fact that they escape associations with classical colour stereotypes [20].

4.3. Phase III: Fabric Swatch Construction & Designer's Evaluation



Figure 6. Texture-themed fabric swatches constructed in 12 gg knitting machine.

The fabric swatches were constructed using a Shima Seiki computerized flat knitting machine programmed with colour codes corresponding to basic knit structures—this included regular single jersey, double jersey, cable, tucks, miss and transfer stitches. By combining the code logic, these structures were generated, forming their distinct texture in the fabric. Also, the technique of plating was used during knit pattern simulations, which created uniqueness in the chosen swatches. The knit stitch codes that were used in programming the design in the software are listed in Figure 6.

It is evident from Table 2 that a wide range of stitch codes was utilized to create diverse textures and structures. For instance, codes for cable knits (e.g., 4 and 5) and tuck stitches (e.g., 11 and 12) contributed to the swatch variety. This detailed breakdown connects directly to the experimental swatches, showcasing how each stitch code was essential in achieving the desired aesthetics and functionality.

Based on the complexity of the design, the time taken for structure formation was between 5 - 45 minutes. The techniques helped them know that the fabric swatches fit the client and the trends of the emerging new export market.

Table 2. List of stitch codes used in the fabric structures.

Swatch No.	Stitch Code	Knit Stitch
1	1	Front knit
2	2	Back knit
3	3	Front and back knit
4	4	Cable (lower)
5	5	Cable (upper)
6	6	Front knit + move (1 p left)
7	7	Front knit + move (1 p right)
8	8	Back knit + move (1 p left)
9	9	Back knit + move (1 p right)
10	10	Back knit (lower)
11	11	Front tuck
12	12	Back tuck
13	13	Auto yarn feeder point
14	14	Front knit (lower)
15	15	Front knit (upper)
16	100	Back knit (lower)

4.4. Phase IV: Merchandiser's Evaluation

The input and feedback from the merchandiser are an important step. It consists of a discussion between the merchandiser and designer on a one-to-one basis. The feedback and the evaluation of the fabric structures were done on the Likert scale of 1 to 5, where one is the lowest score and 5 is the highest score. It considers key elements such as knitting time, yarn utilization, machine availability, ease of op-

eration for knitters, and aesthetic appearance. This type of process for decision-making means that only the designs that satisfy all the criteria are approved; other proposals are rejected for improvements or recasts. According to Table 3, the evaluation process revealed key insights into the suitability of various swatches. As observed in the table, swatches with excessive knitting time or high yarn consumption were rejected, while those meeting the criteria for cost-effectiveness, ease of operation, and aesthetic appeal were approved. This iterative feedback mechanism, reflected in the table, ensured the alignment of swatches with both client requirements and market trends.

Table 3. Fabric swatch evaluation parameters.

Evaluation Parameters	Rejection Basis	Approval Basis
Alignment with Client Brief	Swatches not with the indicated themes, the tissue structure, or the brand identity. Swatch No. 10	Thematic work on Texture—all of which honours the client's brief. Swatch No. 1 - 9, 11, 12, 13, 14, 15
Knitting Time	To spend too long (more than 45 minutes) producing a single swatch. Swatch No. 8, 6	Swatches that can take you an ideal amount of time to knit: 5 - 45 minutes. Swatch No. 1, 5, 9, 11, 12, 15
Yarn Consumption	Cost-effective swatches, e.g. swatches that take a lot of yarn that cannot be replicated in an economically practicable fashion. Swatch No. 9	Swatches that use yarn in an economical way, striking a balance between cost-effectiveness and durability. Swatch No. 12, 14
Ease of Operation	Swatches that require constant adjusting of the machine while you work, breaking your flow. Swatch No. 10	Seamless knits with minimal interruptions or setting changes for machine operators. Swatch No. 5, 9, 11, 12, 14
Aesthetic Appeal	Patterns that miss the visual simplicity, balance, or neutral tone of unisex clothing. Swatch No. 6, 15, 13	Designs and textures that suit client preferences, unisex aesthetics and market trends. Swatch No. 1, 3, 8, 14
Market Relevance	Designs that are outdated with Spring/Summer 2025 styles and consumer preferences	Market-reflective swatches including delicate textures and neutral shades for unisex apparel. Swatch No. 1 - 15
Durability and Practicality	Structures that are too flimsy and have a high chance of deformation after repeated washing. Swatch No. 12	Structures that are sturdy and hold their shape, and are practical for everyday wear. Swatch No. 2, 7, 9, 14

This evaluation process was done keeping in mind the brand's USP, commercial viability, and client requirements, thereby ensuring that creativity merges with functionality as well as commercial aspects.

4.5. Phase V: Designer's Evaluation Analysis

Following the above processes, the merchandiser provided feedback, upon which the designer will go through an evaluation to correct and harmonize the fabric and garment designs so as to have the design aligned with the client standard, production feasibility, and market flow.

4.5.1. Relevance to Client's Needs

The designer double-checks the fabric swatches and garment designs to ensure they

comply with the specifications given by the client.

Any manner of alterations made by the merchandiser, adjusting shape, texture even colours, goes into the final design.

4.5.2. Refinement of Aesthetics

After the merchandiser gives feedback, the designer looks again to see whether the fabrics and garments will hold their aesthetic appeal within real-world restrictions.

If the comments identify any need for more visual simplicity or alignment with the market, the designer tweaks the patterns, textures or proportions to make them more unisex.

4.5.3. Feasibility of Company Infrastructure

As the designer re-evaluates how the piece is knit, what machines are used and how many yards of yarn are consumed, they can confirm that the design is practical for production-pod scale. Including feedback on ease of operation or production efficiency in the revised design process allows designs that do not take your workflow or production costs into account to be avoided.

4.5.4. Iterative Design Improvements

It is evident from **Figure 4** that the front of the swatch highlights the detailed aesthetic texture achieved through cable knits. Meanwhile, the back view demonstrates the technical precision of the stitch placements and yarn alignment. This dual perspective validates the swatch's adherence to both the client's aesthetic requirements and functional criteria. The selected swatch embodies the theme "Textures" and draws inspiration from natural patterns, specifically honeycombs. The swatch was designed using a 12-gauge Shima Seiki computerized flat knitting machine and incorporates cable knits for its 3D texture.

As discussed in Phase IV, the merchandiser's evaluation played a crucial role in determining the suitability of the developed fabric swatches. Based on the established evaluation parameters, several swatches were rejected by the merchandiser due to multiple factors affecting their commercial and functional viability. Some swatches lacked alignment with the client brief, particularly in terms of simplicity, balance, and gender-neutral aesthetics required for unisex clothing. Others were rejected due to high knitting time and production inefficiency, as they required excessive time or frequent machine adjustments, making them unsuitable for large-scale manufacturing. In certain cases, excessive yarn consumption resulted in higher production costs, reducing economic feasibility. Additionally, swatches that involved operational complexity or required constant machine intervention were considered impractical. A few designs were also found to deviate from current market trends, especially the preference for subtle and minimal textures for Spring/Summer 2025. Furthermore, durability issues such as deformation and lack of structural stability led to rejection in some cases. These findings highlight the importance of the merchandiser's role in ensuring that design outcomes align with client expectations, production feasibility, and market relevance.

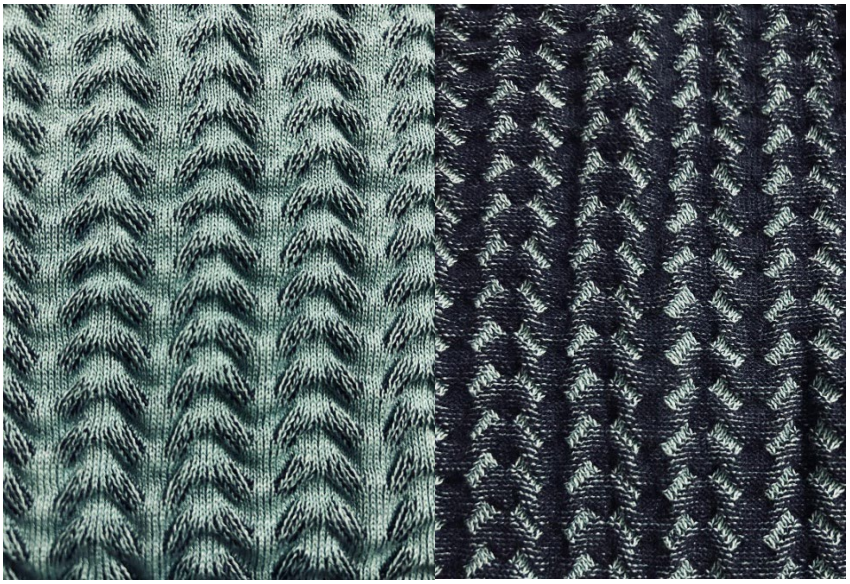


Figure 7. (a) Front side of the Swatch; (b) Back side of the Swatch.

The rejected swatches were therefore excluded from further development based on the merchandiser's evaluation. Specifically, Swatches 1 and 6 were found to lack the required depth, balance, and simplicity for gender-neutral design. Swatches 2 and 12 demonstrated durability concerns, including deformation and insufficient structural stability. Swatches 3 and 5 were identified as inefficient due to extended knitting time and the need for frequent machine adjustments. In addition, Swatch 8 was considered economically unviable due to excessive yarn consumption, while Swatch 10 did not align with the aesthetic direction of Spring/Summer 2025 trends. Swatch 15 was rejected for being overly intricate, deviating from the minimalist and neutral design approach required for unisex clothing.

The front and back sides of the developed swatch are shown in **Figure 7(a)** and **Figure 7(b)**, respectively, illustrating the surface appearance and structural characteristics of the selected knit design.

4.6. Phase VI. Digitalisation

According to the feedback and evaluation from Phase I and Phase V, there were areas requiring improvement; the designer reiterated and then proceeded with the digitalization of the swatch into a unisex pullover. The virtual visualization helped evaluate the garment's final look and fit. Based on the prototype, further iterations can be implemented on the digital platform, where the designer presented updated designs, enhancing convenience as there is no longer a requirement for a physical prototype. Final Approval Readiness: Incorporating feedback from the merchandiser, the designer conducted a final assessment to ensure alignment with the combined criteria—Aesthetic harmony. This is one of the main criteria for approval from the client.

The aesthetic harmony was assessed by checking if the single neutral tone created depth and interest. Also, the use of two different colours on the front and back

of the fabric was evaluated. The concurrence with the client's tech pack was always kept as a point of reference to iterate.



Figure 8. (a) Front of simulated garment in CLO3D; (b) Back of simulated garment in CLO3D.

As seen in **Figure 8(a)** and **Figure 8(b)**, the fabric swatch was simulated using the tools Graphics (2D Pattern), Edit, Select/Move, and Simulate. As observed in **Figure 5**, the simulated garment views showcase how the selected swatches translate into wearable designs. The front view highlights the drape and fit achieved through the textured knit structures, while the back view emphasises construction continuity. These simulations, created using CLO3D software, illustrate the integration of texture and form, confirming the suitability of the knit designs for unisex clothing.

5. Conclusions

This exploratory research demonstrates the various steps taken to satisfy client requirements and designer deliverables. Through a series of phases, the study analyses different types of knit structures used in the development of unisex garments, considering current trends and market preferences. The study, supported by insights from market reports and consumer studies reviewed in Phase I (Saksa, 2023; WGSN, 2024), indicates a growing preference among both male and female consumers for discreet textured fabrics over plain surfaces. It further highlights how the use of organic materials, advanced knitting techniques, and structural variations can achieve an effective balance between comfort, durability, and aesthetics—key elements essential for unisex garments.

In addition, the study demonstrates the suitability of various knit structures in meeting both functional and aesthetic requirements. Through an iterative design process involving CLO3D simulation and physical sampling, knit patterns such as cable, tuck, and jersey variations were identified as optimal in delivering comfort, flexibility, and durability.

In conclusion, this research provides valuable insights into the development of unisex knitwear that is not only aesthetically relevant but also sustainable, practi-

cal, and commercially viable for both manufacturers and consumers.

Author Contributions

Jeyashree Jeyaraman: Conceptualization, methodology, literature review, experimental work, data collection, data analysis, and manuscript preparation. **Sridhar Amanchy:** Supervision, methodology validation, interpretation of results, and critical review of the manuscript. **Habeebunissa:** Data analysis, validation, and manuscript review. All authors reviewed and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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