

Study on the Application of Lean Six Sigma in Supply Chain Management

-- Take L Clothing Company as an Example

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Abstract

With the deepening of the national fitness strategy, the rise in consumer health awareness, and the growing trend of sports and leisure, the demand for sportswear brands has continued to expand. However, as the sportswear market becomes increasingly saturated, competition among brands is getting tougher, and they are also facing the serious challenge of upgrading and optimizing their supply chains. Lean Six Sigma, as a mature quality management tool, has significant effects on optimizing enterprise supply chain management. Therefore, this article will discuss how to apply Lean Six Sigma management methods to the apparel industry. Using the well-known sportswear brand L as an example, it addresses a series of supply chain issues within L, proposing strategies such as quality control, optimizing supply chain inventory, improving innovative design, and transforming operational models. The goal is to help L optimize its supply chain processes, achieve lean management, and realize sustainable development.

Keywords

Lean Six Sigma Theory; Supply Chain Management; Apparel Companies; Inventory Optimization.

1. Introduction

With the deepening of the national strategy for fitness, the continuous rise in residents' health awareness, and the wide spread of sports and leisure fashion trends, China's sportswear industry has ushered in unprecedented development opportunities. By 2024, the market size of China's sportswear industry has reached 260.2 billion yuan, showing steady growth. However, as the market continues to expand, competition among sportswear brands has become increasingly fierce, and supply chain management, as a key part of a company's core competitiveness, faces an urgent need for transformation and upgrading. Lean management[1] emphasizes improving efficiency by eliminating waste, while Six Sigma focuses on data-driven approaches and aims for zero defects. The combination of the two provides strong theoretical support and practical tools for corporate supply chain management. L Apparel, as the world's second-largest sports brand, has gained broad market recognition thanks to its high-end positioning, community culture, and quality products. However, in recent years, L has exposed several issues in its global supply chain management, including over-reliance on external suppliers for production and procurement, a lack of innovation in design, risks in inventory management, and plummeting profits, which have seriously constrained the company's development.

Based on this, this article takes L Apparel as the research subject and uses Lean Six Sigma theory to deeply analyze the prominent problems in its supply chain management, while proposing targeted optimization strategies. The goal is to provide valuable reference and insights for both L and similar sportswear brands regarding supply chain optimization and lean management through an organic combination of theory and practice.

2. Theoretical Basis

2.1. Clothing Company Supply Chain Management

Supply chain management refers to connecting upstream and downstream suppliers with customers. This is a management approach for product manufacturing, transportation, distribution, and sales. It mainly includes three parts: product supply, warehousing and logistics, and product sales. The clothing industry market[2] changes quickly and has clear seasonality, with consumer preferences updating rapidly and inventory management being complicated. So, effective supply chain management can help clothing companies respond faster to the market, quickly adjust production plans and product designs. At the same time, it can optimize inventory and costs, reduce warehousing and transportation expenses, enhance flexibility, improve competitiveness, and achieve sustainable development.

2.2. Lean Six Sigma and Supply Chain Management

Six Sigma is a data-driven approach to enterprise quality management and process improvement that aims for zero defects. Lean Six Sigma is the result of combining the strengths of Lean management and Six Sigma: Lean focuses on reducing waste in the production process through management, while Six Sigma focuses on the quality of production and services, emphasizing reducing variability through management. Lean can provide specific solutions for specific problems to achieve immediate improvements, but it is less effective for improving complex business processes. Lean Six Sigma combines the two to improve business processes[3], integrating Lean's speed, 5S methods, and people-oriented advantages with Six Sigma's goal orientation, DMAIC methodology, and data-based strengths, achieving significant results quickly in business process improvement. Existing research has explored the relationship between Lean Six Sigma and supply chain management from different mechanisms. Lan Yulin (2022) believes that companies should measure various variables in the production and operation process according to Lean Six Sigma standards to reduce waste and lower quality variability, thereby achieving supply chain risk management and operational continuity[4]. Sun Jiali (2025) suggests that companies should establish a Lean Six Sigma corporate culture. Every company involved in Lean Six Sigma management within the supply chain should integrate the culture internally and pass it along the supply chain, embedding elements of Lean culture and quality culture into the company's spirit and values[5]. Zhang Shiming (2025) points out that using Lean Six Sigma tools to analyze a company's planned information technology projects, combined with the concepts and methods of a flexible supply chain, can help supply chain members optimize cooperation conditions to enable faster and more accurate information flow across the supply chain, better responding to market changes[6].

From the above literature, most studies focus on standardized control, cultural transmission, and information-based collaboration, but they provide fewer explanations on how Lean Six Sigma management principles and methods can be specifically applied within enterprise supply chain management. Therefore, this paper will propose key measures and strategies for L clothing company's internal supply chain management based on Lean Six Sigma theory, aiming to achieve lean production and improve the company's risk resistance.

3. Analysis of the Current Situation of L Clothing Company's Supply Chain

L Apparel was founded in 1998 and is headquartered in Canada. The brand initially focused on yoga wear, and later expanded into running, training, and everyday active-wear and accessories. L's products are known for their high-quality fabrics and are also famous for their comfort. Their main categories, yoga pants and leggings, are loved and highly rated by consumers. L Apparel not only sells sports products but also emphasizes lifestyle and community culture. Their marketing strategy focuses on cultural storytelling and user experience[7], highlighting the combination of health, fitness, and lifestyle. At first, L Apparel's global supply chain management model was one of the key factors to its success. By working with suppliers in multiple countries and regions around the world, the brand ensured high-quality products and timely delivery. However, while this diverse supplier model brings supply chain flexibility, it also increases management complexity and quality control challenges. At the same time, the brand is facing high costs due to new tariff policies. With poor supply chain management, rising costs, and issues with product innovation, the company's supply chain stability, quality, and pricing have been affected to some extent.

3.1. L Heavily Relies on External Suppliers for Production.

L Company doesn't produce raw materials or products itself; instead, it buys fabrics from third parties and outsources the production to third-party manufacturers. The brand's production is spread across Vietnam, Cambodia, Sri Lanka, China, and other places. Vietnam is the biggest production base, making about 40% of the products. L Company works with around 41 manufacturers, with the top five producing 57% of the brand's products and the largest one producing 15%. Major fabric suppliers include the Taiwanese company Eclat Textile, which provides 50%-70% of the fabrics. This shows that L Company heavily relies on external suppliers. If the suppliers raise fabric or production costs, the company will face high expenses. At the same time, the company has frequently been criticized by consumers for quality control issues. Its clothes have been punished for being "subpar" and various quality failure incidents have led to serious revenue losses. This has constantly eaten away at consumer trust, causing the company's reputation to drop significantly[8]. With consumers becoming increasingly rational, "poor quality" is a label that L company must shake off. Moreover, many of the special fabrics used in the company's products are developed and produced by third parties. In the event of a supply chain disruption, this could cause all sorts of problems, and the company can't guarantee it can quickly find alternative fabric suppliers or manufacturers, which heavily affects L company's supply chain stability.

3.2. The Clothing Styles Lack Innovation

L company's brand design promotes its main products by combining high-tech fabrics with fashion elements, ensuring comfort and style during exercise. For example, "Nulu fabric" has good compression and sweat absorption, suitable for high-intensity exercise; while the "Everlux fabric" provides strong support, making it suitable for training scenarios. However, it has long relied on core items like yoga wear, with new products accounting for only 23%, resulting in long product lifecycles and slow style updates; Define jackets and Scuba sweatshirts have long been untailored, maintaining a new rhythm by changing colors, earning consumers the nickname "copy-paste." Management acknowledges that the core clothing line has experienced aesthetic fatigue, and the casual line has "become outdated and no longer resonates." Menswear, footwear, and other categories have expanded below expectations, with men's wear accounting for about 25% for a long time. Since launching its footwear business in 2022, the company hasn't really built any core strengths, and revenue from it makes up less than 5%. The product range is pretty narrow, which makes the company more vulnerable-any hiccup in the yoga wear market could hit overall revenue hard. L Company is used to picking

products based on algorithms and repeating bestsellers, but consumers aren't buying it anymore. Nowadays, competition in sportswear is getting tougher, and innovative design is a key part of that. L Company should take a good look at itself and tweak its innovation strategy so it can stand out in the competitive market again.

3.3. Inventory Management Risks are Getting Tougher

Since Brand L faces a global market, its inventory management fluctuates depending on the market. In the Chinese market, L often runs into stockouts of popular items, especially colors like dark shades and linen, which are favored by Asian consumers. These low-saturation colors often sell out in stores on the very first day of being restocked. Part of the reason for these stockouts is that L's product allocation is decided centrally by its headquarters, making it less agile in responding to market changes. In the North American market, L's inventory management is relatively more mature, but high inventory levels are still an issue. According to financial reports, by the end of Q2 2025, the company's total inventory reached \$1.7 billion[9], up 21% from \$1.4 billion in the same period last year, while inventory turnover remains below the historical average. These high inventory levels have a certain impact on retailer profits, leading to lower gross margins. At the same time, with the effects of the global pandemic and consumers generally shifting to more budget-conscious spending, L's clothing inventory has piled up even more.

3.4. Operational and Cost Pressures are Becoming More Obvious.

Due to the impact of U.S. tariff policies[10], 87% of L company's Southeast Asian production capacity faces the risk of skyrocketing costs. Full-year profits are expected to drop by \$240 million in 2025, and tariff gross costs are projected to rise to \$380 million in 2026, with a net impact of \$220 million after mitigation measures. At the same time, the U.S. 'minimum duty-free threshold' policy has been abolished, affecting about two-thirds of U.S. e-commerce orders, further increasing cost pressures. Capacity relocation to Mexico is progressing slowly and is unlikely to quickly ease cost pressures. Additionally, aggressive store expansion in the Chinese market raises questions about whether lower-tier markets can support high-end pricing. Overexpansion could dilute brand scarcity while also raising operational costs.

4. Suggestions for Supply Chain Management Strategies of L Clothing Company Based on Lean Six Sigma

4.1. Strengthen Quality Control in the Production Process to Improve Product Quality

Lean management emphasizes building long-term, stable partnerships with high-quality suppliers. By introducing a lean supply chain management system and combining it with information filtering and market forecasting techniques, it ensures supplier quality and allows for timely adjustments to inventory and purchasing plans. At the same time, companies should set up and refine a product quality management system, regularly evaluate suppliers, and establish customer-oriented development goals. Next, companies need to optimize strategies through visual management to avoid over-controlling costs at the expense of product quality. Management should also strengthen their understanding and grasp of advanced management concepts like lean production and agile management. Finally, companies can bring in third-party testing agencies to strictly inspect and evaluate their production processes. For example, for garment quality, QMS standards can be used with audits by SGS; for the production environment, Higg FEM self-assessment and third-party verification can be applied. Regular on-site inspections and employee training help enhance staff awareness and skills in production.

4.2. Strengthening the Application of Lean Six Sigma in Supply Chain Inventory Management

The core idea of Lean Six Sigma lies in lean production and eliminating waste. So, when it comes to inventory management, L Apparel should smartly do some 'subtraction'. For example, they could cut down on some slow-selling categories and make reasonable production plans tailored to different regions like North America and China. Next, L Apparel should optimize its inventory management methods to further improve efficiency. The core Lean Six Sigma management approach, the 'DMAIC cycle', can quantify inventory management pain points with data, accurately identify shortcomings, and develop a series of solutions. Using statistical process control methods alongside this can reduce the impact of market fluctuations. Additionally, L Apparel should achieve a digital supply chain to continuously track market changes and set inventory goals based on actual customer demand. For instance, by using RFID technology, they can monitor inventory in real-time—seeing which products are selling well, which need replenishing quickly, and which have long sales cycles and thus require reduced production. This is crucial for the brand's production and sales strategy. Finally, the company can adopt a lean supply chain strategy, introduce the JIT (Just-In-Time) production model to prevent inventory risks, enhance the supply chain's rapid response ability, and reduce the impact of the 'bullwhip effect'.

4.3. Strengthen Innovation in Design to Achieve Differentiated Competition

L Apparel is popular for its yoga-focused clothing, but nowadays consumers have gotten used to repetitive styles or 'recycled' designs. What really excites them is the continual sense of freshness that new clothing brings. Lean Six Sigma principles emphasize that companies should follow the idea that 'value is defined by the customer.' L Apparel should constantly explore market demands and turn external feedback into design outputs. As a sports brand, L could think about how its clothes are used in different scenarios. For sports-minded consumers, L could consider the clothing's performance features and the wearers' physical characteristics, designing for storage space, cross-environment insulation, breath ability, cooling functions, and more. For variety, they could create different types of clothes to make products that work 'from the gym to the office.' The product strategy should focus on a dual track of 'upgrading core categories while expanding into new scenarios.' For core items like yoga pants, tech elements and fashionable designs should be added to reignite consumer enthusiasm. At the same time, product development for sports like tennis and golf should be accelerated, using the existing community base to build a 'sporty lifestyle' ecosystem. Lastly, Lean Six Sigma advocates replacing gut feelings with data. Decisions on design trade-offs, fabric choices, and color selection should all be backed by objective evidence, creating a culture of data-driven decision-making.

4.4. Change the Operation Way and Optimize the Cost Structure

In today's world of global trade, L Company is facing the double pressure of tariff shocks and inventory backlogs. The gross margin of L's apparel business has dropped significantly, which has had a huge impact on profits. One of the core principles of Lean Six Sigma management is that 'value is defined by the customer.' For the North American market, that value isn't about 'higher market share', but about scarcity, brand belonging, and the full-price buying experience. So, for North America, L's apparel business shouldn't just chase size. Instead, it should focus on a high-end positioning, using limited releases and community events to reshape brand tone, while maintaining the competitiveness of its core high-end product lines, and also consider launching more price-competitive sub-lines or entry-level series. For the Chinese market, the value isn't in 'opening stores the fastest.' What's more important is healthy profitability and sustainable growth for stores. So, for China, L's apparel business should seize growth

opportunities, adapt to local conditions, and explore a more efficient local supply chain model to reduce logistics and manufacturing costs.

5. Conclusion

This paper takes the well-known sportswear brand L Company as the research object, introduces Lean Six Sigma theory around prominent issues exposed in global supply chain management, and systematically explores the applicability and practical paths of this theory in supply chain optimization for apparel enterprises. Research shows that Lean Six Sigma, as a systematic methodology integrating "waste elimination" and "reducing variation," can effectively address the core pain points of Company L across all supply chain links. For clothing companies to achieve sustainable development amid the current pessimistic global economic situation, they must not only achieve lean production but also apply Six Sigma quality management theory as a practical foundation in supply chain management. In managing a company's global supply chain, it is essential to balance risk control and cost control to ensure supply chain risk management and operational continuity.

In summary, by embedding the Lean Six Sigma method throughout the entire supply chain—from fabric procurement, contract manufacturing, warehousing and logistics to terminal retail, Company L is expected to improve operational efficiency while maintaining its premium brand premium and enhancing risk resistance, ultimately achieving sustainable growth. Furthermore, future research can further focus on the integrated application of Lean Six Sigma in the context of digital transformation in sportswear enterprises, as well as the empirical testing of differentiated implementation in different regional markets, to enrich the depth of theory and practice in this field.

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