A Study on Factors Influencing Operational Efficiency of Textile Firms in Tiruppur District, Tamil nadu

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ABSTRACT
The study explores the operational efficiency and profitability factors in textile firms, with functional areas, strategies, and main contributors. Operational efficiency in textile firms is vital for reducing production costs, improving product quality, and ensuring timely deliveries. It enhances competitiveness by optimizing resource use and minimizing waste. Efficient operations lead to higher profitability, better customer satisfaction, and sustainable growth in the highly competitive textile industry. Result reveals that production, design, and other functional areas contribute equally to operational efficiency. The main strategies for enhancing efficiency include process automation, lean manufacturing, and supply chain integration. Additionally, cost reduction and production process optimization are identified as crucial for profitability. Findings confirms the importance of production efficiency, supply chain management, and human resources management in driving operational success. The findings also indicate that balanced focus across these areas is essential for improving both efficiency and profitability in textile firms.

1. Introduction

The textile industry stands as one of the most vital sectors in the global economy, significantly contributing to employment, economic development, and trade. In India, the textile industry is particularly important, with the country being one of the largest producers and exporters of textiles and garments worldwide. Among the various regions known for their textile production, Tiruppur District in Tamil Nadu is a prominent hub. This district is renowned for its knitwear production, which not only caters to domestic needs but also plays a crucial role in international markets. Tiruppur's textile industry, often referred to as the "Knitwear Capital of India," has witnessed substantial growth over the years. The industry's development has been driven by factors such as favorable policies, skilled labor, and technological advancements. Despite these advancements, the sector faces numerous challenges that impact its operational efficiency. Operational efficiency is crucial as it directly influences the productivity, profitability, and sustainability of textile firms. Efficient operations lead to optimized resource use, reduced costs, and improved product quality, all of which are essential for maintaining competitive advantage in a rapidly evolving market.

Operational efficiency in textile firms encompasses various dimensions, including production processes, supply chain management, quality control, and workforce management. Each of these dimensions contributes to the overall performance of the firm and its ability to meet market demands effectively. Efficient production processes are fundamental to achieving high operational efficiency. It involves the optimization of machinery and technology, minimizing production downtime, and ensuring smooth workflow. In many textile firms, outdated machinery and manual processes can lead to inefficiencies and increased operational costs. Effective supply chain management is critical for ensuring timely delivery of raw materials and finished products. Disruptions in the supply chain can lead to delays, increased costs, and lower customer satisfaction. Managing relationships with suppliers, optimizing inventory levels, and improving logistics are key aspects of supply chain efficiency. Maintaining high quality is essential for meeting customer expectations and reducing returns and rework. Efficient quality control processes help in identifying and addressing defects early in the

production cycle, thus ensuring that the final products meet the required standards. A skilled and motivated workforce is crucial for operational efficiency. Training programs, employee retention strategies, and effective management practices contribute to a productive workforce. Inadequate workforce management can lead to inefficiencies and decreased overall performance.

Operational efficiency is the capability of an organization to deliver products or services to its customers in the most cost-effective manner without compromising quality. Operational efficiency is crucial as it directly impacts productivity, cost management, and the ability to meet market demands. Efficient utilization of resources, including raw materials, energy, and labor, is essential for minimizing waste and reducing production costs. Textile firms that optimize their resource use can significantly cut down on operational expenses, leading to higher profit margins. Streamlining production processes through automation, lean manufacturing, and continuous improvement initiatives can enhance efficiency. By minimizing downtime, reducing defects, and speeding up production cycles, textile firms can increase their output without incurring additional costs. Effective management of the supply chain ensures the timely delivery of raw materials and finished goods, reducing the risk of production delays and stock outs. A well-integrated supply chain also allows firms to respond quickly to market changes, maintaining a competitive edge. Maintaining high quality standards is critical for operational efficiency. Consistent quality reduces the likelihood of returns, rework, and customer complaints, which can otherwise increase operational costs and damage the firm's reputation. A well-trained and motivated workforce is crucial for efficient operations. Investing in employee development and maintaining high morale can lead to higher productivity and lower turnover rates, contributing to overall operational efficiency. In the highly competitive textile industry, where margins are often thin, operational efficiency can be the difference between success and failure. Efficient operations allow textile firms to produce high-quality goods at lower costs, enabling them to offer competitive prices in the market. Additionally, operational efficiency contributes to better customer satisfaction by ensuring timely delivery and consistent quality, fostering brand loyalty.

Profitability enhancement in textile firms requires a strategic focus on several key areas. The most effective ways to boost profitability is by optimizing production processes. Implementing lean manufacturing practices helps reduce waste and improve efficiency, which in turn lowers production costs. Process automation can further streamline operations, allowing for faster production times and reduced labor costs. Ensuring a well-coordinated and responsive supply chain, textile firms can minimize delays and reduce inventory costs, leading to better cash flow management. Effective supply chain integration also allows firms to respond swiftly to market demands, thereby increasing sales opportunities. Offering unique and high-quality products, textile firms can differentiate themselves from competitors and command higher prices. Additionally, optimizing pricing strategies based on market demand and consumer behavior can further enhance profit margins. Energy efficiency measures also play a vital role in reducing operational costs, directly impacting profitability. Lastly, maintaining a skilled workforce through continuous training and development ensures high productivity and quality, which are essential for long-term profitability in the competitive textile industry. Focusing on these areas, textile firms can significantly enhance their profitability.

2. Statement of the Problem

The textile industry, a crucial sector in Tiruppur District, Tamil Nadu, render a main role in the local and national economy. Known for its substantial contribution to textile manufacturing and export, this sector faces increasing pressures to enhance operational efficiency amidst a competitive market environment. Despite its growth and importance, many textile firms in Tiruppur struggle with optimizing their operations to achieve higher efficiency and profitability. Operational efficiency in textile firms encompasses various aspects such as production processes, supply chain management, quality control, and workforce management. The challenge lies in identifying and addressing the factors that impact these aspects effectively. Factors like outdated machinery, inefficient production processes, supply chain disruptions, and quality control issues can severely hinder the operational

efficiency of textile firms. Additionally, the rapidly changing market demands and the need for innovation further complicate the environment. The problem is exacerbated by a lack of comprehensive research that specifically addresses the operational efficiency challenges faced by textile firms in Tiruppur. While there is substantial research on operational efficiency in broader contexts, limited studies focus on the unique challenges and dynamics of the textile industry in this region.

3. Need for the Study

The study on operational efficiency of textile firms is vital for several reasons. Firstly, the textile industry is a major employment generator and economic contributor in the Tiruppur district. Enhancing operational efficiency can lead to increased productivity, reduced costs, and improved financial performance, benefiting not only the firms but also the local economy. Secondly, with the global textile market becoming increasingly competitive, firms must optimize their operations to maintain and improve their market position. The study is needed to provide insights into the specific factors affecting operational efficiency in textile firms. Recognizing these factors, the research can offer practical recommendations for improving operational practices, which can lead to more efficient production processes, better resource utilization, and overall improved performance. Furthermore, realizing these factors can help textile firms adopt best practices, innovate their operations, and respond more effectively to market changes. Moreover, the study will fill the existing knowledge gap by focusing on the particular challenges faced by textile firms in the area, thus contributing valuable insights to both industry practitioners and academic scholars. The findings will be beneficial for business owners, managers, and policymakers by providing a clearer understanding of operational challenges and strategies for improvement.

4. Review of Literature

Operational efficiency is a critical determinant of success in the textile industry, where firms must navigate complex supply chains, fluctuating market demands, and intense global competition. The efficiency of production processes is often cited as a foundational element of operational efficiency in textile firms. Improving production workflows, reducing downtime, and minimizing material wastage are crucial for maintaining high levels of efficiency (Anser et al., 2021). Techniques such as lean manufacturing and just-in-time production have been widely adopted in the textile industry to streamline operations and reduce costs. These methods help in eliminating non-value-adding activities, thereby increasing output per labor hour and improving the overall production cycle. Firms that effectively implement these techniques are better positioned to respond to market demands and maintain a competitive edge (Rasheed et al., 2023). Supply chain management plays a pivotal role in enhancing operational efficiency. Effective supply chain ensures that materials and products move seamlessly from suppliers to customers, minimizing delays and reducing costs. Additionally, the adaptability of the supply chain to market changes is a critical factor in maintaining operational continuity and profitability in textile firms (Doan et al., 2022).

The human resource aspect of operational efficiency maintains that competency and motivation of the workforce directly impact productivity. Employee skill development, retention strategies, and effective workforce management are integral to sustaining operational efficiency (Abbas et al., 2023). Firms investing in continuous training and development programs tend to experience higher levels of productivity and innovation. Moreover, human resource practices that focus on employee engagement and well-being contribute to a more motivated workforce, which is essential for maintaining efficiency in labor-intensive industries like textiles (Naeem et al., 2021). Technological advancements have revolutionized the textile industry, offering new avenues for improving operational efficiency. The adoption of automation and advanced manufacturing technologies, such as computer-aided design and computer-aided manufacturing, has streamlined production processes, reduced human error, and increased precision (Mantravadi, 2020). Textile firms embracing technology-driven innovation are

more likely to achieve higher operational efficiency. Furthermore, digitalization in areas such as supply chain management and customer relationship management has enhanced the ability of firms to respond swiftly to market changes, thereby improving overall operational efficiency (Li and Wu, 2017).

Quality management ensures that products meet the required standards reduces the incidence of rework and waste, which are significant contributors to inefficiency. The role of total quality management and rating methodologies in maintaining high-quality standards and minimizing defects. Firms that consistently adhere to quality control measures are likely to experience lower production costs and higher customer satisfaction, both of which are key drivers of operational efficiency (Lo et al., 2012). Efficient financial management and optimal resource utilization are also highlighted in the literature as essential for operational efficiency. Proper allocation of resources, including capital, labor, and materials, ensures that firms operate within budget constraints while maximizing output (Bayraktar et al., 2017). Financial strategies that focus on cost reduction, investment in innovation, and efficient asset management contribute significantly to a firm's operational efficiency. Firms with robust financial management practices are better equipped to navigate economic challenges and sustain long-term efficiency (Kolte et al., 2020).

5. Research Objectives

The study commenced with the following objectives.

1. To identify the various functional areas on operational efficiency of textile firms.
2. To evaluate the strategies to enhance operational efficiency of textile firms.
3. To examine the factors contributing in favour of profitability of textile firms.
4. To investigate the factors influencing operational efficiency of textile firms.

6. Research Methodology

The present study employs descriptive research design to explore factors influencing operational efficiency and profitability in textile firms. A total of 100 textile firms in Tiruppur district, Tamilnadu are selected using simple random sampling to ensure representative and unbiased results. Data collection involves a structured questionnaire designed to gather information on various functional areas, strategies, profitability factors, and factors influencing operational efficiency of textile firms. The descriptive approach facilitates a better understanding of the current operational practices and profitability determinants within textile firms. Statistical analysis, including Kruskal-Wallis test, ranking analysis, descriptive statistics, Chi-Square test, and factor analysis are used analyze the data. The methodology provides visions into effective strategies and operational practices essential for enhancing efficiency and profitability in textile firms.

7. Results and Discussions

7.1 Functional Areas on Operational Efficiency

In order to evaluate the impact of various functional areas on the operational efficiency of textile firms, an analysis is performed using the Kruskal-Wallis test. This test is applied to compare the differences among more than two independent groups with ordinal data. Accordingly, the textile firms are approached to rank their level of involvement in three parameters like, high, medium, and low. The null hypothesis postulates that there is no association between the functional areas and operational efficiency in textile firms. The results are described in Table 1.

Table 1: Test Statistics of Kruskal-Wallis

Test Statistics								
Test Statistics	**Production**	**Design and Development**	**Quality Control**	**Supply Chain Management**	**Marketing and Sales**	**Finance and Accounting**	**Human Resources**	**Research and Development**
Chi-Square	4.245	2.741	3.945	2.860	3.534	4.102	3.287	2.981
df	2	2	2	2	2	2	2	2
Sig.	.120	.254	.141	.192	.173	.108	.195	.211

Source: Primary data

Table 1 presents the Kruskal-Wallis test results to assess the relationship between various functional areas and operational efficiency in textile firms. The test shows no significant differences among the functional areas, including production, design and development, quality control, supply chain management, marketing and sales, finance and accounting, human resources, and research and development, as the p-values are greater than the significance level. The result indicates that the performance in these functional areas does not significantly differ in relation to profitability. Thus, the analysis reveals that all functional areas contribute uniformly to the overall operational efficiency of textile firms.

7.2 Strategies to Enhance Operational Efficiency

The study explores strategies to enhance operational efficiency in textile firms. The study identified seven important strategies, which includes process automation implementation, supply chain integration, energy efficiency measures, lean manufacturing practices, employee skill development, inventory management optimization, and continuous improvement programs. The effectiveness of these strategies was evaluated using a ranking analysis, and the results are presented in Table 2.

Table 2: Ranking Analysis

S. No	Strategies	Mean Score	Total Score	Rank
1	Process automation implementation	34.5	345	1st
2	Employee skill development	30.1	301	4th
3	Continuous improvement programs	26.9	269	7th
4	Lean manufacturing practices	32.8	328	2nd
5	Inventory management optimization	27.8	278	6th
6	Energy efficiency measures	29.4	294	5th
7	Supply chain integration	31.7	317	3rd

Source: Primary data

Table 2 clearly shows that the most crucial strategy for enhancing operational efficiency is process automation implementation (345 points), which ranks as the top priority. The strategy stresses the importance of integrating automated systems to streamline operations. The second most important strategy is lean manufacturing practices (328 points), which focuses on minimizing waste and

improving efficiency. Supply chain integration (317 points) ranks third, highlighting the need for seamless coordination across the supply chain. Employee skill development (301 points) is the fourth-ranked strategy, stressing the significance of training and upskilling the workforce. Following closely are energy efficiency measures (294 points), which accentuate the importance of reducing energy consumption. Inventory management optimization (278 points) and Continuous improvement programs (269 points) rank sixth and seventh, respectively, indicating their roles in maintaining operational efficiency but at a slightly lower priority compared to the other strategies.

7.3 Factors Contributing to Profitability

There are several factors significantly contribute to the profitability of textile firms. The most important aspects are **cost reduction strategies**, which optimize expenses and enhance margins. **production process optimization** and **efficient resource utilization** improve operational efficiency and reduce waste. **Pricing strategy optimization** and **effective supply chain management** ensure competitive pricing and streamlined operations. Additionally, **customer relationship management** and **market demand forecasting** help align products with market needs, while **high-quality product standards** and **innovative product development** drive customer satisfaction and differentiation. Finally, **inventory turnover rate, energy efficiency measures**, and **skilled workforce retention** further support profitability through improved efficiency and sustainability. Chi-Square test is administered, null hypothesis stating that all factors are not equally contribute to profitability of textile firms. The results are furnished in Table 3.

Table 3: Descriptive Statistics

S. No	Factors	N	Mean Rank	Mean Score	Standard Deviation	Chi-Square Test
1.	Cost reduction strategies	100	11.20	3.254	1.5127	148.237 (p=0.000)
2.	Production process optimization	100	10.05	2.903	1.3267	
3.	Efficient resource utilization	100	9.87	2.315	1.3156	
4.	Pricing strategy optimization	100	8.92	3.211	1.2998	
5.	Effective supply chain management	100	7.68	2.937	1.2125	
6.	Customer relationship management	100	7.45	3.056	1.1424	
7.	Market demand forecasting	100	7.30	3.275	1.5273	
8.	High-quality product standards	100	6.95	3.084	1.1985	
9.	Innovative product development	100	6.80	3.233	1.1746	
10.	Inventory turnover rate	100	6.62	2.507	1.6456	
11.	Energy efficiency measures	100	6.54	3.112	1.5321	
12.	Skilled workforce retention	100	6.35	2.183	1.5124	
13.	Operational risk management	100	5.95	2.820	1.2876	
14.	Lean manufacturing practices	100	5.80	2.473	1.2105	
15.	Sales and distribution efficiency	100	5.65	2.441	1.5432	

Source: Primary data

Table 3 presents the results of a Friedman test conducted to evaluate the significance of various factors contributing to profitability in textile firms. The test determines whether there is a significant

difference in the importance assigned to each aspect. The results indicate that cost reduction strategies (11.20) are the most crucial factor for profitability, it renders significant role in enhancing financial performance. It is followed by production process optimization (10.05) and efficient resource utilization (9.87), which are also key contributors to profitability. These high-ranking factors stress the importance of managing costs and optimizing production processes to achieve better financial outcomes. Then, pricing strategy optimization (8.92) and effective supply chain management (7.68). Although slightly less critical, the aspects still play an important role in maintaining profitability by ensuring that pricing strategies are competitive and supply chains are well-managed. Furthermore, customer relationship management (7.45) and market demand forecasting (7.30) are essential for understanding and meeting customer needs and anticipating market trends. High-quality product standards (6.95) and innovative product development (6.80) also contribute to profitability by ensuring that products meet quality expectations and incorporate innovation. Subsequently, inventory turnover rate (6.62), energy efficiency measures (6.54), skilled workforce retention (6.35), operational risk management (5.95), lean manufacturing practices (5.80), and sales and distribution efficiency (5.65) have minimum effect in profitability. The chi-square value of 148.237, with a p-value of 0.000, indicates a statistically significant difference among the ranks of the variables. The result confirms that all factors are equally contribute to profitability of textile firms. Therefore, textile firms perceive all these factors are important; instead, certain factors like cost reduction and process optimization are deemed more critical for achieving profitability.

7.4 Factors Influencing Operational Efficiency

Factor analysis identified the important factors influencing operational efficiency in textile firms. The analysis identified five critical factors, like production efficiency, supply chain management, human resources management, quality management, and financial management. These factors, supported by strong factor loadings, significantly contribute to overall operational efficiency, highlighting the importance of optimizing processes, resources, and management practices. The results are furnished in Table 4.

Table 4: Results of Factor Analysis

Factor	Variable	Factor Loadings	Eigen Value	% of Variance Explained
Production Efficiency	Optimal use of machinery	0.832	10.324	25.959
	Output per labor hour	0.821		
	Minimizing idle production time	0.798		
	Extent of automated processes	0.775		
	Streamlining production workflows	0.751		
	Minimizing material wastage	0.748		
	Energy used per product	0.788		
	Proportion of usable output	0.809		
	Shortening production cycles	0.794		
	Effective production planning	0.768		
Supply Chain Management	Consistency in supplier performance	0.815	7.268	16.324
	Frequency of inventory replenishment	0.785		
	Optimized transport and distribution	0.784		
	Punctuality in product delivery	0.765		
	Precision in demand predictions	0.783		

Factor	Variable	Factor Loadings	Eigen Value	% of Variance Explained
	Minimizing inventory levels	0.788		
	Adaptability to market changes	0.759		
Human Resources Management	Competency of workforce	0.812	5.952	13.627
	Employee skill enhancement initiatives	0.784		
	Employee retention rate	0.783		
	Workplace safety measures	0.776		
	Employee reward systems	0.816		
	Supporting work-life balance	0.787		
Quality Management	Percentage of flawed products	0.802	4.632	7.159
	Frequency of customer issues	0.801		
	Quality certification compliance	0.785		
	Supplier quality assurance	0.763		
	Quality control costs	0.742		
Financial Management	Efficiency in asset utilization	0.818	3.068	5.237
	Efficiency in managing liquidity	0.782		
	Effective use of capital investments	0.754		
	Funds allocated to innovation	0.743		

Source: Primary data

Table 4 presents the results of a factor analysis conducted to determine the key factors influencing the operational efficiency of textile firms. Five primary factors were identified like, production efficiency, supply chain management, human resources management, quality management, and financial management. Each factor is associated with specific variables, factor loadings, eigenvalues, and the percentage of variance explained. The variables under **production efficiency** have high factor loadings ranging from 0.748 to 0.832, it indicates that it strongly contributes to the production efficiency. The highest loading is seen for optimal use of machinery (0.832), highlighting its critical role in enhancing production efficiency. The eigenvalue for this factor is 10.324, which is the highest among all factors. **It** explains 25.959% of the total variance, it signifying that production efficiency is a dominant factor in operational efficiency within textile firms. The factor loadings for **supply chain management** range from 0.759 to 0.815. Consistency in supplier performance has the highest loading (0.815), emphasizing its importance in the supply chain. The eigenvalue is 7.268, indicating significant importance. It explains 16.324% of the variance, making it the second most influential factor. Loadings for **human resources management** are slightly lower but still strong, ranging from 0.776 to 0.816. Employee reward systems has the highest loading (0.816), underlining the importance of effective HR management in operational efficiency. The eigenvalue for human resources management is 5.952. It accounts for 13.627% of the total variance, demonstrating its significant impact on operational efficiency.

The loadings for quality management range from 0.742 to 0.802, with percentage of flawed products having the highest loading (0.802). It suggests that reducing defects is crucial in maintaining quality. The eigenvalue is 4.632 and it explains 7.159% of the variance, indicating its moderate impact. Loadings for financial management are between 0.743 and 0.818, with efficiency in asset utilization showing the highest loading (0.818). Effective financial management is thus vital for operational efficiency. The eigenvalue for Financial Management is 3.068. It explains 5.237% of the variance,

making it the least dominant but still an essential aspect. The factor analysis reveals that production efficiency is the most influential factor, it describes the largest portion of the variance in operational efficiency. Supply chain management and human resources management also play critical roles, followed by quality management and financial management. The results indicated that the identified variables are closely related to their respective factors, making them significant contributors to the overall operational efficiency of textile firms.

8. Conclusion

The analysis of operational efficiency, strategies for enhancement, and factors contributing to profitability in textile firms reveals a comprehensive view of their operational dynamics. The Kruskal-Wallis test indicates no significant differences among various functional areas such as production, design, and quality control, it indicates that all areas contribute uniformly to operational efficiency. It involves a balanced importance across functional areas, reinforcing the idea that each plays a crucial role in maintaining overall efficiency. To enhance operational efficiency, the strategies include process automation, lean manufacturing, and supply chain integration. These approaches are crucial for streamlining operations, reducing waste, and improving coordination across the supply chain. Employee skill development and energy efficiency also emerge as significant, highlighting the need for a well-trained workforce and sustainable practices. Regarding profitability, cost reduction, and production process optimization are identified as critical factors. These elements feature the importance of managing expenses and improving production techniques to boost financial performance. The factors like pricing strategies, supply chain management, and customer relationship management also play vital roles, though with varying degrees of impact. Finally, factor analysis emphasizes that production efficiency, supply chain management, and human resources management are paramount in influencing operational efficiency. The strong factor loadings and explained variance for these areas reflect their dominant roles. A strategic focus on these areas will significantly enhance the operational efficiency and profitability of textile firms.

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