

Strategies for Reducing Costs Through Efficient Material Management of Manufacturing Industries

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ABSTRACT

The apparel industry is fundamental to Bangladesh's economy, contributing significantly to national exports and employment. However, rising manufacturing costs, material waste, and supply chain inefficiencies pose challenges to long-term sustainability and profitability. This study explores solutions for cost reduction through efficient material management, emphasizing strategies such as lean manufacturing, inventory optimization, and waste minimization. A quantitative methodology was employed, with data collected from 450 industry professionals through standardized questionnaires. The results indicate that manufacturers who adopted digital inventory systems, Just-in-Time (JIT) methodologies, and modern cutting technologies achieved substantial cost reductions and improved production efficiency. Collaboration with suppliers and routine waste audits enhanced cost management. Notwithstanding these advantages, obstacles such as restricted technological access, worker skill deficiencies, and supply chain volatility impede wider adoption. The report indicates that tackling these difficulties via industry support and legislative measures can enable Bangladeshi garment producers to attain improved cost efficiency, bolster global competitiveness, and shift towards more sustainable production techniques.

Keywords: Material Management, Cost Reduction, Lean Manufacturing, Inventory Optimization, Apparel Industry, Bangladesh.

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INTRODUCTION

The garment industry is a cornerstone of the Bangladeshi economy, contributing over 80 percent of total export earnings and employing more than four million workers, the majority of whom are women (Debnath et al., 2024). It has positioned Bangladesh as the world's second-largest garment exporter, supplying leading international brands and retailers. However, despite this rapid growth, the industry faces persistent challenges that threaten its long-term stability and profitability (Debnath et al., 2023). Rising production costs, volatile raw material prices, intense global competition, and mounting pressure to adopt sustainable

practices necessitate a strategic rethinking of operational models by manufacturers (Park-Poaps et al., 2021). One of the most effective solutions to tackle such challenges is efficient material management. Since materials such as fabric and trim account for approximately 60–70% of a garment's total production cost, even marginal improvements in material usage or waste reduction can translate into significant savings (Jahed et al., 2022). Inefficient material management often leads to overstocking, excessive waste, production delays, and quality issues all of which erode profit margins and constrain business growth (Kumar,

2023). For Bangladeshi apparel manufacturers, many of whom operate on thin margins while facing constant pressure from buyers to lower prices, optimizing material management practices is no longer a competitive advantage but a survival necessity (Rahaman et al., 2024). Technological advancements—ranging from accurate demand forecasting and lean inventory processes to digital tracking systems—offer pathways to sustainable waste reduction and can transform how production, distribution, and sales are managed across the industry. (Khan et al., 2024). For instance, the adoption of fabric utilization software can help minimize cutting waste, while building stronger relationships with reliable suppliers can stabilize costs and ensure timely material availability (Karmaker et al., 2023). Furthermore, embracing sustainable materials and circular economy principles not only reduces long-term costs but also enhances brand reputation in a market increasingly shaped by conscious consumerism (Habib et al., 2021). This article examines supply chain strategies that Bangladeshi apparel manufacturers can implement to improve material management and lower production costs. These strategies include, but are not limited to, Just-in-Time (JIT) inventory, Vendor-Managed Inventory (VMI), the adoption of Industry 4.0 technologies, and the application of lean manufacturing principles within the local industry context. However, such approaches may serve as short-term fixes unless manufacturers adopt a long-term vision that prioritizes eco-automation and sustainable technologies. Businesses that can afford investments to maintain profitability must also recognize the value of investing in clean technologies, as environmentally sustainable practices not only address human and ecological costs but also make sound business sense.

LITERATURE REVIEW

Bangladesh's apparel sector has been the subject of much attention given its economic importance and sensitivity to cost pressures. The literature has discussed dimensions of material management as a vital peg of production efficiency and profit. In this section, an overview of the existing literature is presented in terms of key themes including material cost control, inventory optimization, waste reduction, and the adoption of digital technologies - all focusing on the garment sector in Bangladesh.

Material Cost Control and Its Impact on profitability

Material cost is the biggest cost component of total production cost in the apparel industry, typically accounting for 60-70% of the total cost per garment (Khanam & Ghosh, 2022). Even small improvements in material utilization yield enormous gains in profit margins according to studies. Rahman et al. and Asha et

al. (2023) highlight that poor planning of material requirements often results in over-purchasing, deadstock, and cash flow problems. In contrast, organized procurement practices—such as bulk purchasing and long-term supplier contracts—can help reduce costs and minimize material price fluctuations. Since 60–70% of garment production costs are tied to raw materials, effective cost control is directly proportional to profitability (Khairul Akter et al., 2022). A study of Aboni Knit Wear Ltd. using Data Envelopment Analysis (DEA) also demonstrated that improved material sourcing and optimized procurement strategies led to significant cost savings (Khairul Akter et al., 2022). Similarly, Uddin et al. (2023) confirm that production costs in the Bangladeshi apparel sector are heavily dependent on raw materials, particularly imported fabrics. This study recommends bulk purchasing and establishing long-term relationships with suppliers to achieve cost stabilization and predictability (Uddin et al., 2023). Similarly, Wren (2022) applied linear programming to optimize apparel production and found that efficient allocation of materials, including threads and fabrics, led to increased profitability in direct proportion to improved resource distribution (Wren, 2022).

Inventory Optimization and Lean Manufacturing

Just-in-time inventory management and lean manufacturing methods are critical for lowering costs and increasing efficiency in Bangladesh's garment sector. Studies demonstrate that implementing these practices reduce waste, improve production efficiency, and maximize resource use, all of which lead to cost savings. Chowdhury et al. (2023) claim that the application of lean manufacturing can be a game changer for Bangladesh's apparel industry through waste removal, overproduction reduction, and enhanced workflow efficiency. The research provides evidence that factories can reduce production costs and enhance delivery flexibility by implementing lean tools such as value stream mapping and continuous flow/Kaizen processes. For instance, Razzak (2023) conducted a case study demonstrating that the application of lean tools, including Kanban and 5S, significantly improved inventory accuracy and minimized production delays. The study highlights that lean practices are employed to address the inefficiencies of conventional manufacturing systems, particularly within the highly dynamic apparel production environment. Hasan et al. (2022) extended this work by examining the role of Lean Six Sigma in logistics management, incorporating these techniques into dynamic inventory management models to better align material flow and minimize costs arising from excess inventory or stockouts. Similarly, Jahed et al. (2022) found that inventory optimization techniques significantly improved manufacturing performance.

Notably, their study revealed that manufacturers implementing Just-in-Time (JIT) inventory systems reduced material holding costs by approximately 25%, thereby freeing up capital for other operational improvements. Khan et al. (2024) conducted a study on a Bangladeshi garment factory and found that the adoption of a Material Requirement Planning (MRP) system led to reduced material waste and shorter production lead times. Their findings suggest that even partial lean adoption can yield measurable cost savings. Similarly, Islam (2021) examined lean implementation in the Bangladeshi apparel industry and reported that its effectiveness is often hindered by inadequate employee training and resistance to change..

Waste Reduction and Sustainable Material Management

Waste management is an integral part of cost minimization in the apparel sector of Bangladesh, where it is estimated that 15% of material used in the industry is fabric waste (Honey and Sultana, 2023). Since materials account for the largest share of production costs, even small gains in waste reduction can lead to considerable cost savings. Research highlights several strategies that can minimize material waste while enhancing sustainability—two critical factors for manufacturers competing in global markets where consumer demand for responsible production is steadily increasing. Cutting remains one of the primary sources of waste in garment production. To address this, manufacturers can adopt digital patternmaking and automated cutting machines, which enable greater precision and significantly reduce fabric off-cuts (Honey, 2019). Additionally, advanced nesting software can optimize the layout of patterns on fabric rolls, thereby maximizing fabric yield and minimizing waste. For example, Rahman et al. (2025) reported that the integration of digital cutting systems with optimization techniques increased cutting efficiency from 15–25% to 30%, compared to traditional manual methods. Beyond fabric utilization, the adoption of non-physical solutions such as digital processes not only reduces material costs but also accelerates production, enabling faster turnaround times and greater flexibility in responding to market demand. Moreover, collaborations with local recycling facilities or the establishment of in-house recycling programs can help factories close the production loop, thereby enhancing sustainability and mitigating the environmental impact of textile waste. Several Bangladeshi factories have already begun recycling leftover cotton to produce cost-effective blended fabrics, simultaneously reducing waste and lowering raw material expenses. The evidence suggests that sustainable material management is not merely a strategy for cost reduction but a cornerstone of long-term business competitiveness. As global brands increasingly

demand sustainable supply chains, factories that can demonstrate strong environmental credentials are more likely to secure long-term contracts and benefit from premium pricing. For Bangladeshi manufacturers, sustainability should not be seen as a burden but rather as an opportunity—a potential source of resilience, growth, and competitive advantage. Apparel producers can reduce costs, elevate brand reputation, and future-proof their businesses in a changing global market at the same time, by investing in waste-reduction technologies, promoting a material-efficient culture, and exploring opportunities in the circular economy.

Technology Integration and Industry

The next major advancement in material management lies in the adoption of digital technologies. Ahmed et al. (2021) demonstrate that the use of material tracking systems, RFID technology, and enterprise resource planning (ERP) software enhances inventory visibility, reduces human error, and strengthens overall supply chain performance. For garment factories in Bangladesh, the adoption of digital stock management methods is particularly critical, as it helps reduce stock pilferage, which can reach as high as 10%, while also minimizing reliance on manual processes.

Contextual Challenges in Bangladesh's Apparel Sector

While efficient material management is proven to yield positive results, the state of manufacturing in Bangladesh presents unique challenges to implementation. Limited access to financing, skill gaps in technology adoption, and infrastructural constraints can hinder small and medium-sized enterprises (SMEs) from investing in advanced material management systems (Basak et al., 2020). However, case studies demonstrate that even modest improvements—such as better material forecasting or closer supplier collaboration—can yield measurable cost savings and productivity gains. The literature underscores that efficient material handling and management is a pivotal lever for cost reduction in the apparel sector. Strategies ranging from procurement optimization and lean inventory practices to waste reduction and digital innovation can be adapted to the specific context of Bangladesh's garment industry. Nevertheless, successful implementation requires not only investment in workforce training and technological capacity but also a nuanced understanding of the local challenges that shape the sector's operating environment.

This paper contributes to the literature by offering actionable solutions for Bangladeshi manufacturers on how to translate theory into practice, thereby carving a sustainable pathway toward operational efficiency and global competitiveness.

PROBLEM OF THE STUDY

Though managing materials efficiently has great potential to reduce costs, Bangladesh's apparel industry faces many challenges that prevent implementation. A lot of factories still use old, manual inventory systems that are susceptible to human error, inefficiencies, and excessive material waste, over-producing and production delays. Limited access to new technologies and financial constraints make it more difficult for SMEs to implement automated material tracking or even digital pattern-making tools. In addition, insufficient workforce training on lean practices and appropriate waste management leads to a higher rate of defects and unneeded material waste (Karmaker et al., 2023). With supply chain disruptions, varying quality of materials from suppliers and price volatility of raw materials, it is harder for manufacturers to keep their costs down. However, as most production facilities operate on decades of prevailing thought of the Just-In-Time (JIT) inventory, it takes a long time to adopt modern practices, and with the ebbing momentum of a more circular economy, resistance is aplenty to change, especially in traditional production setups (Rahaman et al., 2024). All of these factors are significant barriers to effective material management and achieving sustainable cost reduction.

RESEARCH OBJECTIVES

The study aims to,

1. Evaluate the effect of effective material management on cost reduction in Bangladesh's garment industry.
2. Identify principal obstacles to the implementation of lean manufacturing and inventory management techniques.
3. Assess the efficacy of waste reduction measures in reducing material expenses.
4. Investigate the impact of supplier collaboration and sustainable sourcing on material cost efficiency.
5. Formulate pragmatic recommendations for apparel manufacturers to improve material management practices.

METHODS AND METHODOLOGY

We conducted a quantitative research study on cost reduction through efficient management of materials in the Bangladeshi garment industry. Data were obtained through a structured questionnaire survey, which was distributed to 450 respondents, including the production managers, supply chain officers, and quality control personnel of small, medium, and large apparel factories. The sample size was calculated using Cochran's formula,

$$n = \frac{Z^2 \cdot p \cdot (1 - p)}{E^2}$$

Where $Z=1.96$ $Z = 1.96$ for a 95% confidence level, $p=0.5$ $p = 0.5$ (assumed proportion), and $e=0.05$ $e = 0.05$ (margin of error). This calculation yielded a required sample size of 384, which was increased to 450 to account for potential non-responses. The questionnaire includes five sections: (1) demographic information, (2) practices of material management, (3) waste management, (4) technology adoption, and (5) supply chain collaboration. Responses were gathered through a 5-point Likert scale in most questions, as well as through multiple-choice and dichotomous items. To represent factories of varying sizes and production capacities, factories were sampled using stratified sampling. Descriptive statistics, correlation analysis, and regression modeling were used to examine the relationships between management practices and cost efficiency. The methodology ensured a comprehensive, data-driven approach, capturing a broad spectrum of industry perspectives while maintaining statistical rigor.

RESULTS AND DISCUSSION

The following section details the study findings, as well as their interpretation with respect to the research objectives. To examine the impact of effective material management on cost reduction, data were collected and analyzed from 450 respondents employed in various job positions within the Bangladeshi apparel industry.

Demographic Profile of the Respondents

It is important to take into consideration the demographic profile of the respondents to the survey to help understand the findings of the study. Understanding the roles, experience levels and factory sizes help give context to how representative the sample is of Bangladesh's varied apparel industry. Key demographic characteristics of the participants are shown in this section and provide valuable context for the workforce involved in and influencing material management practices and cost decisions.

Figure 1 represents the demographic status of the respondents of this study. The demographics breakdown of the respondents helps provide useful background information in interpreting the study findings. The sample comprised production managers (35%), supply chain officers (25%), quality control officers (20%), and factory owners or senior executives (20%). Regarding scale, 40% worked in factories with 100–500 employees, 30% with 501–1000 employees and 30% in a factory with more than 1000 workers. The vast majority of the factories (55%) reported a monthly production capacity of 100,000–500,000 pieces, showcasing the scale of Bangladesh's garment export sector. Interestingly, the respondents had varying levels of

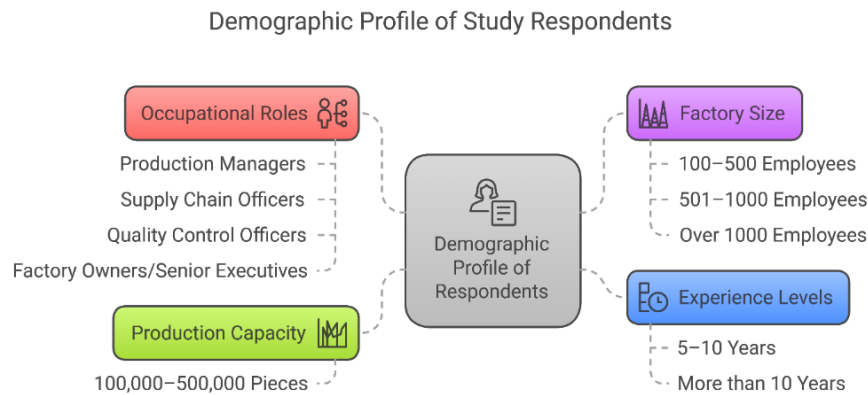


Figure 1: Demographic Profile of the Respondents.

Respondents' Views on Material Costs in Production

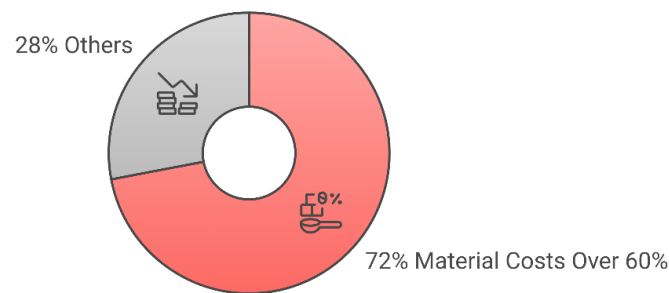


Figure 2: Views on Material Costs in Production.

experience, with 45% having 5–10 years of industry experience and 30% more than 10 years of industry experience, necessary to glean insights into long-term material management practices.

Impact of Material Management on Cost Reduction

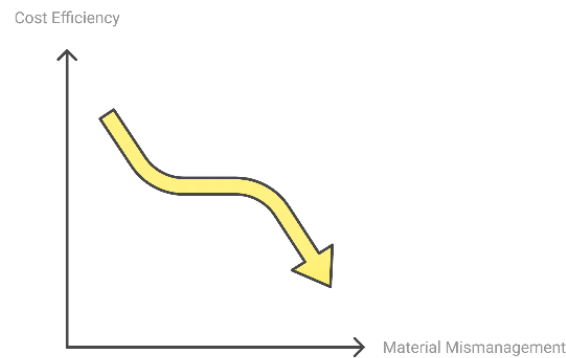
Efficient material management can significantly influence production cost control, as raw materials constitute the largest portion of apparel manufacturing expenses. For manufacturers seeking to maintain a competitive edge, it is essential to understand how proactive measures such as accurate forecasting and streamlined inventory management contribute to overall cost efficiency. This section examines the impact of material management on cost reduction, drawing on insights from survey data and real-world practices within garment factories.

Figure 2 represents the respondents' view on material costs in production. The main focus was how material management impacts cost efficiency. 72% percent of respondents felt that over 60% of production costs came

from materials. Factories that utilized digital inventory systems or ERP software reported less material wastage and quicker production cycles. Material mismanagement (e.g., over-purchasing, stockouts) was negatively correlated with overall cost efficiency in regression analysis ($R = -0.68$, $p < 0.01$) (Figure 3). These results are consistent with the literature, suggesting that improved material prediction and monitoring systems, when implemented effectively, can lead to decreased costs.

Adoption of Lean and Inventory Optimization Practices

With lean manufacturing and inventory optimization practices, apparel factories can reduce waste, maintain optimum stock levels to avoid overstocking, and streamline production processes. Increased efficiency and reduced costs have made these practices widely adopted but their portfolio varies from factory to factory; those differences can be attributed to the financial, technical and organizational conditions of those



Negative Correlation Between Material Mismanagement and Cost Efficiency

Figure 3: Negative Correlation Between Material Mismanagement and Cost Efficiency.

Adoption of Lean Practices and Cost Reduction

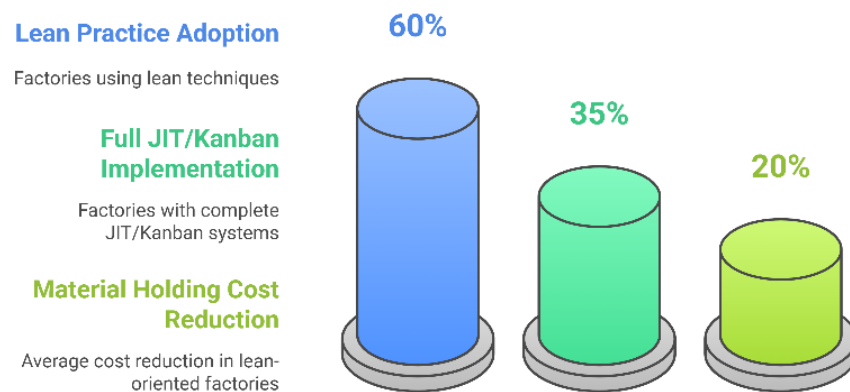


Figure 4: Adoption of Lean Practices and Cost Reduction.

factories. The implementation status of lean and inventory management practices and their impact on cost reduction in the RMG industry of Bangladesh is explored in this section.

Figure 4 demonstrates the adoption of lean practices and cost reduction. It also looks at how many factories had adopted lean manufacturing and inventory optimization techniques. In this survey, it is revealed that while 60% of respondents employed forms of lean practice, only 35% had adopted systems such as Just-in-Time (JIT) inventory or Kanban in their entirety. Lean-oriented factories reported an average material holding cost reduction of 20% among respondents. Smaller factories were less likely to adopt lean practices, and many cited financial constraints and a lack of technical expertise as barriers. This has highlighted the need for industry-wide capacity-building initiatives to promote lean adoption.

Waste Management and Cost Savings

It is an essential part of reducing the costs of production, particularly in Bangladesh's garment sector, where fabric waste materials and production defects can dramatically raise costs. Cutting down on material waste means lower costs. It also means more sustainable production practices and that is an increasingly important consideration for global buyers. The next part highlights how overall cost savings for apparel manufacturers are influenced by comprehensive waste reduction methods like digital cutting systems and recycling methods.

Figure 5 displays waste management practices in apparel industry. Waste reduction became an important driver of savings. Approximately 65% of respondents gave figures of 10%–20% for fabric waste, mostly from cutting and defective production. Factories equipped

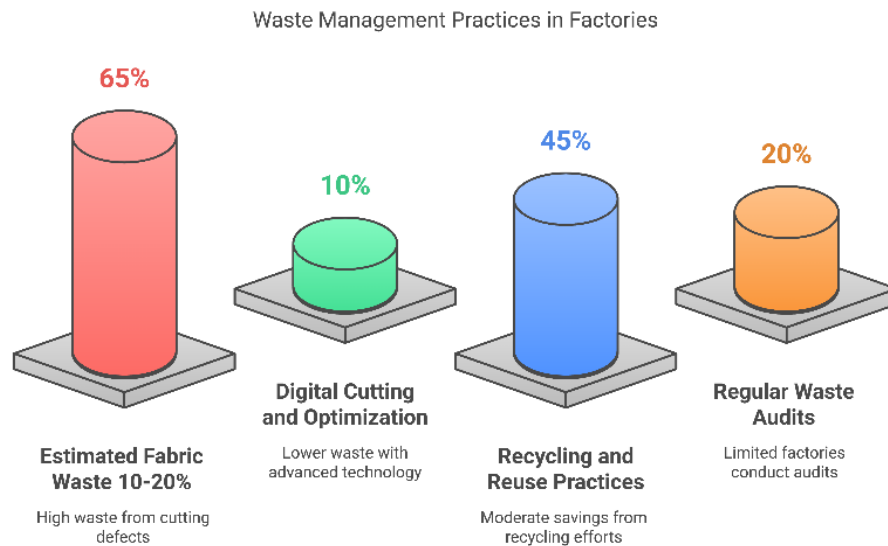


Figure 5: Waste Management Practices in Factories.

with digital cutting machines and pattern optimization software had reported lower waste percentages (less than 10%). Forty-five percent of factories with recycling systems or fabric reuse practices indicated moderate cost savings, and only 20 % the recycling-certified factories, or just under a quarter of factories generally, performed regular waste audits. The results indicate that long-term savings could be made by implementing technologies for waste reduction and regularly monitoring waste.

Role of Technology and Supplier Collaboration

Through the use of technology and collaboration with suppliers, tools such as ERP systems and material tracking software can help ensure accurate inventories and reduce waste. Also, a strong relationship with suppliers can help stabilize the cost of materials as well as avoid potential disruptions. In this section, we discuss the role of technology adoption and partnerships with suppliers in reducing costs and streamlining production flows for Bangladesh's apparel sector.

Figure 6 highlights the role of technology and supplier collaboration in this study. The researchers also explored technology and supplier collaboration impact on material cost efficiency. Approximately 55% of factories had invested in digital material tracking systems, and those factories said they had experienced better inventory accuracy and fewer production delays. Supplier collaboration was the second most important driver: Among respondents who communicated on a frequent basis with suppliers and agreed upon flexible order quantities, as many as 70% of the respondents did not experience overstocking or material shortages. In other words, strategic supplier relationships can help factories stabilize costs and optimize material flow.

Key Challenges in Material Management

Although efficient material management can greatly reduce time and costs, its full potential is often constrained in many Bangladeshi apparel factories. Challenges such as limited access to technology, insufficient workforce training, and supply chain uncertainties hinder cost-saving efforts. This section discusses the key obstacles manufacturers face and their impact on improving material utilization and cost control.

Figure 7 illustrates the challenges faced by garment factories in Bangladesh. While many factories demonstrated the potential to operate more cost-effectively, they continued to encounter significant obstacles. The most frequently reported issues were a lack of advanced technology (40%), limited workforce training (30%), and unreliable material suppliers (20%). Smaller factories struggled particularly with securing financing for technology upgrades, whereas larger ones faced difficulties in managing extensive material inventories across hundreds of production lines. These findings underscore the importance of industry stakeholders in supporting SMEs through targeted training programs, financial assistance, and policy incentives to accelerate technology adoption. The results further reinforce the critical role of efficient material management in reducing production costs. Factories that adopted digital technologies, lean practices, and waste reduction strategies achieved measurable cost savings, consistent with global research on material efficiency. Nonetheless, structural challenges remain, particularly for smaller manufacturers with limited resources to implement sophisticated systems. Policymakers and industry associations can help bridge this gap by enhancing access to technology, facilitating training, and

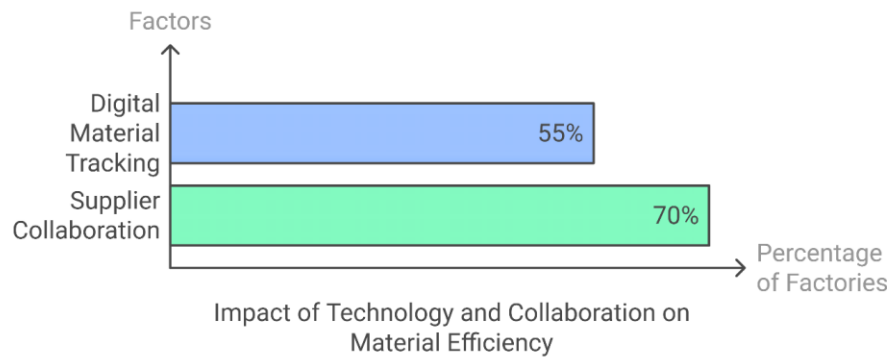


Figure 6: Role of Technology and Supplier Collaboration.

Challenges Faced by Factories in Cost Reduction

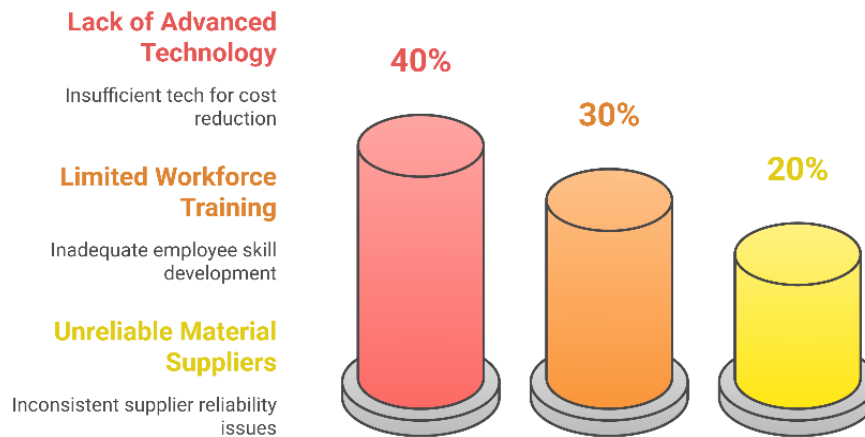


Figure 7: Challenges Faced by Factories.

promoting sustainable production practices. Ultimately, this study provides a data-driven foundation for developing tailored material management strategies, helping Bangladeshi apparel manufacturers improve profitability while enhancing sustainability, a crucial step for maintaining global competitiveness in an evolving fashion market.

FINDINGS

The study provides valuable insights relevant to the relationship between material management practices and cost reduction in the Bangladeshi apparel industry. The findings paint a clear picture of how they are done today, their impact on production costs and the hurdles factories are facing to make better use of material.

1. The majority of respondents (72%) indicated that raw materials accounted for more than 60% of total

production costs, underscoring the importance of material management as a key area of cost control. Factories relying on rudimentary material tracking systems and weak forecasting practices reported more frequent instances of overstocking and material shortages.

2. While 60% of factories reported practicing some form of lean manufacturing, only 35% had fully implemented systems such as Just-in-Time (JIT) inventory or Kanban. Those that adopted these techniques achieved, on average, a 20% reduction in material holding costs. However, smaller factories struggled to adopt lean practices due to limited resources..

3. Fabric waste was a significant contributor to unnecessary costs, with 65% of factories reporting 10–20% material waste. Factories using digital cutting systems and waste monitoring practices reduced waste to below 10%, highlighting the importance of technology in waste reduction.

4. Approximately 55% of factories had implemented

digital material tracking systems or ERP software.

These factories experienced fewer production delays, improved inventory accuracy, and more stable costs. However, smaller manufacturers were limited in their ability to implement technology because of finances.

5.70% of respondents who engaged in regular communication with suppliers and negotiated flexible order quantities reported fewer instances of material waste and more stable material costs. Strong supplier relationships helped mitigate issues related to fluctuating raw material prices and supply chain disruptions.

6. Factory struggles to develop better material management stemmed from a lack of technology (40%), poor workforce training (30%), and unreliable suppliers (20%).

These challenges particularly overwhelmed smaller factories, showcasing the necessity of collaborative support and capacity building across the industry.

In conclusion, the results showed a significant relationship between proper material handling in construction site and decreasing costs. Productivity improvements were greatest in the factories that combined lean practices and waste reduction strategies, along with technology adoption and supplier collaboration. These insights reaffirm the potential that improvements in materials management can provide for immediate cost savings as well as long-term competitiveness for the Bangladesh apparel industry. By building on proven practices and directly addressing the specific hindrances identified in this study, businesses can not only overcome existing challenges but also expand their opportunities for sustainable growth and long-term competitiveness.

RECOMMENDATIONS

The findings suggest that several strategies can enable garment manufacturers in Bangladesh to strengthen material management and reduce production costs. Investments in digital technologies such as ERP systems and material tracking software can improve inventory accuracy and minimize waste.

The adoption of lean methodologies, including Just-in-Time (JIT) inventory and value stream mapping, supports process optimization and lowers holding costs. Conducting systematic waste audits and introducing advanced cutting technologies further reduce fabric losses, while recycling and upcycling programs can convert waste into additional revenue streams. Strengthening supplier relationships through collaborative forecasting and flexible ordering enhances cost stability and mitigates supply chain risks.

In addition, industry associations and policymakers should provide financial incentives, training, and resources to help smaller firms adopt technology and lean practices. Collectively, these measures can drive

cost efficiency, enhance global competitiveness, and foster more sustainable production practices in the Bangladeshi apparel industry.

LIMITATIONS

This study offers significant insights into material management strategies and cost reduction within Bangladesh's garment industry; however, it possesses certain limitations. The study depended on self-reported data from 450 participants, potentially leading to response bias or mistakes in the recollection of material management procedures. The study concentrated predominantly on big and medium-sized industries, indicating that the findings may not comprehensively reflect the realities of smaller factories with limited resources. The research analyzed cost reduction from an operational standpoint but neglected to consider exogenous issues such as global market swings, political instability, or abrupt supply chain interruptions, which can also affect material costs. The study's cross-sectional design restricts the capacity to monitor long-term effects of material management enhancements; future research may gain from longitudinal studies or case-based methodologies for more profound insights. Notwithstanding these constraints, the results provide a robust basis for comprehending the function of material management in cost reduction and for pinpointing potential for enhancements across the industry.

CONCLUSION

This study emphasizes the vital importance of effective material management in lowering manufacturing costs and improving competitiveness in Bangladesh's garment sector. Given that raw materials constitute the predominant portion of production costs, enhancing material utilization, implementing lean methodologies, minimizing waste, and utilizing technology can result in substantial cost reductions and operational enhancements. The results indicate that factories utilizing digital inventory systems, Just-in-Time (JIT) methodologies, and sophisticated waste management techniques achieved enhanced cost control and production efficiency. Nonetheless, obstacles such as restricted access to technology, inadequate staff training, and supply chain uncertainty persist in impeding advancement, particularly for smaller enterprises. Resolving these challenges by comprehensive industry capacity-building programs, policy reinforcement, and enhanced supplier engagement can facilitate new avenues for sustainable growth. Enhancing material management methods is not merely a cost-saving initiative but a strategic imperative for Bangladesh to continue its status as a worldwide leader in clothing manufacture within an increasingly competitive and sustainability-focused industry.

REFERENCES

- Asha AA, Dulal M, Habib A (2023). The influence of sustainable supply chain management, technology orientation, and organizational culture on the delivery product quality-customer satisfaction nexus. *Cleaner Logistics and Supply Chain*. 7: 100107. <https://doi.org/10.1016/j.clscn.2023.100107>
- Basak S, Gazi Md D H, Mazharul Hoque Chowdhury S M (2020). A Review Paper on Comparison of Different Algorithm Used in Text Summarization. In D. J. Hemanth S. Shakya, & Z. Baig (Eds.), *Intelligent Data Communication Technologies and Internet of Things*. 38:114–119. https://doi.org/10.1007/978-3-030-34080-3_13
- Chowdhury Md M H, Rahman S, Quaddus M A, Shi Y (2023). Strategies to mitigate barriers to supply chain sustainability: An apparel manufacturing case study. *Journal of Business and Industrial Marketing*. 38(4): 869–885. <https://doi.org/10.1108/JBIM-04-2021-0233>
- Debnath B, Siraj M T, Rashid Kh H O, Mainul Bari A B M, Karmaker C L, Aziz R A (2023). Analyzing the critical success factors to implement green supply chain management in the apparel manufacturing industry: Implications for sustainable development goals in the emerging economies. *Sustainable Manufacturing and Service Economics*. 2:100013. <https://doi.org/10.1016/j.smse.2023.100013>
- Debnath B, Taha MR, Siraj Md T, Jahin Md F, Ovi SI, Bari ABMM, Islam AR Md T, Raihan A (2024). A grey approach to assess the challenges to adopting sustainable production practices in the apparel manufacturing industry: Implications for sustainability. *Results in Engineering*. 22: 102006. <https://doi.org/10.1016/j.rineng.2024.102006>
- Habib Md A, Bao Y, Nabi N, Dulal M, Asha AA, Islam M (2021). Impact of Strategic Orientations on the Implementation of Green Supply Chain Management Practices and Sustainable Firm Performance. *Sustainability*. 13(1): 340. <https://doi.org/10.3390/su13010340>
- Hasan S, Khan G, Hoque M R, Hassan F and Ahmed N (2022). Lean practices in the Bangladeshi ready-made garments industry and global significance. *International Journal of Logistics Research and Applications*. 25(3): 309–327. <https://doi.org/10.1080/13675567.2020.1847262>
- Honey S (2019). Promoting Sustainable Marketing in the RMG Sector: A Step for Transformation. *AIUB Journal of Business and Economics*. 16(1): 30-42.
- Honey S, Sultana R (2023). Analysis of Waste Management System in Bangladesh- A Study on Some Selected RMG Industries. *Journal of Economics and Development Studies*. 12(1): 721-731.
- Islam Md S (2021). Ready-made garments exports earning and its contribution to economic growth in Bangladesh. *GeoJournal*. 86(3): 1301-1309. <https://doi.org/10.1007/s10708-019-10131-0>
- Jahed MA, Quaddus M, Suresh N C, Salam MA, Khan EA (2022). Direct and indirect influences of supply chain management practices on competitive advantage in fast fashion manufacturing industry. *Journal of Manufacturing Technology Management*, 33(3): 598-617. <https://doi.org/10.1108/JMTM-04-2021-0150>
- Karmaker CL, Aziz RA, Ahmed T, Misbauddin SM, Moktadir Md A (2023). Impact of industry 4.0 technologies on sustainable supply chain performance: The mediating role of green supply chain management practices and circular economy. *Journal of Cleaner Production*, 419: 138249. <https://doi.org/10.1016/j.jclepro.2023.138249>
- Khairul Akter M Md, Haq U N, Islam Md M, Uddin M A (2022). Textile-apparel manufacturing and material waste management in the circular economy: A conceptual model to achieve sustainable development goal (SDG) 12 for Bangladesh. *Cleaner Environmental Systems*, 4: 100070. <https://doi.org/10.1016/j.cesys.2022.100070>
- Khan T, Emon MMH, Siam SAJ (2024). Impact of Green Supply Chain Practices on Sustainable Development in Bangladesh. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4958443>
- Khanam Z, Ghosh R (2022). Impact of sustainable supply chain management on cost performance: Empirical evidence from manufacturing companies of Bangladesh. *Journal of Economic and Administrative Sciences*. <https://doi.org/10.1108/JEAS-02-2022-0050>
- Kumar Kanike U (2023). Factors disrupting supply chain management in manufacturing industries. *Journal of Supply Chain Management Science*, 4(1–2): 1–24. <https://doi.org/10.18757/jscms.2023.6986>
- Park-Poaps H, Bari M S, Sarker Z W (2021). Bangladeshi clothing manufacturers' technology adoption in the global free trade environment. *Journal of Fashion Marketing and Management: An International Journal*, 25(2). 354-370. <https://doi.org/10.1108/JFMM-06-2020-0119>
- Rahaman Md T, Pranta AD, Repon Md R, Ahmed Md S, Islam T (2024). Green production and consumption of textiles and apparel: Importance, fabrication, challenges and future prospects. *Journal of Open Innovation: Technology, Market, and Complexity*. 10(2):100280. <https://doi.org/10.1016/j.joitmc.2024.100280>
- Rahman R, Rahman MA, Al Sany SMA, Ebad AN, Alam MJ, Anik MNH (2025). Importance of ERP System in Increasing the Inventory Management Productivity in Apparel Industry of Bangladesh. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.5113910>
- Razzak MR (2023). Mediating effect of productivity between sustainable supply chain management practices and competitive advantage: Evidence from apparel manufacturing in Bangladesh. *Management of Environmental Quality: An International Journal*. 34(2): 428-445. <https://doi.org/10.1108/MEQ-01-2022-0022>
- Uddin MH, Razzak MR, Rahman AA (2023). Sustainable supply chain management practices, dynamic capabilities and competitive advantage: Evidence from Bangladesh READY-MADE garments industry. *Business Strategy and Development*, 6(2):176-188. <https://doi.org/10.1002/bsd2.232>
- Wren B (2022). Sustainable supply chain management in the fast fashion Industry: A comparative study of current efforts and best practices to address the climate crisis. *Cleaner Logistics and Supply Chain*, 4: 100032. <https://doi.org/10.1016/j.clscn.2022.100032>