E-ISSN: 2706-8927
P-ISSN: 2706-8919
Impact Factor (RJIF):7.28
www.allstudyjournal.com
IJAAS 2025; 7(9): 114-117
Received: 03-08-2025
Accepted: 05-09-2025

Samyak Gangurde
Assistant Professor, Navjeevan Institute of Management (Affiliated to Savitribai Phule Pune University, Pune), Nasik, Maharashtra, India

Dr. Shinde Suvarna R
I/C Director, Navjeevan Institute of Management (Affiliated to Savitribai Phule Pune University, Pune), Nasik, Maharashtra, India

Corresponding Author:
Dr. Shinde Suvarna R
I/C Director, Navjeevan Institute of Management (Affiliated to Savitribai Phule Pune University, Pune), Nasik, Maharashtra, India

Implementing green supply chain management to reduce waste in the manufacturing industry: Strategies and best practices

Samyak Gangurde and Shinde Suvarna R

DOI: https://www.doi.org/10.33545/27068919.2025.v7.i9b.1691

Abstract
A complex network of processes and interactions that governs the flow of resources, components, and information from the suppliers of raw materials to the final customer is known as the supply chain. In the 21st century, the manufacturing industry has undergone a comprehensive transformation into green supply chain management particularly environmentally responsible practices. The practices of the Green Supply Chain Management in manufacturing industries to eliminate waste in the production system and from logistics and procurement operations. Implementing a mixed-methods framework; including process mapping, waste-audit data, stakeholder interviews, and performance metrics, the strategies implemented, their operational and environmental results, challenges faced, and effective practices for duplication. The case study undertaken scrutinized that integrating supplier collaboration, process reconfiguration, circular product mindset, and performance-driven incentives led to significant decreases in material waste (26%), energy usage (14%), and disposal expenses (26%) over a period of 12 months. The document wraps up with a viable implementation plan and suggestions for managers and policymakers.

Keywords: Green supply chain management, waste reduction, manufacturing, circular economy, supplier engagement, process redesign, case study

1. Introductions
Production sectors play a major role in worldwide resource utilization and waste production. The green supply chain management is as an important organizational philosophy to achieve corporate profit and market share objectives by reducing environmental risks and impacts while improving ecological efficiency of these organizations and their partners (Zhu *et al*., 2008) [11]. It is necessary to integrate the organizational environmental management practices into the entire supply chain to achieve a sustainable supply chain and maintain competitive advantage (Zhu *et al*., 2008) [11]. The green supply chain management practices should cover all the supply chain activities, from green purchasing to integrate lifecycle management, through to manufacturer, customer, and closing the loop with reverse logistics (Zhu *et al*., 2008) [11]. Green Supply Chain Management (GSCM) broadens conventional supply chain methods to incorporate environmental aims including waste reduction, resource efficiency, and pollution control along with objectives related to cost and service. The GSCM literature emphasizes various intervention areas such as sustainable procurement, environmentally friendly design, cleaner manufacturing, reverse logistics, and partnerships with suppliers and clients. Empirical research connects GSCM implementation with enhanced environmental results, cost reductions via waste minimization, and a competitive edge. Practitioners often utilize frameworks such as the waste hierarchy (reduce, reuse, recycle), lifecycle analysis, and principles of a circular economy. The case study presented in this paper examines how a automobile component manufacturing company (ACMC) adopted GSCM practices to minimize waste, highlighting successful strategies and insights gained throughout the transition process. The case study is of a sole mid-sized manufacturer of metal components throughout a 12-month implementation timeframe. The objectives of this case study are 1) to record the sequential execution of GSCM at ACMC 2) to measure alterations in waste, energy consumption, and expenses after implementation 3) to recognize facilitators, obstacles, and effective methods for implementing GSCM in comparable companies. Results are tailored to specific contexts yet seek to offer applicable strategies. The research

highlights supply-chain and operational actions instead of product alterations that necessitate extended R&D periods.

2. Methodology

The methodology representing adopted for green supply chain management implementation is shown in fig,1.

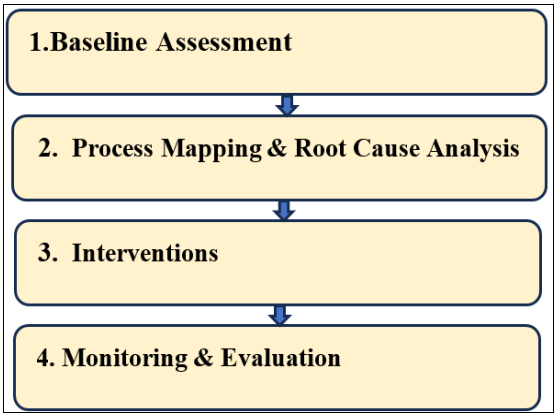

Fig 1: Methodology for green supply chain management implementation

1. **Baseline Assessment:** A detailed waste audit and energy usage analysis for 6 months before interventions established baseline KPIs: production scrap rate, hazardous waste tonnage, landfill disposal costs, energy consumption per unit, and supplier defect returns.

2. **Process Mapping & Root Cause Analysis:** Value-stream mapping workshops identified high-waste processes and their root causes (e.g., machine setup losses, supplier over-spec materials, inefficient packaging).

3. **Interventions:** Phased deployment of GSCM interventions.

4. **Monitoring & Evaluation:** Monthly KPI tracking over 12 months, supplemented by semi-structured interviews with 15 stakeholders (shop-floor supervisors, procurement, logistics, suppliers, and senior management).

Data sources included internal ERP/tracking systems, procurement records, shop-floor logs, and interview transcripts. Results combine quantitative KPI changes and qualitative insights.

3. Case Background: ACMC

ACMC is a medium-sized manufacturing company that creates precision-stamped and machined metal components for automotive and industrial clients. Main features: - Yearly income: average for industry - Staff: 280 workers - Infrastructure: one facility with stamping, machining, finishing, and assembly operations - Supplier network: 35 consistent vendors for raw materials and subassemblies - Fundamental issues: elevated scrap rates at stamping (6.6%), surplus packaging waste, energy-heavy finishing methods, and minimal supplier sustainability involvement. The company encountered demands from key clients to show environmental responsibility and pursued cost reductions following a time of decreased profit margins.

4. Implemented Strategies

The initiatives were categorized into five pillars:

4.1 Sustainable Purchasing & Supplier Collaboration

- Supplier Evaluation & Metrics: Procurement incorporated environmental standards in supplier selection, recycling of materials, reduced packaging, and established quality procedures. Suppliers were provided with a sustainability scorecard that contributed to quarterly assessments.
- Collaborative Enhancement Initiatives: ACMC launched joint Kaizen sessions with major suppliers to minimize over-spec usage and streamline coil widths for stamping to lessen offcut.
- Extended Agreements with Environmental Provisions: Selected vendors were presented with multi-year agreements based on mutually established waste and quality objectives.

4.2 Process Enhancement & Lean-Green Methods

- Setup Reduction & SMED: Single-Minute Exchange of Dies (SMED) initiatives minimized setup waste and downtime, decreasing material losses during transitions.
- Poka-yoke & Defect Prevention: Extra fastening verifications, tool modifications, and immediate sensors minimized misfeeds and flawed outputs.
- Lean Value-Stream Mapping (VSM): Recognized processes that do not add value and create waste; later Kaizen events removed unnecessary handling and surplus inventory that resulted in obsolescence.
- On-site Material Separation: Introduced color-coded containers and distinct pathways for metal scrap, recyclable materials, and hazardous waste to enhance recycling efficiency and minimize contamination.

4.3 Product & Packaging Reengineering

- Design for Manufacturability (DFM): Engineers collaborated with clients to make minor adjustments to tolerances when possible, minimizing expensive over-processing and yield reductions.
- Reusable/Returnable Packaging: Transition from one-time use wooden crates to a framework of recyclable plastic or metal returnable racks monitored through barcodes. This minimized packaging waste and expenses in the long run.

4.4 Reverse Logistics & Circular Economy Practices

- Internal Rework Center: Created a rework station for products that can be cost-effectively repaired instead of discarded.
- Sell-Back & Recycling Collaborations: Collaborated with local recyclers and metal brokers to convert clean metal scrap into resale markets, generating revenue rather than incurring disposal costs.
- Customer Take-back Agreements: For specific subassemblies, ACMC arranged the return of end-of-life components for remanufacturing.

4.5 Governance, Training & Rewards.

- Green KPI Dashboard: Management launched a dashboard displayed on shop-floor screens that

highlights scrap rate, recycling rate, energy usage per unit, and trends in disposal costs.
- Staff Training & Eco Advocates: Consistent training sessions along with a volunteer "Eco Advocates" network on the floor encouraged responsibility for waste initiatives.
- Reward Program: A share of the savings from minimizing waste was distributed to teams meeting monthly goals; suppliers who improved their scorecards earned performance incentives.

5. Optimal Strategies & Execution Plan

Drawing from ACMC's experience, the next best practices and phased roadmap (Fig.2.) are suggested for manufacturers aiming to adopt GSCM for minimizing waste.

Fig 2: Phase wise execution Plan

Phase 1: Evaluate & Rank (0-1 months)

- Perform a targeted waste/energy assessment to pinpoint significant streams.
- Identify key processes to pinpoint the origins of waste.
- Set baseline KPIs and form a small cross-disciplinary steering committee.

Phase 2: Immediate Gains & Supplier Coordination (2-5 months)

- Apply low-capex measures (material separation, mistake-proofing, SMED) for rapid reductions.
- Implement supplier scorecards and commence collaborative improvement events with the top 10 suppliers.
- Test reusable packaging with 1-2 clients.

Phase 3: Expand & Institutionalize (6-8months)

- Implement returnable packaging and recycling collaborations throughout the facility.
- Incorporate sustainability metrics into purchasing agreements and evaluation processes.
- Initiate employee reward programs and establish a structured training plan.

Phase 4: Enhance & Create (9-12 months)

- Investigate circular product designs and return programs that transform the business model.
- Allocate resources to automation/sensors for ongoing tracking of process losses.
- Communicate environmental performance to stakeholders/customers.

Phase 5: Universal best practices

- Synchronize environmental objectives with business KPIs and financial motivations.
- Implement decision making based on data; enhance ERP codes and metrics for waste streams.
- Begin with significant suppliers and processes; implement pilots to showcase ROI.
- Share successes broadly to maintain cultural transformation.

6. Results and Performance

During the 12-month implementation, ACMC noted substantial advancements in both operational and environmental areas:

Key results - Material Waste (scrap) reduction: from 6.6% to 4.9% Landfill disposal expenses: lowered by 26% through segregation and recycling collaborations. - Energy usage per unit: reduced by 14% through process optimization and decreased rework. - Packaging waste: single-use packaging amounts fell by 62% following implementation of returnable systems and supplier alignment. - Recycled material collected: increased by 160% in throughput to brokers (generated as a secondary income source). - Lead time variability: diminished, leading to an enhancement in on-time delivery.

Qualitative advantages involved enhanced supplier connections, increased employee morale from noticeable environmental successes, and augmented customer satisfaction scores related to sustainability.

7. Discussion: Facilitators, Limitation, Obstacles and Recommendations

7.1 Facilitators

- Commitment from Top Management: A definite mandate and resource allocation were essential.
- Interdepartmental Teams: Cooperation between procurement, engineering, operations, and logistics expedited execution.
- Supplier Partnership: Collaborative efforts generated savings that neither side could realize independently.
- Clear Metrics & Incentives: Open KPIs and shared savings built momentum.

7.2 Limitation

This case study is constrained by its focus on one firm and a 12-month timeframe. Future studies might: - Analyze various companies across different sectors to pinpoint sector-specific drivers. - Conduct life-cycle assessments (LCA) to assess net environmental advantages beyond waste weight (e.g., embodied energy, emissions). - Explore the lasting financial effects of circular business models on a larger scale.

7.3 Obstacles

- Initial Investment: Upfront expenses for reusable packaging, sensor enhancements, and training resulted in immediate financial strain.

- Variability in Supplier Readiness: Some suppliers lacked the ability or motivation to adapt swiftly, necessitating either capacity enhancement or finding new suppliers.
- Cultural Resistance: Initially, some shop-floor employees were doubtful; ongoing training and immediate successes were needed to change attitudes.
- Data Quality: Precise monitoring of waste streams necessitated enhancements to ERP coding and on-site reporting.

7.4 Recommendations

- According to the results of this research, it is advisable for manufacturing companies to embrace Green Supply Chain Management (GSCM) practices as a strategic method to decrease waste and enhance sustainability performance.
- Managers ought to incorporate eco-friendly procurement policies, invest in cleaner production technologies, and encourage collaboration with suppliers and distributors to lessen environmental impact. Additionally, employee training and awareness initiatives should be prioritized to cultivate a culture of sustainability throughout all organizational levels.
- Moreover, policymakers should establish supportive regulations and incentive programs that motivate industries to adopt green practices without sacrificing competitiveness. Industry associations can significantly contribute by facilitating knowledge sharing, setting standards, and promoting best practices.
- For future investigations, it is suggested that researchers analyze the long-term financial effects of GSCM adoption, perform comparative studies across various sectors, and investigate the influence of digital technologies such as artificial intelligence and blockchain in improving supply chain sustainability.
- By executing these strategies, the manufacturing sector can progress towards a more sustainable and competitive future while aiding in the achievement of global environmental objectives.

8. Conclusion

The experience of ACMC shows that adopting GSCM through a practical, staged method can result in significant waste reduction and cost savings in a relatively brief time frame. Key success factors comprised the commitment of top management, collaboration with suppliers, monitoring based on data, and alignment of incentives. The suggested roadmap and best practices offer a reproducible model for other manufacturers seeking to minimize waste, harness value from by-products, and transition to circular operations. Some of the implications for management and suggestions for policy makers are to Consider GSCM as a strategic chance to lower expenses and enhance customer connections. Investing early in measurement and working with suppliers yields benefits. - Design incentives to distribute savings and recognize ongoing performance and to offer grants or low-cost financing to SMEs for investments in reusable packaging systems and recycling infrastructure. - Facilitate supplier capacity-building initiatives and standards (e.g., environmental scorecards for suppliers) that minimize adoption hurdles.

References

1. Eltayeb TK, Zailani S, Ramayah T. Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes. Resources, Conservation and Recycling. 2011;55(5):495-506. doi:10.1016/j.resconrec.2010.09.003.
2. Garza-Reyes JA. Lean and green: a systematic review of the state of the art literature. Journal of Cleaner Production. 2015;102:18-29. doi:10.1016/j.jclepro.2015.04.064.
3. Geng R, Mansouri SA, Aktas E. The relationship between green supply chain management and performance: A meta-analysis of empirical evidence in Asian emerging economies. International Journal of Production Economics. 2017;183:245-258. doi:10.1016/j.ijpe.2016.10.008.
4. Kumar S, Gupta A, Sharma R. Investigation of green supply chain management practices and low-carbon performance in Indian manufacturing firms. Scientific Reports. 2025;15(1):1-13. doi:10.1038/s41598-025-99999-y.
5. Laari S, Töyli J, Solakivi T, Ojala L. Firm performance and customer-driven green supply chain management. Journal of Cleaner Production. 2016;112:1960-1970. doi:10.1016/j.jclepro.2015.06.150.
6. Nazir S, Zhaolei L, Mehmood S, Nazir Z. Impact of green supply chain management practices on environmental performance of manufacturing firms. Sustainability. 2024;16(2):856. doi:10.3390/su16020856.
7. Sarkis J, Zhu Q, Lai KH. An organizational theoretic review of green supply chain management literature. International Journal of Production Economics. 2011;130(1):1-15. doi:10.1016/j.ijpe.2010.11.010.
8. Srivastava SK. Green supply-chain management: A state-of-the-art literature review. International Journal of Management Reviews. 2007;9(1):53-80. doi:10.1111/j.1468-2370.2007.00202.x.
9. Zhu Q, Sarkis J. Green supply chain management: Pressures, practices and performance within the Chinese automobile industry. Journal of Cleaner Production. 2007;15(11-12):1041-1052. doi:10.1016/j.jclepro.2006.05.021.
10. Zhu Q, Sarkis J, Lai KH. Green supply chain management implications for “closing the loop.” Transportation Research Part E: Logistics and Transportation Review. 2008;44(1):1-18. doi:10.1016/j.tre.2006.06.003.
11. Zhu Q, Sarkis J, Lai KH. Confirmation of a measurement model for green supply chain management practices implementation. International Journal of Production Economics. 2008;111(2):261-273. doi:10.1016/j.ijpe.2006.06.003.