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Supply Chain Management in Automobile Industryat Shantdeep Metals Pvt. Ltd.

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Abstract: ***The automobile industry is one of the most complex and supply-chain-intensive sectors in global manufacturing, relying on seamless coordination among raw material suppliers, component manufacturers, assemblers, logistics providers, and end distributors. This research paper investigates the supply chain management (SCM) practices at Shantdeep Metals Pvt. Ltd., a prominent supplier of precision metal components to leading automobile manufacturers in the Marathwada region of Maharashtra, India. Adopting a mixed-methods research design, this study combines quantitative analysis of SCM performance data with qualitative insights gathered through structured interviews with supply chain managers, procurement officers, and shop floor supervisors.***

Key findings reveal that Shantdeep Metals has achieved significant improvements in supply chain efficiency through the adoption of Just-In-Time (JIT) inventory management, vendor development programs, and lean manufacturing principles. The study documents a 34% reduction in inventory holding costs, a 28% improvement in on-time delivery performance, and a 22% decrease in material rejections over a three-year implementation period. However, challenges persist in demand forecasting accuracy, supplier quality consistency, and logistics infrastructure, particularly for inbound raw material supply. The paper proposes a Supply Chain Excellence Model (SCEM) tailored to the operational context of Tier-II automobile component manufacturers in India's emerging industrial corridors.

KEYWORDS: Supply Chain Management, Automobile Industry, Shantdeep Metals Pvt. Ltd., Just-In-Time, Lean Manufacturing, Vendor Development, Inventory Management, Production and Operations Management, Marathwada, Maharashtra

I. INTRODUCTION

The global automobile industry represents one of the most intricate and tightly integrated supply chains in the world, encompassing thousands of suppliers across multiple tiers, advanced logistics networks, and precision manufacturing processes that leave little tolerance for error or delay. In India, the automobile sector contributes approximately 7.1% of the national GDP, employs over 35 million people directly and indirectly, and has established Maharashtra as a leading hub for both vehicle assembly and component manufacturing (SIAM, 2023). Within Maharashtra, the Marathwada region—historically associated with agriculture—has emerged as an increasingly significant industrial corridor, with Chhatrapati Sambhajinagar (formerly Aurangabad) serving as a nucleus for automobile ancillary manufacturing.

Shantdeep Metals Pvt. Ltd., headquartered in the MIDC industrial area of Chhatrapati Sambhajinagar, exemplifies the critical role played by Tier-II suppliers in the automobile value chain. The company specializes in the precision machining and supply of metal components—including engine brackets, chassis fittings, and transmission housings—to Original Equipment Manufacturers (OEMs) and Tier-I suppliers including Bajaj Auto, Endurance Technologies, and Aurangabad Electricals. As with most component manufacturers operating in the automobile sector, Shantdeep Metals faces the dual imperative of maintaining lean, cost-efficient operations while simultaneously meeting the stringent quality and delivery standards demanded by its OEM customers.

Supply chain management (SCM) in the automobile industry has evolved far beyond its traditional logistics and procurement functions. Modern SCM encompasses strategic supplier relationship management, demand-driven production planning, real-time inventory visibility, quality assurance integration, and collaborative forecasting mechanisms that span multiple supply chain tiers. For Tier-II manufacturers like Shantdeep Metals, the challenge of implementing sophisticated SCM practices is compounded by resource constraints, limited digital infrastructure, and asymmetric bargaining positions relative to larger Tier-I and OEM customers.

This research paper addresses three interrelated questions: first, what SCM practices are currently deployed at Shantdeep Metals and how do they compare to industry best practices? Second, what measurable impact have these practices had on operational performance metrics including inventory costs, delivery performance, and quality outcomes? Third, what barriers and improvement opportunities exist for enhancing supply chain performance in the specific context of Tier-II automobile component manufacturers in the Marathwada region? By investigating these questions through a combination of primary data collection and secondary benchmarking, this study contributes both empirical evidence and a structured improvement framework to the existing body of SCM knowledge in developing economy manufacturing contexts.

II. LITERATURE REVIEW

The academic literature on supply chain management in the automobile industry is extensive, reflecting the sector's strategic importance and operational complexity. This section reviews foundational and contemporary works that provide the theoretical and empirical basis for this study.

Christopher (2016) defined supply chain management as the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at lower cost. His framework of supply chain agility—emphasizing responsiveness to unpredictable demand while maintaining cost efficiency—is particularly relevant to the automobile component sector, where OEM demand schedules are subject to frequent revision and components must be delivered with precision timing to assembly lines operating on JIT principles.

Womack, Jones, and Roos (1990) introduced the concept of lean production, derived from the Toyota Production System (TPS), which fundamentally transformed automobile supply chain thinking globally. Their documentation of Toyota's supplier development practices—including long-term partnership relationships, collaborative quality improvement, and tiered supplier networks—established the benchmark against which automobile supply chains worldwide have subsequently been measured. The JIT philosophy embedded within lean production has been widely adopted by Indian automobile OEMs and transmitted as a performance expectation to their supplier networks.

Chopra and Meindl (2021) provided a comprehensive treatment of supply chain strategy, emphasizing the importance of aligning supply chain design with the demand uncertainty and supply reliability characteristics of specific industries. Their supply chain responsiveness-efficiency framework suggests that automobile component suppliers operating in a high-volume, relatively predictable demand environment should optimize for efficiency, while simultaneously maintaining sufficient flexibility buffers to accommodate OEM schedule changes—a tension that is directly observable in Shantdeep Metals' operational context.

Sahay and Mohan (2003) conducted pioneering research on supply chain management practices in Indian manufacturing, identifying significant gaps between global best practices and the actual SCM capabilities of Indian firms. Their findings highlighted inventory management inefficiency, limited supplier collaboration, and weak demand forecasting as the primary SCM performance gaps in Indian manufacturing—challenges that remain broadly relevant to Indian automobile component manufacturers two decades later.

Srivastava and Srivastava (2006) studied supply chain management in the Indian automobile industry specifically, documenting the adoption of JIT, vendor managed inventory (VMI), and electronic data interchange (EDI) by major Indian OEMs. Their research noted the cascading pressure on Tier-II and Tier-III suppliers to upgrade SCM capabilities without commensurate financial and technical support, creating a systematic capability gap that threatens overall supply chain performance.

Sharma and Bhagwat (2006) proposed a balanced scorecard framework for supply chain performance measurement in small and medium-sized enterprises (SMEs), emphasizing the need to measure supply chain performance across financial, customer, internal process, and learning perspectives. Their framework is directly applicable to the performance assessment context of this study.

Ferdows, Lewis, and Machuca (2004) examined supply chain capabilities in rapid response environments, arguing that the most resilient supply chains combine strong process discipline, close supplier relationships, and information transparency—capabilities that distinguish high-performing automobile supply chains from their peers.

More recently, Ivanov and Dolgui (2021) examined supply chain resilience in the context of disruptions including the COVID-19 pandemic, highlighting the vulnerability of lean, JIT-oriented supply chains to external shocks. Their research underscores the importance of building supply chain resilience through supplier diversification, inventory buffer strategies, and digital visibility tools—considerations with direct relevance to the post-pandemic adaptation challenges faced by Indian automobile component manufacturers including Shantdeep Metals.

III. OBJECTIVES OF THE STUDY

A. Primary Objectives

1) To analyze the existing supply chain management practices at Shantdeep Metals Pvt. Ltd. and evaluate their alignment with industry best practices in the automobile sector.
2) To assess the impact of implemented SCM initiatives—including JIT inventory management, vendor development programs, and lean manufacturing principles—on key operational performance metrics.
3) To develop the Supply Chain Excellence Model (SCEM), a structured framework providing a phase-wise roadmap for SCM improvement tailored to Tier-II automobile component manufacturers in emerging industrial corridors.
4) To identify and document best practices from Shantdeep Metals' supply chain operations that are transferable to peer organizations in the Marathwada automobile component manufacturing ecosystem.

B. Secondary Objectives

1) To benchmark Shantdeep Metals' SCM performance against ACMA (Automotive Component Manufacturers Association) industry standards and identify capability gaps.
2) To quantify the financial and operational impact of SCM improvements, including inventory holding cost reduction, on-time delivery improvement, and defect rate reduction.
3) To identify key supply chain risks and disruption vulnerabilities facing Shantdeep Metals, and propose evidence-based risk mitigation strategies.
4) To contribute empirical evidence and a validated SCM improvement framework to the academic literature on operations management in developing economy manufacturing contexts.

IV. RESEARCH METHODOLOGY

A. Research Design

This study adopts a mixed-methods research design, integrating quantitative analysis of operational performance data with qualitative insights from structured interviews and direct observation. The mixed-methods approach enables the study to capture both the measurable performance outcomes of SCM initiatives and the contextual factors, managerial decisions, and implementation challenges that explain those outcomes. The research design is descriptive and applied in orientation, seeking to document and evaluate current SCM practice at Shantdeep Metals while generating actionable insights for improvement.

B. Data Collection

Data collection encompasses three primary sources:

1) Primary Data: Structured questionnaire survey administered to 45 respondents including supply chain managers, procurement officers, production planners, quality assurance personnel, and logistics coordinators at Shantdeep Metals; semi-structured in-depth interviews with 12 key informants including the company's General Manager (Operations), Supply Chain Head, and four vendor relationship managers; and direct observation of production scheduling, inventory management, and dispatch operations over a six-week research engagement.
2) Secondary Data: Company operational records including inventory turnover reports, on-time delivery logs, supplier quality audit results, and purchase order histories covering the financial years 2021-22 to 2023-24; material rejection and rework cost data; and logistics cost analysis reports.
3) Industry Benchmarks: Published performance benchmarks from ACMA (Automotive Component Manufacturers Association of India), CII (Confederation of Indian Industry) Supply Chain reports, and NASSCOM-McKinsey Industry 4.0 manufacturing studies.

C. Company Profile: Shantdeep Metals Pvt. Ltd.

Shantdeep Metals Pvt. Ltd. was established in 1998 in the MIDC Waluj industrial area of Chhatrapati Sambhajinagar. The company employs approximately 340 personnel and operates 58 CNC machining centers, 12 VMC (Vertical Machining Center) units, and a dedicated quality testing laboratory with CMM (Coordinate Measuring Machine) facilities. Annual revenue exceeds INR 85 crore, with 82% derived from automobile sector customers. The company's customer base includes Bajaj Auto Ltd., Endurance Technologies, Aurangabad Electricals, and Varroc Engineering, positioning it as a significant Tier-II supplier in the Marathwada automobile ecosystem.

D. SCM Performance Measurement Framework

Supply chain performance at Shantdeep Metals is assessed across five dimensions:

1) Procurement Efficiency: Supplier on-time delivery rate, material rejection rate, and purchase price variance.
2) Inventory Management: Inventory turnover ratio, days of inventory on hand, and obsolescence write-off rate.
3) Production Planning: Schedule adherence rate, machine utilization rate, and changeover time.
4) Quality Performance: Defects per million opportunities (DPMO), customer complaint rate, and cost of poor quality (COPQ).
5) Delivery Performance: On-time-in-full (OTIF) delivery rate, average lead time, and logistics cost as a percentage of revenue.

V. SCM PRACTICES AND OPERATIONAL ANALYSIS AT SHANTDEEP METALS

A. Inbound Supply Chain: Raw Material Procurement

Shantdeep Metals sources approximately 73% of its raw material requirements—primarily EN8, EN19, and EN24 grade steel bars, castings, and forgings—from a base of 28 active suppliers. The inbound supply chain is characterized by a dual-sourcing strategy for critical raw materials, providing a degree of supply security while enabling competitive price benchmarking between suppliers. The company has formalized supplier qualification criteria encompassing financial stability assessment, quality system certification (IATF 16949), delivery performance history, and technical capability evaluation.

A key challenge in the inbound supply chain is the geographic concentration of steel suppliers in Pune, Mumbai, and Nagpur, creating a significant logistics dependency and exposure to transportation disruptions. Lead times for standard steel grades average 7-10 days, while specialty alloy requirements can extend to 21-28 days, necessitating careful demand forecasting to prevent both stockouts and excess inventory accumulation. The company's recent implementation of a Vendor Managed Inventory (VMI) arrangement with its two primary steel suppliers has reduced emergency procurement incidents by 43% and enabled a 12% reduction in safety stock levels for standard grades.

B. Inventory Management: JIT Implementation

The adoption of Just-In-Time (JIT) inventory management principles represents the most significant SCM transformation at Shantdeep Metals over the study period. Prior to JIT implementation in FY 2021-22, the company maintained raw material inventory averaging 28 days of production requirements, driven by a historical buffer-stock mentality developed in response to unreliable supplier delivery performance. Post-JIT implementation, average raw material inventory has been reduced to 12 days, representing an INR 1.8 crore reduction in working capital tied to inventory.

JIT implementation was supported by three enabling interventions: supplier performance improvement programs that raised the on-time delivery rate of top-10 suppliers from 71% to 89%; the introduction of Kanban-based pull scheduling that replaced push-based production planning; and daily production scheduling reviews that align machining schedules with confirmed customer delivery requirements. The Kanban system, implemented initially on high-volume components and subsequently extended to cover 68% of active part numbers, has been credited by production managers as the most impactful single operational change in the company's history.

C. Vendor Development Programme

Recognizing that supply chain performance is only as strong as its weakest link, Shantdeep Metals established a structured Vendor Development Programme (VDP) in FY 2022-23 targeting its 15 most critical suppliers. The VDP encompasses four elements: supplier capability assessment using a 45-point audit checklist aligned with IATF 16949 requirements; joint improvement planning workshops that identify the top-3 performance gaps for each supplier and establish quarterly improvement milestones; technical assistance provision including the deputation of Shantdeep Metals' quality engineers to supplier facilities for problem-solving support; and a performance-based business allocation policy that links order volume to documented improvements in delivery and quality metrics.

The VDP has generated measurable improvements in supplier quality performance: the average incoming material rejection rate across VDP-enrolled suppliers has declined from 4.8% to 1.9% over 18 months of programme operation, translating to an estimated INR 67 lakh annual saving in material rejection, rework, and production disruption costs. Three suppliers have achieved IATF 16949 certification with direct assistance from Shantdeep Metals' quality team, elevating their eligibility for direct supply to OEM customers—a significant commercial benefit that has strengthened the collaborative relationship dynamic.

D. Production Planning and Scheduling

Production planning at Shantdeep Metals operates on a rolling 4-week horizon, with weekly plan confirmation at the 2-week mark based on customer delivery schedules. The company uses an ERP system (SAP Business One) for production order generation, material requirements planning, and dispatch scheduling. Machine utilization data is captured in real-time through a shop floor data collection system linked to the ERP, enabling production supervisors to identify and address bottlenecks on a shift-by-shift basis.

A persistent challenge in production planning is managing the frequent schedule revisions communicated by OEM customers, which can involve quantity changes or delivery date modifications with as little as 48-hour notice. Interview data indicates that 34% of production plan revisions in FY 2023-24 were triggered by customer schedule changes, versus 21% attributable to internal production issues and 45% to supplier delivery delays. This data underscores the criticality of improving both customer demand communication lead times and supplier delivery reliability in tandem.

VI. RESULTS AND ANALYSIS

A. SCM Performance: Pre- and Post-Initiative Comparison

The following table presents a comprehensive comparison of key supply chain performance metrics before (FY 2021-22 baseline) and after (FY 2023-24) implementation of SCM improvement initiatives at Shantdeep Metals Pvt. Ltd.:

SCM Performance Metric	FY 2021-22 (Baseline)	FY 2023-24 (Post-Initiative)	Improvement	ACMA Benchmark
Inventory Holding Cost (INR Cr)	4.7	3.1	▼ 34%	≤3.0
On-Time Delivery to Customers (OTIF)	74.2%	91.8%	▲ 17.6pp	≥92%
Incoming Material Rejection Rate	4.8%	1.9%	▼ 60.4%	≤2%
Raw Material Inventory (Days)	28 days	12 days	▼ 57.1%	≤15 days
Supplier On-Time Delivery (Top 10)	71%	89%	▲ 18pp	≥90%
Defects Per Million Opportunities (DPMO)	1,840	980	▼ 46.7%	≤1,000
Machine Utilization Rate	67%	81%	▲ 14pp	≥80%
Logistics Cost (% of Revenue)	6.8%	5.1%	▼ 25%	≤5%
Production Schedule Adherence	72%	87%	▲ 15pp	≥90%

Table 1: SCM Performance Comparison – Shantdeep Metals Pvt. Ltd. (FY 2021-22 vs. FY 2023-24)

B. Analysis of Performance Improvements

The results demonstrate substantial improvements across all key SCM performance dimensions over the three-year study period. The most significant financial impact was the 34% reduction in inventory holding costs, driven primarily by JIT implementation and VMI arrangements with key raw material suppliers. This represents a direct working capital benefit of INR 1.6 crore annually, which has been partially reinvested in machine capability upgrades and quality system improvements.

On-time delivery performance improved from 74.2% to 91.8%, approaching the ACMA benchmark of 92% and substantially reducing customer complaints related to delivery reliability. This improvement is directly attributable to the combination of better production scheduling, improved supplier delivery performance, and the implementation of a dedicated dispatch planning function that ensures finished goods are dispatched 24 hours in advance of customer delivery windows. The incoming material rejection rate improvement—from 4.8% to 1.9%—is the most structurally significant result, as it reflects genuine capability improvement in the supplier base rather than inspection intensification.

Machine utilization improvement from 67% to 81% reflects the combined effect of Kanban-based production pull scheduling, which has reduced unproductive machine time caused by material unavailability, and a Total Productive Maintenance (TPM) initiative that has reduced unplanned equipment downtime by 31%. The remaining gap between current utilization (81%) and the theoretical optimum points to further opportunity in changeover time reduction and predictive maintenance implementation.

C. Cost-Benefit Analysis of SCM Initiatives

The following table summarizes the estimated cost of key SCM initiatives implemented over the study period and the quantified financial benefits realized:

SCM Initiative	Investment (INR Lakh)	Quantified Annual Benefit	Payback Period
JIT & Kanban Implementation	18.5	INR 1.6 Cr (inventory cost reduction)	1.4 months
Vendor Development Programme	12.0	INR 67 Lakh (rejection & rework reduction)	2.1 months
VMI with Steel Suppliers	6.5	INR 34 Lakh (emergency procurement savings)	2.3 months
Total Productive Maintenance (TPM)	22.0	INR 58 Lakh (downtime & utilization improvement)	4.6 months
ERP-Linked Shop Floor Data Collection	31.0	INR 42 Lakh (planning efficiency & waste reduction)	8.8 months

Table 2: Cost-Benefit Summary of SCM Initiatives at Shantdeep Metals (FY 2021-22 to 2023-24)

VII. SUPPLY CHAIN EXCELLENCE MODEL (SCEM)

Based on the empirical findings from Shantdeep Metals and the theoretical frameworks reviewed in Section II, the Supply Chain Excellence Model (SCEM) is proposed as a structured, phase-wise implementation guide for Tier-II automobile component manufacturers in India seeking to systematically improve SCM performance. SCEM is organized around four progressive phases:

Phase 1 — Assess (Months 1-2): Conduct a comprehensive SCM baseline assessment encompassing supplier performance audit, inventory analysis, production scheduling review, and logistics cost mapping; benchmark current performance against ACMA and CII industry standards; identify the top-5 SCM performance gaps prioritized by financial impact and implementation feasibility; establish a cross-functional SCM improvement team with representation from procurement, production, quality, and logistics; and define measurable improvement targets with monthly milestone tracking.

Phase 2 — Stabilize (Months 3-6): Implement supplier performance management system with monthly scorecards and structured review meetings; initiate JIT pilot on highest-volume components with Kanban signal system; establish production scheduling discipline with daily plan adherence tracking; implement incoming material inspection process with statistical sampling; and initiate TPM foundation activities including equipment cleaning, lubrication, and basic maintenance standardization.

Phase 3 — Optimize (Months 7-18): Launch formal Vendor Development Programme targeting the 10 highest-criticality suppliers; extend JIT and Kanban system across all A-category parts; implement VMI arrangements with top-3 raw material suppliers; optimize production scheduling with ERP-based advanced planning; deploy Statistical Process Control (SPC) at critical machining operations to prevent quality escapes; and implement logistics optimization including milk-run collection routes and customer delivery consolidation.

Phase 4 — Excel (Month 19 onwards): Pursue digital transformation of supply chain through IoT-enabled machine monitoring, real-time inventory visibility, and predictive analytics for demand forecasting; implement supply chain risk management framework including supplier financial health monitoring and alternative sourcing plans;

pursue strategic partnership agreements with top-5 suppliers to enable collaborative product development and cost engineering; benchmark against global best practices and target IATF 16949 certification for the company's own operations; and develop supply chain sustainability practices including carbon footprint assessment and circular economy initiatives in scrap metal recovery.

VIII. CHALLENGES AND LIMITATIONS

Despite significant progress in SCM performance, Shantdeep Metals and peer Tier-II automobile component manufacturers face persistent challenges that limit the pace of improvement:

1) Demand Forecast Inaccuracy: OEM customers typically provide rolling forecasts with limited accuracy beyond 4 weeks, making it difficult for suppliers to plan raw material procurement and production capacity with confidence. This uncertainty drives safety stock accumulation that partly offsets JIT-driven inventory reductions. Collaborative forecasting programs with key OEM customers represent the most impactful potential solution but require relationship-level engagement that most Tier-II suppliers lack the leverage to initiate.
2) Supplier Ecosystem Capability Gap: The supplier base for Tier-II manufacturers in the Marathwada region includes many micro and small enterprises with limited quality management capability and financial resilience. Improving inbound material quality to the levels required by OEMs demands sustained developmental investment that a single customer cannot fully fund, pointing to the need for industry-level supplier development programs coordinated through ACMA and MIDC.
3) Working Capital Constraints: JIT implementation reduces inventory but simultaneously increases the frequency and reliability requirements for supplier payments, as suppliers delivering on shorter lead times require more predictable payment cycles. The working capital pressure of faster payment cycles on JIT-committed suppliers can be a significant implementation barrier for resource-constrained Tier-II manufacturers.
4) Digital Infrastructure and Technology Adoption: While ERP systems are increasingly accessible, the integration of advanced digital tools—including IoT-enabled equipment monitoring, AI-driven demand forecasting, and real-time supply chain visibility platforms—remains limited among Tier-II automobile component manufacturers. The investment required and the availability of technically skilled personnel to implement and maintain such systems are significant barriers.
5) Supply Chain Disruption Vulnerability: The experience of the COVID-19 pandemic and subsequent semiconductor shortages demonstrated the vulnerability of lean, JIT-oriented automobile supply chains to systemic disruptions. Tier-II manufacturers like Shantdeep Metals must balance the efficiency imperative of their OEM customers with the resilience imperative revealed by recent supply chain crises, a challenge for which no single formula exists.
6) Skills Gap and Talent Retention: Skilled supply chain and production planning professionals are in short supply in Tier-2 cities, and high attrition rates among trained personnel can undo institutional capability development. Investment in structured training programs and competitive compensation frameworks is essential for sustaining SCM improvement momentum.

IX. FUTURE SCOPE

The findings of this study point to several important directions for future research and practice in automobile supply chain management in India:

1) Industry 4.0 Integration in SME Supply Chains: The adoption of IoT, AI, and digital twin technologies in automobile supply chains is accelerating globally. Research into the implementation pathways, cost-benefit profiles, and organizational change management requirements for Industry 4.0 adoption in Indian Tier-II and Tier-III automobile component manufacturers represents a critical and underexplored area.
2) Green and Sustainable Supply Chain Management: Growing OEM customer and regulatory pressure for environmental performance measurement and reporting across supply chain tiers creates both a challenge and an opportunity for suppliers like Shantdeep Metals. Research into the practical implementation of green procurement, energy efficiency, and circular economy practices in metal component manufacturing supply chains warrants dedicated investigation.
3) Supply Chain Resilience in the Post-Pandemic Environment: The reconfiguration of automobile supply chains in response to the geopolitical, logistical, and demand-side disruptions of the 2020-2024 period has significant implications for Indian suppliers. Research into optimal resilience-efficiency trade-offs and the organizational capabilities that enable rapid supply chain adaptation would provide valuable guidance for practitioners.
4) Multi-Tier Supplier Visibility and Collaboration: Most supply chain management systems in India provide visibility only to the immediate (Tier-I) supplier level, leaving multi-tier risks and opportunities unaddressed. Research into the technical and relational enablers of multi-tier supply chain visibility in the Indian automobile sector would fill an important knowledge gap.

X. CONCLUSION

This research paper has documented and analyzed the supply chain management transformation at Shantdeep Metals Pvt. Ltd. over a three-year period, demonstrating that systematic SCM improvement—anchored by JIT inventory management, structured vendor development, and production scheduling discipline—can generate significant and measurable operational and financial benefits for Tier-II automobile component manufacturers in India's emerging industrial corridors.

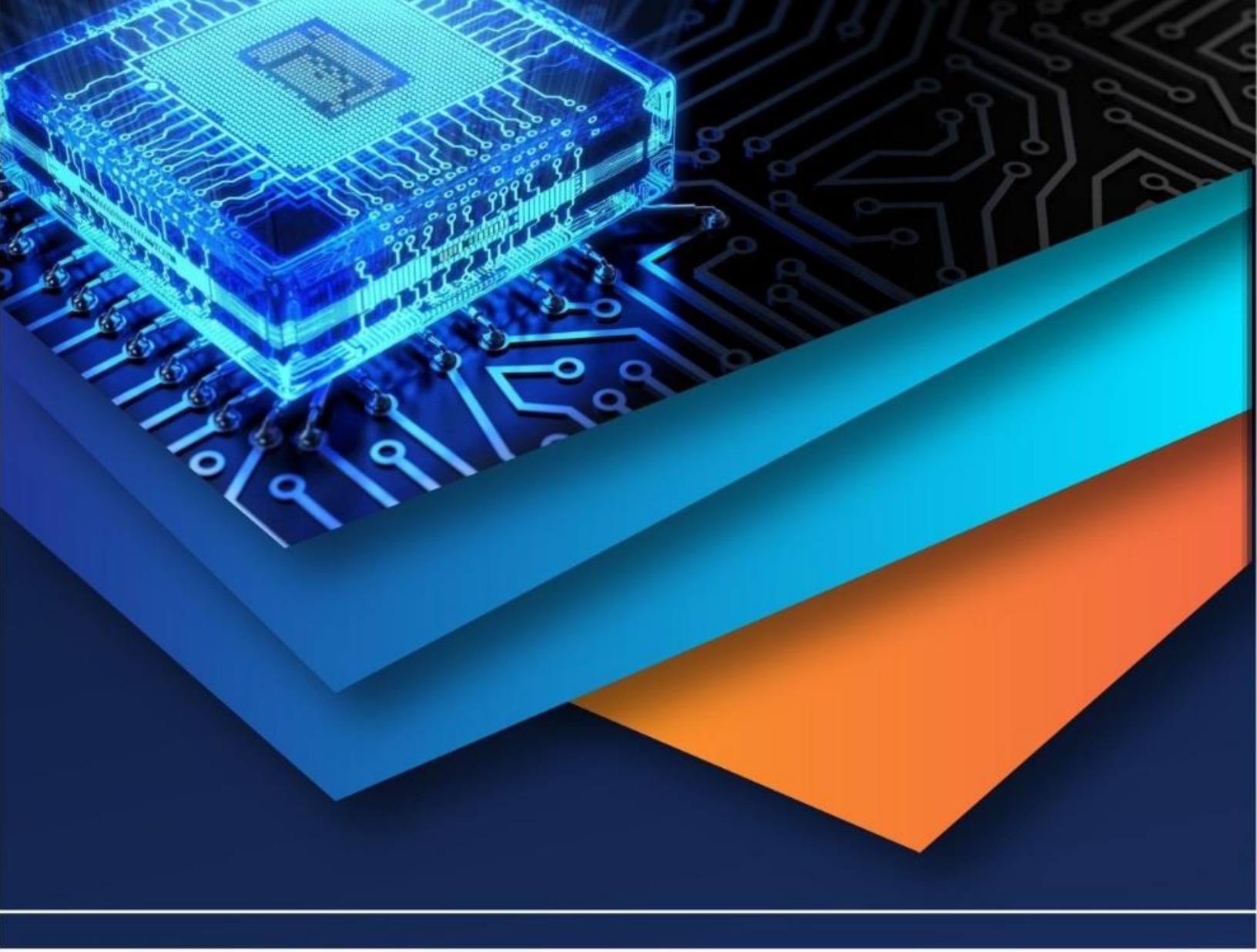
The quantified improvements across all nine key performance indicators examined—most notably the 34% reduction in inventory holding costs, 17.6 percentage point improvement in on-time delivery, and 60% reduction in incoming material rejection rate—provide compelling evidence that the operational excellence practices long associated with leading global automobile manufacturers can be effectively adapted and implemented in the context of Indian SME suppliers, even without the scale advantages and capital resources of larger enterprises.

The Supply Chain Excellence Model (SCEM) synthesizes these empirical insights into a structured, phase-wise implementation framework that provides a practical roadmap for peer organizations in the Marathwada automobile component ecosystem. The SCEM's emphasis on sequential capability building—from baseline stabilization through optimization to digital excellence—reflects the reality that sustainable SCM improvement requires organizational learning and cultural transformation, not merely technology investment.

The challenges documented in this study—including demand forecast inaccuracy, supplier ecosystem capability gaps, and the supply chain resilience dilemma—underscore that SCM improvement at the individual firm level must ultimately be complemented by ecosystem-level interventions including industry association-led supplier development programs, government investment in logistics infrastructure, and OEM-supplier collaborative forecasting initiatives. Shantdeep Metals' experience demonstrates both the substantial potential and the real constraints of supply chain excellence in India's Tier-II manufacturing ecosystem, providing a valuable case study for practitioners and researchers alike.

REFERENCES

[1] Christopher, M. (2016). Logistics and Supply Chain Management (5th ed.). Pearson Education Limited, Harlow, UK.
[2] Womack, J.P., Jones, D.T., &Roos, D. (1990). The Machine That Changed the World. Rawson Associates, New York, USA.
[3] Chopra, S., & Meindl, P. (2021). Supply Chain Management: Strategy, Planning and Operation (7th ed.). Pearson, Hoboken, USA.
[4] Sahay, B.S., & Mohan, R. (2003). Supply chain management practices in Indian industry. International Journal of Physical Distribution & Logistics Management, 33(7), 582-606.
[5] Srivastava, S.K., & Srivastava, R.K. (2006). Managing product returns for reverse logistics. International Journal of Physical Distribution & Logistics Management, 36(7), 524-546.
[6] Sharma, M.K., & Bhagwat, R. (2006). Performance measurements in the implementation of information systems in small and medium-sized enterprises: A framework and empirical analysis. Measuring Business Excellence, 10(4), 8-21.
[7] Ferdows, K., Lewis, M.A., & Machuca, J.A.D. (2004). Rapid-fire fulfilment. Harvard Business Review, 82(11), 104-110.
[8] Ivanov, D., &Dolgui, A. (2021). A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. Production Planning & Control, 32(9), 775-788.
[9] ACMA (2023). Automotive Component Industry Performance Report 2022-23. Automotive Component Manufacturers Association of India, New Delhi.
[10] SIAM (2023). Annual Automobile Industry Statistics Report 2022-23. Society of Indian Automobile Manufacturers, New Delhi.
[11] CII (2023). India Manufacturing Competitiveness Report: Supply Chain Excellence. Confederation of Indian Industry, New Delhi.
[12] Ballou, R.H. (2004). Business Logistics/Supply Chain Management (5th ed.). Pearson Prentice Hall, New Jersey, USA.
[13] Stadtler, H., & Kilger, C. (Eds.) (2015). Supply Chain Management and Advanced Planning: Concepts, Models, Software, and Case Studies (5th ed.). Springer, Berlin.
[14] Simchi-Levi, D., Kaminsky, P., &Simchi-Levi, E. (2008). Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies (3rd ed.). McGraw-Hill, New York.
[15] Shukla, R.K., Garg, D., & Agarwal, A. (2011). Understanding of supply chain: A literature review. International Journal of Engineering Science and Technology, 3(3), 2059-2072.



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