

Evaluating the Relationship Between Lean Management Maturity and Business Performance in Manufacturing SMES

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Abstract: *This paper examines the relationship between Lean management maturity and business performance in manufacturing small and medium-sized enterprises (SMEs). Through a systematic review of empirical studies, including research conducted in India, Jordan, Malaysia, Iraq, and other developing economies, the analysis identifies that Lean maturity develops incrementally through staged, context-adaptive processes rather than through standardized, one-size-fits-all implementations. The findings indicate that higher Lean maturity levels correlate positively with operational performance improvements, including significant reductions in changeover time, downtime, and rejection rates. Studies demonstrate that mature Lean implementation can yield changeover time reductions of up to 95.2%, downtime reductions of 88.9%, and rejection rate improvements of 72.4%. However, many manufacturing SMEs remain at low-to-moderate maturity levels, constrained by resource limitations, skill shortages, and organizational resistance. The paper proposes that Lean maturity development follows a capability pathway progressing from foundational practices like 5S and Kaizen to more advanced tools such as Total Productive Maintenance (TPM) and Just-in-Time (JIT). Social Lean practices—including leadership commitment, workforce engagement, and human resource development—emerge as critical enablers that mediate the relationship between Lean implementation and performance outcomes. The study concludes that successful Lean transformation in manufacturing SMEs requires integrated approaches combining technical tools with social infrastructure, supported by digital platforms that sustain and scale improvements.*

Keywords: Lean management, Lean maturity, manufacturing SMEs, operational performance, business performance, Lean implementation, continuous improvement

I. INTRODUCTION

Small and medium-sized enterprises (SMEs) constitute the backbone of manufacturing economies worldwide, particularly in developing nations where they contribute substantially to employment, industrial output, and economic growth. However, these enterprises face persistent challenges: limited resources, skill shortages, outdated management practices, and institutional barriers that constrain their competitiveness in increasingly globalized markets.

Lean manufacturing, originating from the Toyota Production System, offers a structured approach to waste elimination, process optimization, and continuous improvement that has demonstrated transformative potential for manufacturing organizations. Yet, the adoption of Lean in SMEs remains less vigorous than in large organizations. This disparity raises important questions: Does Lean maturity—the progressive development of Lean capabilities over time—translate into measurable business performance improvements for manufacturing SMEs? What factors enable or constrain the development of Lean maturity in resource-constrained contexts?

This paper evaluates the relationship between Lean management maturity and business performance in manufacturing SMEs, drawing on empirical evidence from multiple national contexts. It synthesizes findings from systematic literature reviews, survey-based studies, and case analyses to address three key questions: (1) How does Lean maturity

develop in manufacturing SME contexts? (2) What is the nature and magnitude of the relationship between Lean maturity and business performance? (3) What factors enable effective Lean maturity progression?

II. LITERATURE REVIEW

2.1 Lean Management: Conceptual Foundations

Lean management encompasses a philosophy and set of practices aimed at eliminating waste, improving flow, and creating customer value through continuous improvement. Core Lean tools include 5S workplace organization, Kaizen (continuous improvement), Just-in-Time (JIT) production, Total Productive Maintenance (TPM), Value Stream Mapping (VSM), and Single-Minute Exchange of Dies (SMED).

In the SME context, Lean implementation is often conceptualized through three interrelated constructs: process improvement (PI), flow management (FM), and waste minimization (WM). A study of 121 Indian manufacturing SMEs found that all three constructs are significantly related to operational performance, with PI and WM practices showing higher levels of significance compared to FM practices.

2.2 Lean Maturity: Conceptualization and Measurement

Lean maturity refers to the progressive development of Lean capabilities, practices, and culture within an organization over time. Rather than a binary state (Lean vs. non-Lean), maturity exists on a continuum from initial experimentation to embedded organizational culture.

Research has conceptualized Lean maturity through several frameworks. One study of Malaysian machinery and equipment SMEs found that these companies generally operate at a low-to-moderate maturity level in terms of Lean understanding, with implementation and success levels remaining moderate. The researchers proposed that proper synchronization of Lean understanding, implementation, and success is vital for building a strong Lean maturity foundation.

A systematic review of 123 empirical studies (2015–2025) developed the "SME Lean Capability Pathway," a three-phase model of context-driven Lean maturity. This framework suggests that SMEs adopt Lean incrementally through phased, hybrid, and locally tailored approaches rather than standardized models. Regional contrasts are evident: formalized Lean Six Sigma in South Asia, incremental "Lean-Lite" adaptations in Africa, and sector-specific Lean-Green integrations in Latin America.

A study of 268 manufacturing SMEs in Jordan distinguished between social and technical aspects of Lean management. Social Lean practices—including leadership commitment, employee empowerment, and human resource development—were found to positively affect both process and management innovations, while technical Lean practices showed significant direct effects on operational performance.

2.3 Lean Implementation in Manufacturing SMEs: Barriers and Enablers

The literature identifies several persistent barriers to Lean implementation in manufacturing SMEs:

Resource Constraints: Limited financial resources restrict investment in training, technology, and external expertise. Skill shortages constrain the development of Lean capabilities internally.

Organizational Resistance: Employee and management resistance to change represents a significant obstacle. A study of Indian SMEs highlighted "attitude of workmen" as the main obstacle in successfully implementing Lean.

Leadership and Cultural Factors: Outdated management styles, lack of top management commitment, and substandard employee attitudes impede Lean adoption. Inadequate training opportunities and resistance to adopting innovations are identified as highly ranked hurdles.

Technological Infrastructure: Poor technological infrastructure constrains the adoption of digital Lean practices, particularly in developing country contexts.

Conversely, critical success factors enabling Lean implementation include:

- **Leadership Commitment:** High involvement from middle and senior management is vital for Lean implementation and performance improvement .
- **Workforce Engagement:** Employee training and involvement in continuous improvement activities are essential for sustaining Lean practices .
- **Integrated Implementation:** SMEs benefit from implementing Lean as an integrated system, progressing from foundational tools (5S, Kaizen) to advanced practices (TPM, JIT) only when discipline, engagement, and leadership readiness are evident .

2.4 Business Performance in Manufacturing SMEs

Business performance in manufacturing SMEs encompasses multiple dimensions:

Operational Performance: Includes productivity metrics, quality indicators (rejection rates, defect reduction), efficiency measures (changeover time, downtime), and inventory performance. A study of Indian automotive tooling SMEs documented a 95.2% reduction in die changeover time, 88.9% reduction in downtime, and 72.4% reduction in rejection rates following Lean-ERP integration .

Financial Performance: Includes profitability, sales growth, and market share. A study of Karnataka SMEs found that 50% of firms experienced profit growth of more than 10% following Lean implementation, with 12.50% achieving very consistent profits .

Customer and Employee Performance: Customer satisfaction, employee satisfaction, competitiveness growth, and ergonomic improvement represent important non-financial performance dimensions .

III. METHODOLOGY

This paper synthesizes findings from peer-reviewed empirical studies examining Lean management implementation in manufacturing SMEs. The analysis draws on:

1. **Systematic literature reviews:** Including a 123-study PRISMA-guided review of Lean implementation in developing country SMEs .
2. **Survey-based quantitative studies:** Including studies of 121 Indian SMEs , 268 Jordanian SMEs , and 207 SMEs in the Kurdistan Region of Iraq .
3. **Case studies and implementation research:** Including documented Lean-ERP integration in Indian automotive tooling SMEs and Lean implementation across twelve Indian manufacturing units .
4. **Maturity assessment studies:** Including assessment of Lean maturity in Malaysian machinery and equipment SMEs .

The analysis examines relationships between Lean maturity levels and business performance outcomes, identifying patterns across different national and sectoral contexts.

IV. FINDINGS

4.1 The Relationship Between Lean Maturity and Operational Performance

Empirical evidence demonstrates a positive relationship between Lean maturity and operational performance in manufacturing SMEs. The magnitude of performance improvement increases with higher maturity levels:

Performance Metric	Improvement Documented	Context
Die changeover time	95.2% reduction	Indian automotive tooling SME
Machine downtime	88.9% reduction	Indian automotive tooling SME

Performance Metric	Improvement Documented	Context
Rejection rate (PPM)	72.4% reduction	Indian automotive tooling SME
Setup time utilization	148.6% improvement	Indian automotive tooling SME
Inventory turnover	54.7% improvement	Indian automotive tooling SME
Traceability resolution	77.1% reduction	Indian automotive tooling SME

A study of 121 Indian manufacturing SMEs found that all three Lean constructs—process improvement, flow management, and waste minimization—are significantly related to operational performance. Process improvement and waste minimization practices showed higher levels of significance compared to flow management practices . The study of 268 Jordanian manufacturing SMEs confirmed that both social and technical Lean management positively affect operational performance. Social Lean practices were found to positively affect both process and management innovations, which in turn mediated the relationship between social Lean and operational performance .

4.2 Lean Maturity Levels in Manufacturing SMEs

The evidence indicates that most manufacturing SMEs operate at low-to-moderate Lean maturity levels:

- **Iraqi SMEs:** Lean practices in manufacturing SMEs in the Kurdistan Region of Iraq were found to be "not matured," with many impediments including language barriers, outdated management styles, poor technological infrastructure, and lack of government support .
- **Malaysian SMEs:** Machinery and equipment SMEs in Malaysia demonstrated low-to-moderate levels of Lean understanding, with implementation and success levels remaining moderate .
- **Indian SMEs:** Classification of Indian manufacturing SMEs revealed three groups: "lean-Beginners," "In-transition lean," and "lean" firms. 5S workplace organization was identified as the most practiced Lean tool .
- **Karnataka SMEs:** While 70.83% of studied SMEs reported improved market share following Lean implementation, only 12.50% achieved very consistent profits, suggesting that financial performance benefits may lag operational improvements .

4.3 The Lean Maturity Development Pathway

The "SME Lean Capability Pathway" model proposes that Lean maturity develops through three phases :

Phase 1: Foundation Building: Initial implementation focuses on foundational tools (5S, Kaizen, visual management) and building workforce engagement. This phase addresses immediate waste reduction opportunities and establishes organizational discipline.

Phase 2: Systematic Implementation: Organizations progress to systematic deployment of Lean tools across value streams. JIT, TPM, and VSM are introduced as capability develops. Performance measurement systems are established to track improvements.

Phase 3: Integrated Excellence: Lean becomes embedded in organizational culture, with continuous improvement as a routine practice. Advanced practices including Lean Six Sigma, digital integration, and supply chain Lean are implemented.

The research emphasizes that progression through these phases depends on organizational readiness, leadership commitment, and workforce engagement rather than mere tool deployment .

4.4 Factors Mediating the Lean Maturity-Performance Relationship

Several factors mediate the relationship between Lean maturity and business performance:

Social Lean Practices: Leadership commitment, workforce engagement, and human resource development enable both process and management innovations, which in turn enhance operational performance. Social Lean practices were found to mediate the relationship between Lean implementation and performance outcomes in Jordanian SMEs .

Digital Integration: Integration of Lean with Enterprise Resource Planning (ERP) systems supports real-time visibility, traceability, and data-driven decision-making. The ERP-Lean synergy model demonstrated substantial performance improvements in Indian tooling SMEs, with results aligned with ISO 9001:2015 requirements .

Process and Management Innovations: Process innovation (new production methods, workflow improvements) and management innovation (new organizational practices, leadership approaches) mediate the relationship between social Lean practices and operational performance .

Organizational Culture: Lean culture development—characterized by continuous improvement, employee empowerment, and customer focus—sustains performance improvements over time .

V. DISCUSSION

5.1 Interpreting the Lean Maturity-Performance Relationship

The evidence supports a positive relationship between Lean maturity and business performance in manufacturing SMEs, but this relationship is neither simple nor automatic. Several observations emerge from the synthesis:

Incremental vs. Transformative Impact: Lean maturity development produces incremental performance improvements that accumulate over time. The most dramatic documented improvements—such as 95.2% changeover time reduction—result from integrated approaches combining multiple Lean tools with digital enablement .

Operational Performance Precedes Financial Performance: Operational improvements (reduced waste, improved quality, faster changeovers) tend to precede financial performance gains. This temporal lag explains why some firms report strong operational improvements while financial benefits remain modest .

5.2 Implications for SME Management

For manufacturing SME managers, the findings suggest several practical implications:

1. **Start with Foundations:** Begin with foundational Lean tools (5S, Kaizen) that require minimal investment while building organizational discipline and engagement .
2. **Develop Social Infrastructure:** Invest in leadership development, workforce training, and employee engagement. Social Lean practices enable process and management innovations that sustain performance improvements .
3. **Progress Systematically:** Advance to more sophisticated Lean tools (TPM, JIT, VSM) only when foundational practices are embedded and organizational readiness is evident .
4. **Consider Digital Enablement:** Integration of Lean with digital platforms (ERP, real-time monitoring) can enhance traceability, sustain improvements, and support data-driven decision-making .
5. **Measure What Matters:** Track both operational metrics (changeover time, defect rates) and business outcomes (profitability, customer satisfaction) to assess the full impact of Lean maturity development .

5.3 Implications for Policymakers

For policymakers supporting SME development, the findings suggest:

1. **Support Phased Adoption:** Provide training and resources that support staged Lean capability development, recognizing that SMEs cannot implement comprehensive Lean programs immediately .
2. **Address Resource Constraints:** Offer incentives, shared infrastructure, and accessible training programs that reduce the resource burden of Lean adoption .
3. **Promote Inclusive Programs:** Design programs that engage women and workers transitioning from informal to formal employment, recognizing Lean's potential for job creation and economic inclusion .

4. **Support Digital Integration:** Facilitate access to digital platforms and technologies that enable Lean-ERP integration, particularly for SMEs in high-precision manufacturing sectors .

5.4 Limitations and Future Research

Several limitations constrain current understanding of Lean maturity-performance relationships in manufacturing SMEs:

Limited Longitudinal Evidence: Most studies provide cross-sectional snapshots rather than tracking Lean maturity development over time. Longitudinal research is needed to understand the temporal dynamics of Lean maturity and performance improvement .

Contextual Variation: Country-specific and sector-specific factors shape Lean implementation and outcomes. More research is needed on under-studied regions and industry sectors .

Measurement Inconsistency: Studies use varied measures of Lean maturity and business performance, complicating cross-study comparison. Standardized maturity assessment frameworks would enhance comparability .

External Factors: Most studies focus on internal organizational factors while excluding external variables such as government support, national culture, and supply chain dynamics that influence Lean implementation .

Future research should address these gaps through multi-coder systematic reviews, longitudinal mixed-methods studies, and expanded geographic coverage .

VI. CONCLUSION

This paper has evaluated the relationship between Lean management maturity and business performance in manufacturing SMEs. The evidence demonstrates that higher Lean maturity levels are associated with significant operational performance improvements, including dramatic reductions in changeover time, downtime, rejection rates, and improvements in inventory turnover and traceability.

However, Lean maturity development in manufacturing SMEs is neither automatic nor straightforward. Most manufacturing SMEs operate at low-to-moderate maturity levels, constrained by resource limitations, skill shortages, organizational resistance, and inadequate technological infrastructure. Successful Lean transformation requires incremental, phased progression through a capability pathway, beginning with foundational practices and advancing only when organizational readiness and engagement are evident.

Social Lean practices—leadership commitment, workforce engagement, and human resource development—emerge as critical enablers that mediate the relationship between Lean implementation and performance outcomes. Integration with digital platforms enhances the sustainability and scalability of Lean improvements.

The findings have practical implications for SME managers, who should prioritize foundational Lean practices, invest in social infrastructure, progress systematically, and consider digital enablement. For policymakers, the findings suggest supporting phased adoption, addressing resource constraints, and facilitating digital integration.

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