JOURNAL OF INDUSTRIAL ENGINEERING TRIDINANTI
e-ISSN: 2988-2303
http://jietri.univ-tridinanti.ac.id

# Human-Centered Lean Transformation: Integrating Organizational Culture, Digital Capability, and Sustainable Performance

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ARTICLE INFO

Article history:
Diterima 26-02-2026
Diperbaiki 24-05-2026
Disetujui 21-06-2026

Keywords:
Lean Manufacturing; Human-Centered Transformation; Digital Capability; Organizational Foundation; Operational Excellence

ABSTRAK

The increasing complexity of manufacturing systems has shifted Lean Manufacturing from a tool-oriented approach toward a comprehensive organizational transformation strategy. However, previous studies have predominantly examined organizational, human, digital, and operational factors independently, resulting in a fragmented understanding of sustainable Lean transformation. This study aims to develop an Integrated Human-Centered Lean Transformation Framework by synthesizing the current body of knowledge on Lean Manufacturing. A Systematic Literature Review (SLR) combined with bibliometric analysis was conducted using 118 Scopus-indexed journal articles to identify research trends, thematic evolution, and conceptual relationships among key constructs. The findings reveal five interrelated dimensions that drive Lean transformation: Organizational Foundation, Human Capital Development, Digital Capability, Lean Transformation Process, and Strategic Performance Outcomes. The proposed framework highlights that successful Lean transformation is achieved through the sequential integration of these dimensions rather than through isolated implementation of Lean practices. This study contributes to literature by offering a comprehensive conceptual framework that bridges organizational readiness, human-centered development, digital enablement, and Lean implementation within a single transformation pathway. From a practical perspective, the framework provides strategic guidance for manufacturing organizations seeking sustainable operational excellence. Nevertheless, this study is limited to Scopus-indexed publications and has not empirically validated the proposed relationships. Future research should examine the framework using quantitative or mixed method approaches across different manufacturing contexts to assess its generalizability and predictive capability.

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# 1. Introduction

## *1.1 Manufacturing Transformation*

The transformation of the manufacturing sector has emerged as a rapidly evolving strategic agenda in recent years, driven by the increasing complexity of the global business environment, shifting market dynamics, and the accelerated advancement of digital technologies [1][2]. Intensifying competition no longer merely demands that companies produce high-quality goods cost-effectively [3]; it also requires organizations to be agile enough to adapt to rapid, continuous change [4],[5]. These conditions compel manufacturing firms to undertake comprehensive transformations—spanning operational systems, business processes, and organizational management models—to sustain long-term competitiveness [6],[7]. Based on Scopus-indexed literature indicates that manufacturing transformation has evolved from a narrow focus on productivity enhancement toward a more comprehensive approach that integrates technological, human, and sustainability aspects as the core pillars of organizational development.

The emergence of the industry 4.0 concept has been a primary driver of this shift, facilitating the adoption of digital technologies such as the Internet of Things (IoT) [8], Artificial Intelligence (AI) [9], Big Data Analytics [4], Cloud Computing [10], Cyber-Physical Systems [11], and intelligent automation [12]. Integrating these technologies enables companies to access real-time information, enhance production process transparency, accelerate decision-making, and create manufacturing systems that are more responsive to fluctuating market demands. Recent studies demonstrate that implementing Industry 4.0 not only boosts operational efficiency but also strengthens process flexibility, product quality, and organizational resilience in the face of business environment uncertainties [13][14]. Consequently, digitalization has become a crucial element of modern manufacturing transformation strategies.

On the other hand, the orientation of manufacturing transformation is no longer directed solely toward achieving economic performance but also takes sustainability dimensions into account. Growing attention to climate change, natural resource constraints, and demands from various stakeholders is driving companies to integrate sustainability principles into their operational activities [15]. This approach emphasizes a balance between economic performance, social responsibility, and environmental protection, ensuring that organizational success is measured not only by productivity but also by the ability to create long-term value for all stakeholders. Recent Scopus-indexed literature shows a significant increase in research linking manufacturing transformation with sustainable manufacturing and sustainable operational performance [16].

In line with the evolving sustainability paradigm, the concept of green manufacturing is gaining increasing attention as an operational approach focused on reducing environmental impact throughout the production cycle [17],[18]. Implementing green manufacturing encompasses various strategies, including energy efficiency, waste reduction, material consumption optimization, the adoption of eco-friendly technologies, and the development of production processes that support the circular economy. Studies report that adopting eco-friendly principles yields not only ecological benefits but also enhances resource efficiency, strengthens organizational reputation, and creates a sustainable competitive advantage. Consequently, green manufacturing has become an integral part of manufacturing transformation strategies across various industrial sectors.

Although digital technology advancements and sustainability principles have charted a new course for manufacturing transformation, research indicates that successful implementation depends on more than just technological readiness or infrastructure investment. Such transformation also requires organizational readiness to build an adaptive work culture, enhance human resource competencies, strengthen leadership, and foster the engagement of all organizational members in the change process. These findings suggest that manufacturing transformation is a multidimensional process requiring the integration of technological, organizational, and human aspects. Therefore, developing a conceptual framework that explains the interrelationships among these factors is increasingly important as a foundation for implementing sustainable manufacturing transformation.

## *1.2 The Persistent Challenge of Lean Implementation*

Although Lean Manufacturing is recognized as an effective operations management approach for enhancing organizational efficiency, quality, flexibility, and competitiveness, its implementation continues to face various challenges at both operational and strategic levels. For over three decades, manufacturing companies have adopted diverse Lean practices—such as Just-in-Time (JIT), Kaizen, Value Stream Mapping (VSM), 5S, and Continuous Improvement—to eliminate non-value-added activities [19],[20]. Research indicates that implementing these practices can reduce waste, accelerate process flows, and boost organizational productivity. However, Lean implementation is not always successful across companies. Studies show that many organizations struggle to sustain implementation

results, with Lean benefits often declining after the initial adoption phase.

These varying levels of success demonstrate that Lean's effectiveness is determined not merely using operational tools and techniques, but also by an organization's readiness to manage the transformation process holistically. Recent Scopus-indexed literature reveals a shift in research focus from technical aspects toward the organizational factors influencing successful Lean implementation. Researchers are increasingly focusing on the roles of organizational culture, leadership commitment, employee engagement, organizational learning, communication, and readiness for change as key determinants of transformation sustainability. These findings suggest that Lean is fundamentally an organizational change process requiring simultaneous adjustments to behaviors, mindsets, and work systems.

The evolution of digital transformation has also broadened perspectives on Lean implementation within modern manufacturing environments. Integrating Industry 4.0 technologies offers opportunities to enhance Lean effectiveness using real-time data, process automation, intelligent analytics, and interconnected production systems. Nevertheless, research indicates that technology investment does not automatically guarantee successful transformation unless accompanied by organizational and human resource readiness. This suggests that the success of Lean in the digital era depends not only on adopting technology but also on an organization's capacity to build synergy among digital capabilities, the human element, and structured change mechanisms.

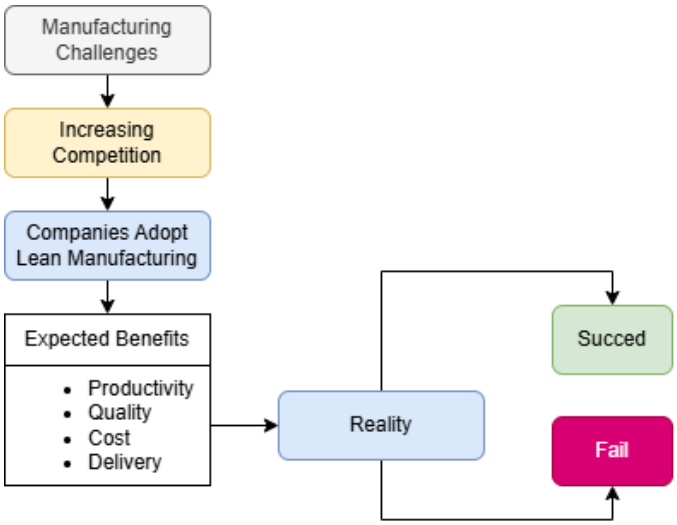


**Figure 1.** Lean Manufacturing Implementation Paradox in Modern Manufacturing

Although research on Lean Manufacturing continues to evolve, most studies still treat organizational culture, leadership, employee engagement, and digital capabilities as independent variables. While this approach offers valuable insights into the impact of individual factors, it fails to explain how the interrelationships among these factors shape the Lean transformation process. Consequently, there remain limitations in explaining the mechanisms of change that enable organizations to achieve sustainable operational excellence. This situation presents an opportunity to develop a conceptual framework that integrates organizational, human, and digital capability dimensions into a more comprehensive and systematic Lean transformation process.

Figure 1 illustrates the phenomenon driving manufacturing transformation in the era of global competition. Increasing market pressures, shifting customer needs, the advancement of digital technologies, and demands for sustainability are compelling companies to adopt Lean Manufacturing as a strategy to enhance competitiveness. By implementing various Lean principles, organizations are expected to boost productivity, improve product quality, reduce waste, accelerate process flows, and achieve sustainable operational efficiency.

### *1.3 Evolution of Lean Transformation Research*

Recent research developments regarding Lean Manufacturing reveal a significant shift in orientation. Based on a synthesis of Scopus-indexed articles forming the basis of this study, the research focus is no longer confined to the effectiveness of applying various Lean tools to enhance operational efficiency [21], [22]. More recent publications demonstrate a trend toward examining Lean as part of a broader organizational transformation process, involving the interplay between business strategy, organizational capabilities, human resources, and digital technology advancements. This shift reflects a paradigm change: Lean success depends not merely on implementing operational techniques, but also on an organization's ability to manage change sustainably.

In the early stages of literature's development, most research centered on the relationship between the adoption of Lean practices and improvements in operational performance. Various studies evaluated the contributions of Lean tools—such as Just-in-Time, Kaizen, 5S, Value Stream Mapping, and Continuous Improvement—to productivity, quality, cost efficiency, and waste reduction [23], [24]. Although this relationship has been consistently demonstrated across various industrial contexts, subsequent research indicates that successful implementation is not always sustainable in the long term. These findings have prompted greater attention toward the factors influencing the sustainability of Lean transformation at the organizational level, rather

than focusing solely on the resulting operational outcomes.

As research has evolved, academic attention has shifted toward the roles of organizational and human factors as determinants of successful Lean implementation. Literature indexed in Scopus identifies organizational culture, leadership, employee engagement, organizational learning, communication, and change management as key contributors to successful transformation. This shift reflects an understanding of Lean not merely as a set of techniques for enhancing process efficiency, but as a management philosophy requiring changes in mindset, work behavior, and organizational culture. Consequently, social and organizational dimensions have become increasingly significant in explaining the varying degrees of success in Lean implementation across manufacturing sectors.

More recent research has further evolved by integrating Lean concepts into the contexts of digital transformation and sustainability. Topics such as Lean 4.0, Industry 4.0, digital capabilities, human-centered manufacturing, sustainable manufacturing, and sustainable performance are increasingly emerging as central research themes. These developments indicate that Lean implementation is now viewed as part of a modern manufacturing transformation that combines the use of digital technologies, the development of organizational capabilities, and the achievement of sustainability goals. Nevertheless, much of the existing research examines variable relationships in a fragmented manner—dictated by the specific focus of individual studies—and thus fails to provide a comprehensive explanation of the Lean transformation mechanism that integrates organizational, human, and digital capability dimensions into a unified conceptual framework.

Based on this evolution, it can be concluded that Lean Manufacturing research has shifted from a focus on technical improvements toward a more holistic approach that integrates organizational, human, technological, and sustainability aspects. This shift in research direction highlights the expanding scope of Lean as an organizational transformation strategy. However, a synthesis of the literature also indicates a scarcity of studies that systematically map the interconnections among these various dimensions within a coherent transformation process. This situation presents an opportunity to develop a new conceptual framework that explains how organizational culture, leadership, employee engagement, digital capabilities, and human-centric change interact to drive sustainable Lean transformation. Consequently, developing an integrated conceptual framework is a crucial step toward enriching theory development while providing guidance for Lean implementation in modern manufacturing environments.

### *1.4 Research Objective and Contributions*

Research on Lean Manufacturing transformation reveals a shift in focus from approaches centered on technical improvements to a more holistic perspective that integrates organizational, human, digital, and sustainability dimensions. However, a synthesis of the literature indicates that most studies still explore variable relationships in a fragmented manner, failing to comprehensively explain the mechanisms of Lean transformation. Against this backdrop, this study aims to develop an integrated conceptual framework that elucidates the interrelationships among organizational culture, leadership, employee engagement, digital capabilities, human-centric change, Lean implementation, operational excellence, and sustainable performance within the context of modern manufacturing transformation.

Theoretically, this study contributes by fostering a new perspective on Lean transformation, viewing it not merely as the implementation of a set of operational tools, but as an organizational change process involving the interaction of various strategic capabilities. The proposed framework integrates concepts that have previously evolved in isolation within literature, including organizational culture, leadership, human factors, digital capabilities, and sustainability orientation. This integration is expected to broaden the conceptual understanding of Lean transformation mechanisms and serve as a foundation for developing empirical models in future research.

From a practical standpoint, the developed conceptual framework offers guidance to manufacturing organizations in designing more systematic and sustainable Lean transformation strategies. The proposed model emphasizes the importance of aligning organizational, human, and technological aspects as prerequisites for successful transformation; this ensures that Lean implementation yields not only short-term operational improvements but also supports the achievement of sustainable competitive advantage. Furthermore, this study is expected to serve as a reference for academics developing empirical research to test the proposed construct relationships and to enrich theoretical development regarding Lean transformation in the era of digital manufacturing.

## 2. Research Method

### *2.1 Research Design*

This study employs a Systematic Literature Review (SLR) approach combined with bibliometric analysis to identify, evaluate, and synthesize research developments regarding Lean Manufacturing transformation in the modern manufacturing industry. The SLR approach was

selected for its ability to provide a systematic, transparent, and replicable process for identifying literature, thereby yielding a comprehensive synthesis of knowledge within the research field. Furthermore, this approach enables the identification of conceptual evolution, research directions, and scholarly gaps requiring further development.

Bibliometric analysis serves as a complement to map publication characteristics, the progression of research themes, keyword interrelationships, and the evolving focus of Lean Manufacturing research. This approach provides a quantitative overview of research trends, dominant themes, and the interconnectedness of topics within the international literature. Subsequently, the results of the bibliometric mapping are combined with a conceptual synthesis to formulate a new conceptual framework; this framework elucidates the mechanisms of Lean transformation through the integration of organizational, human, digital capability, and sustainability aspects.

By combining the Systematic Literature Review, bibliometric analysis, and conceptual synthesis, this study not only maps existing research developments but also generates an integrated conceptual framework that can serve as a foundation for future empirical research and the implementation of Lean transformation in modern manufacturing environments.

### *2.2 Data Source'*

The research data was obtained from the Scopus database, as it is one of the largest international scientific databases, offering multidisciplinary publication coverage and maintaining high quality standards. All bibliographic data were collected in July 2026 using search results aligned with the research focus on Lean Manufacturing transformation. Utilizing Scopus enabled the acquisition of peer-reviewed articles, thereby ensuring sufficient scientific credibility.

### *2.3 Search Strategy*

The literature search process was conducted systematically using the Scopus database, employing a combination of keywords related to Lean Manufacturing and organizational transformation. Search strategies were formulated using Boolean operators (AND and OR) to ensure the retrieved articles were highly relevant to the research objectives. Furthermore, the search was restricted to English-language publications to maintain consistency in the quality of the analyzed literature.

Search keywords were selected based on a combination of terms representing the study's core topics: Lean Manufacturing, Organizational Culture, Digital Capability, Human Factors, Operational Excellence, and Sustainable Performance. Additionally, the search was limited to relevant document types, including journal articles, conference papers, and review articles. All articles meeting these criteria were exported in CSV format to serve as the basis for bibliometric analysis and literature synthesis.

### *2.4 Screening and Selection Process*

The article selection process was conducted in stages to ensure that all analyzed publications were directly relevant to the research focus. The initial stage involved gathering all articles obtained from searches within the Scopus database. Subsequently, titles, abstracts, and keywords were examined to determine the alignment of each article with the topic of Lean Manufacturing transformation.

The next stage involved a screening process to exclude articles that were irrelevant, focused on research outside the manufacturing context, or were duplicates. Publications failing to meet the inclusion criteria were eliminated, ensuring that only articles directly relevant to the research objectives were retained for the final dataset. This selection process was carried out systematically to produce a body of literature representative of the evolution of research on Lean Manufacturing transformation.

All articles that passed the selection process were then analyzed using a bibliometric approach to identify publication trends, the evolution of research themes, and relationships between keywords. The analysis results were subsequently synthesized conceptually to identify research development patterns, uncover research gaps, and formulate an Integrated Human-Centered Lean Transformation Framework as the study's primary contribution.

## 3. Result

### *3.1 Publication Trend Analysis*

The article selection process was conducted in stages to ensure that all analyzed publications were directly relevant to the research focus. The initial stage involved gathering all articles obtained from searches within the Scopus database. Subsequently, titles, abstracts, and keywords were examined to determine the alignment of each article with the topic of Lean Manufacturing transformation.

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Figure 2 illustrates the trend in the number of Scopus-indexed publications regarding Lean Manufacturing transformation over the 2016–2026 period. A search yielded 118 articles that met the study's inclusion criteria. Overall, the number of publications shows an upward trend year-on-year, despite fluctuations during certain periods. The number of articles rose from six in 2016 to fourteen in 2022, before dropping to nine in 2023. The trend rebounded in 2024, reaching a peak of 18 articles in 2025, before declining slightly in 2026. This pattern indicates that research on Lean transformation remains a significant focus within international literature and continues to evolve in response to the changing needs of the manufacturing industry.

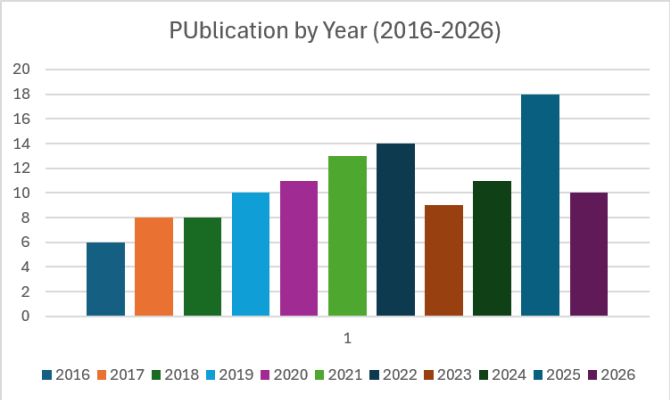


Figure 2. Publication Trend by year 2016-2026

The increase in the number of publications in recent periods indicates that Lean transformation has evolved into an increasingly multidisciplinary research topic. Contemporary literature no longer focuses solely on implementing Lean tools but has begun to integrate issues such as organizational culture, leadership, human resource engagement, digital transformation, Industry 4.0, and sustainability as part of strategies to enhance organizational competitiveness. This shift in orientation demonstrates that Lean transformation has evolved from an operational approach into a strategic perspective that positions the organization, people, and technology as complementary components. These findings serve as the basis for further analysis regarding the evolution of research themes and the development of the conceptual framework presented in the subsequent subsection.

### *3.2 Evolution of Lean Manufacturing Research*

In the initial phase of research development, Lean Manufacturing was positioned as an approach focused on enhancing operational efficiency through the application of various process improvement tools and techniques. Scopus literature indicates that research during this period was dominated by the implementation of Just-in-Time (JIT), Kaizen, Value Stream Mapping (VSM), 5S, Kanban, Single-Minute Exchange of Dies (SMED), and Total Productive Maintenance (TPM) as primary instruments for reducing waste and increasing the value-added of production processes. Most studies evaluated the effectiveness of applying specific Lean tools against operational indicators such as cycle time, product defect rates, inventory levels, and productivity. While these approaches successfully demonstrated that Lean could significantly improve process efficiency, implementation remained focused on improving operational activities without considering the organizational factors that influence the sustainability of such changes. Consequently, research in the subsequent phase began to shift from a technical focus toward evaluating Lean's impact on broader organizational performance.

As Lean adoption expanded across various manufacturing sectors, research attention shifted from implementing tools to achieving Operational Excellence as a strategic organizational goal. Scopus articles demonstrate that Lean is no longer viewed merely as a waste-reduction method but also as an approach capable of enhancing quality, production flexibility, customer response speed, cost efficiency, and overall operational performance. During this phase, research success indicators became increasingly diverse, incorporating metrics ranging from operational, manufacturing, and quality performance to overall business performance. Although a positive relationship between Lean and performance improvement has been widely established, research findings also reveal that implementation success rates vary across organizations. These disparities indicate that achieving operational excellence is not determined solely by the application of Lean techniques but is also influenced by internal organizational characteristics—factors that began to receive attention in the subsequent phase of research.

Subsequent literature reveals a paradigm shift that positions Lean Manufacturing as an integral part of the organizational transformation process. Research indexed in Scopus has identified organizational culture, leadership, organizational learning, communication, and employee engagement as critical factors determining the

long-term success of Lean implementation. Lean is no longer viewed merely as an operational system but as a management philosophy requiring a comprehensive shift in mindset, work behavior, and organizational culture. Studies from this period also confirm that Lean implementation failures are more frequently linked to an organization's lack of readiness to manage change than to the limitations of the Lean tools themselves. This shift has broadened the research perspective, moving from a process-oriented approach to one that prioritizes people and the organization as the primary drivers of transformation.

As we enter the Industry 4.0 era, research is evolving to integrate Lean Manufacturing with digital technologies, aiming to enhance the effectiveness of organizational transformation. Scopus-indexed literature reveals growing interest in the "Lean 4.0" concept—the integration of Lean principles with technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data Analytics, Cyber-Physical Systems, Cloud Computing, and Digital Twins. Studies demonstrate that digital technologies can improve process visibility, support real-time data-driven decision-making, and strengthen an organization's ability to rapidly identify and eliminate waste. However, implementing digital technology does not guarantee successful transformation unless supported by organizational capabilities, human resource competencies, and adaptive leadership. Consequently, research is increasingly focusing on integrating digital capabilities, organizational readiness, and human-centric change as the foundation for modern Lean transformation.

Recent research trends indicate that Lean Manufacturing is increasingly linked to sustainability goals as part of long-term manufacturing transformation strategies. Scopus publications are integrating Lean with concepts such as sustainable manufacturing, green manufacturing, the circular economy, organizational resilience, and Environmental, Social, and Governance (ESG) criteria to illustrate how Lean can simultaneously support the creation of economic, social, and environmental values. In this context, Lean success is no longer measured solely by productivity gains or operational efficiency, but also by an organization's ability to build adaptive, resilient, and sustainable production systems. Despite this shift toward integrating various strategic dimensions, a synthesis of the literature reveals that most studies still examine the relationships between variables in a fragmented manner. This highlights the need for an integrated conceptual framework to explain how organizational dimensions, human factors, digital capabilities, Lean implementation, operational excellence, and sustainability interact to shape modern manufacturing transformation.

### *3.3 Thematic Synthesis and Development of the Integrated Human-Centered Lean Transformation Framework*

After identifying the evolution of Lean Manufacturing research across its various developmental phases, the next step involves a thematic synthesis of the analyzed literature. This synthesis aims to identify the most dominant construct groups, conceptual relationships between dimensions, and research patterns consistently emerging in Scopus-indexed publications. Unlike bibliometric analysis, which emphasizes quantitative trends, thematic synthesis focuses on integrating concepts to provide a more comprehensive explanation of Lean transformation mechanisms.

The synthesis reveals that the constructs identified in the literature can be categorized into five key dimensions: Organizational Foundation, Human Capital, Digital Capability, Lean Transformation Process, and Strategic Performance Outcomes. These dimensions do not operate in isolation but instead constitute an interconnected transformation process. The literature indicates that the success of Lean Manufacturing stems from the interplay among organizational readiness, human competence, the ability to leverage digital technology, the implementation of Lean practices, and the achievement of sustainable organizational performance.

The findings reveal that most prior research has examined each dimension in isolation. For instance, some studies emphasize organizational culture and leadership, while others focus on digitalization, Lean 4.0, or sustainability. Consequently, there is a lack of a conceptual model capable of systematically explaining the relationships between these dimensions. Based on this synthesis, this study proposes a new conceptual framework, the Integrated Human-Centered Lean Transformation Framework, which integrates the various perspectives emerging in the literature.

Figure 3 presents the Integrated Human-Centered Lean Transformation Framework, developed through a synthesis of Scopus-indexed literature on Lean Manufacturing transformation. The framework illustrates that successful Lean transformation begins with an "Organizational Foundation"—comprising organizational culture, leadership commitment, and strategic vision—as a prerequisite for building readiness for change. This foundation subsequently drives "Human Capital Development" by enhancing employee engagement, competence, empowerment, and continuous learning to support a culture of continuous improvement. In the next stage, "Digital Capability" acts as an enabler, leveraging Industry 4.0 technologies, the Internet of Things (IoT), Artificial Intelligence (AI), and data-driven decision-making to enhance the effectiveness of Lean

implementation. These capabilities are then applied through the "Lean Transformation Process," which encompasses Kaizen, Just-in-Time, Value Stream Mapping, continuous improvement, and waste elimination as primary mechanisms for process improvement. The integration of these five dimensions ultimately yields "Strategic Performance Outcomes": Operational Excellence, Sustainable Performance, Organizational Resilience, and Competitive Advantage. Thus, the proposed framework asserts that Lean transformation is not merely the application of operational tools but a strategic process that integrates the organization, people, technology, and Lean practices to achieve sustainable manufacturing performance.

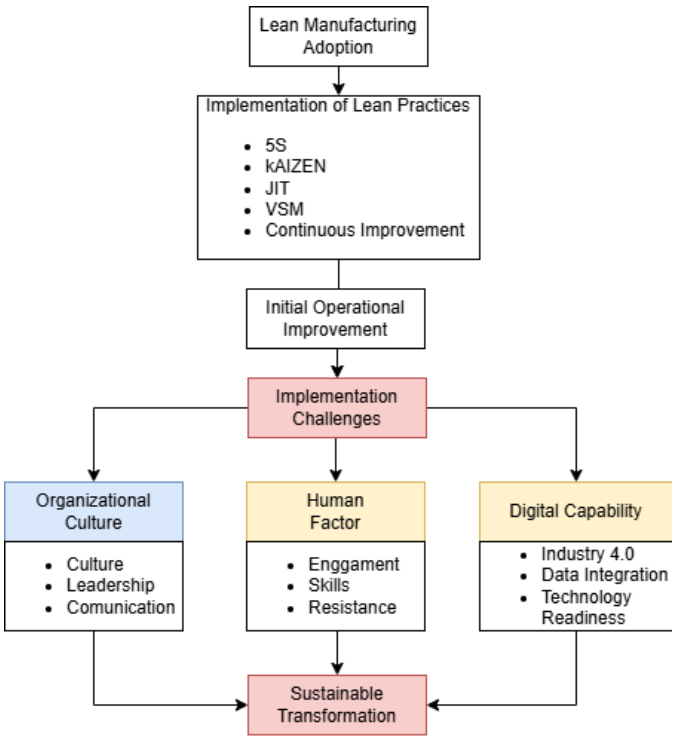


**Figure 3.** Illustration of Lean Manufacturing Implementation Challenges

A synthesis of 118 Scopus-indexed articles reveals that research on Lean Manufacturing transformation can be categorized into five key dimensions that consistently appear across various publications. These dimensions are Organizational Foundation, Human Capital, Digital Capability, Lean Transformation Process, and Strategic Performance Outcomes. This categorization serves as the basis for the proposed conceptual framework, as it illustrates the logical relationships among the factors influencing the success of sustainable Lean transformation. A summary of the thematic synthesis results is presented in Table 1.

**Table 1**. Thematic Synthesis of Lean Manufacturing Transformation Literature

| Dimension | Main Constructs | Dominant Research Focus | Expected Role |
|---|---|---|---|
| Organizational Foundation | Organizational Culture, Leadership, Strategic Commitment | Organizational readiness | Building transformation readiness |
| Human Capital | Employee Engagement, Competency, Empowerment, Learning | Human-centered change | Driving Lean implementation |
| Digital Capability | Industry 4.0, AI, IoT, Big Data, Digital Integration | Digital enablement | Accelerating transformation |
| Lean Transformation Process | Kaizen, JIT, VSM, Continuous Improvement, Waste Elimination | Operational improvement | Executing the transformation |
| Strategic Performance Outcomes | Operational Excellence, Sustainability, Resilience, Competitive Advantage | Long-term performance | Transformation outcomes |

## 4. Disscussion

This study demonstrates that the transformation of Lean Manufacturing has evolved from an approach focused on the implementation of Lean tools toward a more holistic perspective that integrates organizational, human, digital technology, and sustainability dimensions. Based on a synthesis of 118 Scopus-indexed articles, this study proposes an "Integrated Human-Centered Lean Transformation Framework." This framework depicts Lean transformation as a phased process commencing with an Organizational Foundation, followed by Human Capital Development, Digital Capability, and the Lean Transformation Process, ultimately yielding Strategic Performance Outcomes. The study's novelty lies in

integrating these five dimensions into a single, systematic transformation pathway, thereby offering a more comprehensive perspective than prior research, which has generally addressed variable relationships only partially. The proposed framework not only enriches Lean Manufacturing theory but also provides a conceptual reference for manufacturing organizations to design more integrated and sustainable transformation strategies.

However, this study has limitations; the proposed conceptual framework relies on a literature synthesis without empirical validation and utilizes only Scopus-indexed publications as data sources. Consequently, future research should empirically test the relationships between the constructs within this framework across various manufacturing sectors using quantitative or mixed methods approaches. Furthermore, the model could be further developed by incorporating additional variables—such as organizational innovation, artificial intelligence, supply chain resilience, or Environmental, Social, and Governance (ESG) factors—to ensure the framework remains relevant to the dynamics of modern manufacturing transformation and future technological advancements.

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