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RESEARCH ARTICLE OPEN ACCESS

A SELF–EVALUATION MATURITY ASSESSMENT MODEL FOR LEAN SIX SIGMA IMPLEMENTATION IN SMES

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ABSTRACT

This study develops a structured maturity model to assess SMEs' readiness for the implementation of Lean Six Sigma. The model presents a tool that will assist organizations in evaluating their current maturity level before LSS deployment. A comprehensive literature review was performed to find the critical success elements, barriers, and relevant frameworks. These insights were then used to develop a four-level LSS maturity model with a scoring-based assessment instrument. The developed model was refined by expert consultations and subsequently validated using four SME case studies. Findings: The model successfully distinguished the preparedness levels of LSS among the participating SMEs. Scores ranged from Level 1 (Uncertain or Limited) to Level 3 (Understanding or Good). The tool demonstrated strong capability in identifying organizational strengths, gaps, and priorities. Practical implications: It can assist owners or managers by providing an evidence-based mechanism to assess their readiness, benchmark their performance, and plan the implementation of LSS more effectively. It aids structured decision-making and reduces the likelihood of failure at early deployment stages. Originality/value: This work is one of the first LSS maturity models focused on SMEs, along with a quantifiable scoring system, making both academic and practical contributions to improve the assessment of LSS.

I. INTRODUCTION

Manufacturing enterprises today are under high pressure to improve productivity at lower costs along with high quality, in a competitive global environment [1], [2]. In such a scenario, high-quality output is no longer an option—it is a question of survival. To achieve this, most organizations depend upon continuous improvement methods, which are effectively used in the manufacturing industries [3], and Lean Six Sigma, which combines Lean's principles of waste reduction and Six Sigma's statistical and variation control techniques, has been recognized as a structured strategy that can enhance operating efficiency and competitiveness [4], [5]. However, as far as SMEs are concerned, they face unique challenges when implementing LSS, such as limited technical knowledge, informal organization structures, and limited financial resources compared to major organizations [6-8]. Although SMEs could gain considerably from LSS, Current frameworks are generally developed for large organizations and are too complex or resource-intensive for smaller firms [9-11].

Therefore, most SMEs initiate LSS initiatives based on intuition rather than a systematic understanding of their readiness [12]. While recent studies have considered readiness evaluation as the first step for any LSS deployment process, despite this recognition, the literature suggests that there is currently no valid self-assessment instrument that would organizations to measure their maturity level. Most contributions either focus on selective factors, lack any scoring mechanisms, or remain purely conceptual without any diagnostic instruments. To take up this challenge, the present study proposes a maturity model based on self-evaluation specifically designed for SMEs concerning the implementation of Lean Six Sigma. Guided by the model, SMEs would be able to recognize their strengths, weaknesses, and areas where improvement is needed.

The model will support the SMEs in making well-grounded decisions with regard to the introduction and implementation of LSS by offering a structured diagnostic instrument. It aims at reducing reliance on external consultancy, increasing the success rate of LSS implementations, and also anticipating operational and sociocultural hurdles during transformative change. Thus, this study aims to address the following questions:

1. Under what organizational conditions can SMEs be considered ready to implement Lean Six Sigma?
2. How can the readiness or maturity of SMEs for implementing Lean Six Sigma be systematically evaluated?

This research contributes to the further development of Lean Six Sigma scholarship by proposing a maturity self-assessment model, developing and validating it, and thus offering a practical instrument to support SMEs in planning and executing LSS initiatives with improved effectiveness.

II. THEORETICAL REFERENCE

II.1 AN OVERVIEW OF SMALL AND MEDIUM ENTERPRISES AND LEAN SIX SIGMA.

LSS combines Lean's philosophy of waste elimination along with the statistical rigor of Six Sigma in pursuit of improved operational efficiency, process stability, and product [13], [14]. Despite being widely adopted by large organizations, SMEs face different challenges because of their limited financial resources, informal organizational structures, and dependence on tacit worker knowledge [15]. Amongst other researchers, [7] and [16] emphasized that the successful implementation of LSS within SMEs significantly depends upon leadership support, learning culture, internal competencies, and basic infrastructural resources. However, most of the currently existing implementation frameworks are either overly complex, resource-intensive, or intended for large-scale enterprise use and, therefore, limit their practical applicability to SMEs [9]. Encouraged by this need, recent research efforts have pushed toward recommending simple, structured, and SME-specific maturity assessment models [17], [12].

II.1.1 Obstacles and Difficulties for Small and Medium Enterprises

Although Lean Six Sigma has been effective in enhancing quality and operational performance [18], [19], SMEs frequently experience constraints that limit its successful implementation [20]. Table 1 highlights in summary form the primary barriers identified in the literature.

Table 1: Key Barriers to Lean Six Sigma Adoption in SMEs.

Barriers	Description	Sources
Resource Limitations	Some factors include limited time, budget, and manpower to undertake improvement projects	[18],[21]
Lack of LSS knowledge and skills	Employees have limited familiarity with Lean Six Sigma tools and methods	[7],[11]
Poor organizational culture	Resistance to change and inconsistency in CI practice	[10],[16]
Limited leadership commitment	Support for LSS is still more symbolic than strategic	[2], [22]
Inadequate Infrastructure	Lack of harmonization in processes, data systems, and documentation	[12],[23]

Source: Authors, (2026).

II.1.2 Important Success Elements for Small and Medium Enterprises

The effective application of Lean Six Sigma in SMEs is accomplished by some organizational enablers that support structured improvement, learning, and employee engagement. Literature also identifies leadership commitment, workforce involvement, skills development, tool usage, motivation systems, and supportive working conditions as the key enablers for LSS implementation in organizations [18],[24],[25]. The main Critical Success elements, their applicability to SMEs, and their compatibility with the dimensions of the suggested maturity model are shown in Table 2.

Table 2: Essential Components of LSS Success in SMEs.

Essential Components	Relevance in SMEs	Corresponding Maturity Model Dimension	Sources
Top management commitment	Ensures strategic support and resource allocation	Top Management & Employee Involvement	[18], [22]
Employee involvement and empowerment	Encourages participation in CI and project activities	Top Management & Employee Involvement	[7], [25]
Structured training and skill development	Builds capability to apply LSS tools effectively	Infrastructure & Training	[10], [11]
Availability and use of improvement tools	Enables systematic problem-solving and process control	Tools & Techniques	[12], [17]
Reward and recognition mechanisms	Maintains motivation and supports cultural acceptance of CI	Motivation & Recognition	[4],[18]
Fair and safe working environment	Promotes workforce stability and supports an improvement culture	Social Performance	[7],[25],[26]

Source: Authors, (2026).

II.1.3 Foundation for integrating Lean, Six Sigma, and Lean Six Sigma

Significant efforts have been made to develop frameworks and models that help apply Lean and Six Sigma principles in practice. Table 3 highlights a thorough examination of these contributions.

Table 3: List of different lean and Six Sigma models and frameworks.

Sr.no	Authors	Strengths	Limitations	Scoring System
1.	[22]	Emphasizes how crucial it is to do a readiness assessment before implementing LSS. Suggests a paradigm that combines knowledge and risk management.	Early-stage idea; framework requires additional real-world case testing.	No
2.	[11]	Offers a thorough scholarly summary of the LSS deployment variables based on a systematic review.	Theoretical, with little validation from practitioners.	No
3.	[12]	Proposes a streamlined framework for SMEs to integrate Six Sigma and Lean tools.	Validation is restricted to one case study; generalization is problematic.	No
4.	[9]	Identifies the obstacles and readiness criteria for LSS adoption in the context of SMEs.	Lacks a measurement tool that has been validated; the framework is still conceptual.	No
5.	[27]	Highlights important leadership and cultural elements while concentrating on LSS implementation in the service industry.	Limited case validation; less established manufacturing applicability.	No
6.	[28]	Highlights the obstacles and elements that make SMEs successful while implementing LSS. offers helpful advice to managers.	Mostly exploratory, with a greater emphasis on concept than prescription.	No
7.	[29]	Suggests an LSS deployment paradigm that is centered on SMEs and places a strong emphasis on flexibility and ease of usage.	The scope is restricted to Swedish SMEs and requires more extensive empirical validation.	No

Source: Authors, (2026).

An overview of current LSS implementation and readiness models indicates that, while there have been numerous studies that have made useful contributions, the most significant shortcoming is the lack of a standardized scoring system. [22] recognize the importance of readiness assessment and provide a paradigm that includes knowledge and risk management, but that remains at a conceptual level without measurable scoring. Similarly, [11] provide a systematic review of LSS deployment factors but avoid providing a measurement instrument at the practitioner level. Although models by [12], [9], [27] offer useful insights in highlighting challenges, cultural concerns, and SME-specific issues, their frameworks are mostly descriptive in nature and lack validated measurements. Even [17], [29] studies, as informative as they were in pinpointing success factors and barriers, are exploratory and contextual and thus possess limited generalizability. This is the critical gap that highlights the originality of this proposed model in this research. By converting qualitative information into measurable metrics, the scoring-based model improves objectivity, comparability, and usability for practitioners and SMEs.

III. RESEARCH METHODOLOGY AND DEVELOPMENT OF MODEL

Research shows that although Lean Six Sigma research has advanced significantly in industrialized nations [30-32], developing countries are still lacking context-specific adoption frameworks [33]. To address this gap, a practical and SME-friendly self-evaluation maturity model was created over the course of nine months using a systematic four-stage process in order to close this gap (Figure 1).

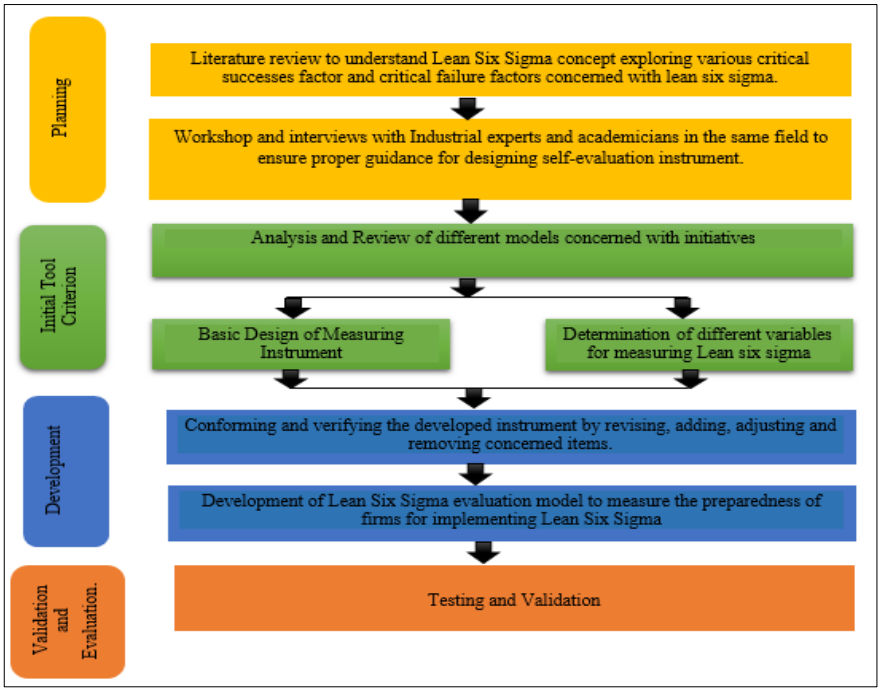

Figure 1: Research methodology.
Source: Adapted from [34].

Planning: In the beginning, five industry professionals participated in semi-structured interviews. All of the professionals who took part had carried out Lean six sigma initiatives within their firms. These professionals all had a cumulative experience in continuous improvement of between 2 and 20 years. A workshop on Lean and Six Sigma was also held, this time with three professors. Through networking and personal connections, industry professionals and academics were located. Although the workshop and interview results aren't discussed in great detail in this section, they provided a strong foundation for the preparation self-evaluation model instrument. The results revealed that there is a vital need to create a realistic instrument to assess whether businesses were ready to implement Lean and Six Sigma practices, because during the study, it was found that there was still a lot of difference between the current industrial scenario and theory related to the evaluation of Lean and Six Sigma implementation. The majority of participants mentioned challenges when implementing Lean Six Sigma into practice. Although they had a complete understanding of the company's working environment, they still faced a number of obstacles that prevented its effective implementation. Moreover, they recommended that the instrument needed to be easily usable, blend in with the SMEs environment. The preparedness self-evaluation needed to be uncomplicated, trustworthy, and resource-light, according to all of the experts.

Initial instrument creation: A preliminary list of criteria for assessing how ready a company is to apply Lean Six Sigma was created on the basis of Csfs, barriers, and existing LSS frameworks. Items were modified from previous instruments that assessed the Lean and/or Six Sigma implementation. An additional eight models (Table 4) from different sectors were also studied to extract the best practices regarding the scoring logic, design of the model, and the structure of its validation process. The draft instrument was reviewed by five industry professionals.

Table 4: Summary of the existing readiness and maturity models.

Sr.no	Authors	Focus	Inspired elements
1.	[35]	Created a self-assessment preparedness for the application of statistical procedures tailored to the food sector.	• Technique of scoring • Participation of academics and industry experts • Creation of models based on literature.
2.	[36]	Proposed a self-checking tool to assess preparedness.	• Use motivations, obstacles, and facilitators as input when creating the tool. • Completing the readiness evaluation as a team. - defining the readiness assessment's scope, such as the entire company or a particular division?
3.	[37]	Outlines a method for assessing an organization's preparedness for the fundamental ideas and components of safety change management.	• Sampling method: Developing the readiness model using Nertney's principle.
4.	[38]	Aims to examine the Swedish industry's preparedness for data analytics.	• Developing the evaluation tool using a number of preparedness capabilities. • Results of the study were used to prepare a robust model.
5.	[39]	Evaluated how well the various Industry 4.0 and smart manufacturing maturity models match the unique needs of small and medium-sized businesses.	• Rules for scoring readiness levels. - Building a solid model based on the findings of this investigation.
6.	[40]	Provide a mechanism to gauge the level of preparedness for Industry 4.0 adoption.	• Method development: Determining the level of preparedness.
7.	[34]	Proposed a maturity model for evaluating Industry 4.0 adoption	• The approach used to create the maturity model.
8.	[41]	Presented a self-assessment to help organizations measure and visualize their capabilities with respect to key elements for successful sustainability integration in the product innovation process.	• Long-term outlook on the three aspects of sustainability, with a focus on the social aspect.

Source: Authors, (2026).

Development: By updating, amending, adding, correcting, and/or eliminating some criteria and items, as necessary, this step attempted to validate the instrument. A multi-case study approach was chosen to accomplish this. This kind of approach is crucial when the subject is complicated and needs to be examined in its context [42]. Especially considering the lack of evidence on organizations' preparedness to adopt Lean Six Sigma. Employing such approach helps in the production of more trustworthy outcomes and broad conclusions. However, using this method will take a lot of time and work to complete the research.

Validation and assessment: The proposed preparedness self-evaluation model and tool were validated and evaluated throughout the fourth and final development phase. In order to reduce misunderstanding and raise the instrument's quality, queries about its functioning, item clarity, and visibility were also posed to industry specialists. An encouraging sign of the suggested tool's validity was that industrial experts said it could be used to undertake a preparedness self-evaluation for Lean Six Sigma implementation.

III.1 MATURITY LEVEL SELF-EVALUATION MODEL FOR THE IMPLEMENTATION OF LEAN SIX SIGMA

A self-evaluation maturity model has been created especially for SMEs to gauge an organization's level of readiness to apply Lean Six Sigma (LSS). The model consists of 5 components**.**

1. Commitment of top management and employees' involvement.
2. Knowledge of Tools and Techniques.
3. Infrastructure and training.
4. Motivation and Recognition
5. Social Alignment.

Each of the dimensions reflects one of the fundamental capabilities that underpin LSS implementation in SMEs, depending on which the model would be both theory-driven and practice-oriented. The following section outlines the Maturity levels, scoring mechanism, and calculation of the Lean Six Sigma Maturity Index (LSS-MI).

Table 5: Lean Six Sigma Maturity Index (LSS-MI).

Sr.no	Categories		Maturity level 1	Maturity level 2	Maturity level 3	Maturity level 4	Final Evaluation
1	**Top Management & Employees Involvement**	Does management join or attend improvement/project meetings? (e.g., project reviews, problem-solving meetings, or improvement events)?					
		Are resources (time, budget, basic tools, and key staff) allocated by top management for different projects?					
		Does top management promote a culture of learning and continuous improvement by recognizing achievements and encouraging employee contributions?					
		Are employees encouraged to share problems, ideas, or suggestions for improvement in their daily work?					
		Have employees received at least basic awareness or training on Lean, Six Sigma, or continuous improvement tools?					
2	**Infrastructure & Training**	Does the organization provide the necessary infrastructure (e.g., basic IT systems, data collection tools, process mapping tools)?					
		Are employees given awareness or basic training on Lean Six Sigma concepts and problem-solving tools?					
		Does the organization invest in training and certification for selected employees?					
		Are employees encouraged to apply learned tools (5S, DMAIC, SPC, etc.) in their daily work, with management support?					
		Does the organization have mechanisms to share knowledge from training and past projects (e.g., lessons learned, best practices)?					
3	**Tools & Techniques**	Do employees use simple quality tools (like check sheets, cause-and-effect diagrams, or basic charts) to solve everyday problems?					
		Are employees aware of Lean Six Sigma tools (e.g., Value Stream Mapping, Pareto chart, scatter plots), even if they are not using them regularly?					
		Are more structured tools and techniques (e.g., 5S, Poka Yoke, SMED, FMEA) being used in projects to improve processes?					
		Are Lean tools and some Six Sigma statistical tools (e.g., control charts, process capability, basic hypothesis					

		testing) used across most departments or teams?					
		Are advanced Lean and Six Sigma tools (both problem-solving and statistical) commonly used and integrated into daily operations?					
4	**Motivation & Recognition**	Do employees feel interested in joining improvement activities?					
		Does management say “thank you” or appreciate employees who give ideas?					
		Are small rewards (like certificates, gifts, or public praise) given for good improvement work?					
		Do employees take part in improvement work because they want to, not just for rewards?					
		Is there a regular system in place to reward and recognize employees for Lean Six Sigma efforts?					
5	**Social Performance**	Are all employees treated fairly and respectfully at work?					
		Does the company ensure that no child labor or forced labor is used?					
		Do employees have equal opportunities, without discrimination (e.g., gender, religion, caste, or background)?					
		Do employees get proper working hours, rest days, and fair treatment for overtime?					
		Does the company check workplace safety risks and take steps to prevent accidents or hazards?					

Source: Authors, (2026).

Each of the five dimensions of the maturity model is rated across four levels of maturity, reflecting the organization's capability to adopt Lean Six Sigma practices. These four levels range from minimal awareness to stable and confident deployment. The levels themselves have been adapted from classical maturity theory [43], [44] and contextualized for SMEs.

III.2 MATURITY LEVELS:

Each component is assessed across four levels of maturity, ranging from limited or uncertain adoption to full capability. The levels are described below:

Maturity Level 1: Uncertain or Limited

Organizations at this level are characterized by limited or no apparent adoption of Lean or Six Sigma. Though one or a few individuals may have former training or exposure from previous work, there is no structured implementation, no formal projects, and limited evidence of LSS-supportive behavior [45]. Resource constraints, management's lack of involvement, and low awareness among employees characteristically suppress any start [17]. This stage resembles the "Initial" level in classic maturity models in that processes are informal and at the mercy of individual effort rather than being systematically practiced [43].

Maturity Level 2: Awareness and Fair

At this stage, SMEs begin to investigate Lean and Six Sigma ideas temporarily. Basic awareness initiatives and introductory training are introduced across the departments, but systematic deployment has not been considered yet [46], [47]. In this context, organizations generally demonstrate poor standardization of processes with fragmented tools [18], [22]. This level matches the “Repeatable/Structured” phase of capability maturity, where the fundamental practices have just started to take shape but remain unstable [44].

Maturity Level 3: Understanding or Good

This level is called as ‘**Understanding or Good**’, because organizations at this level are able to comprehend and acquire new information and techniques. Compared to the previous level, this organization employs more sophisticated tools and approaches for issue resolution and has a greater understanding of LSS at the shop floor level. These organizations have moved past their own inertia in relation to LSS and have become self-learning. SMEs at this level are usually in a position to relate LSS activities to process improvements and operational performance, overcoming initial barriers including resistance from staff and absence of formal training [18],[23]. This level is an indication of increasing organizational capability and learning mindset, aligned with prevailing LSS and maturity model research.

Maturity Level 4: Capability and Certainty

This stage has been named as **'Capability and Certainty'** because organizations at this stage are better equipped to implement LSS than those at previous levels. At this stage, the organization becomes independent because the advantages are clear, and LSS begins to positively alter the organization's culture by putting in place strong infrastructure and internal training [45], [48]. Top management is involved in supporting organizational learning behaviors. SMEs in this stage generally enjoy robust leadership backing, a formal reward scheme, and wide employee engagement, allowing a self-reinforcing culture of constant improvement [17], [18]. This phase reflects the "Optimizing" stage in maturity literature, signaling institutionalized learning and strategic alignment [43].

III.3 SCORING CRITERIA:

Existing Lean Six Sigma readiness models [9],[11],[12],[23] have critical limitations; they are largely descriptive and conceptual in nature, making their practical application for SMEs limited. The present study has overcome such a limitation by adopting a scoring-based framework that converts qualitative organizational characteristics into quantifiable readiness scores. The scoring criteria are adapted from the rubric-based maturity assessment approaches commonly used in several change management and quality management models [49], [50]. Each of the 25 indicators in the proposed model is evaluated using a 0–1 scale, where 0 denotes the practice's absence, and 1 denotes its presence. This approach makes collecting evidence in SMEs easier and is consistent with the maturity evaluation's maximum score of 25. The following formula was used to determine each organization's maturity percentage:

LSS-MI= (Total Score/25) *100

The four maturity levels specified in the model were then mapped to this percentage.

Table 6: Levels of Lean Six Sigma Maturity Using Percentage Scores.

Percentage Score	Maturity Level	Interpretation
0–25%	Level 1:Uncertain or Limited	Minimal awareness; no structured LSS activity
26–50%	Level 2: Awareness and Fair	Basic awareness; inconsistent practices
51–75%	Level 3: Understanding or Good	Structured efforts; moderate tool usage
76–100%	Level 4: Capability and Certainty	Systematic, sustained LSS deployment

Source: Authors, (2026).

This structured scoring approach enhances objectivity, comparability, and practical usability for SME decision-makers.

III.4 STEPS FOR CONDUCTING SELF-ASSESSMENT.

Step 1 – Formation of the Assessment team and Model Briefing.

Performing an LSS readiness self-assessment does require the involvement of the senior management and clarity of purpose. The objective of this stage is to make the executives, managers, and owners understand why the organization is performing the assessment. A cross-functional assessment team should be assembled to perform the assessment. It should include all key operational areas represented, such as production, quality, and maintenance, among others.

Step 2: Data Collection and Preparation

Information collection by the assessment team is done based on the 25 indicators of LSS preparedness. Evidence concerning training records, tool usage, process documentation, employee involvement activities, safety practices, and leadership engagement shall be collected. All information, observations, recordings, and interviews must be impartially recorded.

Step 3: Performing Self-Evaluation for Readiness

The LSS Preparedness instrument in Table 5 is used for the self-evaluation; it has 25 indicators under five dimensions. Against each of the indicators, team members rate an entity a score of 1 (present) or 0 (absent), purely based on verifiable evidence collected in Step 3. All assessors should be asked to apply a common set of rating rules or guidelines for each item to maintain consistency and minimize subjective scoring by any assessor. Evidence may come in the form of—but is not limited to—management and employee interviews, shop-floor observations, training certificates, documented procedures, quality charts, and safety logs.

Step 4: Scoring and Determination of Maturity Level

After all the indicators have been scored, the total is summed (maximum 25). The following formula is then used to convert this score to a percentage:

LSS-MI= (Total Score)/25 *100

Based on the percentage score, each organization's level of preparedness can be determined based on the classification criteria defined in Table 6.

Step 5: Preparation of Findings and Recommendations for Action

The assessment team prepares a concise report that includes the following:

Level of maturity.
Dimension-wise performance.
Critical gaps in capacity, and
Recommended steps for addressing them.

IV. CASE STUDIES

The suggested Lean Six Sigma preparation self-evaluation technique was validated by a multiple-case study involving four SMEs in various manufacturing organizations. A LSS preparedness maturity assessment instrument was applied by each organization to determine the present maturity level through the following percentage score formula:

Percentage = (Total Score/25) × 100

A summary of these four organizations can be found in Table 7.

Table 7: Profile of Case Study Organizations.

Organization	Size	Product	Ownership	Established years
1.	SME	Manufacturer of bolts	Private	12
2.	SME	Die-manufacturing	Proprietorship	18
3	SME	Bath fitting manufacturing	Private	8
4.	SME	Automotive components	Private	19

Source: Authors, (2026).

Case 1: Bolt Manufacturing Firm

Organization 1 produces bolts for both local and export markets through semi-automated production systems. Its main products include standard fasteners, nuts, and High-Tensile Bolts. The firm scored 7/25, which is 28%, hence falling within Level 1: Uncertain or Limited. At this level, most LSS practices are absent, the infrastructure is weak, and there are only a few people with any form of LSS awareness. Top management involvement in and employee engagement with the initiative are at a minimum. Recommended improvement actions:

- Engage a consultancy firm to start basic LSS training.
- Enhance both process- and product-focused improvement activities:
- Introduce basic tools such as Scatter plots, Cause and Effect Analysis, and Pareto charts.
- Implement 5S to organize the workplace.
- Conduct periodic LSS awareness sessions for shop-floor employees.

Case 2: Die Manufacturing Firm

Organization 2 has approximately 100 employees and manufactures precision-machined parts through pressure and gravity die casting. Press tools, Sheet metal dies, forging dies, casting dies, etc., are some of the products of the company. This organization received a score of 11/25, which corresponds to 44% and positions this organization at Level 2: Awareness and Fair. The company shows initial awareness of LSS practices; however, the deployment is inconsistent and lacks a systematic structure.

Case 3: Bath Fittings Manufacturer

Organization 3 is engaged in the manufacturing of Chrome-plated bath fittings. Its products include bathroom accessories, taps, showers, etc. The company has 50 workers. The company scored 12/25, which is equivalent to 48%, and falls into Level 2: Awareness and Fair. The organization demonstrates an elementary knowledge of Six Sigma and Lean, and the application level is limited with inadequate standardization and a lack of management involvement. Improvement actions suggested for Organization 2 and Organization 3:

- Enhance the leadership and participation of the top management in the process of improvement.
- Introduce a wider set of Lean tools and basic statistical tools of Six Sigma.
- Create an official system of rewards and recognition.
- Remove organizational barriers through stronger leadership support.
- Provide external expertise to guide the LSS deployment.
- Improvement initiatives in process stability and product quality.
- Train employees in basic tools.

Case 4: Automotive Components Manufacturer

Organization 4 manufactures commercial and passenger vehicle parts. it is involved in the manufacturing of engine components, transmission parts, suspension parts, brake components, etc. It achieved the highest maturity score from the four cases, reaching 15/25 or 60%, hence placing it at Level 3: Understanding or Good. The enterprise shows stronger infrastructure, better training systems, and more concrete leadership commitment. Improvement activities are more organized, while employees show better tool awareness. Improvement actions recommended:

- Develop and document a formal project selection methodology.
- Expand the application of Six Sigma statistical methods and Lean tools.
- Institutionalize a well-structured reward and recognition system.

Cross-Case Comparison and Insights

These four cases have demonstrated that the proposed model effectively differentiates preparedness levels in SMEs for LSS: Level 1 organizations need basic awareness and infrastructure development. The organizations at Level 2 should institutionalize practices, spread training, and increase engagement at the leadership level. At Level 3, the organizations need to focus on the institutionalization of recognition systems, cross-functional learning, and the use of advanced LSS tools. By applying this maturity model, the SMEs are able to systematically evaluate their readiness, recognize capability gaps, and track their evolution into self-driven Lean Six Sigma organizations. None of the SMEs were able to reach at level 4, as this stage requires a mature organization structure, training systems, strong leadership, and frequent use of advanced tools. Typically, reaching at level 4 requires long-term investments and a sustained improvement culture, a condition that is still challenging for SMEs.

V. CONCLUSION

This research study enhances the LSS discipline by developing an integrated maturity model specifically for SMEs. The model was developed in an attempt to close the research gap, i.e., A lack of a maturity model for Lean Six Sigma, without which organizations implementing LSS cannot measure their existing level of maturity. In order to accomplish this goal, an SLR was done to explore pertinent studies on the application of Lean Six Sigma, its crucial success elements, and its hindrances. Building on these insights, the Lean Six Sigma Maturity Model was created, comprising of several maturity stages, their traits, and scores. The model was later tested and validated by interviews with subject-matter experts and subsequently applied to evaluate the current level of LSS maturity within four organizations. This model can potentially have a substantial impact on practice and knowledge. Nonetheless, it also has certain drawbacks, which are detailed in the following section, along with suggestions for additional improvement in the future.

VI. LIMITATIONS AND FUTURE DIRECTIONS FOR RESEARCH

The research done to develop the self-evaluation model/instrument has some major limitations. Comparatively few semi-structured interviews and workshops were performed. Second, in regard to the model's or instrument's use in only four organizations. Thirdly, the case studies' evaluations of social performance are restricted to the employees. It's possible that the businesses won't disclose their actual social performance regarding issues like employee maltreatment or forced labour, etc. As a result, the social performance outcomes should be interpreted with care. In order to assess whether organizations are prepared to successfully apply Lean Six Sigma, this study suggests a fresh self-evaluation model or tool. Therefore, by identifying the elements that covers a larger scope in the implementation of Lean Six Sigma, outlining problems for businesses, and suggesting the model/instrument, the study has increased knowledge in the field. It can assist practitioners in conducting a diagnostic of needs to make sure that all necessary conditions are met before beginning a Lean Six Sigma journey. It assists in the preparation phase of a Lean Six Sigma transformation, improving the likelihood that such an effort will be successful before a company invests its resources in it. This metric can be used by qualified managers to compare their organization's readiness against others because the established instrument provides a maturity score that indicates how prepared the organization is overall for launching a Lean Six Sigma initiative. The proposed methodology can also be adopted by different business activities to start their Lean Six Sigma journey, including medical, management, the hotel industry, and logistics, even though this study was done in relation to the manufacturing industry.

VII. AUTHOR'S CONTRIBUTION

Conceptualization: Sushil S Mishra and Dr. Ravi Terkar.
Methodology: Sushil S Mishra and Dr. Ravi Terkar.
Investigation: Sushil S Mishra and Dr. Ravi Terkar.
Discussion of results: Sushil S Mishra and Dr. Ravi Terkar.
Writing – Original Draft: Sushil S Mishra.
Writing – Review and Editing: Sushil S Mishra and Dr. Ravi Terkar.
Resources: Dr. Ravi Terkar.
Supervision: Dr. Ravi Terkar.
Approval of the final text: Sushil S Mishra and Dr. Ravi Terkar.

VIII. REFERENCES

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