

Achieving sustainability through the integration of lean, agile, and innovative systems: implications for Indian micro small medium enterprises (MSMEs)

Indian micro
small medium
enterprises

365

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Abstract

Purpose – The purpose of this study is to learn how the incorporation and use of leanness, agility and innovation in Indian manufacturing micro, small and medium enterprises (MSMEs) affect their bottom lines and how much these factors contribute to the MSMEs' ability to meet their long-term sustainability goals.

Design/methodology/approach – The suggested model was subjected to data validation and additional empirical validation using a sample of 411 Indian manufacturing MSMEs. The analysis of construct measures is conducted through the utilization of confirmatory factor analysis, a statistical technique that is grounded in the theoretical framework of structural equation modeling (SEM). In addition, path model analysis was applied for the purpose to validate the assumptions that were included in the structural models.

Findings – Consistent with the proposed model, the findings of this study demonstrate that leanness, agility and innovation have a substantial favorable impact on the sustainability of a company's performance. These findings may be helpful in gaining professionals, academics and policymakers to acknowledge the significance of leanness, agility and innovation in enhancing the long-term sustainability of MSMEs and enhancing the overall performance of a particular company. This research excluded the service industries-based research papers.

Research limitations/implications – Many research in the field of manufacturing industries that have adopted leanness, agility, innovativeness and sustainability as individual approaches or as a collective methodology of two or more were considered in the current study. This research excluded the service industries-based research papers.

Practical implications – This literature review has recognized and analyzed various dimensions and roles of leanness, agility, innovativeness and sustainability that are prevalent in manufacturing industries that include the positive and negative effects on the performance of the industries. The research enlightens the path and shows future directions for research to develop efficient, effective and sustainable manufacturing industries.

Social implications – By promoting the concept of focusing on the “human factor”, namely, stakeholder perspectives, the MSME sector is propagating a strategy that moves away from an excessive focus on technology and toward a more humane one. Through the application of the three key concepts of leanness, agility and innovation, this work aims to create a framework for measuring the sustainability performance of micro-, small- and medium-sized enterprises (MSMEs), with the ultimate goal of assisting the country in achieving the Sustainable Development Goals in the fields of industry, innovation and infrastructure by



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supporting environmentally friendly and resource-conserving businesses that give back to society and the natural environment.

Originality/value – The objective of this research is to assess the importance and effectiveness of integrating various approaches such as leanness, agility, innovativeness and sustainability within the framework of manufacturing micro, small, and medium enterprises (MSMEs). The authors hope that by going further into these concepts, they will be able to broaden their understanding and get a more comprehensive insight into the role that these concepts play and how they might be successfully used within this environment.

Keywords Agile, Lean, Innovative, Sustainability, Organizational performance, MSMEs

Paper type Research paper

1. Introduction

In recent years, there has been a discernible trend in the modern world toward embracing strategies that prioritize sustainability. Companies are forced to relook at and review their operational strategies to remain environmentally amicable, fulfill regulatory requirements and remain sustainable (Bubber *et al.*, 2022; Bubber and Jain, 2022; de Freitas *et al.*, 2017; Shashi *et al.*, 2019). The dominance of small and medium enterprises (SMEs) in any nation's economic prosperity, whether developing or upcoming economies, is a tactical desideratum (Redmond *et al.*, 2016). The aftereffects of globalization have imposed increased strain and remaining competitive is a humongous challenge for micro, small and medium-sized enterprises (MSMEs) in the highly-competitive 21st millennium (Iqbal *et al.*, 2018). Recent decades have witnessed manufacturing industries increasingly embrace and choose approaches such as leanness, innovativeness and agility to be sustainable (Gupta and Jain, 2013; Khalfallah and Lakhal, 2021; Mathiyazhagan *et al.*, 2021; Sánchez *et al.*, 2019).

1.1 Related work

Previous research investigations have emphasized the significant impact of leanness on improving the overall performance of a business. (Naim and Gosling, 2011; Hofer *et al.*, 2012; Narasimhan *et al.*, 2006). Moreover, antecedent studies additionally have accentuated the positive relationship between innovation and organizational performance that further leads to competitive advantage for organizations (Azadegan and Dooley, 2010; Babber and Keshav, 2022; Negrão *et al.*, 2020). Eminently, product, process, organizational and marketing perspectives have all been used to investigate innovativeness in addition to radical or incremental, administrative or technological innovation (Camisón and Villar-López, 2014; Cirera and Muzi, 2020; Kim *et al.*, 2012). Keeping operations management perspectives, this paper contemplates product and process innovativeness as used in manufacturing industries (Shashi *et al.*, 2018; Ramos *et al.*, 2018; Chen *et al.*, 2020; Cirera and Muzi, 2020; Xie *et al.*, 2019). Agility in integration refers to an operational approach adopted by businesses that effectively addresses the volatile demands of customers and the unpredictable dynamics of the market. This is achieved through the implementation of novel manufacturing techniques (Sindhvani and Malhotra, 2018; Vinodh *et al.*, 2016; Kumar *et al.*, 2020; Möldner *et al.*, 2020; Nejatian *et al.*, 2019). Considering a solitary perspective, companies that practice leanness find it arduous to apply agile manufacturing. These conceptualizations acknowledge the notion that businesses capable of simultaneously embodying both leanness and innovativeness exhibit ambidexterity (Abdallah *et al.*, 2019; Maier, 2015). However, ambidexterity has been recognized critically for achieving organizational performance and long-term organizational sustainability goals (He and Wong, 2004).

1.2 Government initiatives to handhold micro, small and medium enterprise

In February 2023, the Government of India (GOI) implemented a revised credit guarantee scheme for MSMEs, which was scheduled to commence on April 1, 2023. This initiative involved the injection of Rs. 9,000 crores (US\$1.09bn) into the scheme's corpus. This proposed scheme would facilitate the provision of an additional Rs. 2 lakh crores (US \$24.41bn) in collateral-free guaranteed credit. Furthermore, it is anticipated that the scheme would result in a reduction of approximately 1% in the cost of credit (Ministry of Finance (01.02.2023) press release).

The GOI proposed a unified Indian Skill Digital Media Platform in its budgetary proposal for the fiscal year 2023–2024. The platform's major objective is to allow demand-based formalized skilling by building links with businesses, especially MSMEs. In addition, the platform aims to provide easier access to entrepreneurial activity schemes. The total grants sanctioned under the Pradhan Mantri MUDRA Yojana (PMMY) initiative is 10.03 million loans, with a disbursed amount of Rs. 73,199.89 crores (equivalent to US\$9.15bn) as of July 8, 2022. In the fiscal year 2022–2023, the Union Budget included an allocation of Rs. 50,000 crores (US\$6.55bn) for the Emergency Credit Line Guarantee Program targeting the MSMEs sector (MSME ANNUAL REPORT 2022–2023).

1.3 Contribution and significance of the study

The primary focus of this paper is to concentrate on the perspective of Indian manufacturing MSMEs where practicing techniques such as leanness, agility and innovativeness are still in their infancy. Consequently, an opportunity arises to explore the influence of these methodologies on the operational performance of Indian MSMEs. Moreover, the outcome of the empirical findings and analysis can be used to raise consciousness among policymakers and top management by enlightening the path of improvement by assisting organizations to reinvigorate ways that help them improve overall performance and achieve sustainable global competitiveness.

1.3.1 Research questions. The present study seeks to address the gaps identified in the literature review and establish the groundwork for our research, which will examine the following research issues.

- RQ1. What are the various leanness and agility practices used in MSMEs and the interrelationship between them?
- RQ2. What effect does leanness have on technical innovation, process innovation and product innovation in MSMEs?
- RQ3. What will be the outcome of sustainability performance using, the leanness, agility and innovativeness of MSMEs?

2. Hypothesis development

Goldsby *et al.* (2006a, 2006b) provides empirical support for the well-established idea of the “leagile” hybrid, which highlights the need to incorporate leanness and agility combined in the research model. In addition, numerous kinds of research that are well-supported combine together leanness and innovation in the research model (Abdallah *et al.*, 2019; Ghobadian *et al.*, 2020). Furthermore, the impact of lean practices and innovative developments on an organization's ecological footprint and bottom line are considered (De *et al.*, 2020; Kumar and Rodrigues, 2020; Abdallah *et al.*, 2019; Dey *et al.*, 2019). The subsequent sections provide

an in-depth assessment of the development of the research's hypotheses in light of these theoretical assumptions (Sakshi *et al.*, 2020).

2.1 Conceptualization

The literature review has given our study a more comprehensive foundation. Overall, seven constructs were identified for the study and their thorough conceptualization is depicted in Figure 1, which also describes the linkages between leanness, agility and sustainability performance among MSMEs.

2.1.1. *Intent of amalgamating leanness into the supply chain.* The term “lean supply chain” implies a systemic approach to managing the distribution of products and services that eliminates waste while improving efficiency. Organizations in a lean supply chain framework collaborate to streamline the distribution of goods and services that engage in the dominant exchange of products, services, finances and information, with the shared objective of minimizing costs and eliminating waste. According to a study carried out by Mollen *et al.* (2010), lean techniques have been implemented on a global scale to effectively manage and synchronize various activities both within and outside of organizations. Lean techniques have historically emerged as a methodology aimed at enhancing the efficiency of the production process.

2.1.2 *Concept of a responsive and agile supply chain.* The term “agility” in the context of the supply chain refers to an organizational approach that places an emphasis on flexibility, responsiveness and adaptability in managing the flow of goods, services and information across the supply chain network. Harrison *et al.* (1996) argue that the origin of flexible supply chains could have been attributable to the acceptance of time as an advantage in the highly competitive business atmosphere. The study conducted by Vecchiato (2015) examined the correlation between commercial insight and a company’s ability to attain

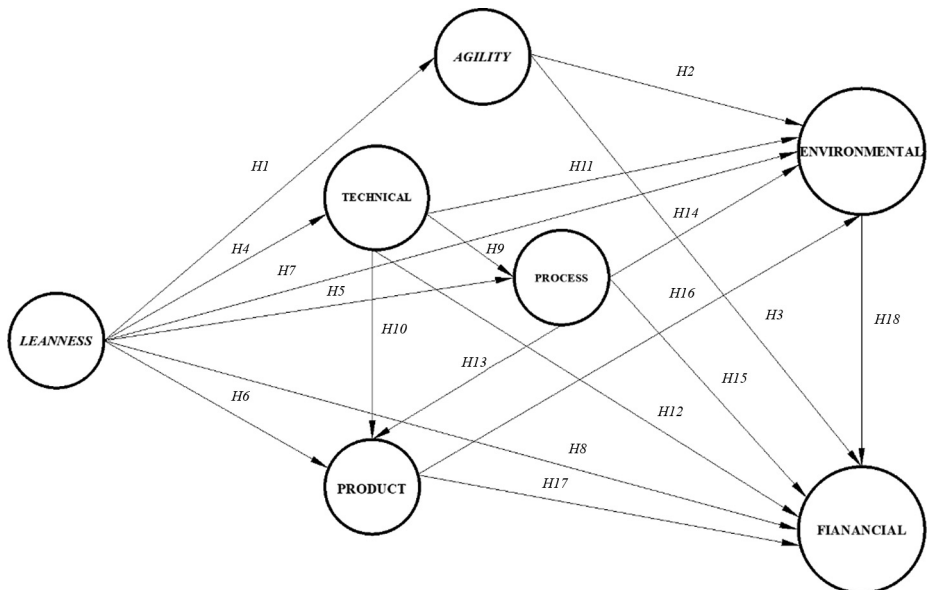


Figure 1.
Comprehensive
proposed model

Source: Authors’ own work

strategic agility. According to the findings of the study, there are three essential components of strategic agility, namely, strategic sensibility, asset mobility and administration unity, played a pivotal role in strengthening interorganizational relationships.

2.1.3 *Integrating sustainability with technical processes leading to product formation* Dangayach and Deshmukh (2003) assert that the economic sector's reforms and global competition have presented Indian manufacturing companies with an opportunity to recognize the significant role of manufacturing. This has served as a catalyst for Indian enterprises to prioritize quality and technology management.

2.2 Aims and objectives of the study

- This research aims to investigate how methodologies like leanness, agility and innovativeness influence the performance of manufacturing MSMEs in India.
- This study intends to comprehensively analyze the collective impacts of integrating leanness, agility, innovativeness and sustainability on the operational performance of MSMEs.
- The primary objective of this research is to do a reliability analysis using established statistical techniques such as exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modeling (SEM). These approaches will be used to evaluate the interrelationships between variables/constructs and their significance within the context of this research investigation.

2.2.1 *Implications of leanness on agility.* Prior studies have identified several distinct design approaches that are mutually incompatible, including efficient vs responsive and lean vs agile. Several academics have proposed the concept of “leagile”, which combines leanness with agility (Ghobakhloo and Azar, 2018; Goldsby *et al.*, 2006a, 2006b; Krishnamurthy and Yauch, 2007; Naylor *et al.*, 1999). Another study conducted by Katayama and Bennett (2023) demonstrated the disparities between lean and agile manufacturing in terms of their relative ramifications and implications. The research offers substantiating evidence for a favorable correlation between leanness and agility, thereby highlighting the need for extended investigation within the realm of MSMEs. Consequently, the subsequent theories have been formulated.

H1. Leanness positively impacts agility.

2.2.2 *Elevating innovations: the transformative power of leanness on technology, process and product frontiers.* The success of any manufacturing industry depends upon the continual augmentation of its operational capabilities. Manufacturing with lean principles has evolved into one of the most trusted strategies for organizational growth (Ghobakhloo and Fathi, 2020; Pearce *et al.*, 2018; Stone, 2012). The effective use of resources helps companies to explore and implement different approaches that help them to enhance their process and product value (Bubber and Jain, 2022; Dey *et al.*, 2019; Jastia and Kodali, 2015; Marodin *et al.*, 2018; Panwar *et al.*, 2018). Furthermore, implementing leanness in an organization supports the development of product and process innovation (Eltawy and Galleary, 2017).

This study examines three dimensions of innovativeness, namely, technological innovativeness, product innovativeness and process innovativeness in the context of manufacturing MSME's perspectives. Considering the operational aspects, process innovation falls within the geographical boundaries of the manufacturing organization. Previous research has stressed the positive relationship between leanness and process innovativeness (Cherrafi *et al.*, 2018; Rahman *et al.*, 2010; Shashi *et al.*, 2019; de Giovanni and Cariola, 2021). Furthermore, product innovativeness, the focus of this approach, is based on

significantly improving the existing products that are technically superior in terms of materials, features and user-friendly that are better than the existing ones based on market feedback (Paladino, 2007; Vega-Jurado *et al.*, 2008; Xie *et al.*, 2019).

The aforementioned research provides evidence that there is a positive correlation between leanness on the use of technology, the ability to innovate in processes and the ability to innovate in products. Consequently, the subsequent hypotheses are formulated.

H2. Leanness has a positive effect on technological innovativeness.

H3. Leanness has a positive effect on process innovativeness.

H4. Leanness has a positive effect on product innovativeness.

2.2.3 Encompassing impact of leanness, agility, innovation and sustainability on the performance of micro, small and medium enterprises. This research work sets out to develop a sustainability performance model for Indian MSMEs, by investigating the impact of concepts of leanness, agility, innovativeness and sustainability performance. While previous works have independently related the concepts of leanness, agility and innovativeness with sustainability (Harvey, 2019; Candra *et al.*, 2022; Dambiski Gomes de Vasquez *et al.*, 2021; Gunasekaran *et al.*, 2019; Lakshmi *et al.*, 2021; Radyanto and Hyati, 2020; Gunasekaran *et al.*, 2019; Sahu *et al.*, 2022; Shrafat and Ismail, 2019; Suguna *et al.*, 2022; Suprapti and Suparmi, 2022; Mathiyazhagan *et al.*, 2021; Dinis-Carvalho *et al.*, 2021). As stated in another research by Rana *et al.* (2023), the significance of quality in services, systems and information impacts the objectives, which in turn has a positive effect on application and aim for a holistic sustainable development. There is a dearth of research searches that have integrated all these concepts into one model and are innovative in their methodology for researching the effects of leanness on agility, agility on innovativeness and performance and innovativeness on performance. Therefore, the following hypothesis is developed:

H5. Leanness has a positive effect on the environmental performance.

H6. Leanness has a positive effect on financial performance.

H7. Agility positively impacts the environmental performance of MSMEs.

H8. Agility positively impacts the financial performance of MSMEs.

H9. Technological innovativeness has a positive effect on process innovativeness.

H10. Technological innovativeness has a positive effect on product innovativeness.

H11. Technological innovativeness has a positive effect on environmental performance.

H12. Technological innovativeness has a positive effect on financial performance.

H13. Process innovativeness has a positive effect on product innovativeness.

H14. Process innovativeness has a positive effect on environmental performance.

H15. Process innovativeness has a positive effect on financial performance.

H16. Product innovativeness has a positive effect on environmental performance.

H17. Product innovativeness has a positive effect on financial performance.

H18. Environmental performance has a positive effect on financial performance.

The inclusion of hypotheses in the present study is characterized by its novelty, as it establishes a link between the results through rigorous experimentation. This entails evaluating the constructs, using standardized ratios for related items and computing Cronbach’s alpha coefficients for assessing the reliability of the research.

3. Research approaches and methodologies

3.1 Instrument design and data gathering

This study investigates the research objectives empirically using a self-designed survey questionnaire. Moreover, the survey questionnaire data is subjected to comprehensive analysis using descriptive statistical techniques such as EFA, CFA and SEM. These analytical tools are used to assess the associations among variables/constructs and their significance in the context of this research study. These methods are chosen because they provide precise information by interlinking constructs based on the testing of the hypothesis. The study has opted to use a Likert scale instrument comprising seven points, wherein the rating scale spans from “1”, signifying strong disagreement, to “7”, representing strong agreement. The aforementioned statements were compiled from the cited resource in [Table 1](#). A survey questionnaire is shown in [Appendix](#).

To ensure the final survey questionnaire was unidimensional, valid and reliable, a comprehensive pilot study was conducted before gathering data. The questions on the survey instrument, which was administered to 725 Indian manufacturing MSMEs, were prepared in writing in both English and bilingual sentences (Hindi) to ensure optimum understanding and clarity. In totality, 432 responses were received. The survey was conducted in the form of a questionnaire, which is attached in [Appendix](#) at the end of this article. In continuation of the analysis, a total of 21 responses were excluded from consideration due to zero deviation, resulting in a final sample size of 411 valid responses having a response rate of 59.5%. Similar studies in the past have been conducted with a 56.3% response rate ([Shashi et al.,2019a](#)). [Basu et al. \(2021\)](#) conducted a 57.92% response rate and a study with a response rate of 36.75% was also conducted ([Centobelli et al., 2021](#)).

[Table 2](#) summarizes the experience characteristics of respondents and [Table 3](#) abridges the qualification of the respondents.

3.2 Bias due to nonresponses and bias due to common methods

To confirm the reliability of outcomes, a test for nonresponse bias was conducted. With the application of a *t*-test, the difference between the first responses received and the final ones received (39 received responses) was evaluated. From the previous literature, looking at the *p*-value for the significance threshold being ≤ 0.05 , therefore, the difference between the two

Constructs	Source reference
Leanness	(Shah and Ward, 2007; Shashi et al., 2019b ; Yu et al., 2020)
Agility	(Bouguerra et al., 2021 ; Jadoon et al., 2020 ; Sharifi and Zhang, 2001)
Technical innovativeness	(Rahman et al., 2019 ; Santos-Vijande and Álvarez-González, 2007 ; Yu et al., 2020)
Process innovativeness	(Gunday et al., 2011 ; Kahn, 2018 ; Shashi et al., 2019a)
Product innovativeness	(Gunday et al., 2011 ; Xie et al., 2019)
Environmental performance	(Caldera et al., 2017 ; Iranmanesh et al., 2019 ; Sadiq et al., 2021)
Financial performance	(Paladino, 2007 ; Palange and Dhattrak, 2021)

Source: Authors’ own work

Table 1.
Constructs and
source reference

groups is statistically significant (Shashi *et al.*, 2019; Bubber and Jain, 2022). The results of the *t*-test revealed that there was no notable difference between the responses collected in the early and later stages ($p > 0.05$). Therefore, there was no cause for worry regarding nonresponse bias in our investigation (Armstrong and Overton, 1977; Prahinski and Benton, 2004). Subsequently, an evaluation of potential common method bias was undertaken using Harman’s one-factor test, as recommended by Podsakoff *et al.* (2003) and Harman (1976). EFA was performed on each and every item in the study, and the results revealed that there was a variation of 70.74% among the seven factors that were identified. Because it is less than 50% of the overall variance, the first extracted component only described 42.894% of it (Ghosh and Jhamb, 2021). The outcome does not account for most of the variance that may be explained. Consequently, the absence of common method bias was established in the present research.

4. Outcome from data analysis

4.1 Validity and reliability assessments

As elucidated in established scholarly literature, it is critical to ascertain the reliability and validity of the conceptual framework prior to proceeding with the examination of the final hypotheses (Centobelli *et al.*, 2021; Jhamb *et al.*, 2022).

4.1.1 Reliability analysis of constructs and items. To achieve the objective of assessing construct reliability (CR), the metrics of composite reliability and Cronbach’s alpha (α) were examined. As stated by Nunnally (1978) and Fornell and Larcker (1981), the CR value for each construct must have to be >0.70 . As stated in Table 4, all seven constructs have CR values that are >0.7 , which demonstrates that they have adequate empirical features. The threshold for the item loading is typically set at >0.6 (Hair *et al.*, 2010). In addition, the value of Cronbach’s alpha (α) should surpass a minimum of 0.7, according to guidelines by

Table 2.
Respondent’s
experience

Respondent’s experience	No of responses	Percentage of responses (%)
0–5 years	63	15.5
6–10 years	63	15.5
11–15 years	75	18
16–20 years	56	14
21–25 years	66	16
26 and above	88	21
	411	

Source: Authors’ own work

Table 3.
Respondent’s
qualification

Respondent’s qualification	No of responses	Percentage of responses (%)
Diploma	97	24
Graduate	194	47
Post graduate	87	21
Doctoral	1	0.25
Others	32	7.75
	411	

Source: Authors’ own work

Table 4.
Standardized items
loading for each
construct

Construct	Item	Item loadings	Cronbach's alpha
Operational lean practices	LE1	0.880	0.920
	LE6	0.868	
	LE2	0.858	
	LE7	0.835	
	LE5	0.820	
Proactive lean practices	LE9	0.776	0.915
	LE10	0.907	
	LE3	0.903	
	LE8	0.871	
	LE4	0.863	
Agility practices	AG1	0.746	0.864
	AG2	0.716	
	AG3	0.540	
	AG4	0.604	
	AG5	0.635	
Technical innovation	TI1	0.804	0.942
	TI2	0.809	
	TI3	0.782	
	TI4	0.839	
	TI5	0.831	
Process innovation	PR1	0.788	0.920
	PR2	0.825	
	PR3	0.605	
	PR4	0.770	
	PR5	0.709	
	PR6	0.685	
Product innovation	P1	0.807	0.921
	P2	0.732	
	P3	0.690	
	P4	0.778	
	P5	0.802	
Environmental performance	EP1	0.755	0.948
	EP2	0.791	
	EP3	0.743	
	EP4	0.813	
	EP5	0.783	
	EP6	0.576	
	EP7	0.708	
	EP8	0.725	
Financial performance	FP1	0.785	0.925
	FP2	0.701	
	FP3	0.832	
	FP4	0.798	
	FP5	0.750	

Source: Authors' own work

Cerchione *et al.* (2018) and Ghosh *et al.* (2022). Such numbers are seen in the references listed below. Moreover, as depicted in Table 2, all item loadings exceeded the threshold of 0.6, meeting the minimum criteria. In addition, the Cronbach's alpha (α) values for each variable comfortably surpassed 0.7, in accordance with the standards established by Nunnally (1978) and Jhamb and Mittal (2022).

4.1.2 Establishing convergent and discriminant validity. A study by Fornell and Larcker (1981) proposed the following for each element to test convergent validity: items loading >0.6 , CR > 0.7 and AVE > 0.5 . Tables 4 and 5 indicate loadings >0.6 , CR > 0.7 and average variance extracted (AVE) scores >0.5 for all variables. These findings demonstrate model convergence. We used Hair *et al.* (2010) guidelines for discriminant validity: The concept of discriminant validity requires that the maximum shared variance (MSV) be less than the AVE and that the square root of AVE exceeds the interconstruct correlations. As seen in Table 5, the AVE values and their respective square roots exhibit superior values compared to both the MSV values and the correlations across constructs. This compellingly supports the notion of discriminant validity. To evaluate the adequacy of the confirmatory model in relation to predetermined benchmarks, a variety of metrics were used: According to Hair *et al.* (2010), it is recommended that the CMIN/DF ratio should be less than 3. In addition, the goodness-of-fit index (GFI), incremental fit index (IFI), Tucker–Lewis index (TLI) and comparative fit index (CFI) should all surpass a value of 0.9. Finally, the root mean square error of approximation (RMSEA) should be lower than 0.05. The results indicated a satisfactory model fit, as evidenced by the CMIN/DF value of 1.77, GFI value of 0.909, IFI value of 0.948, TLI value of 0.941, CFI value of 0.947 and RMSEA value of 0.045. The results indicate that the suggested model is very suitable for further structural testing.

4.2 Hypothesis validation

The present research adopted the SEM methodology to evaluate the significance of the relationships between independent and dependent components. The model is depicted in Figure 2, using the methodology of SEM. Prior to presenting the findings of the SEM analysis, the adequacy of the model fit was assessed and afterward validated. This was accomplished by examining several fit indices, including the CMIN/DF ratio of 1.406, the GFI value of 0.879, the IFI value of 0.977, the TLI value of 0.975, the CFI value of 0.977 and the RMSEA value of 0.031 (Hair *et al.*, 2010; Cerchione *et al.*, 2018). The findings of hypothesis testing are presented in Table 5, demonstrating that out of all of the 18 research hypotheses put up, 17 were confirmed by the data. Below, a comprehensive analysis of the hypothesis-testing findings is presented.

4.2.1 Hypothesis testing results for Objective 1. Furthermore, the regression results of the path between leanness and agility have been presented in Table 6. As the effect size for both paths is close to 0.06, this indicates that the strength of the relationship is moderate. Given that the p -value is lower than the predetermined level of significance, it may be concluded that both hypotheses proposed by the routes are substantiated.

As the critical ratio for both paths is more than 1.96 and the p -value is less than 0.05 level (***) indicating p -value smaller than 0.001) of significance, this implies that both paths and relationships are significant. Estimates depict the regression weight or the measure of the direct effect of a given variable on another. As the tabulated estimate value suggests, the effect of operational leanness on agility is greater than the effect of proactive lean on agility.

4.2.2 Hypothesis testing results for Objective 2. Furthermore, the regression results of the paths between both types of leanness and three types of innovativeness have been presented in Table 4. All paths have effect sizes ranging close to 0.04, indicating that there exists a moderate level of association between all three types of innovation and the two categories of leanness (Fritz *et al.*, 2012). Moreover, all of the hypotheses outlined by these pathways are corroborated, given that the p -value is lower than the predetermined level of significance (when indicated by *** implies that the p -value is smaller than 0.001). As the critical ratio for all the paths is more than 1.96 and the p -value is below the significance level of 0.05 (***) indicating p -value smaller than 0.001), this implies that all these paths and the relationships specified by them are significant.

	CR	AVE	MSV	Financial performance	Operational lean	Proactive lean	Technological innovation	Product innovation	Process innovation	Agility	Environmental performance
Financial performance	0.926	0.715	0.664	0.845							
Operational lean	0.922	0.663	0.460	0.578	0.814						
Proactive lean	0.916	0.733	0.350	0.565	0.274	0.856					
Technological innovation	0.943	0.766	0.666	0.815	0.678	0.531	0.875				
Product innovation	0.922	0.702	0.613	0.783	0.599	0.592	0.746	0.838			
Process innovation	0.922	0.664	0.599	0.755	0.548	0.588	0.710	0.774	0.815		
Agility	0.864	0.563	0.314	0.560	0.472	0.347	0.414	0.527	0.514	0.750	
Environmental performance	0.949	0.700	0.666	0.797	0.534	0.526	0.816	0.754	0.709	0.406	0.836

Source: Authors' own work

Table 5.
Reliability and
validity analysis

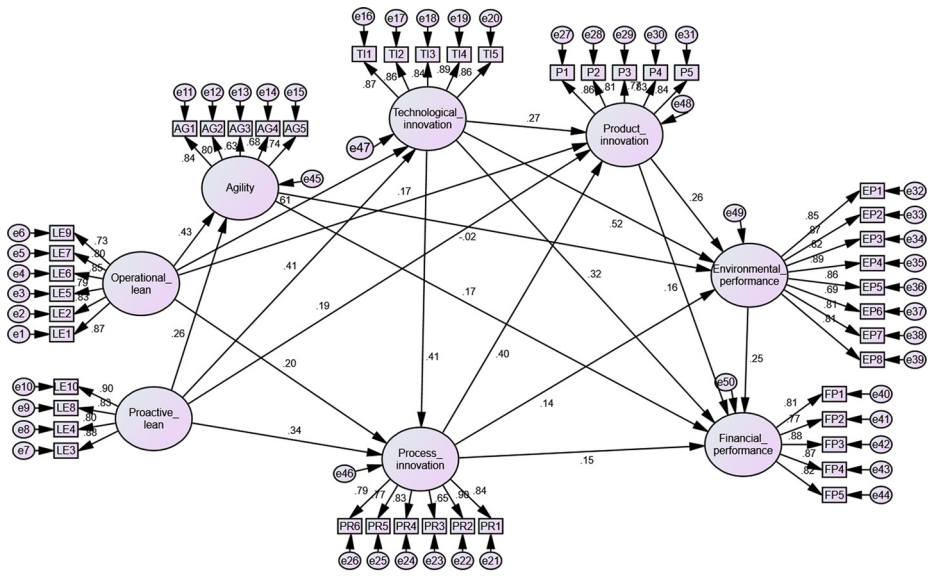


Figure 2.
Structural model

Source: Authors' own work

Table 6.
Hypothesis testing
results – Objective 1

Hypothesis (H1)	Estimate	Standardized effect	Critical ratio	p-value	Remark
Agility ← Operational lean	0.428	0.064	6.697	***	Supported
Agility ← Proactive lean	0.225	0.062	3.615	***	Supported

Source: Authors' own work

Table 7.
Hypothesis testing
results – Objective 2

Hypothesis	Estimate	SE	CR	p	Remarks
Product innovation ← Operational lean	0.503	0.041	12.358	***	Supported
Process innovation ← Operational lean	0.423	0.039	10.947	***	Supported
Process innovation ← Proactive lean	0.438	0.037	11.867	***	Supported
Product innovation ← Proactive lean	0.460	0.038	12.165	***	Supported
Technological innovation ← Operational lean	0.606	0.042	14.300	***	Supported
Technological innovation ← Proactive lean	0.385	0.036	10.641	***	Supported

Source: Authors' own work

The estimates depict the regression weight or the measure of the direct effect of a given variable on another. Estimates suggest that the impact of operational leanness on technological innovation is strongest and is least on process innovation.

4.2.3 Hypothesis testing results for Objective 3. The relationship between the constructs to develop sustainability performance model for MSMEs has been examined through analysis of the structural model in Figure 2, which aids in hypothesis testing. The present

Table 8.

Hypotheses testing
results – Objective 3

Hypothesis	Estimate	SE	CR	<i>p</i>	Remarks
Technological innovation ← Proactive lean	0.372	0.038	9.906	***	Supported
Technological innovation ← Operational lean	0.582	0.043	13.549	***	Supported
Process innovation ← Technological innovation	0.373	0.057	6.574	***	Supported
Process innovation ← Proactive lean	0.280	0.040	7.031	***	Supported
Process innovation ← Operational lean	0.176	0.048	3.656	***	Supported
Product innovation ← Technological innovation	0.257	0.057	4.484	***	Supported
Product innovation ← Process innovation	0.422	0.060	7.058	***	Supported
Agility ← Operational lean	0.453	0.055	8.235	***	Supported
Agility ← Proactive lean	0.265	0.050	5.256	***	Supported
Product innovation ← Proactive lean	0.168	0.041	4.145	***	Supported
Product innovation ← Operational lean	0.157	0.047	3.351	***	Supported
Environmental performance ← Process innovation	0.157	0.060	2.622	0.009	Supported
Environmental performance ← Product innovation	0.262	0.061	4.265	***	Supported
Environmental performance ← Technological innovation	0.511	0.055	9.373	***	Supported
Environmental performance ← Agility	0.022	0.032	0.680	0.497	Rejected
Financial performance ← Process innovation	0.143	0.051	2.814	0.005	Supported
Financial performance ← Agility	0.137	0.028	4.972	***	Supported
Financial performance ← Technological innovation	0.281	0.052	5.370	***	Supported
Financial performance ← Environmental performance	0.219	0.053	4.137	***	Supported
Financial performance ← Product innovation	0.147	0.053	2.770	0.006	Supported

Source: Authors' own work

structural model delineates the correlation between leanness and its consequential influence on agility and innovativeness, as well as the subsequent impact of agility and innovativeness on the sustainability performance of micro, small and medium enterprises. All these constructs are treated as latent variables and their measurement items as observed variables. The structure of all the constructs and their relationship with corresponding measurement items is further validated by significant path coefficients indicated in this model.

Table 6 presents a comprehensive overview of the regression outcomes pertaining to the relationships among the latent variables that were postulated in the construction of the sustainability performance model. According to the tabulated *p*-value, only the pathways with a *p*-value less than 0.05 (the anticipated level of significance) are considered statistically significant. There is only one hypothesis that has been rejected based on this criterion, namely, impact of agility on environmental performance. The remaining paths are acceptable with *p*-values less than the level of significance. Effect sizes further provide insight into the strength of the relationship between different latent variables. According to Fritz *et al.* (2012), the strength of the impact is classified into three categories: weak, moderate or strong. These categories are determined based on the effect size values, which range from 0.02 to 0.04 for weak, 0.04 to 0.06 for moderate and 0.06 and higher for strong. The critical ratio values further assert the significance of these paths, as all the accepted paths have a CR value of more than 1.96. Estimates depict the regression weight, which is the magnitude of the impact of one variable on another. As the estimated value increases, so does the magnitude of the influence observed between the two variables.

This discussion will focus on the impact of agility on sustainability performance and different types of innovation on performance, as the remaining hypothesis have already been discussed in the previous sections. Furthermore, it should be noted that the variable of agility does not exert any influence on the environmental performance of MSMEs. However,

it does exhibit a noteworthy and statistically significant effect on the financial performance of such enterprises. Nurjaman *et al.* (2021), note that by prompting firms to replace outdated technologies and ensuring coordination and internal alignment in firms to provide a quick and dynamic response, agility positively affects the firm's performance. By emphasizing sensing and responding, agility enables firms to gain a competitive advantage that critically affects their business performance, thereby increasing financial revenues (Kale *et al.*, 2019). Especially, driving the focus toward the volatility, uncertainty, complexity and ambiguity environment, Troise *et al.* (2022) propound that in small- and medium-scale enterprises, agility positively impacts both the financial and innovation performance of the firms. Specifically, the authors demonstrate that agility influences product and process innovation (Aghina *et al.*, 2022). Their McKinsey report state that agility leads to better customer satisfaction, employee engagement and operational performance, all three of which increase the financial performance of the firms, primarily through cost reduction. Wen *et al.* (2021) argue that agility will lead to environmental performance enhancement only when firms commit to introducing front-end cleaner production technologies. Therefore, as this work proves, prior works also agree that the effect of agility on environmental performance is unclear and that the agility of firms will create environmental impact only when firms collaborate to achieve environmental success as a goal (Bouguerra *et al.*, 2021; El-Khalil and Mezher, 2020). Summarizing, prior literature supports the findings of this work that agility positively affects financial performance, whereas the effect on environmental performance is not realized.

Relating innovation with the financial performance of MSMEs, this work deduces that technological innovation contributes to the highest financial performance, followed by product and process innovation, sorting them by their regression weights. Akinwale (2020) also agrees with these findings, asserting that innovation becomes a valuable resource, especially during times of crisis. Supriadi and Arieftiara (2022) also note that innovating technologically such as adopting digitization in business ensures business success through improvement in the financial performance of these businesses. Moreover, globalization causing worldwide integration of markets, dynamic changes in technologies and dwindling product lifecycles have necessitated MSMEs to adopt innovative practices to sustain themselves, especially technological innovation that leads to sustainability performance enhancement across all three dimensions as per the study conducted by Khurana *et al.* (2019), which analyzed the performance of enterprises in terms of their social, environmental and financial aspects. Furthermore, the purpose of process innovation is to reduce cost, improve product quality and upgrade products as per varying customer requirements, consequently leading the firms to deliver better and efficiently, thereby aiding the firms to attain competitive advantage and sustain by ensuring improved financial inflows (Yu *et al.*, 2019; Centobelli *et al.*, 2018; de Muharram *et al.*, 2020; Oliveira *et al.*, 2018). Therefore, it can be clearly said that process innovation leads to better financial performance. Also, product innovation practices in MSMEs ensure financial performance success, because it makes the company's products up-to-date as per the latest market requirements, ensures the dependability of the firm and creates market support for the company's product (Akinwale, 2020; Centobelli *et al.*, 2018; Lussak *et al.*, 2020; Nandal *et al.*, 2021).

Khurana *et al.* (2019) posit and present evidence through literature support that technological innovation is becoming an essential element for MSMEs to ensure sustainability performance in all three aspects, namely, social, environmental and financial, as outlined by triple bottom line (TBL), especially as environmental concerns have gained global attention and are also part of the United Nations Sustainable Development Goals. Product and process innovations can be adapted for achieving sustainability in SMEs (Dambiski Gomes de

Carvalho *et al.*, 2021), however, this requires the presence of key enablers such as information, skills and networking, among others. Achi *et al.* (2022) also demonstrate that corporate social responsibility practices alone cannot foster the performance of MSMEs, especially in the environmental domain, these practices need to be channeled through innovation such as the adoption of green processes. When firms innovate to make the business sustainable, it heavily relies on integration and collaboration along the supply chain such as among suppliers, internal departments and so on, paving the way for environmental collaboration, thereby increasing the environmental performance of the firms (Bouguerra *et al.*, 2021). This proposition that different types of innovations in MSMEs contribute to the environmental performance of firms has also been agreed upon by prior research works (Centobelli *et al.*, 2018; Gani *et al.*, 2022). As Astadi *et al.* (2022) note that although the path to achieving green economy performance for MSMEs is long, the journey has already begun, and through the adoption of green processes, manufacturing green products and technologies, which are environmentally friendly and create less damage to the environment, firms can ensure environmental performance and sustainability of the society. Finally, environmental performance positively impacts the financial performance of the firms. As global firms are oriented to protect and sustain the environment for future generations, basis TBL, firms are now including social and environmental aspects in their economic performance (Khurana *et al.*, 2019). Therefore, it is not a novel insight that firms that gain status as better environmental performers would also be reaping higher financial benefits. However, it is important to note that this relationship is generally U-shaped (Nguyen, 2022), that is, in the beginning, environmental performance would incur more costs than benefits, however, in the long run, the benefits will outweigh the costs due to increase in market value and corporate image of the firm.

5. Conclusions

The purpose of this research was to examine the links between leanness, agility, innovation and the long-term sustainability of Indian manufacturing MSMEs. To emphasize the critical importance of leanness, agility and innovation in obtaining optimum sustainable performance, a conceptual model was established and subsequently verified by gathering and analyzing data from a sample of senior managers, owners and supervisors working in industrial firms situated in the northern region of India. After providing a concise overview of the theoretical and practical implications of our research findings, we put up recommendations for further research.

5.1 Theoretical implications

The sustainable performance of MSMEs has been investigated in previous research by applying various theoretical models. Sahu *et al.* (2022) used behavioral reasoning theory to establish the role of lean manufacturing practices in achieving sustainable performance of these firms, it is witnessing slow adoption in the sector owing to the attitude and behavioral intentions of MSME employees toward such practices. Octasyva *et al.* (2022), in their research, used dynamic capability theory to investigate the effect of innovativeness on the sustainable performance of MSMEs, in which innovativeness is measured from the entrepreneurs' orientation toward the same. Furthermore, the human capital theory has been used to investigate and deduce that is essential to develop human resources for the deployment of agile and lean practices in firms to ensure sustainable performance (Maheshwari *et al.*, 2020; Onyeje *et al.*, 2022). The resource-based view theory has found ample application in studies involving the sustainable performance of MSMEs (Arora and Siddiqui, 2022; Kustiningsih *et al.*, 2022; Sunargo, 2022) to explain the role of strategic utilization of resources. Also, ecological modernization theory has also been applied to

advocate the use of soft technologies and socio-technical innovation, in addition to 3R involving recycling, reuse and renewable resources concept of circular economy to promote the ecologically sustainable economic growth of the firms (de Sousa Jabbour *et al.*, 2020; Martínez-Ros and Kunapatarawong, 2019; Suherlan and Widiyanti, 2021).

Although these theories have been useful in explaining different aspects of the sustainable performance of MSMEs such as human issues, resource utilization and so on, a single theory will not be sufficient to provide a basis to explain how leanness, agility and innovation in MSMEs can create sustainable performance in terms of financial and environmental performance dimensions. As the focus of the current work is to investigate how innovation and agility contribute to the creation of sustainable performance of MSMEs and how leanness practices relate to the agility of these enterprises, therefore this work adopts a multi-theory approach. At the beginning of the work, a deductive approach was assumed such that all hypotheses, facts and testing were done to confirm the theoretical basis laid down at the beginning, which is the “Resource-based view (RBV)” and “Ecological Modernization theory”.

5.2 Limitations and future research directions

A major limitation of this work is the use of self-reported data. Prior works also indicate that self-reporting presents bias such as cognitive bias in the studies, also marred by personal judgments (Nordhagen, 2022). In addition, it may also be marred by social desirability bias (Talwar *et al.*, 2021). Future works may model actual or observed behavior to overcome this limitation as this work used a questionnaire to conduct a survey, which contained measures and statements adapted from previous studies. The role of demographics in understanding the perspectives of stakeholders in MSMEs has not been studied in this work, whereas Eijdenberg (2019) in the research noteworthy states that sociodemographic characteristics significantly contribute to the comprehension of the sustainable performance of MSMEs.

This work used quantitative data to investigate and report the perceptions of MSME stakeholders. However, many prior works used qualitative data such as case studies to understand sustainability can be achieved in MSMEs (Badoc-Gonzales *et al.*, 2021). Similarly, thematic analysis or frequency analysis, or inferential analysis, has been carried out in prior works to conduct a literature review and extract meaningful themes relating MSMEs with sustainable performance (Dambiski Gomes de Carvalho *et al.*, 2021; Hattimbire and Harkal, 2022). Maheshwari *et al.* (2020) also collected interview data to understand the role of human resources in achieving sustainable performance or identify key enablers for success using expert opinions (Ghadimi *et al.*, 2021). Future works may supplement the investigations by gauging expert opinions and using qualitative data.

Besides this work was carried out during the period of COVID-19 pandemic, however, no research proposition in this work addresses the impact of the pandemic on the adoption of leanness, agility and innovation practices in MSMEs. Neither the impact of a pandemic on sustainability has been assessed in this work. Competition stiffened during a pandemic and the situation was tougher for MSMEs than multinational firms, how they navigated through this crisis to sustain their performance has been investigated by (Affandi *et al.*, 2020).

Aghina *et al.* (2020) have observed that this concept of agility has significant impacts on several facets of an organization, among which are customer satisfaction, employee engagement, operational performance and financial performance. Although the last two have been accounted for in this work, the author suggests that organization-wise variation in these outcomes may be observed. Therefore, future works may inculcate comparative research to understand the impact of agility on different industrial sectors. Furthermore, comparative works may include a comparison of MSMEs with environmental orientation

and without understanding how it affects sustainability. Besides, the drivers and challenges of adopting leanness, agility and innovation in MSMEs can also be considered as future research avenues (Dambiski Gomes de Carvalho *et al.*, 2021).

5.3 Contributions made by research

- Covers the scenario of MSMEs at the national as well as international levels.
- Inculcate studies related to MSMEs to examine relationships between agility, leanness and innovative practices within the MSMEs.
- Investigated different theoretical implications to understand different aspects of sustainable performance within MSMEs.

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SECTION –I

Please tick the appropriate option most representative to you and your company.

Your Company's classification as per Micro, small, medium enterprises (MSME) act amendment 2020

- Micro (Investment <1Crore or turnover <5 Crore) []
- Small (Investment <10Crore or turnover <50 Crore) []
- Medium (Investment <50Crore or turnover <250 Crore) []

Type of Industry

- Chemicals []
- Food products and beverages []
- Machinery and equipment []
- Materials and metal products []
- Motor vehicle and transport equipment []
- Plastic products []
- Textile []
- Wood Products []
- Automobile parts manufacturing []
- Forging and casting []
- Others []

Number of employees

- Up to 10 []
- 10–50 []
- 51–100 []
- 101–500 []
- Above 500 []

Respondent's qualification

- Diploma []
- Graduate []
- Post graduate []
- Doctoral []
- Others []

Respondent's position

- General Manager/Owner/Proprietor/Partner/Director []
- Shop floor In charge/Shift In charge/Foreman []
- Production/Operations manager []
- Purchasing/Procurement manager []
- Sales/Distribution manager []
- Supply chain director []
- Senior Manager/other position []

Respondent's experience

- Up to 5 years []
- 6-10 years []
- 11-15 years []
- 16-20 years []
- 21-25 years []
- Above 25 years []

(continued)

SECTION –II

Key word with meaning

Leanness: *It is a business ideology that is based on techniques that identify and eliminates wastes from operations through continual improvement initiatives, and competitiveness strategy to maximize value by working efficiently, and effectively, and focusing strategically to satisfy the wants of the customer through delivering improved product and services.*

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Leanness: यह एक व्यावसायिक विचारधारा है जो ऐसी तकनीकों पर आधारित है जो निरंतर सुधार पहलों के माध्यम से और संचालन से waste को पहचानती है और कुशलतापूर्वक, प्रभावी ढंग से और रणनीतिक रूप से कम कर के ग्राहक को बेहतर उत्पाद और सेवाओं की इच्छाओं को पूरा करती है।

Lean practices: Please indicate the extent to which you disagree or agree that your company has implemented each of the following measures on a seven-point scale (1 = Strongly disagree, 2 = Disagree, 3 Somewhat disagree, 4 = Neither agree nor disagree, 5 = Somewhat agree, 6 = Agree, 7 = Strongly agree)

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = अत्यधिक असहमत, 2 = असहमत, 3 कुछ हद तक असहमत, 4 = न सहमत न असहमत, 5 = कुछ हद तक सहमत, 6 = सहमत, 7 = पूरी तरह सहमत)]

Code	Measure	1	2	3	4	5	6	7
LE1	Our company uses lean concepts like Kanban/Milk-Run/Supermarket for supply chain management. [हमारी कंपनी आपूर्ति श्रृंखला प्रबंधन के लिए कानबन / मिल्क-रन / सुपरमार्केट जैसी लीन अवधारणाओं का उपयोग करती है।]							
LE2	Our company's key suppliers deliver products to our plant on a just-in-time basis as per pull-based strategy. [हमारी कंपनी के प्रमुख आपूर्तिकर्ता सही समय पर पुल (Pull)-आधारित रणनीति के अनुसार उत्पाद वितरित करते हैं।]							
LE3	Our company directly links the pace of production to the rate of customer demand (Takt time). [हमारी कंपनी सीधे उत्पादन की गति को ग्राहक की मांग की दर (Takt time) से जोड़ती है।]							
LE4	Our company classifies products into groups (same family type) with similar routing requirements through integrated and collaborative engineering systems.							

(continued)

	[हमारी कंपनी एकीकृत और सहयोगी इंजीनियरिंग प्रणालियों के माध्यम से उत्पादों को समान रूटिंग आवश्यकताओं के साथ समूहों (Same family type) में वर्गीकृत करती है।]						
LE5	Our company uses tools like fishbone diagrams, and why-why analysis aided by collaborative engineering systems to identify root causes and eliminate defects in quality-related issues. [हमारी कंपनी मूल कारणों की पहचान करने और गुणवत्ता संबंधी मुद्दों में दोषों को खत्म करने के लिए फिशबोन आरेख (Fishbone diagram), क्यों-क्यों विश्लेषण (Why-why analysis) सहयोगी इंजीनियरिंग प्रणालियों द्वारा सहायता प्राप्त जैसे उपकरणों का उपयोग करती है।]						
LE6	Our company monitors the majority of equipment/processes on shop floor through applicable tools of statistical process control. [हमारी कंपनी सांख्यिकीय प्रक्रिया (Statistical process control) नियंत्रण के लागू साधनों के माध्यम से शॉप फ्लोर पर अधिकांश उपकरणों/प्रक्रियाओं की निगरानी करती है।]						
LE7	Our company conducts process capability studies (C_p & C_{pk}) before product launch and mass production. [हमारी कंपनी उत्पाद लॉन्च और बड़े पैमाने पर उत्पादन से पहले प्रक्रिया क्षमता अध्ययन (C_p & C_{pk}) आयोजित करती है।]						
LE8	Our company takes feedback from customers on delivery and quality performance. [हमारी कंपनी डिलीवरी और गुणवत्ता प्रदर्शन पर ग्राहकों से फीडबैक लेती है।]						
LE9	Our company regularly conducts audits at our supplier end. [हमारी कंपनी नियमित रूप से हमारे सप्लायर एंड पर ऑडिट करती है।]						
LE10	Our company continues to develop and adopts techniques to improve and reduce production costs.						

(continued)

[हमारी कंपनी उत्पादन लागत को सुधारने और कम करने के लिए तकनीकों का विकास और अपनाना जारी रखती है।]									
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Key word with meaning

Agility: *Agile manufacturing or agility is an operational approach practiced by organizations that are able to respond quickly to volatile customer needs and market uncertainties through the demonstration of innovative manufacturing processes/practices, superior tooling, and better cross-trained employees, all working efficiently focusing on superior quality at lower costs.*

Agility: फुर्तीली निर्माण पद्धति या चपलता संगठनों द्वारा अभ्यास किया जाने वाला एक परिचालन दृष्टिकोण है जो ग्राहकों की अस्थिर जरूरतों और बाजार की अनिश्चितताओं का जल्दी से प्रतिक्रिया करने के लिए और जवाब देने में सक्षम है जोकि नवीन निर्माण प्रक्रियाओं/प्रथाओं, बेहतर टूलिंग और प्रशिक्षित कर्मचारियों के प्रदर्शन के माध्यम से कुशलतापूर्वक बेहतर गुणवत्ता और कम लागत पर ध्यान केंद्रित करता है।]

Agile practices: Please indicate the extent to which you disagree or agree that your company has implemented each of the following measures on a seven-point scale (1 = Strongly disagree, 2 = Disagree, 3 Somewhat disagree, 4 = Neither agree nor disagree, 5 = Somewhat agree, 6 = Agree, 7 = Strongly agree).

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = अत्यधिक असहमत, 2 = असहमत, 3 कुछ हद तक असहमत, 4 = न सहमत न असहमत, 5 = कुछ हद तक सहमत, 6 = सहमत, 7 = पूरी तरह सहमत)]

Code	Measure	1	2	3	4	5	6	7
AG1	Our company reacts quickly to incorporate changes into its manufacturing processes and systems based on customer feedback. [हमारी कंपनी ग्राहकों की प्रतिक्रिया के आधार पर अपनी निर्माण प्रक्रियाओं और प्रणालियों में बदलावों को शामिल करने के लिए तुरंत प्रतिक्रिया करती है।]							
AG2	Our company has the appropriate dynamic capabilities in manufacturing, delivering and order processing that helps to quickly respond to uncertainties in customer demand. [हमारी कंपनी के पास विनिर्माण में गतिशील क्षमताएं, वितरण और ऑर्डर प्रोसेसिंग में उपयुक्त गतिशील क्षमताएं हैं जो ग्राहकों की मांग में अनिश्चितताओं का तुरंत जवाब देने में मदद करती हैं।]							

(continued)

AG3	Our company can quickly get new products to market. [हमारी कंपनी जल्दी से नए उत्पादों को बाजार में ला सकती है।]							
AG4	Our company managers have the knowledge and skills necessary to manage agile manufacturing. [हमारी कंपनी के प्रबंधकों के पास फुर्तीली निर्माण का प्रबंधन करने के लिए आवश्यक ज्ञान और कौशल है।]							
AG5	Our company's key suppliers are located in close proximity to our plant. [हमारी कंपनी के प्रमुख आपूर्तिकर्ता हमारे संयंत्र के निकट स्थित हैं।]							

Key word with meaning

Innovativeness: *Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, services, or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.*

Innovativeness: नवप्रवर्तन एक बहु-स्तरीय प्रक्रिया है जिसके द्वारा संगठन अपने बाज़ार में सफलतापूर्वक आगे बढ़ने, प्रतिस्पर्धा करने और खुद को अलग करने के लिए विचारों को नए और बेहतर उत्पादों, सेवाओं या प्रक्रियाओं में बदलते हैं।

Technological innovativeness: Please indicate the extent to which you perceive that your company has implemented the following measures on a seven-point scale (1 = Never implemented, 2 = Rarely implemented, 3 = Occasionally implemented, 4 = Sometimes implemented, 5 = Frequently implemented, 6 = Usually implemented, 7 = Every time implemented).

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = कभी लागू नहीं किया गया, 2 = दुर्लभ रूप से लागू किया गया, 3 = कभी-कभार लागू किया गया, 4 = कभी-कभी लागू किया गया, 5 = बार-बार लागू किया गया, 6 = आमतौर पर लागू किया गया, 7 = हर बार)]

Code	Measure	1	2	3	4	5	6	7
T11	Our company continuously launches new products through technological breakthroughs. [हमारी कंपनी तकनीकी सफलता के माध्यम से लगातार नए उत्पाद लॉन्च करती है।]							

(continued)

T12	Our company continues to develop and adopts techniques to improve and reduce production costs. [हमारी कंपनी उत्पादन लागत को सुधारने और कम करने के लिए तकनीकों का विकास और अपनाना जारी रखती है।]							
T13	Our company actively adopts advanced/latest inspection technology. [हमारी कंपनी सक्रिय रूप से उन्नत / नवीनतम निरीक्षण तकनीक को अपनाती है।]							
T14	Our company adopts advanced real-time process control technology. [हमारी कंपनी उन्नत रीयल-टाइम प्रक्रिया नियंत्रण प्रौद्योगिकी को अपनाती है।]							
T15	Our company uses advanced technology/software available for design and machining. [हमारी कंपनी डिजाइन और मशीनिंग के लिए उपलब्ध उन्नत तकनीक/सॉफ्टवेयर का उपयोग करती है।]							

Process innovativeness: Please indicate the extent to which you perceive that your company has implemented the following measures on a seven-point scale (1 = Never implemented, 2 = Rarely implemented, 3 = Occasionally implemented, 4 = Sometimes implemented, 5 = Frequently implemented, 6 = Usually implemented, 7 = Every time implemented).

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = कभी लागू नहीं किया गया, 2 = दुर्लभ रूप से लागू किया गया, 3 = कभी-कभार लागू किया गया, 4 = कभी-कभी लागू किया गया, 5 = बार-बार लागू किया गया, 6 = आमतौर पर लागू किया गया, 7 = हर बार)]

(continued)

Code	Measure	1	2	3	4	5	6	7
PR1	<p>Our company takes the initiative to determine and eliminate non-value-adding activities in delivery-related processes.</p> <p>[हमारी कंपनी वितरण संबंधी प्रक्रियाओं में गैर-मूल्य (Non-value) वर्धित गतिविधियों को निर्धारित करने और समाप्त करने के लिए पहल करती है।]</p>							
PR2	<p>Our company takes measures to decrease process costs.</p> <p>[हमारी कंपनी प्रक्रिया लागत को कम करने के उपाय करती है।]</p>							
PR3	<p>Our company takes measures to increase delivery speed related logistics processes.</p> <p>[हमारी कंपनी वितरण गति संबंधी रसद (Logistics) प्रक्रियाओं को बढ़ाने के उपाय करती है।]</p>							
PR4	<p>Our company incorporates measures that increase process output through the use of the latest manufacturing processes, techniques, machinery, and software.</p> <p>[हमारी कंपनी उन उपायों को शामिल करती है जो नवीनतम निर्माण प्रक्रियाओं, तकनीकों, मशीनरी और सॉफ्टवेयर के उपयोग के माध्यम से प्रक्रिया आउटपुट को बढ़ाते हैं।]</p>							
PR5	<p>Our company focuses on reducing variable component costs through improved manufacturing processes, techniques, machinery, and software.</p>							

(continued)

	[हमारी कंपनी बेहतर निर्माण प्रक्रियाओं, तकनीकों, मशीनरी और सॉफ्टवेयर के माध्यम से परिवर्तनीय घटक लागत को कम करने पर ध्यान केंद्रित करती है।]								
PR6	Our company adopts methods to determine and eliminate non-value-adding activities in production processes. [हमारी कंपनी उत्पादन प्रक्रियाओं में गैर-मूल्य (non-value) वर्धित गतिविधियों को निर्धारित करने और समाप्त करने के लिए विधि अपनाती है।]								

Product innovativeness: Please indicate the extent to which you perceive that your company has implemented each of the following measures on a seven-point scale (1 = Never implemented, 2 = Rarely implemented, 3 = Occasionally implemented, 4 = Sometimes implemented, 5 = Frequently implemented, 6 = Usually implemented, 7 = Every time implemented).

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = कभी लागू नहीं किया गया, 2 = दुर्लभ रूप से लागू किया गया, 3 = कभी-कभार लागू किया गया, 4 = कभी-कभी लागू किया गया, 5 = बार-बार लागू किया गया, 6 = आमतौर पर लागू किया गया, 7 = हर बार)]

Code	Measure	1	2	3	4	5	6	7
P1	Our company proactively innovates new products with enhanced/improved technical specifications and functionalities totally differing from the current ones. [हमारी कंपनी उन्नत/बेहतर तकनीकी विशिष्टताओं और कार्यक्षमताओं के साथ सक्रिय रूप से नए उत्पादों का नवाचार करती है जो वर्तमान से पूरी तरह भिन्न हैं।]							
P2	Our company focuses on developing newness for current products leading to improving their usability for customers.							

(continued)

	[हमारी कंपनी मौजूदा उत्पादों के लिए नयापन विकसित करने पर ध्यान केंद्रित करती है जिससे ग्राहकों के लिए उनकी उपयोगिता में सुधार हो सके।]							
P3	Our company focuses to develop new products with components and materials totally differing from the current ones. [हमारी कंपनी वर्तमान से पूरी तरह से अलग घटकों और सामग्रियों के साथ नए उत्पादों को विकसित करने पर ध्यान केंद्रित करती है।]							
P4	Our company focuses on decreasing the manufacturing cost of components and materials of current products. [हमारी कंपनी वर्तमान उत्पादों के घटकों और सामग्रियों में विनिर्माण लागत को कम करने पर ध्यान केंद्रित करती है।]							
P5	On company focuses on increasing manufacturing quality in components and materials of current products. [कंपनी वर्तमान उत्पादों के घटकों और सामग्रियों में विनिर्माण गुणवत्ता बढ़ाने पर ध्यान केंद्रित करती है।]							

Keyword with meaning

Sustainability: - *Sustainability is referred as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

(continued)

Sustainability: स्थिरता को विकास के रूप में संदर्भित किया जाता है जो भविष्य की पीढ़ियों की अपनी जरूरतों को पूरा करने की क्षमता से समझौता किए बिना वर्तमान की जरूरतों को पूरा करता है।

Environmental performance: Please indicate the extent to which you perceive that your company has achieved each of the following measures on a seven-point scale (1 = Not at all, 2 = To a small extent, 3 = To some extent, 4 = Neutral, 5 = To a moderate extent, 6 = To a great extent, 7 = To a very great extent).

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = बिल्कुल नहीं, 2 = कुछ कम हद तक, 3 = कुछ हद तक, 4 = तटस्थ, 5 = मध्यम सीमा तक, 6 = बहुत हद तक, 7 = बहुत ज्यादा हद तक)]

Code	Measure	1	2	3	4	5	6	7
EP1	Our company takes initiatives to save energy through energy efficient measures /devices like solar panels and energy efficient equipment (5 star ratings). [हमारी कंपनी ऊर्जा कुशल उपायों / उपकरणों जैसे सौर पैनल और ऊर्जा कुशल उपकरण (5 स्टार रेटिंग) के माध्यम से ऊर्जा बचाने की पहल करती है।]							
EP2	Our company adopts measures to decrease the consumption of hazardous/harmful/toxic materials. [हमारी कंपनी खतरनाक/हानिकारक/विषैले पदार्थों की खपत को कम करने के उपाय अपनाती है।]							
EP3	Our company reuses and recycles materials and also promotes use of non-toxic materials for new product manufacturing. [हमारी कंपनी सामग्रियों का पुनः उपयोग और पुनर्चक्रण करती है और नए उत्पाद निर्माण के लिए गैर विषैले सामग्रियों के उपयोग को भी बढ़ावा देती है।]							

(continued)

EP4	<p>Our company implements measures to reduce wastes (examples like Effluent treatment plants, Catalytic oxidizers, Regenerative thermal oxidizers, Rotary concentrators)</p> <p>[हमारी कंपनी कचरे को कम करने के उपायों को लागू करती है। उदाहरण के लिए एफ्लुएंट ट्रीटमेंट प्लांट (Effluent treatment plants), कैटैलिटिक ऑक्सीडाइज़र (Catalytic oxidizers), रीजेनरेटिव थर्मल ऑक्सीडाइज़र (Regenerative thermal oxidizers), रोटरी कंसंट्रेटर्स (Rotary concentrators)]</p>							
EP5	<p>Our company finds alternates to decrease the use of natural resources.</p> <p>[हमारी कंपनी प्राकृतिक संसाधनों के उपयोग को कम करने के लिए विकल्प तलाशती है।]</p>							
EP6	<p>Our company practices water harvesting techniques to reduce water usage.</p> <p>[हमारी कंपनी पानी के उपयोग को कम करने के लिए जल संचयन तकनीकों का अभ्यास करती है।]</p>							
EP7	<p>Our company takes initiatives to reduce air pollution by decreasing the use of natural fuels (Example use of Induction heating equipment)</p> <p>[हमारी कंपनी प्राकृतिक ईंधन के उपयोग को कम करके वायु प्रदूषण को कम करने की पहल करती है (उदाहरण के लिए इंडक्शन हीटिंग उपकरण (Induction heating equipment) का उपयोग)]</p>							
EP8	<p>Our company does periodic audits to assess effectiveness of measures to decrease environmental accidents (ISO 14000).</p>							

(continued)

[हमारी कंपनी पर्यावरणीय दुर्घटनाओं (आईएसओ 14000) को कम करने के उपायों की प्रभावशीलता तक पहुँचने के लिए समय-समय पर ऑडिट करती है।]									
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Financial performance: Please indicate the extent to which you perceive that your company has achieved each of the following measures during the last three years on seven-point scale (1 = Not at all, 2 = To a small extent, 3 = To some extent, 4 = Neutral, 5 = To a moderate extent, 6 = To a great extent, 7 = To a very great extent).

[कृपया बतायें कि आप किस हद तक सहमत या असहमत हैं कि आपकी कंपनी ने निम्नलिखित उपायों में से प्रत्येक को सात-बिंदु पैमाने पर लागू किया है (1 = बिल्कुल नहीं, 2 = कुछ कम हद तक, 3 = कुछ हद तक, 4 = तटस्थ, 5 = मध्यम सीमा तक, 6 = बहुत हद तक, 7 = बहुत ज्यादा हद तक)]

Code	Measure	1	2	3	4	5	6	7
FP1	Our company has seen growth in return on sales year over year basis. [हमारी कंपनी ने साल दर साल बिक्री के आधार पर रिटर्न में वृद्धि देखी है।]							
FP2	Our company has seen growth in profits on year over year basis [हमारी कंपनी ने साल दर साल आधार पर मुनाफे में वृद्धि देखी है।]							
FP3	Our company has seen positive growth in market share year over year basis. [हमारी कंपनी ने साल दर साल आधार पर बाजार हिस्सेदारी में सकारात्मक वृद्धि देखी है।]							
FP4	Our company has seen growth in return on investment year over year basis.							

(continued)

	[हमारी कंपनी ने साल दर साल निवेश पर रिटर्न में वृद्धि देखी है।]								
FP5	Our company has seen growth in return on assets year over year basis. [हमारी कंपनी ने साल दर साल संपत्ति पर रिटर्न में वृद्धि देखी है।]								

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