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VALIDATING THE EFFICACY OF THE LEAN MANUFACTURING (LM) PRACTICE MODEL FOR ENHANCING PRODUCTIVITY GROWTH IN INDIAN SMALL & MEDIUM SCALE ENTERPRISES (SMES) IN GUJARAT

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ABSTRACT

Implementing Lean manufacturing in any sort of organization offers several benefits, such as decreased waste, enhanced operational efficiency, and improved performance evaluation. Implementing Lean techniques can be a challenging endeavor. Literature offers a variety of frameworks and policies that are designed for certain organizations and may be applied to any type of small and medium-sized enterprises (SMEs). However, the process of implementing these frameworks and policies can still be challenging. Currently, SMEs are actively engaged in implementing Lean practices, as they are recognized as a significant contributor to the strength of economies. This article aims to collect and emphasize the latest Lean techniques that have been implemented or developed with various adaptations to suit the working environment in small and medium-sized enterprises (SMEs). To provide a brief overview of the Lean methods implemented in various production/manufacturing sectors, including those that have achieved some level of success, a tabular format is used to present the information. An important finding from this analysis is that there is a significant possibility for applying Lean methods in small and medium-sized enterprises (SMEs) in developing nations. However, in impoverished countries, the adoption of Lean methods is rarely recorded. There is a need to further explore the use of machine learning techniques, such as artificial neural networks, in this topic of interest, as it is still in its early stages. There are several simulation methods available, and their usefulness may vary depending on the magnitude of strain required.

KEYWORDS: Lean manufacturing, challenging, endeavor, evaluation

1. INTRODUCTION

Examining the current body of research serves as a basic foundation for defining the implementation of lean manufacturing methods across different industries. In addition, it aids in identifying the ambiguity in the key elements for success and the practical challenges related to lean practices. It also enables the collection of a set of operational metrics that can be utilized to assess the performance of any firm. During the review process, we initiated by examining the earliest articles concerning Japanese manufacturing/production systems and concluded by analyzing the most recent publications regarding lean practice. Our observation indicates that early Japanese books provided a more detailed definition of Lean and identified its underlying components more effectively than research articles. This disparity arises because the articles primarily concentrate on defining and describing certain components of the system rather than comprehensively addressing the entire concept. Small and medium firms are the primary contributors to the manufacturing of original equipment manufacturer (OEM) products, as well as experiencing similar growth in other sectors. Consequently, OEMs are burdened with business problems and challenges. Original equipment manufacturers (OEMs) are currently compelling their suppliers to consistently enhance product quality and adopt lean methods and tools. This has generated novel viewpoints and increased demands for output in many small and medium-sized firms. Various quality concepts and tools, including lean manufacturing, six sigma, and lean six sigma, are utilized to enhance quality.

Henry Ford initially conceived the idea of a manufacturing assembly line in continuous motion, which became the pioneering approach for mass production. The traditional model of Henry Ford, which involved assigning workers to monotonous and repetitive jobs, has been substituted with job rotation and teamwork. This change aims to enhance employee morale and also offers notable advantages such as improved product quality and the opportunity for employees to contribute suggestions for process improvement. This paradigm is revolutionizing managers' perspective on production by focusing on the specialization of information work carried out by unskilled workers.

The school and founder of scientific management, Frederick Taylor, encourage the use of mass production to achieve lower costs per unit, standardization of work, and the production of high-volume products. Managers did not contest the effectiveness of the approach until Taiichi Ohno of the Toyota Group in Japan identified certain weaknesses in it. Mass production necessitates significant capital and space, yields subpar product quality, results in excessive inventory of standardized resources, and encounters resistance from established organizations while being inflexible in meeting client demands.

Two techniques for existing production systems are classified as poor production, specifically handcraft manufacturing and mass production. Artisan production involves proficient individuals utilizing uncomplicated yet highly adaptable tools to create a single type of product tailored to satisfy individual customer requirements. Mass production involves the use of highly standardized and designed products, which are manufactured in enormous quantities using relatively low-skilled workers and inflexible, costly machinery. Ohno devised a new concept called the Toyota Production System (TPS). TPS promotes several innovations, such as the reduction of inefficient movements through jidoka, kaizen, and continuous improvement. Light Production principles extend beyond the mere provision of supplies and resources. The objective of this is to enhance efficiency, minimize errors, and optimize operations. Indeed, it is essential for it to infiltrate all operations in order to enhance the worth of your firm.

The key performance indicators of Lean practice and its implementation are discussed, with a particular focus on leadership. No literature has yet integrated the performance management of Lean Practice for small and medium-sized enterprises (SMEs). Hence, more investigation is imperative in this domain due to its significance (Achanga, 2005), (Collins, 2001). The case study validated the importance of incorporating performance indicators early on in a Lean implementation, as suggested by Ahlstrom and Karlsson (1996). PM encompasses the entire value chain to facilitate the shift away from focusing on individual processes and also offers possibilities for enhancement. The notion of PMs is developed in three phases as outlined by Bourne (2000): the creation of performance measures, their implementation, and their utilization. During the process of development and selection, it is vital to choose "relevance" that aligns with corporate objectives and supports efficiency principles. Additionally, it is crucial to select "practical" measures that are applicable and can be implemented easily, such as using blank discs, paper, or a basic computer application. Operational measures include quality, time, and adaptability. In addition to this, Hudson's measures reports also mention the economy, consumer satisfaction, and human resources. The dimensions, including operational and financial indicators, need to be incorporated into the conceptions of correspondent PMs. Furthermore, it is essential to take into account the crucial success criteria while considering the concept of project managers. This article specifically addresses the practical implementation of Lean concepts, with a detailed focus on the strategic factor of "customer satisfaction". However, the authors emphasize the significance of these characteristics, which must be taken into account throughout the later phases of implementing Lean. PMs incorporate standard performance indicators while emphasizing Lean principles. They also incorporate a performance dimension called "leadership," which is derived from critical success determinants (Achanga, 2005). The concept of private messages (PMs) does not exist. Recognized by the Authors want to

incorporate "performance management" into the measuring system of a Lean application project. Leadership has been identified as a crucial determinant of success, as demonstrated by Collins' (2001) study on the "Fortune 500" businesses. The authors emphasize the significance of leader performance in their investigation of the causes behind these companies' achievements. Therefore, it is crucial to monitor the commitments and manage agents of change, as well as their dedication and performance during the implementation of Lean, as stated by Womack and Jones (1996). Some actions that can be taken include reducing the frequency of management seminars, ensuring active participation of directors in Kaizen activities, and organizing production and management meetings with a focus on lean implementation. The notion of Key Performance Indicators (KPIs) encompasses the measurement of performance in various areas, including operating expenses, quality and time, people and organizational performance, leadership, and particular Lean statistics.

1.1 SCOPE OF WORK

The objective is to conduct research by engaging in professional practice within the field of Lean Manufacturing, with a particular focus on the developing Manufacturing sector in India, particularly in Gujarat. The objective is to create a framework for small-to-medium scale manufacturing enterprises that enables them to enhance productivity in an ongoing manner. Initially, the researcher can assert that the stated purpose has been achieved using survey-based research, as detailed in the upcoming chapters. The research can be divided into four key components: literature evaluation, construction of a survey instrument for SMEs, development of a model, and validation phase.

The issue is chosen after conducting a thorough review of the literature, and the problem is formed based on the analysis of gaps identified.

The theme chosen for critical literature assessment and gap analysis is determined, with the selection of theoretical research being motivated by personal interest.

The literature review identified a deficiency in the understanding of the key elements that contribute to the success of lean manufacturing and the indicators that measure operational performance, as well as the correlation between them. The industry in small and medium-sized Gujarat has not yet developed a performance model for Lean Manufacturing. Personally, the research study has captivated researchers who have been working as lead auditors for more than two years. They actively engage in many seminars and conferences annually, focusing on technical quality and presenting research in this field.

Intense competition in the market has compelled corporations to reconsider industrial regulations for their application in manufacturing. Indian manufacturing businesses are highly interested in adopting new production technologies, as well as the corresponding management and quality practices.

2. REVIEW OF LITERATURE

Das, k. (2008) states that SMEs face several constraints: credit facilities, upgrading technology, insufficient infrastructure, weak transportation facilities, etc. **Adrian Wilkinson (1999)** believes that SME recruitment takes place across their networks. Informal networks of people will be active in the process of recruitment. He also explains that SMEs do not follow any job description and job specification techniques for hiring individuals. On the other hand, a US-based study finds that the key explanation for the failure of SME **Mc Evoy** is due to lack of relevance to human capital (1984). **Mukund Chandra Mehta (2013)** notes that there is a shortage of capital, low production capacity, lack of qualified human resources, lack of infrastructure facilities, lack of facilities for industrial land, etc. He concludes that these factors affecting SMEs in the design of any schemes or programmes should be considered by the government.

The theoretical basis of this thesis follows **Bergmiller and McCright's** theory of complementarity (2009); **Mahapatra, Narasimhan and Barbieri (2010)**. Organizational competencies that increase the productivity of companies are lean management strategies and sustainability-oriented innovation. These include the implementation of strategic, policy and organizational involvement. Since one group of practices supports the other, LMP and SOI are complementary. In practice, by sufficient procurement, internal processes and demand management, Inman and Green (2018), LMP removes all types of waste through the supply chain to achieve productivity. **Adams et al., (2016); Martinez-Conesa, Soto-Acosta and Carayannis, (2016);** SOI is commodity, method and organizational creativity to achieve sustainability (2017). In combination, LMP and SOI are likely to help achieve greater sustainability through suitable trade-offs between economic, environmental and social parameters.

Hines, (2004), Holwe & Rich raises awareness of the vision of executives in Study. The main goal is to establish and develop a degree of understanding of the hypothetical foundations of organisational culture into lean philosophy. Womack and Jones argue in "The machine that changed the world" that the introduction of a strategy "will change almost everything in all industries -options for consumers, the nature of work and the wealth industry by combining the benefits of art and mass production." Lean tactics incorporates many strategies that seek to

enhance customer service, productivity and responsiveness. Lean has evolved over time as a term. The researchers based their research effort on **McGill's and Slocum's (1993)** structural structure for the association between values and the achievement of cost and cost benefit balance.

3. OBJECTIVES OF THE STUDY

1. Validating a Lean Practice model for the introduction of lean manufacturing in the Gujrat area of Selected Small & Medium Scale Manufacturing Industries (SMEs).
2. To define key success factors for the adoption of lean manufacturing for small and medium-scale enterprises and organizations through survey-based research performance measures.

4. RESEARCH METHODOGLOGY

The goal of this study is to support the population of small and medium-sized enterprises, primarily in Gujarat and adjacent cities. The eligibility guidelines must be complemented by manufacturing enterprises categorised as small and medium-sized enterprises as of 21.12.1999. (Annual Report 2011 and 2008-09) An industrial enterprise where spending in fixed assets in plants and machinery, whether to maintain or lease or rent land, does not exceed Rs.Ten crore (subject to the conditioning unit is not owned, managed or subsidiary by any other industrial enterprise) (Annual Report 2010-11). The owners and managers are presumed to be able to determine the elements of the business level for SMEs (strongly united). This hypothesis was proved by (Gibson and Birkin Shaw, 2004), which indicates that the data collected from the most senior/experienced level individuals were closely linked to the expertise of the workers in the levels of employment graded by the survey.

The primary objective of this thesis was to analyze the relationship between the latent constructs. Elaborate association, interference, and justice are the study hypothesis; relationships are revealed by modeling of the systemic equation of AMOS 20.00. The linear regression model factorial analysis requires SEM. Proposals for the research study focus on the structure rather than predicting cluster associations or group variances. In addition, earnings are maintained here as a reliant house, so this study does not consider group analysis and improvement necessary. In addition, the degree of relation to a particular profile was not calculated properly now agreed due to a positivist approach instead of rules. The point of the investigation remained to produce linear combinations of independent factors detected and latent to explain linear combinations of response variable (Tabachnick and Fidell 2007). Therefore, SEM was recommended as the key methodology for the evaluation of multi - variate results.

5. RESULTS AND DATA INTERPRETATION

5.1 Age of Organization

From Table 5.1, 47.5% of respondents reported that their organizations are less than or equivalent to 10 years of age, and 52.5% of respondents reported that their organizations are more than 10 years of age.

TABLE 5.1 AGE OF ORGANIZATION

Age	Frequency	Percent	Cumulative Percent
<=10 years	95	47.5	47.5
>10 years	105	52.5	100
Total	200	100	

5.2 Size of Total Workforce

Table 5.2 indicates that the respondents were questioned about the size of the overall workforce. 21.4% of respondents reported a workforce of 0-15. Of the respondents, 22.4 percent reported 16-30 and 30-50 workers, and 33.8 percent reported more than 50 employees.

TABLE 5.2 SIZE OF TOTAL WORKFORCE

Age	*Frequency*	*Percent*	*Cumulative Percent*
0-15	*43*	*21.4*	*21.4*
16-30	*45*	*22.4*	*43.8*
30-50	*45*	*22.4*	*66.2*
>50	*67*	*33.8*	*100.0*
Total	*200*	*100.0*	

Awareness about Lean Manufacturing Practices

In accordance with Table 5.3, it was noted that when asked about the knowledge of lean manufacturing practices, 55% of respondents indicated that they were aware of lean manufacturing practices and 45% of respondents were not aware of lean manufacturing practices.

TABLE 5.3 AWARENESS ABOUT LEAN MANUFACTURING PRACTICES

Awareness Level	*Frequency*	*Percent*	*Cumulative Percent*
Yes	*110*	*55*	*55*
No	*90*	*45*	*100*
Total	*200*	*100.0*	

Table 5.4: Test Statistics: Lean Tools

Lean Manufacturing Practices	*Chi-square*	*Df*	*Asymp. Sig.*
5 S	*8.54*	*3*	*0.023*
Value Stream Mapping	*6.21*	*3*	*0.101*
Total Productive Maintenance	*7.19*	*3*	*0.042*
Single Minute Exchange of Dies	*4.07*	*3*	*0.259*
Just in Time Manufacturing	*5.26*	*3*	*0.153*
Kaizen	*9.16*	*3*	*0.027*
SPC Quality Control	*2.21*	*3*	*0.528*
Quality Circles	*7.17*	*3*	*0.067*
Standardization	*0.86*	*3*	*0.836*
kanban Continuous Flow	*12.38*	*3*	*0.006*

In terms of understanding of Lean Manufacturing Methods, Table 5.4 displays the average rank of different categories of the industry. The estimated chi-square, the degree of freedom, and the significant value are given in the above 5.4 tables. At 5 percent significance level, S, Maintenance, Kaizen, Consistency circles and Kanban continuous flow were found to be significant and Importance Stream Mapping, SMED, Just in Time, SPC and Standardization at 5 percent significance level were not found to be significant.

6. CONCLUSION

This article aims to provide readers with an understanding of the current practice of industrialists and researchers to apply lean manufacturing techniques in small and medium-sized enterprises (SMEs) throughout various regions of the world. A vast number of research articles are published in English language journals, detailing the creation and proposal of a wide range of tactics aimed at enhancing the performance of various classes. Several well-known case studies that were adopted focused on Indian small and medium enterprises (SMEs), highlighting the importance of implementing lean technologies and raising awareness. The deployment of lean techniques in the automobile industry was particularly intriguing due to its widespread adoption. This demonstrates the application of lean tools in the automotive sector, namely in the manufacturing of numerous components. Industries such as printing, machine tool, tool, wood, and cotton have effectively adopted lean manufacturing. In addition, small and medium-sized enterprises (SMEs) should implement some practices such as 5S, last planner, and lean teamwork, which do not require significant investments. Construction SMEs can implement lean tools such as A3's, 5S, and 5 Whys, which require minimal financial inputs. To boost the rate of flowing Lean Management (LM) approach, it is necessary to enhance awareness among both employers and employees. Efforts should be made to organize campaigns and courses to promote the distribution of internally generated models for individual use. Based on findings from a study of SMEs' Critical Success Factors related to performance, two models are articulated. These models are statistical operations and Regression analysis. Factor analysis and structural equation modeling were first tested for their ability to test validity and provide accurate results. The inferences drawn from the path coefficients in structural equation modeling with hypothesis testing were used in the power analysis.

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