

A lean business analytics
implementation
framework for SMEs



MYTHESIS

Abstract

Lean manufacturing is a leading manufacturing paradigm with a systematic approach used to identify and eliminate waste by focusing on production costs, product quality and delivery, and worker involvement. The focus of lean manufacturing is to identify and eliminate waste (non-value adding activities) by implementing lean practices and make the product flow at the pull of the customer in pursuit of perfection. Today, lean manufacturing has become an increasingly important topic for manufacturing companies as they try to find ways to compete more effectively against global competition.

Studies conducted during the past decade on lean implementation, found that the adoption of lean practices in manufacturing firms in India are very much lagging when compared to global counterparts. Companies fail in implementing lean practices due to selection of wrong tools and implementation sequence. There is always pressure on the companies to produce faster, better and be less expensive with existing resources. This can be achieved only through adoption of lean manufacturing practices. As companies try to implement lean, to respond to competitive pressure, they tend to be one dimensional in their approach. Firms cannot get the full benefit of lean adoption by neglecting other areas of manufacturing which will lead to failure in lean implementation. It is clear that a more holistic approach is required for successful adoption of lean practices. Therefore, it was decided that a research with an inclusion of multi-domain lean practices will facilitate firms opting for wider adoption of lean manufacturing practices.

Lean practices are the newest method of managing the business and are based on the principles of waste management while maximizing quality and flexibility. The main aim of the research is the development of Lean Practice Model for Small and Medium Scale Manufacturing Enterprises. The research study also discovered the Critical Success Factors of Lean manufacturing implementation for Small and medium scale industries and organizations performance measures through survey – based research. The research also articulated and developed the meanings and operational measures of such factors and organizations performance measures by involving industry managers / employees practicing Lean Manufacturing Technique as the appropriate subjects. Finally, the Lean Practice model for lean manufacturing is developed and validated in selected small & medium scale industries of Gujarat. A major contribution of the developed model is its ability to achieve growth in productivity by implementing Lean tools in Manufacturing SMEs. It also

supports SMEs to standardize/manage processes, reduce wastes at all stages, reduce the cost, quality, improve profits and improve the customer satisfaction indirectly.

Chapter 1: Introduction

1.1 Introduction

Lean Manufacturing (LM) is recognized as one of the most important manufacturing philosophy that facilitates the companies to compete and sustain in the current dynamic and competitive business world (Filho and Barco, 2015). LM originated in Japan and quickly spread to the USA, Europe as well as in most of the developed and developing countries (Pavnaskar et al., 2003). In the beginning, LM was mainly accepted in the automobile sector. In continuation to this, the implementation of various Lean manufacturing Practices (LMPs) have been causing a profound impact on the majority and wide range of sectors irrespective of the size of the firm. This list of sectors includes process industries, textile, hi-tech industries, aviation/aerospace, healthcare, and many others (Abdulmalek and Rajgopal, 2006; Wang, 2008; Ehret and Cooke, 2010; Kumar et al., 2015; Henrique et al., 2016). LM has also been applied in conjunction with other management approaches, such as Green Manufacturing (GM), Agile Manufacturing (AM) and Sustainable Manufacturing (SM) (Verrier et al., 2014; Putnik, 2012; Cabral et al., 2012).

Small and medium enterprises frequently known as SMEs are playing a crucial role in formulating the economies of most countries in the world (SME, 2012; Bhamu and Sangwan, 2014). In literature, the terms SMEs and SMEs are interchangeably used. The SMEs are acting as the engine of the economic growth and providing social stability by generating the direct and indirect employment opportunities (Hu et al., 2015; Wang, 2016). In most of the developed and developing countries, a major share of the manufacturing output is from the contributions of SMEs. But the SMEs all over the world are facing a lot of challenges and problems in doing the business compared to large firms. Ensuring the sustainable growth and performance of the SMEs are necessities of the current manufacturing world.

1.2 Need for the Study

The furious rivalry in the market has constrained organizations to reevaluate mechanical practices for their usage in improved manufacturing. Manufacturing associations in India are demonstrating incredible enthusiasm for the presentation of cutting edge manufacturing advances, related administration, and quality ideas like Lean and Six sigma.

The vast majority of the SMEs are the providers to the enormous organizations, particularly in the car business, which is exceptionally valid; subsequently, changes in huge organizations that influence SMEs. In any case, on the off chance that we take a gander at the business information in India when all is said in done, contrasted and a year ago is low. From one perspective, the manufacturing business is expanding and the opposite side diminishing deals income, for what reason is it so? For that what to do? One can say that it is a direct result of the worldwide downturn, it is probably the greatest supporter of this opposition. Be that as it may, what these organizations are doing to expand deals right now advertise? OEMs now make it compulsory to utilize quality instruments for quality improvement and systems of Lean Manufacturing - Lean devices through different approaches to deal with their providers and these devices are exceptionally fruitful in huge organizations and Indian car universally. In any case, another issue is the OEM providers particularly little enterprises in Gujarat is really going however Lean Manufacturing Practices or not and would they say they are getting profits by it or not? In the event that indeed, it is just on paper or recorded anyplace. What challenges emerge if settle on execution? Each one of those issue will be delighted through the examination.

1.3 Problem Statement

The research problem is formed from the aspiration and vital necessity to improve on the conventional lean performance models that have been espoused by most researchers so far. The existing lean performance models and studies concentrated on the effect of LMPs on operational, financial performances, mostly on large scale industries. There are no such studies which focused on SMEs to bring out the effect of LMPs on their sustainability performances. The interrelationships between the sustainability performances generated by the LMPs implementation in SMEs are also unfamiliar. Similarly, limited studies have been reported in the areas of linkage between lean operations and sustainability in SMEs. Most of the prior studies on sustainability,

considered lean, just as a means for waste reduction and the consequent benefits of environmental protection.

However, some prior studies have mentioned some of the broad areas of linkage between lean and sustainability in large-scale industries. There is a need to identify all the relevant areas of linkage between lean practices and sustainability in SMEs. The primary intention to ascertain whether there is any relationship between LMPs and sustainability performances in Indian SMEs.

1.4 Research Hypothesis

H₁: there is no association between sector and awareness about the lean manufacturing practices

H₂: There is no association between Age of organization and Awareness about the Lean Manufacturing Practices

H₃: There is no significance difference in awareness of different Lean Manufacturing Practices at different categories of sector

H₄: There is no significance difference in reasons for implementing different Lean Manufacturing Practices in different categories of sector.

H₅: There is no significance difference in reasons for not implementing different Lean Manufacturing Practices in different categories of sector.

H₆: There is a significance difference in reasons for not implementing different Lean Manufacturing Practices in different size of the workforce.

1.5 Research Objectives

- To verify the interrelationship between triple bottom line sustainability performances
- To assess the influence of lean practices on the sustainability performance of SMEs
- To investigate whether the areas of linkage are same or statistically different for the SMEs classified according to the levels of investment, manufacturing process, product category and the manufacturing sector belong to
- To identify the areas of linkage between lean practices and sustainability in SMEs
- To identify the various lean manufacturing practices and sustainability performance measures in SMEs.

All of the above research objectives will be achieved with the help of quantitative approach. In this the researcher will develop a questionnaire containing of close ended questions. The researcher will then conduct a survey through which primary data will be collected and then the collected data will be analyzed via quantitative analysis techniques.

1.6 Literature Review

1.6.1 Lean Definition

In inquire about (Hines et al., 2004) brings issues to light of the vision of administrators. The primary point is to create lean way of thinking and build up an understanding degree of the speculative establishments of hierarchical culture. In the machine that changed the world, (Womack and Jones,1990) guarantee that the execution of a methodology will change nearly everything in all businesses - alternatives for customers, the nature of work and the riches business by consolidating the advantages of workmanship and large scale manufacturing. Lean strategy contains a few techniques, its motivation is to improve the quality, effectiveness, and responsiveness to clients. Lean as an idea has advanced after some time. The analysts put together their examination exertion with respect to the auxiliary system proposed by (McGill and Slocum 1993) for the relationship among values and accomplish balance cost and cost esteem.

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"Information Organization" is the principal sort of association. React to the primary period of the methodology incline, that is, the cell cells and plant mechanical production systems. It is classified by primary lean awareness as the certainty that there is an improved method for playing out the things is set up. This chief advance is regularly similar to move toward the logical administration of Max Weber (1964) and Frederick Taylor (1996). This stage conceals the main range of poor training between 1980 - 1990. Represent an approach that applies the apparatuses and systems, techniques. The first wellspring of lean intuition at the time was the car business.

"Understanding the association" is the second sort of association run by explaining and conveying the guiding principle and the board strategies to reinforce the corporate culture. Various Enterprises right now in the mid of nineties are affected that lean is to apply the strategy for best practices, however this just occurs on the manufacturing plant floor. Toward the decade's end until 1999 starts repositioning of lean reasoning can be utilized in a more extensive scope of mechanical situations (Womack et. al, 1996). It is the beginning of attention to discover answers for the individual organization and its enhancements along the worth chain.

What sort of relationship right now called "learning association". Normally, the utilization of significant worth stream examination and five Lean standards is created by Toyota. Albeit a portion of the techniques and devices are tested, the association is slanted at this stage disregards some other significant procedures, for example, new item advancement, new business openings, which forestalls the association to guarantee the supportability of nonstop improvement. The new century will consider factors, for example, industry, size, the innovation utilized. This implies a higher level of unexpected occasions. The center moved to making an incentive for the client. This model is a "learning association", which implies the chance to build up the information on

representatives, providers, clients and even contenders. Any change is viewed as the capacity of a framework to learn and improve.

The creators (Mefford and Crute, 2004) examined the procedure of lean reasoning and its improvement after some time. They have portrayed and distinguished four significant strides in its advancement. Information is spreading past its beginnings Toyota creation framework. Numerous pundits attempt to assault the powerless, yet what appeared to overlook is that Lean has advanced and keeps on developing as a total administration framework. Lean manufacturing is created by Taiichi Ohno at Toyota Motor Company during the 1950s as a mechanical advancement dependent on the standards of the brains and hands of the time of the craftsmans, together with the institutionalization of work and Ford base administration unit and solid cooperation, for good, Edwards (1996) cited in real life (Motwani ,2003).

Lean manufacturing is tied in with improving and changing the procedure so the information on the variety is basic for understanding the incline. It additionally requires the "re-building the whole procedure, making the framework increasingly stable with less variety regular reason" (Deming, 1986). The fundamental guideline of Lean is responsiveness to change and waste minimization. Take the case of Toyota, Lego and numerous different organizations in the business in the development and aviation enterprises contributed Lean model to accomplish huge execution upgrades by expanding effectiveness as far as cost, quality and time. Womack and Jones (1990) are the principal creators to draw out the points of interest and qualities of model execution improvement after a careful assessment of the creation plant in Toyota. The primary concern is that organizations can turn out to be significantly more adaptable and receptive to client needs by applying the five standards of Lean. As indicated by Womack, the commitment of the book "The Machine that Changed the World" (1990) for the introduction of the Toyota Production System (TPS) as a component of the activity of the framework, the general administration of Toyota and connection the creation procedure, the procedure of client the executives and the executives rehearses and the political procedure for the whole organization. Lean reasoning can be abridged as refine and improve the distinguishing proof estimation of the present worth, making the progression of items with the goal that clients separate worth and seek after flawlessness under (Womack et al. ,2003).

1.6.2 Lean Principles

During the 1970s, it turned out to be obvious to a chosen few that the Japanese, most eminently Toyota, had discovered a superior method to fabricate vehicles, which made various fascinating things occur (Hines et al. 2004). To start with, and most strikingly, most of the manufacturing scene went into an enormous instance of forswearing. This was heard as "that will work in Japan, yet not here" and an assortment of different articulations that could cordially be said to have needed understanding. In any case, some with somewhat more understanding, interest, and modesty asked, "Could there be something to this?" Well, from that little gathering came a progression of endeavors to attempt to catch portions of the Toyota Production System that were serving Toyota so well. The piece that appeared the most engaging was the Just in Time idea (Womack et al. 1990). It was quickly advanced as a stock decrease exertion, which in truth is just a piece of what it truly is. In the nick of time specialists turned up unexpectedly and numerous organizations approached executing kanban and slicing inventories to lessen the significant expense of creating and dealing with the stock. Some approached utilizing the motto of "Zero Inventory" and cut stock with such enthusiasm maybe they were seeking after the Holy Grail of manufacturing. Stock had become a terrible word, much like "piece." Unfortunately, a large number of these endeavors were horribly misinformed. Their solitary spotlight was on stock decrease. They diminished inventories as though it were an autonomous substance that had no relationship to whatever else. In the nick of time usage endeavors turned out to be simply forcefully slicing inventories. Those that had this methodology frequently caused unsalvageable harm. They discovered they expected to speed up almost everything, expected to work a lot of extra time, and afterward still much of the time missed conveyance dates. Others found the most noticeably awful all things considered. They missed shipments as well as they cut inventories they found that creation rates hailed fundamentally. Because of these misinformed endeavors, numerous organizations stopped to be serious and some even left business. At the point when the association executes lean practices just in structures than its lean association. At the point when lean deduction applies to all exercises - including an incentive inside the association and between the association and its providers, the creators (Shah and Ward, 2007) propose the expression "Lean Enterprise". As appeared in the Figure 2.1 of the Lean house to keep together all the essential components of the organization read. Every one of these elements is imperative to be available with the goal that they get the full advantage of the organization embraces. The base of the structure is fruitful Lean execution group of human asset

the executives. The way of thinking of the primary perusing, which is mostly identified with the fitting administration and duty at all degrees of the executives to senior administrators? The attention is on flawlessness to address client issues and consistent improvement, learning and diminish squander. The subsequent layer is simply the human asset the executives (HRM), assurance and cooperation in the usage of the treatment as a key achievement factor, as it centers around "collaboration". Offer estimation of lean standards, representatives are what get things going. The accompanying demonstrates the need to assist the organization with improving their center procedures with an attention on "squander decrease". Inside the association, the creation of "best practice" is "simply intime" (JIT), all out gainful support (TPM) and complete quality administration (TQM), which add to squander decrease? Then again, these essential exercises discussions incorporate advertising, new item advancement (NPD), organizations with providers and clients. The top of the house is a slim and restricted culture that bolsters the destinations of the rooftop and the outcomes. Lean culture will take care of the issues in the learning procedure goes on the way of constant improvement. Culture is both an outcome and a facilitator of an economy feasible and effective business (Liker, 2004). It has the capacity of a good example to control representatives through authoritative qualities lean reasoning changes. At the top are the outcomes through the use of Lean - all objectives and aftereffects of lean intuition for superior. The outcomes are identified with better quality, lower cost, shorter conveyance, profound quality of senior representatives, inquiries concerning security grinding away, better business results. These outcomes give the organization an upper hand (Womack et al., 1990).

To become Lean requires a particular perspective, reasoning and the executives framework that follows Toyota model "4P" Toyota. Liker (2004) depicts in his book "The Toyota Way" fourteen rules that have been the reason for the Toyota Production System (TPS). The creator shares these standards into four classifications that start with the letter "P" - reasoning, procedure, individuals and accomplices and investigating. This model is known as the "four P's" Toyota (Liker 2004), the five standards of the lean application indicated by (Womack and Jones, 1996) acknowledged the way to effective usage. The utilization of these five stages must happen at all degrees of the association and requires a total change of the current business. A genuine test is to realize how to start. The initial step is to painstakingly characterize the estimation of the clients. It is significant that the progression of the ensured estimation of the associations and divisions of each organization.

In the event that the worth isn't set accurately, it can prompt an inappropriate item or administration with an incredible misuse of the association. Second, distinguish the whole worth stream and dispense with squander. The three basic exercises at this stage are the item definition, the board of data and physical change. The structure of the office isn't important to change first, since that is the manner by which the work is better sorted out and perceivability permits executives to identify blunders and issues that happen, to be resolved. The new redesign is essential for the most part as a result of the presentation of new advancements, work process association, and the presentation of employment sheets. Does the entry of fluids require advancement? Chiefs accept that the stream must be accomplished through ceaseless steady enhancements. Yet, almost certainly, poor change happens just if the lean masterminds resort to radical upgrades would manufacture a total arrangement of new business. The subsequent stage is to empower the end client to pull the item you need in the framework if important. Right now, diminishes the significant expense of stock. The remedy for flawlessness is the last phase of execution. It is significant that all means are performed together with the goal that the effect of every one of them is sufficiently able to improve the presentation of others. Poor creation is additionally involved eight standards (Ahlstrom and Karlsson, 2000): squander, zero deformities, planning push, multifunction machines, delay, group pioneer, vertical data frameworks and ceaseless improvement. In the framework, read the accentuation is essentially on lessening misuse of different sorts. The accentuation on wiping out waste and constant improvement, joined with a vital concentration for the organization to guarantee a decrease in quality deformities will consistently be the first. To accomplish this objective, the workers are prepared to utilize different strategies for theoretical proof on the most proficient method to distinguish issues and find fitting answers for them. Discover wellsprings of variety and waste and creating strategies to evacuate them. Another lean confidence (Mefford, 2009) is that the procedure can generally improve somewhat more, paying little mind to the reality how great it is and center and the board ought to urge workers to think right now continually searching for a superior method to get things done. By far most of financial action, for example, development and lodging, transport, nourishment supply framework, manufacturing and individual administrations, are possibly influenced for quite a while on the off chance that they do. The new innovation and interest in human capital can create long haul development, however detestable considerations went capacity to deliver green shoots of development all through the territory in a couple of years. Lean reasoning functions admirably when applied comprehensively

(Womack, Jones, 1996). The issue is a sample of the administrators with the information and vitality to make the bounce, take chivalrous to appropriately set up the worth, distinguish the worth stream and stream esteems increment client splendidly. Womack and Jones (1990) contend that Lean can be applied in the manufacturing setting as well as in another association. The framework is certainly an incentive for manufacturing organizations that have instances of Toyota. Lean consistently connected with decreasing costs, wiping out waste, conveyance without a moment to spare (JIT) (the expression "lean" is likewise considered "the previous name for the in the nick of time" (Holweg, 2007).

An investigation shows how the presentation of Lean is advantageous for the information based exercises, for example, plan, the presentation of new items, innovation and item advancement .Baines et al., (2006) said the mainstream weight today is on client esteem in the "esteem" in a more extensive setting of different helpful exercises, and how to boost this worth. (James Moore et al., 2006) additionally contends that the specialists need to move from the creation strategy, where the principle center is to decrease squander are to recognize and assess them. Chappell (2002) characterizes applying lean speculation to all parts of a business and a constructive outcome on creation as well as the full scope of business forms, including item advancement, structure, and deals. (Womack et al. 1996) characterize lean intuition as a "multi-dimensional method for working with an emphasis on lessening waste." The eight squanders incorporate mistake amendment, overproduction, pointless creation steps, superfluous development or transportation of representatives, pointless development or transport of merchandise, individuals sitting tight for items or administrations that don't address client issues. Liker (2004) added to the worker innovativeness isn't utilized as a significant sort of waste; which is significant for fruitful usage, the creator accentuates that all representatives in the association must acknowledge and comprehend the reason for the appropriation of normal reasoning and take an interest. The creators built up a reasonable system dependent on lean reasoning work (Liker, 2004; Shah, Ward 2003) and control the (Shingo Prize, 2005). The structure met all administrators thought and the connections between them for an effective lean execution. It contains the strategies, standards, and procedures important for the reception of lean intuition all through the association. Lean deduction "as an incorporated administration approach," which affects the whole association and its partners - providers and different colleagues, clients, and so forth.

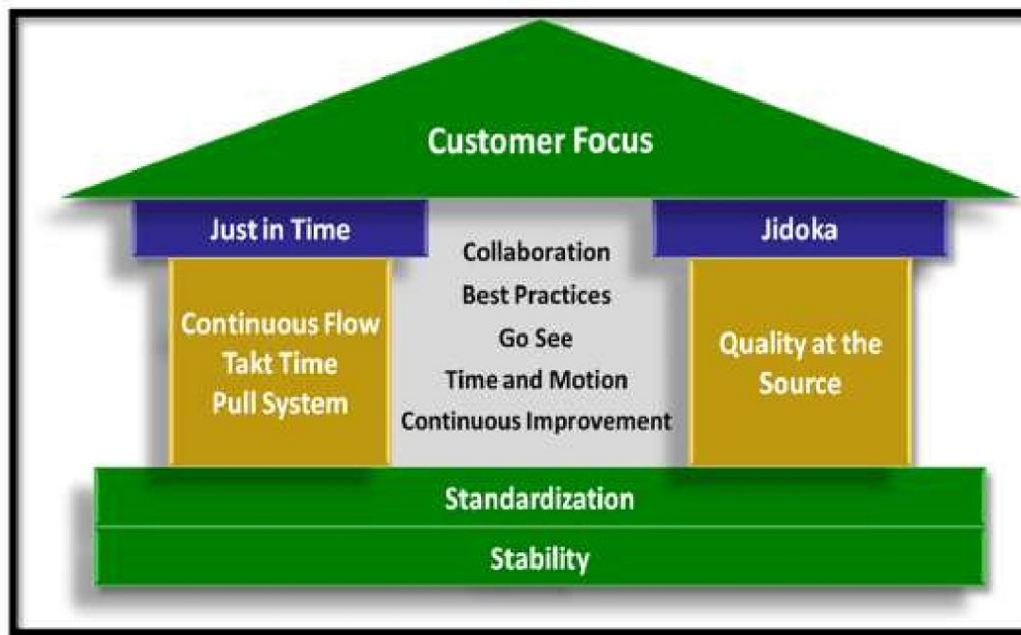


Figure 2.1. Conceptual framework for studying lean thinking

1.6.3 Lean Manufacturing-A History

Lean Manufacturing or Lean Production alludes to a business where the goal is to limit the time and assets utilized in manufacturing forms and different exercises in an organization, with accentuation on killing all types of waste. Manufacturing/Lean Production has been an idea that shares been for all intents and purpose use since the mid 90's when Womack and Jones initially used to depict the Toyota creation framework. Since manufacturing conditions change because of contrasts in reason, structure, and control, there is no single lot of the executives rehearses that can be adjusted by and large to run the show. Makers are feeling the squeeze to improve profitability and quality while diminishing expenses. This has driven numerous associations to actualize the Toyota Production System (TPS), otherwise called lean manufacturing (Liker, 2004; Womack, 2003). TPS utilizes a few instruments to deliberately adjust creation as well as the offices of its providers during the time spent removal of such waste (Berg and Miller McWright, 2009). Half of human work in the processing plant, a large portion of the manufacturing space, a large portion of the interest in devices and a large portion of the building hours to build up another item (Womack et al., 1990).

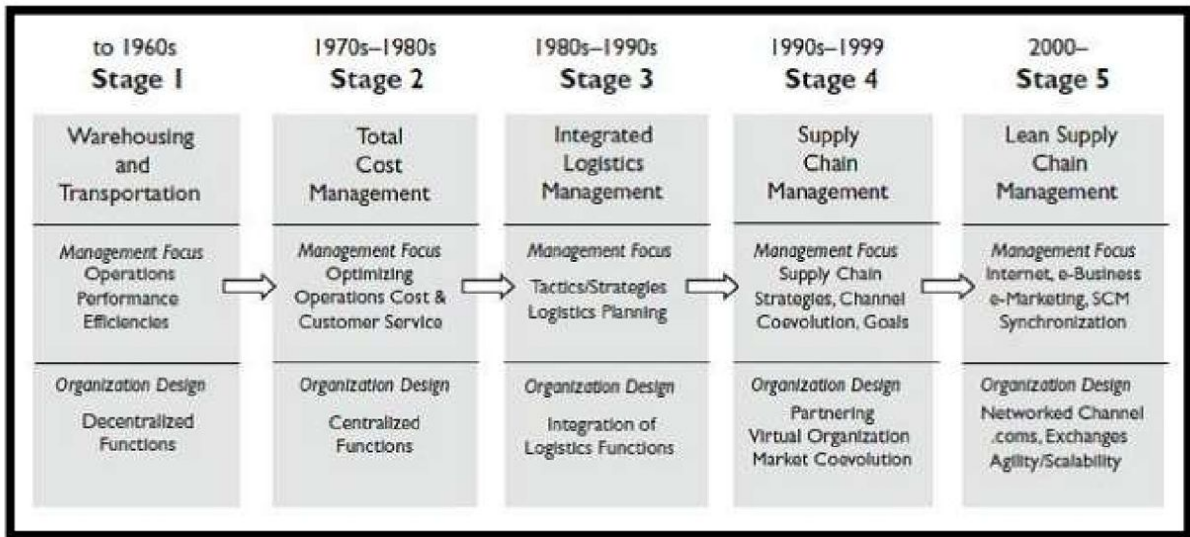


Figure 2.2 Lean Evolutions

Lean manufacturing is regularly connected with the disposal of seven significant waste to improve the impact of variety in the inventory, handling or request (Shah and Ward, 2007). Sawhney, Teparakul, Aruna and Li (2007) shows the connection between light creation and the ecological development expressing that "it is characteristic that the lean idea, the vision inalienable worth stream and its attention on the efficient disposal of waste, trim worldwide system with natural insurance," they call Lean condition (in-Lean).

1.6.5 Performance Measures of Lean Manufacturing Practices

Key execution proportions of Lean practice and its application are given extraordinary regard for the authority. There has not been any writing that incorporates the exhibition the executives of Lean Practice for the SMEs. In this way, more research is required right now of its importance (Achanga, 2005), (Collins, 2001). The requirement for early coordination of the ideas of a presentation estimates bolsters a Lean execution referenced by (Ahlstrom and Karlsson, 1996) could be affirmed for the situation study. PM covers the whole worth chain to help the change in perspective away from speculation the individual procedure and can likewise give chances to progress. The improvement of the idea of the PMs in the three stages referenced (Bourne, 2000): structuring execution gauges, its usage, and use. During the advancement and choice of sufficient "pertinence" (to associate with business targets and bolster the standards of proficiency) and "down

to earth" (in the feeling of relevance of the measures fundamental device significant criteria clear plates, paper or a straightforward PC program). quality, time and adaptability referenced as operational measures. Aside from this, the economy, consumer loyalty, and HR likewise referred to by estimations audits Hudson. These measurements (specifically operational and money related pointers) ought to be incorporated into the ideas of a reporter PMs. Notwithstanding the basic achievement factors must be considered for the idea of the PMs. Since this record centers on the down to earth utilization of Lean standards, or the measurement or vital "consumer loyalty" measurement is treated in detail. Be that as it may, the creators wish to underline the significance of these measurements, which should be considered in the later phases of the usage of Lean. The idea of PMs considers the conventional exhibition measures with an emphasis on Lean standards and incorporates execution measurement of "administration", got from basic achievement factors (Achanga, 2005). There is no understanding of PMs Known by the creators to coordinate the "execution the board" according to an application venture Lean in the estimation framework. Since administration has demonstrated to be one of the most significant basic achievement factors as indicated by an examination by Collins (2001), investigation of the explanations behind the accomplishment of the "Fortune 500" organizations, incorporating Leader execution in the essential thought of the creators. It is, in this way, basic that the duties and overseeing specialists of progress to be checked and their dedication and execution during the usage of Lean can be taken by Womack and Jones (1996). Instances of such measures are to help the most modest number of workshops by the executives, dynamic interest of the chiefs of Kaizen exercises or connected with creation and the executive's gatherings with endeavors to lean in the usage of its program. The entire idea of the KPI is introduced estimated execution working costs, quality and time, individuals and authoritative execution, administration, execution and explicit Lean measurements.

Executing lean manufacturing without the utilization of organized execution estimates won't prompt changes in the operational presentation of the edge structure for execution estimation isn't surely known. System estimation will be made out of all around characterized measures at the venture level - linkages that distinguish connections between activities at numerous levels, and a solitary arrangement of cognizant measures in setting (Fullerton and Wempe, 2009) caution that appropriation of manufacturing effectiveness will deliver blended outcomes - particularly if no proportion of non-money related execution has been actualized. Execution measure helps conquer

any hindrance between effectiveness in manufacturing and the impact on the money related outcome.

Numerous creators (see Table 2.2) talked about the job of PMs in SMEs. PM is a significant component in the incorporation of provider accomplices. Normal data shared incorporates to be specific stock levels, creation plans, request gauges and supply limit (Prajogo and Olhager, 2012; Ding et al., 2011; Yang and Maxwell, 2011). The Lean combination (LI) is basic procedure as it strengthens connectedness, coordination and joint effort among SMEs individuals (Koçoglu et al., 2011). The proper Lean methodologies significantly affects CSFs which may decrease vulnerability. Pandey et al. (2010) analyzed impact of various kinds of PMs on the serious qualities of the producer for Indian manufacturing associations. They found that PMs has critical effect on the serious qualities of the maker all together winning parameters like cost viability and administration level. The PMs is a significant methods for improving a client relationship. PMs improves purchasers' exhibition as for asset utilization, yield, and adaptability. The degree of PMs between a purchaser and key provider relies upon vulnerability and, interdependency of data (Yigitbasioglu, 2010).

1.6 Structure of the Thesis

Chapter 1: This chapter provides the introduction along with the introduction of the research objectives.

Chapter 2: This Chapter will be the Theoretical Framework in which the lean practices and techniques be reviewed to formulate the Theoretical Framework for this paper.

Chapter 3: This chapter will provide the research Approach of the paper.

Chapter 4: This chapter will present the findings of this study.

Chapter 5: This chapter will conclude the study. This chapter will also provide the limitations of the study.

Introduction



Literature Review



Research
Methodology



Findings and
Analysis



Conclusion and
Recommendation



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Chapter 2: Theoretical Framework

2.1 INTRODUCTION

The research objectives given in chapter 1 could be grouped into two major objectives: (i) to study the factors that resist implementing lean manufacturing practices based on the sample that represent the population of SME firms in India and (ii) to test the relationship between widespread lean firms and operational benefits and performance of the firms. This chapter presents the constructs identified from the comprehensive review of literature. It also presents a theoretical framework that explains the linkages between constructs that constitutes lean adoption to meet the organizational objectives and attain competitive advantage Fig.3.1.

The theoretical concept of lean adoption has three phases: The first phase consists of the external factors that create a competitive environment. Firms must study the external environment, foresee the changes that could occur and be prepared to face the competition. The second phase is about the challenges a firm has to overcome in implementing the four domains of lean principles viz., PIM, TQM, TOB and LMT. Firms should adopt these principles in a balanced manner for widespread adoption of lean manufacturing practices. The last phase is the operational competitive advantage.

The logo for MYTHESIS is centered on the page. It features a stylized yellow graduation cap (mortarboard) with a tassel hanging from the right side. Below the cap, the word "MYTHESIS" is written in large, bold, white, sans-serif capital letters. The entire logo is set against a light blue background that has a subtle, larger-scale version of the graduation cap design.

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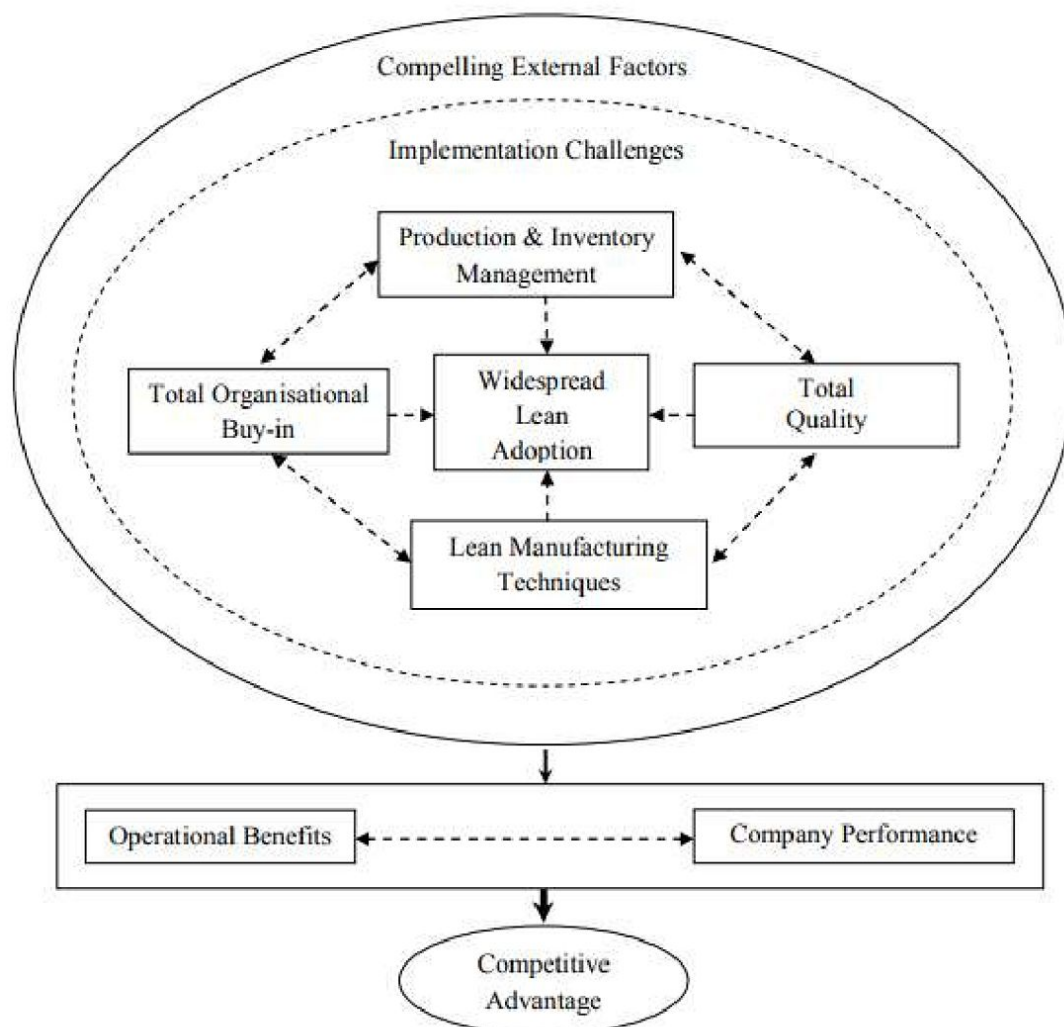


Fig: 2.1 Theoretical frameworks for widespread lean adoption

2.2 EXTERNAL FACTORS (EXTFACT)

The global competitive environment makes firms work under high pressure to reduce the cost of production and increase the quality of product. This is possible by implementing lean tools as stated by Dr. Deming, (popularly known as the quality guru) companies to be competitive unless they adopt lean practices. There are many compelling reasons for a company to implement lean. Entry of foreign company rising, international competition, competitive pricing, rapid introduction

of new products by competing firms; changing customer expectations compels the firms to implement lean.

The EXTFACT construct represents 10 items (or variables). Each item represents the reason for firms to implement lean. This also enables to identify the major reasons as to why firms want to implement lean practices.

2.3 DOMAINS OF LEAN PRINCIPLE

Analysing the use of lean tools in previous studies and interacting with industry experts, four domains of lean principles were identified for this study. The lean principles represent the key areas required for lean manufacturing practices that enable widespread lean adoption. The lean manufacturing principles include the integration of production activities into self-contained units along the production flow (Smeds, Riitta, 1994). A set of tools was considered under each domain. The tools and techniques considered under each lean domain are inter-linked with other domain lean principles. In developing a clear definition of what exactly leanness mean, the present research largely relied on the model developed by Gary Corner 2001 which demonstrates the lean implementation using the Lean Enterprise Vehicle with four wheels and a handle to steer. Each domain consist a set of variables that represent to measure that domain area. For example, quality is measured separately under TQM domain with variables related to it. This is stated in the literature that quality programs are practices within a TQM approach (Adhire et al., 1996).

The four domains of lean manufacturing principles identified were:

(i) Production and Inventory Management, PIM

(ii) Total Quality Management, TQM

(iii) Total Organizational Buy-in, TOB

(iv) Lean Manufacturing Techniques, LMT

2.3.1 Production and Inventory Management, PIM

The primary objective of PIM is to maximize resources and operator utilization while minimizing inventory. Inventory is the idle resource for any organization. Therefore it is necessary to hold

inventories at the minimum required level. Effective inventory management becomes a must for smooth and efficient running of production cycle. Many companies have experienced tremendous success in reducing their inventories while shortening their delivery times (Hunter, Steve, 2004). Table 2.1 lists the lean principles considered under PIM domain.

Measuring Variable	Literature Review	Reference
Forecasting	Forecasting is a process that often contains wasteful activities. Recognizing this is the first step towards applying lean thinking to a company's forecasting process. Proper application of lean thinking can result in lean forecasting.	Kahn, Kenneth B; Mello, John (2004/2005)
Pull System	In a lean system customer places and order, the manufacturing system orders the final assembly cell to produce the product, and all other processes upstream produce the part necessary to supply the product in a pull-through manner. Because of the uniqueness of the pull system, products are manufactured Justin-time; that is, as system needs arise.	Brown, Charles B; Collins, Terry R; McCombs, Edward L (2006)
Supplier Co-ordination	With the lean initiative, integration with suppliers could provide manufacturers the benefits of reduced business risks by joint R&D or joint investment in technology, decreased inventories by sharing sales forecast or production schedule, improved product quality and knowledge by code signing products, and lead to more stable supply prices by committing long-term partnership.	Stuart So and Hongyi Sun, (2010)

Table 2.1 PIM domain principles and Literature support

The PIM construct represents eleven items (or variables). Each item relates to production and inventory management that leads to reduction and control of inventory. This also enables to assess the degree of PIM practices adopted by the firm. The variable description information shown in Table 3.2 was purposely hidden in the research instrument and hence the respondents may not know the variable is being assessed.

Construct	Variable Description	Question
PIM	Forecasting	We predict the customer demand and accordingly the production planning is done
	Pull System	We use the Pull production system and no waiting for material at every work station
	Line Balancing	The inventory Levels are high at all work stations
	Supplier Co-ordination	Our suppliers supply material only when it is needed
	Kanban	We use Kanban squares or containers in the shop floor
	Supermarket	Supermarket concept is used for maintaining inventory buffers
	Routing	Product quantity routing has to be improved in many areas
	Supp Delivery Performance	99 % the products are delivered on time
	Production Planning	Finished goods are stocked in excess to meet out the demand
	Inventory Turns	The frequency of purchase is improved in last two years
	Visual Management	Visual Pull Signals are well used in process flow

Table 2.2 Hidden variables under PIM domain

2.3.2 Total Quality Management, TQM

TQM emphasizes the commitment and involvement of all employees in the organization. (Cudney, Elrod, and Kovach, 2010) states that Total Quality Management is a philosophy that focuses on integrating all functions of an organization in order to meet customer needs and organizational objectives. TQM became a very popular notion in the beginning of the 1990s among researchers and practitioners in order to describe how organizations should work to obtain better performance and customer satisfaction (Andersson, Roy; Eriksson, Henrik; H Akan Torstensson, 2006).

(Dahlgard, Jens J; Dahlgard-Park, Su Mi, 2006) in their comparative study on lean production, six sigma, TQM and company culture conclude that the principles, concepts and tools of lean production and six sigma quality should not be seen as alternatives to TQM but rather as a collection of concepts and tools, which support the overall principles and aims of TQM. Table 3.3 lists the lean principles considered under TQM domain.



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Measuring Variable	Literature Review	Reference
ISO 9000	ISO 9000 and TQM are vitally considered to be one of the most important phenomena in total quality management development and globalization.	Dale, B.G., Wu, P., Zain, M., William, A. R. T. and Van Der Wiele. T. (2001)
Employee Participation	Ohno introduced the concept of teamwork in a bottom relay race and to control the flow of items.	Ramnath, B Vijaya; Elanchezhian, C; Kesavan, R, (2009)
Quality Circles	A Lean Production system involves multi skilled operators, typically organized into small teams, being responsible for quality, continuous improvement and problem solving (Niepce and Molleman, 1998).	Mehta, Vidhi; Shah, Harshit, (2005)
7 QC Tools	The problem solving tools identified as used most frequently were very consistent from company to company	Ceridwen, Janice (1992)
Bench Marking	The results of the analysis can then be compared with existing best "lean" practices already known from the theory and research of production and business management	Smeds, Riitta. (1994)
Information flow	The company feels that strong communication and involvement are essential because it's the employees who often work on the improvements, and employees always have to live with the changes in the facility. Lean production requires frequent, rapid flows of information and goods along the value chain (Levy, 1997)	Olexa, Russ, (Sep 2002) Wu, Yen Chun, (2003)

Table 2.3 TQM domain principles and literature support

The TQM construct represents eleven items. Each item relates to use of TQM tools in the organization that enable to assess the degree of TQM practices adopted by the firm. Table 3.4 shows the hidden variables considered under TQM domain.

Construct	Variable Description	Question
TQM	SPC	All critical processes are controlled using SPC Charts
	Production Smoothing	Waiting time for materials at work stations are very high
	Poke Yoke	Rejections are eliminated using fail-proofing method at critical points
	Work environment	Every place in the organization is neat and well arranged
	ISO 9000	The components produced by us meets the international standards
	Team Work	25 % of process improvement is achieved because of employee's ideas
	Quality Circles	Department level meetings are held regularly to solve problems
	Problem-solving tools	Whenever a problem occurs, the root cause is identified and solved
	Supplier Quality	Most of the products received from suppliers are delivered at point of use
	Bench Marking	We always compare our self with competitors
	Information flow	Communication (Top-down and Bottom-top) both ways need to be improved

Table 2.4 Hidden variables under TQM domain

2.3.3 Total Organizational Buy-in (TOB)

Total Organizational Buy-in represents more on the organisational culture an essential platform for the implementation of lean manufacturing (Pius Achanga, Esam Shehab, Rajkumar Roy and Geoff Nelder, 2006). They state that high-performing companies are those which possess culture

sustainable and proactive improvement. The foundation for the lean enterprise lies in transforming the organization internally first through a cultural transformation and implementing lean tools (Hoyte, David S; Greenwood, Regina A. 2007). As many practitioners have realized, the successful implementation of lean manufacturing techniques requires more than just use of these tools. It requires a cultural change of the organization (Downing and Bryan, 2010). (Ramarapu et al., 1995) in his study conclude that management commitment and employee participation are critical success factors when implementing JIT. Table 3.5 lists the lean principles considered under TOB domain.



Measuring Variable	Literature Review	Reference
Kaizen	Most important of LM principles is “continual improvement”.	Friedman, Dick, (Oct 2004)
Management support	Leaders must set examples, be active and enthusiastic, and be present on the factory floor regularly.	Hunter, Steve (2003)
Leadership style	Without effective leadership, business transformation will not succeed and the strategic vision will not come to fruition	Hoyte, David S; Greenwood, Regina A. (2007)
Change management	<p>Quality improvement techniques like Six-Sigma, Lean thinking, and change management will be the transformation tools used by successful organizations going forward. However, just having this knowledge is not enough. Organizations must abandon the status quo and adapt new paradigms that focus on the removal of waste and promoting operational excellence.</p> <p>This dependence on the nature of the organization for the success of lean initiatives has made the implementation of lean techniques difficult.</p>	Downing and Bryan (2010)
Employee Commitment	<p>Lean is a cultural development process ... a way of thinking. You need to think, see and practice lean. Your people need a passion and fundamental understanding of the roadmap and the tools.</p> <p>Mitchell says that lean requires people to be more responsible and accountable for their own quality.</p> <p>Every employee must be involved, motivated and committed to the change process this is a top-down priority.</p> <p>Every employee must be committed to the elimination of all forms of waste.</p>	<p>Morrey, Stephen, (Aug 2000)</p> <p>Olexa, Russ, (Sep 2002)</p> <p>Hunter, Steve (2003)</p>

Table 2.5 TOB domain principles and Literature support

The TOB construct represents twelve items. Each item relates to total organizational buy-in that enable to assess the degree of TOB practices adopted by the firm. Table 3.6 shows the hidden variables considered under TOB domain.

Construct	Variable Description	Question
TOB	Vision	Most of the employees are aware about the company's goals and targets
	Performance based pay	Best performer announcements are made regularly
	Visuals/Communication	Sign Boards are very effective and displayed at appropriate positions
	Work Groups	Department problems are solved as a team exercise
	Incentives	Employees are rewarded whenever an improvement is made
	Kaizen	At least 25 % of employees suggestions are implemented
	Effective Leadership	There is lack of financial support for effective implementation of lean
	Management style	Most of the suggestions will come from managers rather than operators
	Change management	Most of the employees are not ready to change to a new method
	Safety Focus	Safety is a major problem in the departments
	Employee Commitment	Employees are ready to stay back and work whenever need arises
	Skills Training	Atleast 60% of the employees have attended training programmes

Table 2.6 Hidden variables under TOB domain

2.3.4 Lean Manufacturing Techniques, LMT

Lean manufacturing offers a set of tools and techniques as well as systematic approach for eliminating manufacturing waste and increasing manufacturing flexibility, while creating a continuous improvement-based organizational culture (Cumbo, Dan; Kline, D Earl; Bumgardner, Matthew S, 2006). Many authors have discussed the use and application of lean tools. The foundation of the lean manufacturing concept is application and use of these tools.

The extent of use of these tools may vary depending upon the functions of an organisation. Based on the definitions given by authors and practitioners the tools mentioned under LMT construct were identified. The LMT construct represents nineteen items. Each item relates to lean manufacturing technique that enable to assess the degree of LMT practices adopted by the firm. Table 3.7 lists the lean tools considered under LMT domain.



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Construct	Variable Description	Definition
LMT	5S	The most basic of the lean manufacturing practices which focuses on effective work place organization and standardized work procedures through eliminating waste.
	QC Circles	4-8 employees meet once in a week regularly to sort out the department problems
	Poke Yoke	Error and Mistake-Proofing is one of the powerful Lean tools used to ensure products and processes are completed correctly the first time.
	Kaizen	An improvement philosophy in which continuous incremental improvement occurs over a sustained period of time, creating more value and less waste, resulting in increased speed, lower costs and improved quality.
	Just-in-time	Just in Time manufacturing is the method of producing products with only a minimal amount of raw material and component parts on hand delivered just when they are needed.
	Line Balancing	To adjust the output of a series of cells to the same rate.

Table 2.7 LMT domain variables and definition

2.4 BENEFITS ACHIEVED (BENEACH)

Lean manufacturing benefits are huge and grow overtime. A successful adoption lean manufacturing practices will result in various operational and financial improvements. Lean systems enable the company to meet all of its cost reduction goals and improves total profit margin. (Rizzo and Ken 2008) from their findings state that the benefits of implementing lean manufacturing practices can be significant and go right to the bottom line. (Melton 2005) in his finding state that there are many tangible benefits associated with lean business processes. (Ward Peter; Zhou and Honggeng, 2006) in their concluding remarks states that effective lean and JIT practices significantly reduces customer lead time. A lean business process will be faster, i.e., the

speed of response to a request for the business process will be faster, and as most business processes are linked to organizational supply chains, this can deliver significant financial benefits to a company. The proponents of lean (Womack and Jones, 2005; Bicheno, 2004) advocate that lean manufacturing practices has the following benefits to offer: shorter cycle time, shorter lead times, lower work-in-process, faster response time, lower cost, greater production flexibility, higher quality, better customer service, higher revenue, higher throughput, increased profit.

Based on the literature review, eighteen benefits both tangible and intangible benefits were identified and used for the study. Each item relates to the benefits achieved by the firm by adopting lean practices. The items are measured using five-point scale that measures the level of benefit achieved in each item.

2.5 ORGANISATONAL PERFORMANCE (ORGPFR)

Firms can increase productivity, increase business performance, and build sustainable strategic advantage over its competitors by integrating lean thinking into its operations. Shams Rahman, Tritos Laosirihongthong, Amrik S. Sohal (2010) in their study conclude that adoption of lean manufacturing practices provides further evidence that lean practices are significant in enhancing operational performance.

The ORGPFR construct represents twelve items and each item relates to the performance obtained by the firm by adopting lean practices. The organizational performance is measured by change in status during the previous two years in terms of financial measures that include profit, sales turnover, market share, production cost, cost control, sales return and number of orders.

2.6 COMPETITIVE ADVANTAGE (COMAD)

In order to stay competitive, companies should improve their manufacturing operations. Lean manufacturing improves operations and customer satisfaction (Taj, 2007). The COMAD construct represents nine items. Each item relates to determine how well the firm is able to attain a competitive advantage by adopting lean practices. The competitive advantage is measured in terms of low cost, high quality, fast response, more variety, large volume, excellent design, latest technology and best service.

Fig. 3.2 shows the four domains of lean principle domain constructs and the items under each construct that lays the foundation for widespread adoption of lean manufacturing practices.

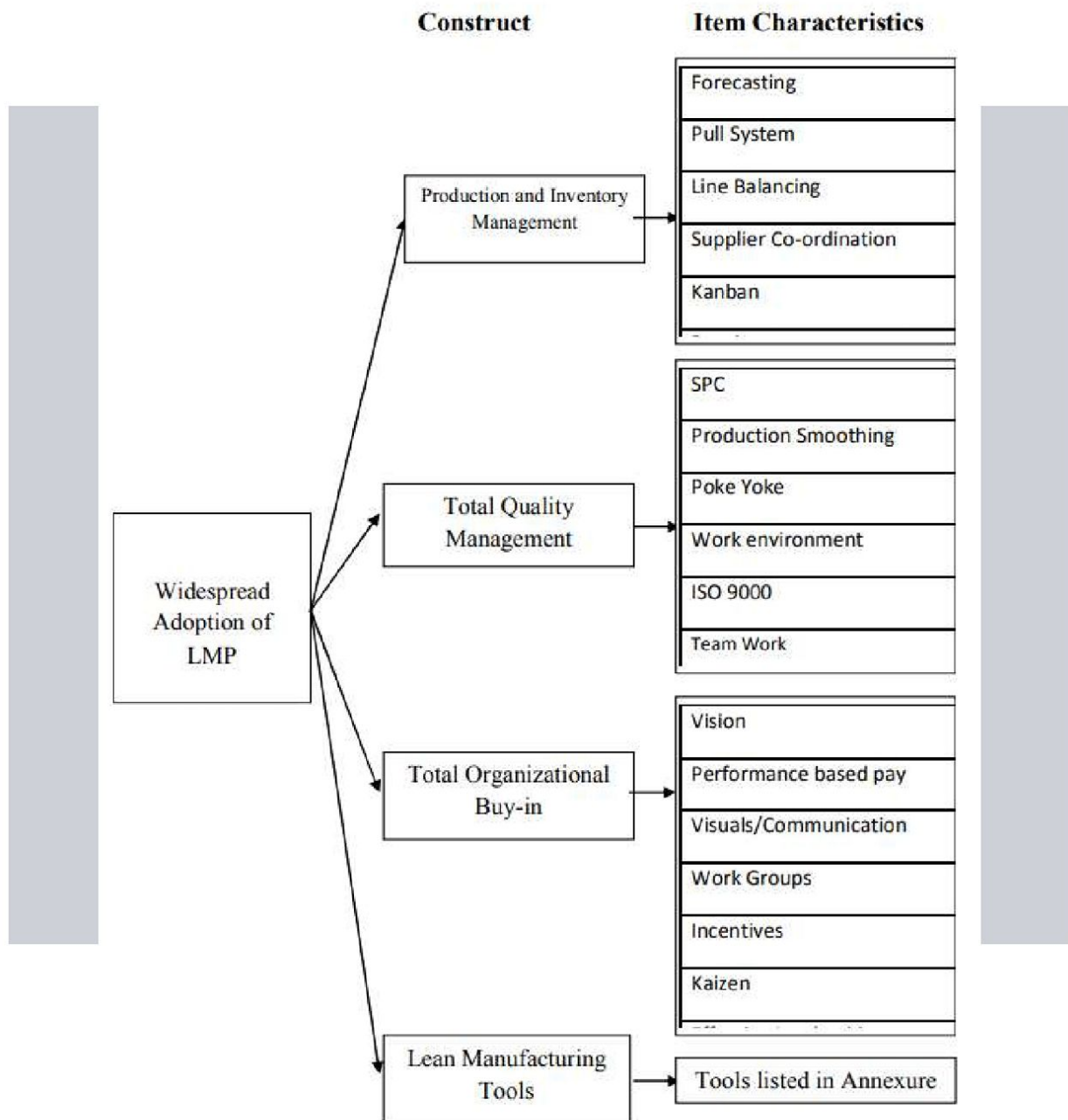


Fig 2.2 Block diagram for widespread lean adoption

2.7 WIDESPREAD AND BALANCED LEAN MANUFACTURING PRACTICES

There are several combinations of techniques possible for lean adoption. Lean tools and techniques can be implemented by selecting the suitable tools required with combination of techniques. Selecting the right tools and techniques encompassing all the lean principles leads to achieve widespread and balanced lean manufacturing practices. Balanced use of lean techniques will help firms in optimal use of resources and to gain better operational benefits. As companies try to implement lean processes in response to competitive pressures, they often become one-dimensional in their approach but becoming a world-class organization demands more than that (Brian Heymans, 2007). Considering the importance of a widespread-balanced lean approach that encompasses a wide variety of management practices in lean adoption, the lean enterprise model was used to demonstrate lean implementation using the four lean domain principles. Each domain represents the critical lean principles viz; Production and Inventory Management (PIM), Total Quality Management (TQM), Total Organizational Buy-in (TOB), and Lean Manufacturing Techniques (LMT). Each lean domain consists of a set of lean practices that support to achieve lean manufacturing. The lean practices are represented as items under the four lean domains. Further, the combination of items in each lean domain forms a continuum with Widespread Lean Firm (WLF) at one end and Limited Lean Firm (LLF) at the other end. A cluster analysis (Chapter 5) was performed to classify the firms under WLF and LLF.

2.8 RESEARCH HYPOTHESES

Five research hypotheses were framed linking the four constructs.

2.8.1 Research Hypotheses Linkage between widespread lean firms and level of preparedness

The manufacturing industry has experienced an unprecedented degree of change in the last three decades, involving drastic changes in management approaches, product and process technologies, customer expectations, supplier attitudes as well as competitive behavior (Ahuja et al., 2006). The contemporary business environment has become considerably complex and challenging, and as a result variety of factors influence the manufacturing organization (Ahuja and J.S. Khamba, 2008).

I.P.S. Ahuja suggest that Indian manufacturing organizations need to shed the sluggish character and move forward aggressively to develop and adapt proactive processes and practices for overcoming the inherent deficiencies in manufacturing systems for harnessing distinct competencies in comparison to their global competitors. To overcome the competition and the external factors, firms should anticipate and prepare them to face the challenges ahead. Adoption of lean tools and techniques will help the firms to face competition. Widespread adoption of lean manufacturing practices is linked with the level of preparedness in terms of how a firm anticipates the changes that occur in external environment. The external factors include entry of foreign companies, increase in raw material prices, rapid introduction of new products by competitors, customer demand for faster delivery. Because lean manufacturing practices help firm to resist the dynamic changes in external environment, it is expected that firms that are well prepared to face external changes will adopt lean practice widely.

H1: Widespread lean firms possess higher level of preparedness to face the external factors than limited-lean firms

2.8.2 Research Hypotheses II: Linkage between widespread lean firms and to obstacles faced

Firms generally find it difficult to make the transformation to lean manufacturing (Meneka, 2007). Previous studies has been observed that many of the organizations that attempted to implement lean manufacturing practices experience difficulties and are not able to achieve the expected benefits. The reason for failure of an organization to successfully implement lean manufacturing practices has been attributed to the various obstacles. These include resistance to change, lack of knowledge in lean tools and techniques. The resistance to change takes number of forms, that is, reluctance of individuals to change roles (Riis et al., 1997; Cooke, 2000). Thus, in adopting lean manufacturing practices, firms should develop manufacturing capabilities that helps them to face the obstacles of employee resistance, management support and knowledge in lean manufacturing practices. This manufacturing capability enables the firm to achieve operational benefits and gain competitiveness. Hence, firms with widespread adoption of lean manufacturing practices are linked with the capability of the firm to overcome the obstacles faced.

H2: Widespread lean firm's exhibit better ability to overcome the obstacles faced while implementing lean techniques than limited-lean firms

2.8.3 Research Hypotheses III - Widespread lean firms versus operational benefits

H2: Widespread lean firm's show higher operational benefits than limited-lean firms

There are many tangible benefits associated with lean processes.

2.8.4 Research Hypotheses IV - Widespread lean firms versus company performance

H4: Widespread lean firms demonstrate better company performance than limited firms

Two research hypotheses were proposed linking operational benefits versus competitive advantage and company performance versus competitive advantage.

2.8.5 Research Hypotheses V- Operational benefits versus competitive advantage

H5: Widespread lean firms that could achieve operational benefits were also able to attain competitive advantage

2.8.6 Research Hypotheses VI - Company performance versus competitive advantage

The global marketplace has witnessed an increased pressure from customers and competitors for greater value from their purchase whether based on quality, faster delivery, and lower cost in manufacturing as well as service sector (Basu, 2001; George, 2002). In general, competitiveness can be achieved in terms of low cost, high quality and rapid response. In addition to these organizations today compete on several other factors such as time, price, technology, innovation, reliable supply, and information management. Kumar et al. (2006) emphasizes the manufacturing organizations to adopt lean manufacturing practices and six sigma principles to attain competitiveness in one or more factors. At the level of the

individual firm many organizations have moved towards becoming lean by adapting different lean tools such as 5S, Just in Time, Set up reduction, TPM, etc. In many such cases, firms have reported some benefits; however, it is apparent that there is a need to understand the entire system in order to gain maximum benefits. Lean manufacturing combines the best features of both mass and craft production: the ability to reduce costs per unit will dramatically improve quality while at the same time providing an ever wider range of products and more challenging work (Womack et al., 1990). (Melton T, 2005) in his study on the benefits of lean manufacturing stated that implementing lean is a revolution but one should welcome with open organizational benefits of starting down a route of real continuous improvement. This is not an initiative, not a fad, it is a philosophy which has the potential to transform the business. Therefore widespread lean firms should be able to achieve better operational benefits and enhanced company performance and enable the firm to attain competitive advantage. Thus, the following hypotheses were proposed in relation to link between operational benefits and company performance and competitive advantage of the firm.

H6: Widespread lean firms that could achieve company performance were also able to attain competitive advantage

MYTHESIS

Chapter 3: Research Methodology

Over the past two decades, the number of research approaches in context to the researchers has increased. Thus, the selection of appropriate research method by the researcher that best characterizes the research problem is important to achieve the purpose of the study. This chapter describes the research methodology adopted in the study and presents the reasons for the selection of specific research methods and research instruments used in the study. The purpose of this study is to differentiate the prearranged grocery retailing and traditional retailing in context to service quality, promotion / pricing strategies, and customers' purchasing preferences, based on differences in product mix obtainable by the shops and their demographic characteristics.

3.1 Research philosophy

According to the statement conferred by Crowther and Lancaster (2008), positivist studies have always adopted a deductive approach, which Gulati (2009) describes as "the rationale for the common to the general." If the causal relationship or link seems to be inherent to a theory or example in a particular case, this may be true in many cases. Therefore, based on the causal links established by previous studies are based on factors like price, service quality and customer behavioural variables of purchase intention, store choice, etc. The intention in the present study aims to take away such relationships that can be comprehensive to organized and traditional retail stores. In context to this study, the deductions were formulated as theories and they were empirically tested alongside reality.

As stated by Easterby-Smith et al., (2002), the study was based on logical inference, focusing mainly on product range, store prices, etc., and the results of the study were observable, quantitative, and generalizable. The hypothesis was based in context to the findings of the study. Differences in context to consumer perceptions are imparted by their gender, differences in choice of store caused by product mix offered. The whole problem of research was subjected to its simplest form by testing only the quality of service, promotion / pricing strategy and the range of products provided by the store. Concepts were executed, separate estimates were made for each goal, and conclusions were drawn only through statistical analysis.

3.2 Research methods

A study that estimates the forecasting approach adopts a quantitative method and generalizes it into the applied research section, otherwise known as action research (Kumar, 2008). This research is classified as applied research because it is to fill the gaps in India's traditional and organized retail stores in context to the behaviour of the consumers towards organized outlets, which will help small retailers to decide and design effective marketing strategies in the future.

3.3 Research design

As a result, the current research was carried out due to insufficient knowledge of the differences between traditional and organized outlets in Bangalore, as no previous research has been carried out in this area. From the above observations, it is clear that the present study classified the study as a researcher according to all of the research definitions provided by different researchers (Sandhusen, 2000; Brown, 2006; Saunders, 2011). The research is descriptive because it more fully describes the situation of traditional and organized retail stores, and answers the key " questions associated with the problem (Ethridge, 2004; Zikmund, 2013), such as "Quality is an organized retail store service and " store choice. What are the effects of product mixing? ".

The study plan adopted by the study, as shown in Figure 3.1, indicates that the researcher started the study by first introducing the correct set of research questions so that the full complexity of the problem was captured. This was followed by an extensive literature review to identify the results of the latest research related to the combination of products in service quality, promotional strategies and consumer choice in stores, as well as conversations related to identification of areas requiring further research. On the basis of the study intervals, the objectives were created through the study, the operationalization of the variables, the hypotheses most relevant to the objectives were formulated, and a questionnaire capable of accurately measuring the structures. The process of selecting the sample population for the study was carefully examined to ensure the depth of the data and to avoid any selection bias, after which questionnaires were distributed for data collection. Of all the questionnaires distributed, only the completed questionnaires were chosen as the final study sample.

3.4 Research instrument

Oppenheim (2005) described the questionnaire as a research instrument or tool used to collect data, so that it consisted of a series of regularly asked questions to obtain the desired answers from the respondents in order to measure the research variables. In general survey-based research, a questionnaire is used to collect information on a particular research topic (Creswell, 2009). It is generally designed with a broad subject in mind and sometimes with already established constructions that are measured through multiple indices (ibid.). There are two main types of questions: open or closed (Oppenheim, 2005). A comparison between closed and open questions is presented in Table 4.6.

Closed questions	Open-ended questions
Quick and easy for participants to answer	Participants might need to provide clarification for giving a specific answer
Participants' answers are easier to compare	Participants' answers are difficult to compare
Easier to ask sensitive questions	Sensitive questions are difficult to ask
Simple to analyse	Requires time and are difficult to analyse
Easier to code answers for statistical analysis	Coding responses are difficult, thus makes statistical analysis difficult
Respondents' answer choices are restricted	Allows participants an unlimited number of possible answers
Restricted to researcher-specific language	Respondents respond in their own language
Restricted opportunity to probe respondents' answers	Good for exploring, self-expression and richness of details, opinions and feelings

Table 4.6: Comparison between closed and open-ended questions

A closed question proposal allows respondents' with choice of answers, such as yes or no or something more complex, such as whether the respondents agree to the selected question by ticking, underlining, or circling as they answer the open-ended question; They are not limited to or limited to any answer thus giving them the freedom to express their opinion (Oppenheim, 2005).

3.5 Question Scaling

The scale, as defined by Bernard (2013), is "a device for defining units of analysis in categories of variables". It is used to classify individual responses to a question or statement, or to compare responses to a group of questions. Trochim (2006) defined the scale as "a branch of measurement involving a material which combines a qualitative structure with qualitative units". The scale is used to measure the intrinsic level of a classification or a rating (Bernard, 2013).

3.5.1 Type of Scales

Different types of scales are used in the questionnaire, but the Likert scale is the most common. It was developed by Rensis Likert in 1932 as a means of measuring respondents' attitudes towards a series of specific descriptions of a subject or theme. It shows the respondents' degree of agreement with the responses, thus attenuating the cognitive and emotional content of their attitude (McLeod, 23). Other commonly used scales include the Guttman scale developed by Louis Guttman in 1944, used to measure response patterns, and the Thurstone scale developed by Robert Thurston in 1929 to measure the attitude of respondents towards questions.

Scale, as defined by Bernard (2013), is "a device for assigning units of analysis to categories of a variable". It is used to rank individual responses to a question or statement, or to compare a group's response to questions. Trochim (2006) has defined scaling as "the branch of measurement that involves the construction of an instrument that associates qualitative constructs with quantitative units". Scale is used for measuring dimensions underlying a set of ranking or ratings (Bernard, 2013).

There are various types of scale used in a questionnaire but the most common is the Likert scale. This was developed by Rensis Likert in 1932 as a means of measuring respondents' attitudes to a series of specified statements on a topic or theme. It shows the degree of respondents' agreement with statements, thereby tapping into the cognitive and affective component of their attitudes (McLeod, 2008). Other commonly used scales include the Guttman scale, developed by Louis Guttman in 1944, used for measuring patterns of respondents' answers to questions, and the Thurstone scale developed by Robert Thurstone in 1929 to measure respondents' attitude to questions.

Likert	Guttman	Thurstone
Easy to construct; not time-consuming	Little guidance for item selection	Hard to construct; time consuming
Respondents have at least 5 alternative choices of answers	Unequal scale intervals	Respondents are restricted to only one choice of answer (agree or disagree)
Fairly easy to understand	Hard to understand	Hard to understand
Good result of validity and reliability	Poor result of validity and reliability	Poor result of validity and reliability
No need to use judges	No use of judges	Involves the use of judges, who may be biased
Requires less statements or questions		Requires lots of statements/questions
Uses a general measurement format		Average value is used as the scale score

Table 4.7: Comparison of different types of scale

3.5.2 Questionnaire preparation

By examining the existing literature on these concepts, a questionnaire was created by first identifying a set of articles to measure the quality of the service, the promotion / pricing strategies and the range of products. Subsequently, the appropriate response formats for the elements were analyzed and appropriately allocated to the elements at different scales such as the binary scale, the five-point Likert scale, etc. Questionnaires based on demographic details such as age, gender, etc. have been assigned to nominal scales, variables such as monthly income have been assigned intermediate scales and fun factor factors such as pricing strategies, pricing strategies, product lines, ranging from strongly disagree to strongly agree. In context to the given the five-point Likert scale. The items were then identified in an intelligible, ambiguous and clear statement form. Finally, the items were examined for reliability and validity, followed by items that exhibited low correlation and discrimination.

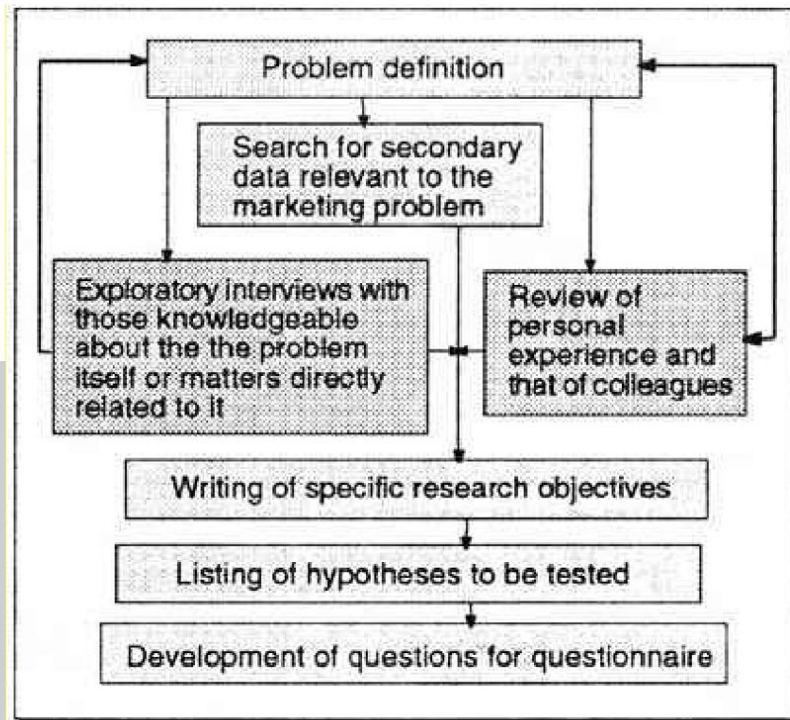


Figure 3.2: Questionnaire preparation

3.5.3 Questionnaire design

The questionnaire was prepared for the study to ensure that participants receive as much information as possible. As Johns (1998) reported, enough questions were linked of all dimensions to accurately describe the purpose of the study and to ensure that the number of questions from participants was not distributed. As suggested by Converse and Presser (1986), the questions have been organized in such a way that the general questions remain at the beginning of the questionnaire. Thus, the first section of the questionnaire began with the description of the respondent population. The elements were worded in such a way that they clearly signified the purpose of the respondents. In addition, negative questions were avoided as suggested by other researchers to avoid resentment from study participants (Foddy, 1993). According to the guideline provided by Leary (1995), no anecdotal hypothesis was made during the preparation of the questionnaires on the respondents. The researcher took care to ensure that bilateral questions were avoided, that is to say that each question was centered on a subject and allowed only one answer.

The survey had three objectives: Collecting information on the quality of service, promotion / pricing strategies and the range of products for Traditional and organized retail grocery stores. Thus, the questionnaire was divided into four categories, focusing on the characteristics of the respondents who collected information on age, sex, profession, number of salaried members, education, marital status, family type and family.

The second category deals with five aspects of quality of service, namely practical reasons and non-intrusive factors: reliable factors, reactive factors, service assurance and empathy. Fun things included items related to the store environment, store amenities, visual appeal, shopping benefits, etc. The reactive factors work with the store's operating time, the resolution of customer complaints and the overall immediacy of the services. The stores' ability to assess customer needs with store assurance was assessed in terms of empathy while assessing the stores' efforts to improve the relationship with customers.

The third section deals with two aspects: the promotional reasons for the prices and the price factors. Customers were asked questions about store plans and discounts. The fourth category includes questions on the range of products offered by stores, such as their product list, product selection and their continuity in the supply of a range of products.

3.5.4 Reliability and validity of the questionnaire

The accuracy of the measurement elements or indicators included in the study was assessed using a reliability and validity analysis to measure the constraints defined by the study researchers.

Validity analysis: Babbie (1973) defines the validity of a questionnaire as "an empirical measurement sufficiently reflects the true meaning of the concept considered", that is to say the accuracy of the questionnaire to signify what the measured. Hein, Weinstein and Ford (2005) point out that of all the critical factors conducting quantitative research, the accuracy of the results presented was the most important problem. In the present study, the construction validity of the questionnaire was assessed using a confirmatory factor analysis. The validity of the construction refers to the ability of the questionnaire to provide the most relevant results with the hypothesis in the study (Sekaran, 2003). For example, through confirmatory factor analysis, researchers can verify that factual questions, assurances, empathy, etc. taken into account in the study accept only the quality of service as a choice and not for any other factor. This high efficiency of a device is

also considered as a transformative and discriminating validity, respectively, compared to the practice and to show a deficiency in the relation between the structures. A confirmatory factor analysis was used in this study to obtain information on the validity of the questionnaire structure in the event of convergent and discriminant validity.

Although the classical model of validity tests has two more important concepts for legitimacy, namely the validity of the subject and the criterion, modern theories have proved that construction validity is proof of a fundamental validity which is understood in all other categories (Guion, 1980; Messick, 1995; Schotte, Maes, Cluydts et al., 1997; Brown, 2005). Therefore, the study is only tested to create the validity of the questionnaire.

Reliability analysis: in the present study, the reliability of the questionnaire was measured using the Cronbach alpha method to confirm the reproducibility of the study, i.e. to check whether a certain number of tests gave the same result. In other words, Cronbach's alpha value represents the durability and continuity of a material, which is achieved in the absence of all types of bias. In accordance to Tavakol and Dennick (2011), no research instrument can test reliability although the concept of reliability is not guided by validity. Thus, the study was tested on the validity of the scale as well as the reliability.

The current study examined the inter-item reliability of the questionnaire, which demonstrated the level of consistency in the models displayed by the study participants' responses to the study items (Trochim, 2006). The Cronbach's alpha used to test reliability can range from 0 to 1, with no continuity of the 0 and 1 scale showing a completely consistent scale. Figure 1.3 illustrates a view of the reliability and validity of the research tools.

3.6 Sample selection

A sample subjects a small section in context to the chosen population from a large population for the conduction of the study (Blair & Czaja, 2013).

3.6.1 Sampling procedure

The general population of a survey refers to the whole group of people with general characteristics, in this case consumers of groceries. Consumers of groceries in the city of Bengaluru were identified by the researchers as the target population for the study. Sampling techniques, modified

by a non-random sampling strategy, were refined during the study period (Bartlett et al., 2001; Dornyei, 2007), to facilitate the group of participants in the study most practical and most relevant by eliminating those who were useless or unable to participate or who were not consulted.

Due to the simplicity and affordability of the technology, researchers have taken advantageous samples (Mackey & Gas, 20). Neutral selection of study participants and representation of the final study sample to a larger population, which is an important factor controlling the external validity of the research during the sample selection process.

3.6.2 Sample size calculation

The size of the sample in the current study was determined based on the variables taken into account in the study and the size of the effect estimated by the statistical test that will be carried out to achieve the objective of the study. The sample size was chosen to confirm the robust statistical analysis of the data and the reliability of the results as possible, even being able to detect the smallest differences between groups. The main concern of the researcher when choosing the sample size was to avoid a second type of error, unable to reject such a false assumption even if a study is false because the study did not detect any such effects (Kraemer & Thiemann, 1987; Cohen, 1988; Wilcox, 2001).

To determine the sample size, data on the total population of several Small, medium and large enterprises were obtained and considered as the target population for the study. A sample size of 100 was considered. The sample size in context to the study was intended with the help of the subsequent formula (Daniel, 1999) for 95% confidence interval and 0.05 Margin of error.

Chapter 4: Findings

4.1 Descriptive Analysis

The characteristics of the SMEs were analyzed from section 1.3 of the questionnaire. 96 respondents supply their products directly to OEMs, 31 respondents supply their products to Tier I companies, and 41 respondents supply their products to Tier II companies. Fig. 4.1 shows percentage of SMEs that supply their products to its customer in the supply chain. This provides an understanding about the supply characteristics of SMEs considered for the study.

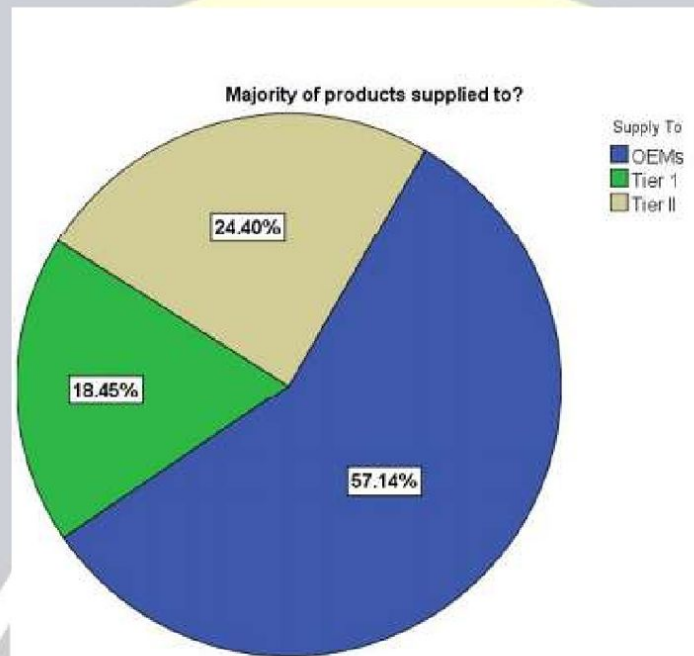


Fig: 4.1 Per cent of SMEs that supply its products in various stages in the supply chain

Fig. 4.2 shows the percentages of customers who agree or disagree that implementing lean manufacturing techniques has organizational benefits. Majority of the customers have strong belief that lean techniques have organizational benefits. But still 14.3 per cent of respondents disagree on this statement.

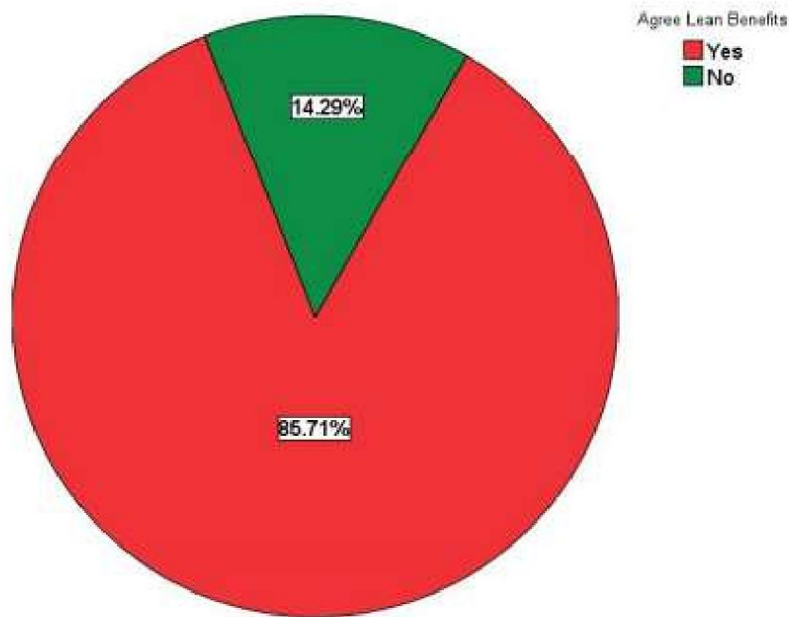


Fig. 4.2 Per cent of respondent agree that lean implementation have benefits

Further, from the analysis it was found that only 24 per cent of the SMEs have achieved a score above the mean value in all the four Lean Domains (LD) as shown in Fig. 4.3. The chart shows that an alarming 24 per cent of the SMEs have not achieved the mean score in any of the lean domain principles which indicates that these SMEs cannot claim that they have implemented lean manufacturing practices in their SME. In comparison, Production and Inventory Management and Lean Manufacturing Techniques domains were less adopted than Total organizational buy-in and Total quality management principles.

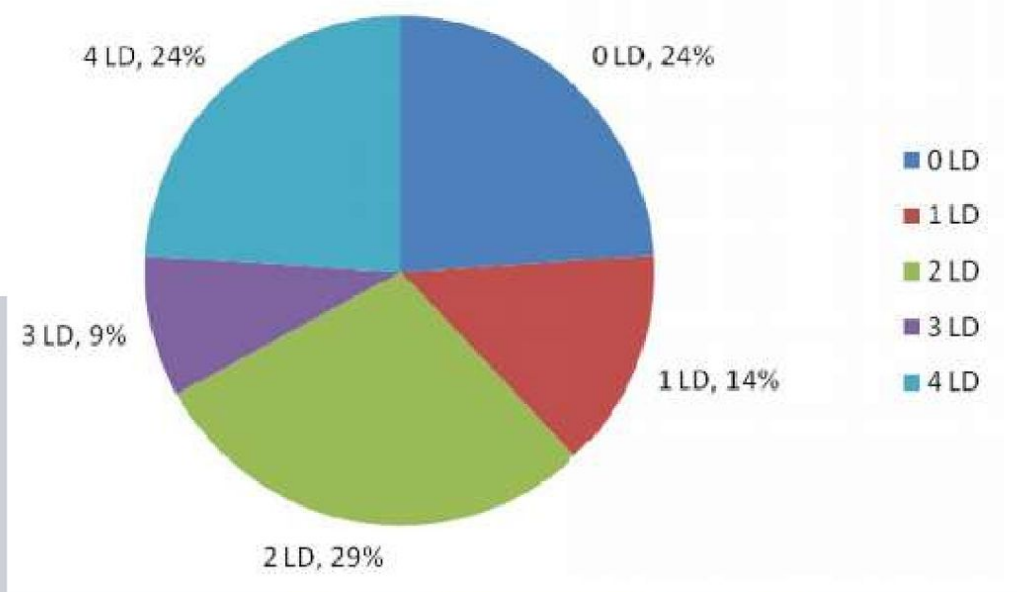


Fig. 4.3 Per cent of SMEs adopting number of Lean Domains (LD) above mean score

Fig. 4.4 shows per cent of SMEs adopting lean domains principles above the mean score. Results indicate that majority of the SMEs adopt TQM principles more than PIM and LMT principles. This indicates the imbalance in implementing lean principles.

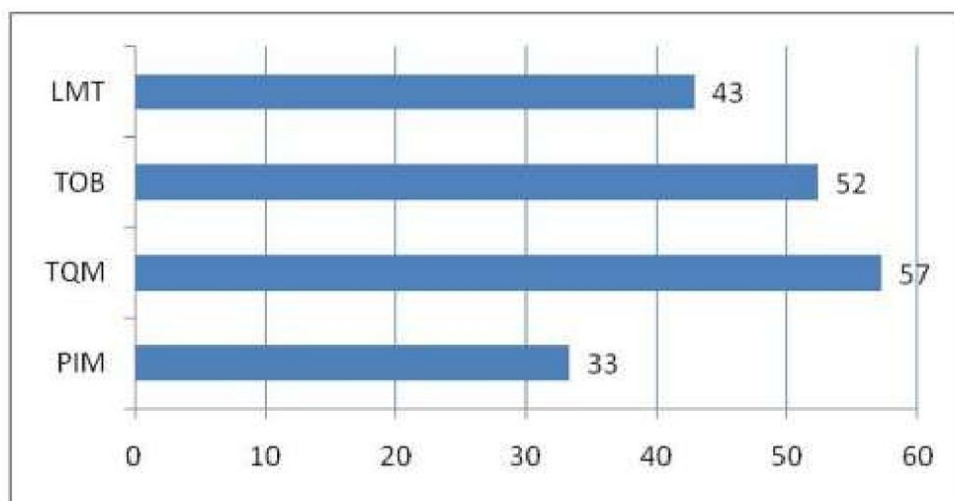


Fig. 4.4 Per cent of SMEs adopting Lean Domains principles above mean score

4.2 Correlation among Constructs

Table 4.1 presents the calculated Pearson bivariate correlations among the four lean domain constructs used in cluster analysis and lean enterprise model. The table shows significant correlations among all the lean domain constructs. Correlation between TQM and TOB domains are highly correlated with a value 0.742.

Lean Domain	Correl with PIM	Correl with TQM	Correl with TOB	Correl with LMT
PIM	1	.706(**)	.563(**)	.680(**)
TQM	.706(**)	1	.742(**)	.605(**)
TOB	.563(**)	.742(**)	1	.541(*)
LMT	.680(**)	.605(**)	.605(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 4.1 Pearson Bivariate Correlations among lean domain constructs

4.3 Cluster Analysis

The items after purification were considered for cluster analysis. Items representing the four lean principles viz., production and inventory management (PIM), total quality management, (TQM), total organizational buy-in (TOB) and lean manufacturing techniques (LMT) were selected as the clustering variables. Item-wise reliability and validity tests has been tested and presented in chapter three.

Initially, hierarchical method of clustering was used to decide the number of clusters by combining the nearest elements into clusters repeatedly till the required number is arrived. This clustering is agglomerative method used for determining the agglomeration coefficients arrived at each stage. The stage that has a largest incremental change in agglomeration coefficient gives the number of clusters to be classified. Table 4.2 shows the incremental change in agglomeration coefficient of twenty clusters.

Number of Cluster Solutions	Incremental Change in Agglomeration coefficient
20	20.000
19	64.000
18	124.000
17	242.000
16	405.600
15	573.600
14	778.667
13	1058.667
12	1344.000
11	1664.667
10	2040.667
9	2464.667
8	2897.067
7	3337.067
6	3901.067
5	4522.667
4	5274.667
3	6077.333
2	7119.111
1	11315.048

Table 4.2 the incremental change in agglomeration coefficient of twenty clusters

The largest incremental change in agglomeration coefficient of twenty clusters is between cluster 1 and cluster 2. Hence the number of clusters is determined as two that has the highest relative increase in cluster homogeneity. The cluster membership of each case and the mean scores of the clusters were calculated for each cluster variable.

Followed by hierarchical method, the non-hierarchical K-means method is used to refine the results arrived. The cluster means scores arrived using the initial method is used to perform K-means method of clustering. The K-means resulted in two cluster grouping. Group 1 with 104

cases and group 2 with 64 cases. The mean scores are arrived for each variable (lean principle) under each group. The results showed that group 1 has high scores in all the four lean principles when compared to group 2. The results indicate that group 1 SMEs adopt all the lean principles extensively. It can also be suggested that these SMEs are well balanced with minimum variation in all the lean principles. On the other hand, group 2 SMEs have lower scores which indicate that these SMEs are not adopting lean principles extensively. The score in cluster centre for group 1 was 3.96 under lean manufacturing techniques (LMT) whereas, for group 2 it was as low as 1.93. Similarly for production and inventory management (PIM), it was 3.59 for group 1 SMEs and 3.17 for group 2 SMEs. The variation in scores of group 2 SMEs were also high than group 1 SMEs. Due to high variation in the scores in adopting lean principles, these SMEs were not well balanced. Hence, SMEs with high scores and minimum variation are categorized under widespread-balanced lean SME and SMEs with lower scores and greater variation are categorized under limited-unbalanced lean SME. The mean scores arrived for each variable (lean principle) under each group using K-means cluster analysis is shown in Table 4.3.

Lean Principle	Group 1 n = 104	Rank	Group 2 n = 64	Rank
PIM	3.593	3	3.159	1
TQM	3.709	2	2.560	3
TOB	3.583	4	3.121	2
LMT	3.966	1	1.931	4
Range	0.407		1.228	

Table 4.3 Final cluster centers of Groups with rank order

The results arrived from cluster analysis classified 104 SMEs as widespread lean SMEs and 64 SMEs as limited lean SMEs out of total 168 SMEs taken for the study (Fig. 4.5).

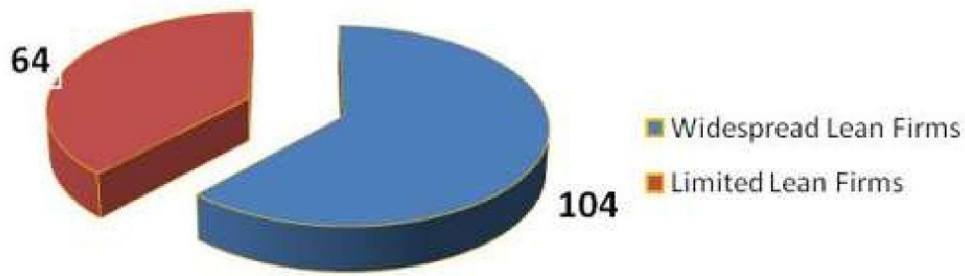


Fig. 4.5 Classification of SMEs using cluster analysis

Based on the classification results the mean scores of two group SMEs on four lean principles adopted were plotted in a radar chart Fig.4.6a and 4.6b. The radar chart (Fig.4.6a) depicts the closeness of all the four domain lines for widespread lean SMEs. This pattern signifies that these SMEs were balanced in adopting lean manufacturing practices.

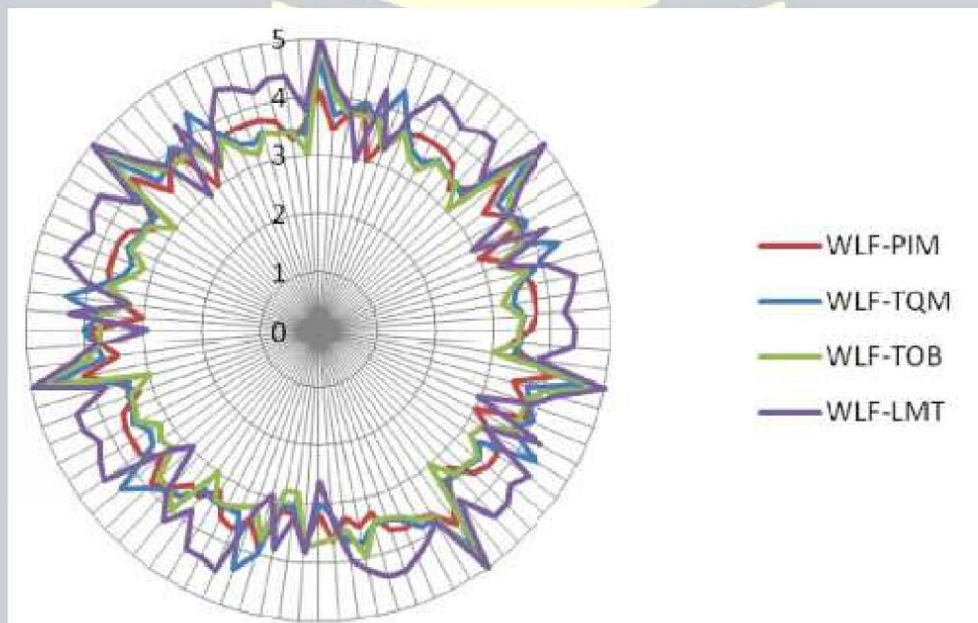


Fig. 4.6 a. Radar chart showing mean scores of Widespread-Balanced Lean SMEs

The radar chart for limited lean SMEs shows wide gap between each domain line plotted in chart (Fig.4.6 b). This pattern signifies that these SMEs are not balanced in adopting lean manufacturing practices.

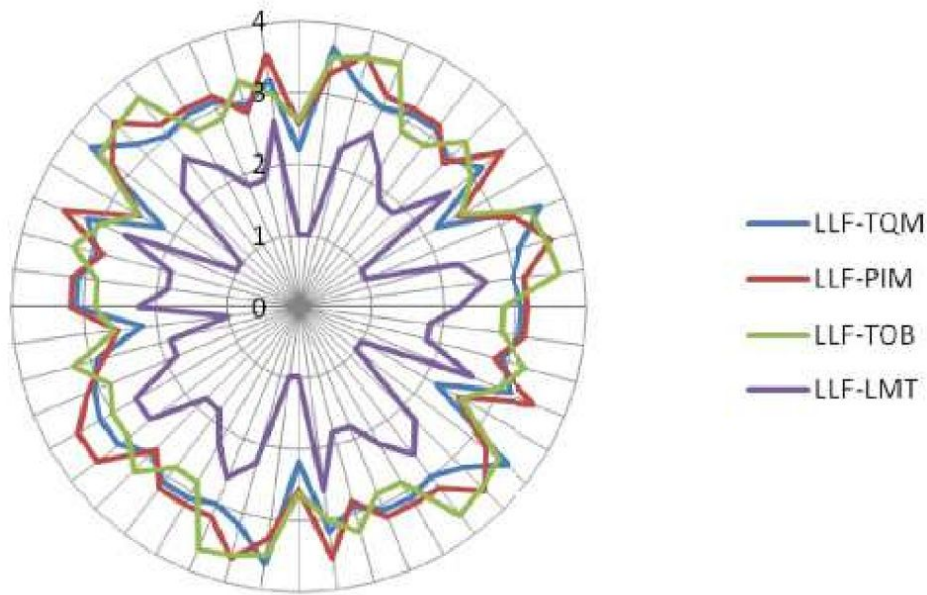


Fig. 4.6 b. Radar chart showing mean scores of Limited-Unbalanced Lean SMEs

4.3 Chi-Square Test

From section 1.8 of the questionnaire on growth percentage in terms of sales turnover of the SMEs compared to previous year, a Chi-Square test was performed to test whether there is a significant difference between the group SMEs. The cross tabulation is shown in Table 4.4.

Count		Growth Percent			Total
		0-5%	6-10%	11-15%	
Wide or Limited	Widespread	8	32	64	104
	Limited	32	24	8	64
Total		40	56	72	168

Table 4.4 Widespread Lean or Limited Lean * Growth Percent Cross tabulation

Null Hypothesis (H0): There is no significant difference between widespread lean SME and limited lean SMEs on percentage of growth by SMEs.

Alternate Hypothesis (H1): There is significant difference between widespread lean SME and limited lean SMEs on percentage of growth by SMEs.

Table 4.5 shows the Chi-Square value of 0.00 which is less than the p-value of 0.05. Therefore null hypothesis is rejected. Hence, there is significant difference between widespread lean SME and limited lean SMEs on percentage of growth by SMEs.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	52.554	2	.000
Likelihood Ratio	56.532	2	.000
Linear-by-Linear Association	52.130	1	.000
N of Valid Cases	168		

Table 4.5 Chi-Square Tests

4.4 ANOVA TEST

In order to test the significance difference between the widespread lean SMEs (Group 1) and limited lean SMEs (Group 2) based on the four lean principles, a univariate ANOVA test is performed. The results of the ANOVA test indicated that the two groups differed significantly on the four lean domain principles as shown in Table 4.6.

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
PIM	7.598	1	.087	166	87.656	.000
TQM	20.207	1	.144	166	140.079	.000
TOB	8.352	1	.199	166	41.875	.000
LMT	187.368	1	.306	166	612.031	.000

Table 4.6 ANOVA results for testing significant difference between groups

4.5 Discriminant Analysis For Cross-Validation

The results arrived in cluster analysis is cross-validated using discriminant analysis. Discriminant analysis takes one categorical dependent variable and multiple metric independent variables for analysis. Considering all the four lean principles as independent variables and group classification as the dependent variable, discriminant analysis is performed. Table 4.7 shows the details of discriminant function. The canonical correlation value of 0.926 indicates a strong relationship between the four lean principles and the group classification.

Function	Eigen value	Cumulative %	Canonical Correlation	Sig.
1	5.985	100.0	.926	.000

Table 4.7 Discriminant Function results

Table 4.8 shows the coefficients of the variables of discriminant function. The higher the value indicates more the discriminating power. Lean manufacturing techniques (LMT) had the highest coefficient and hence LMT has the highest discriminating power. Total quality management (TQM) is the next highest value with 0.376 followed by Production and inventory management (PIM). Total organizational buy-in (TOB) indicates the lowest coefficient value with 0.205. In general a value of 0.3 and more are considered as good discriminating factor (Hair et al., 1998).

Independent Variable	Coefficients
PIM	0.297
TQM	0.376
TOB	0.205
LMT	0.785

Table 4.8 Discriminant coefficients

Table 4.9 shows the classification results of predicted group membership. 104 SMEs fall under the widespread lean SMEs group and 64 under limited lean SMEs group.

Widespread Lean Firms or Limited Lean Firms		Predicted Group Membership		Total
		Widespread	Limited	
Count	Widespread	104	0	104
	Limited	0	64	64
Percentage	Widespread	100.0	0	100.0
	Limited	0	100.0	100.0

a. 100.0% of original grouped cases correctly classified.

Table 4.9 Classification results of predicted group membership

4.6 Hypotheses Testing

Hypotheses are framed to test the objectives and statistically prove the results obtained. Five hypotheses on various constructs are tested and given as follows.

4.6.1 Widespread lean SMEs and level of anticipation

H1: Widespread lean SMEs possess higher level of preparedness to face the external factors than limited-lean SMEs.

Widespread adoption of lean manufacturing practices is linked with the level of preparedness in terms of how a SME anticipates the changes that occur in external environment. Due to the uncontrollable external factors SMEs are put under pressure. In order to remain competitive, SMEs must be prepared to take appropriate operational strategies to overcome these external forces. This could force the SMEs to adopt lean practices to face the threats ahead. Thus, it was expected that the level of anticipation by widespread lean SMEs should be more than limited lean SMEs.

Group	N	Mean	Std. Error Mean	t	Sig.
Widespread Firms	104	2.800	.089		
Limited Firms	64	2.825	.073		
EXFACT				-.216	.829

Table 4.10 SME groups and preparedness

Table 4.10 shows the p-value of 0.829 which is more than the accepted level of 0.05. Therefore null hypothesis that there is no significant difference in the level of anticipation in the changes that occur in external environment by widespread lean SMEs and limited lean SMEs is accepted. It is interesting to identify that though both SME groups differ in lean adoption they were able to foresee the changes that could happen in external environment.

4.6.2 Widespread lean SMEs and obstacles faced

H2: Widespread lean SMEs exhibit better ability to overcome the obstacles faced while implementing lean techniques than limited-lean SMEs.

Widespread adoption of lean manufacturing practices requires knowledge about the pre-requisites of implementation and a suitable work environment that supports the implementation process. It is suggested that the implementation process requires acceptance by the employees at all levels with a positive mindset. The success or failure in implementing lean practices depends upon various factors that include selection of suitable tools, employee involvement and management support. To identify the success factors that determine successful lean implementation the obstacles faced by SMEs are analyzed. It was required to find how widespread lean SMEs were able to overcome the implementation challenges than limited lean SMEs.

Table 4.11 shows the values of mean, standard error and t-values of group SMEs. The results arrived indicate that there was significant difference between the obstacles faced by widespread lean SMEs and limited lean SMEs in all the items. Larger the t-value indicates higher the difference between SME groups.

Group	N	Mean	Std. Error Mean	t	Sig.
Widespread Firms	104	3.535	.061		
Limited Firms	64	3.019	.043		
OBSTFACED				6.799	.000

Table 5.11 SME groups and obstacles faced

Table 4.12 shows the ranking of items according to the difference between groups. Employee training, employee involvement and employee participation are the first three important factors for lean implementation.

Variable	t	Sig.	Std. Error	Rank
Not aware of lean tools	3.648	.000	.148	7
Management not interested	2.642	.009	.095	9
No training given to employees	7.879	.000	.104	1
High employee turnover	2.638	.009	.139	10
Employees have no interest	7.234	.000	.117	2
Employees not empowered	4.010	.000	.122	6
Employees not ready to change	6.049	.000	.118	3
Employees slip back to old method	3.590	.000	.126	8
Investment high for implementation	5.398	.000	.155	5
No consultant available	-2.441	.016	.154	11
Did not know where to start	5.523	.000	.133	4

Table 5.12 Item-wise ranking for obstacles faced by SME groups

4.6.3 Widespread lean SMEs and operational benefits

H3: Widespread lean SMEs are able to gain better operational benefits than limited lean SMEs

Implementing lean practices should result in operational benefits. Hence it is expected that engineering goods manufacturing SMEs that implement lean manufacturing practices extensively should differ in achieving better operational benefits than limited SMEs.

Group	N	Mean	Std. Error Mean	t	Sig.
Widespread Firms	104	3.8846	.03814		
Limited Firms	64	3.3750	.08441		
BENEACH				6.209	.000

Table 4.13 SME groups and benefits achieved

Table 4.14 shows item-wise analysis on benefits achieved between SME groups. The result clearly indicates that widespread lean SMEs were able to achieve reduction in product cost (which has the highest difference between SMEs groups) followed by decrease in delivery lead time and lot size reduction. There was no significant difference between SMEs groups on reduction in inventory level, improvement in supplier lead time and better work environment.

MYTHESIS

Variable	t	Sig.	Std. Error	Rank
Quality Improvement	3.257	.002	.092	12
Meeting Customer demand	5.393	.000	.144	7
Reduction in Inventory Level	1.416	.159	.136	17
Wastage Reduction	4.208	.000	.185	10
Productivity Improvement	2.747	.007	.147	13
Delivery Lead Time	6.077	.000	.149	2
Machine Downtime	4.810	.000	.108	8
Product Cost Reduction	7.456	.000	.120	1
Lot size reduction	5.977	.000	.137	3
Product Cycle Time reduction	5.567	.000	.124	5
Process Flexibility	2.105	.038	.137	14
Setup time reduction	5.632	.000	.128	4
Supplier Lead time reduction	1.687	.094	.114	15
Work Environment	1.668	.098	.161	16
Communication Flow	5.400	.000	.121	6
Employee Morale	3.637	.000	.172	11
Customer Satisfaction	4.457	.000	.091	9

Table 5.14 Item-wise ranking for benefits achieved by SME groups

4.6.4 Widespread lean SMEs and company performance

H4: Widespread lean SMEs are able to achieve high company performance than limited lean SMEs

It is expected that there is significant difference between widespread lean SMEs and limited lean SMEs on company performance.

Table 4.15 shows there was significant difference between SME groups on the performance of the SMEs obtained.

	Group	N	Mean	Std. Error Mean	t	Sig.
COMPERF	Widespread Firm	104	3.4760	.03136		
	Limited Firm	64	3.1992	.03036	6.340	.000

Table 5.15 SME groups and company performance

While analyzing the items that measure the SME's performance, there was significant difference in all the measures except in product variety and export orders received. Widespread SMEs were able to increase their asset value, increase in market share, and increase in sales turnover and followed by other items in the order given in Table 4.16.

Variable	t	Sig.	Std. Error Difference	Rank
Company's Profit	4.318	.003	.094	5
No. of orders	5.132	.000	.133	4
New Customers	4.312	.000	.109	6
Market Share	8.165	.000	.092	2
No. of Products	1.239	.217	.101	9
Sales Turnover	6.985	.000	.087	3
No. of Employees	-7.228	.000	.100	11
Export Orders	1.803	.073	.121	8
Asset Value	9.120	.000	.118	1
Sales Return	-4.073	.000	.149	10

Table 4.16 Item-wise ranking for company performance by SME groups

4.6.5 Widespread lean SMEs and competitive advantage

H5: SMEs with widespread adoption of lean manufacturing practices are able to achieve competitive advantage

SMEs that were able to gain better operational benefits are also able to achieve significant improvement in their' SMEs to achieve a competitive advantage to compete in the market place. Hence it was expected that there is a significant difference in achieving competitive advantage between SME groups.

Table 4.17 shows that there is a significant difference in achieving competitive advantage between widespread lean SMEs and limited lean SMEs.

	Group	N	Mean	Std. Error Mean	t	Sig.
COMPERF	Widespread Firm	104	3.8462	.04241	4.904	.000
	Limited Firm	64	3.5000	.05643		

Table 4.17 SME groups and competitive advantage

There was no difference between SME groups on product variety, use of latest technology and new product development as shown in Table 4.18.

Variable	Sig.	t	Std. Error Difference	Rank
Products are of high quality	.007	4.012	.120	3
Excellent delivery performance	.000	10.615	.105	1
More number of variety products	.000	-.092	.104	7
Excellent design	.375	-.685	.126	6
Can supply any volume	.000	4.551	.072	2
We only have tech and machines	.126	1.537	.113	5
Customers come for new product development	.016	1.535	.119	4

Table 4.18 Item-wise ranking for competitive advantage by SME groups

4.7 PROPOSED MODEL FOR LEAN ENTERPRISE

Liker (1997) stated that lean enterprise embodies lean principles at its heart. Transforming the organization through a cultural change, attain total quality that encompass the entire organization, achieving smooth production flow with minimum inventory and implementing lean tools will result in Lean enterprise. The four lean domain constructs developed with the set of lean principles in this study addresses the requirements for a Lean Enterprise. Engineering goods manufacturing firms those adopt these lean principles will be able to transform their organization from the existing level of lean to lean enterprise level.

Firms those were tested for successful adoption of lean manufacturing practices in all the four lean domains were termed as lean enterprise.

$$[(PIM + TQM + TOM + LMT) * (Wide + Balanced)] = \text{Lean Enterprise}$$

The lean enterprise embodies lean principles at its heart, that is, its operations are based on a manufacturing philosophy that eliminates activities that add cost but not value and it "reduces the time from customer order to delivery by eliminating sources of waste in the production flow". Hoyte, David S in his study states that the foundation for the lean enterprise lies in transforming the organization internally first through a cultural transformation and implementing lean tools.

he results of H3 and H4 states that these firms are able to gain better This is also ascertained based on the classification made using cluster analysis and cross validated using discriminant analysis. A structural equation model is used to develop by linking the lean enterprise and operational benefits achieved, lean enterprise and firm or company performance, operational benefits and competitive advantage, company performance and competitive advantage. Fig. 4.7 shows the linkage between constructs to form a lean enterprise output model.

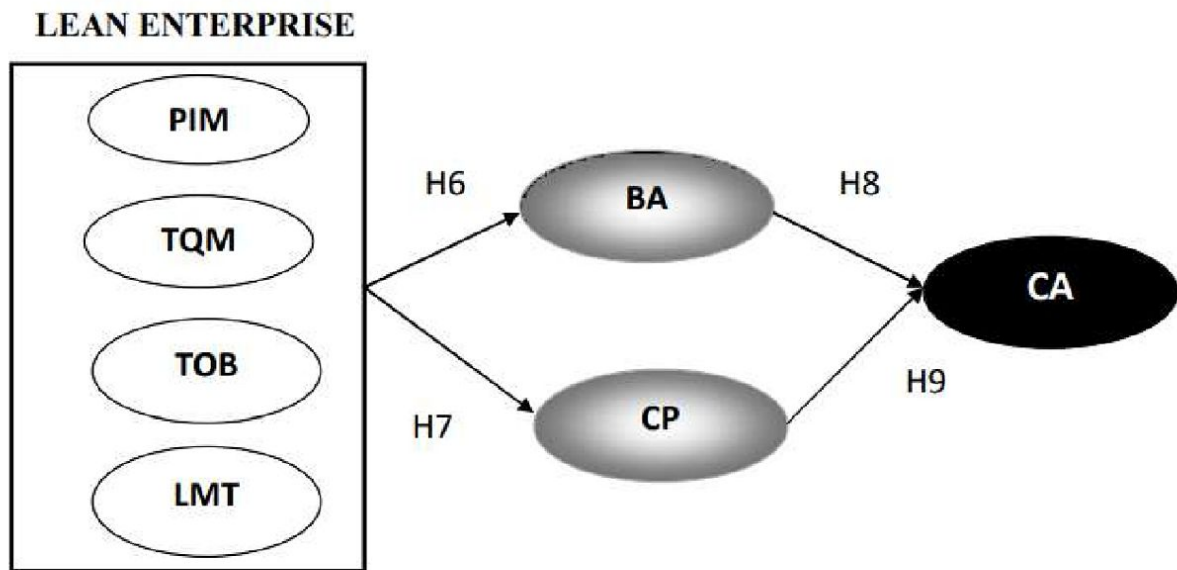


Fig. 4.7 Lean Enterprise Output Model

Each linkage in the model is set with the hypotheses to test the relationship between constructs. The construct scores and correlation values are calculated using Visual PLS software. Table 4.19 shows the hypotheses and its corresponding independent variable and dependent variable. The correlation between company performance and competitive advantage is slightly less than 0.5 and this can be due to the other external influencing factors joint ventures, mergers and acquisitions that affect the dependent variable.

MYTHESIS

Hypothesis	Independent variable	Dependent variable	Correlation	Sig.
H ₆	Lean Enterprise	Benefits Achieved	0.536	.000
H ₇	Lean Enterprise	Company Performance	0.718	.000
H ₈	Benefits Achieved	Competitive Advantage	0.616	.000
H ₉	Company Performance	Competitive Advantage	0.485	.000

Table 4.19 Independent variable and dependent variables

The test of significance for the correlation values arrived for various pairs of constructs are tested. But still, the boot strap function in Visual PLS software is considered to be more reliable for test of significance for proposed combination of constructs. The constructs validity and indicator loading are tested using Visual PLS. PLS path modeling is a non-parametric method, and as such cannot be used for performing a t-test. But it is possible to use re-sampling methods (bootstrap and jack knife) to obtain the significance of the various paths in the model (Efron 1979; Efron and Gong 1983). The standard value of t-statistic is 1.96 at 5% level of significance. The test values arrived are examined for significance and is assumed that if the t-statistic is more than 2, the path is significant.

Hypothesis	Entire sample estimate	Mean of sub sample	Standard error	T – Statistic	RSq.	Sig.
H ₆	0.6360	0.3417	0.0720	4.6637	0.413	Significant
H ₇	0.7180	0.7186	0.0543	13.2151	0.515	Significant
H ₈	0.5750	0.5730	0.0426	13.5024	0.562	Significant
H ₉	0.4300	0.4291	0.0789	5.4478	0.562	Significant

Table 4.20 Structural Model - Boot strap summary

Table 4.20 shows the boot strap summary results arrived using PLS Visual software.

H6: Lean enterprise that adopts widespread and balanced lean manufacturing practices results in better operational benefits.

Table 4.20 shows relation between lean enterprise and operational benefits are significant with t-statistic value (4.6637) which is greater than the acceptance value 2. The relation is found to be significant with sample estimate (0.6360) and R² (0.413). Hence the result confirms the theory that widespread adoption of lean manufacturing practices by engineering goods manufacturing firms has an influence to gain better operational benefits.

H7: Lean enterprise that adopts widespread and balanced lean manufacturing practices results in better company performance.

Table 4.20 shows relation between lean enterprise and operational benefits are significant with t-statistic value (13.2151). The relation is found to be highly significant with sample estimate (0.7180) and R² Sq. (0.515). Hence the result confirms the theory that widespread adoption of lean manufacturing practices by engineering goods manufacturing firms has an influence to achieve better company performance.

H8: The higher the operational benefits of a firm, the better the competitive advantage

Table 4.20 shows the relationship between operational benefits and competitive advantage is significant with a t-statistic value (13.5024). The relation is found to be highly significant with sample estimate (0.5750) and R2 (0.562). Hence the result confirms the theory that higher the operational benefits of a firm, the better the competitive advantage

H9: The greater the performance of a firm, the better the competitive advantage

Table 4.20 shows relation between performance of a firm and competitive advantage are significant with t-statistic value (5.4478). The relation is found to be highly significant with sample estimate (0.4300) and R2 (0.562). Hence the result confirms the theory that greater performance of a firm, leads it to attain competitive advantage.

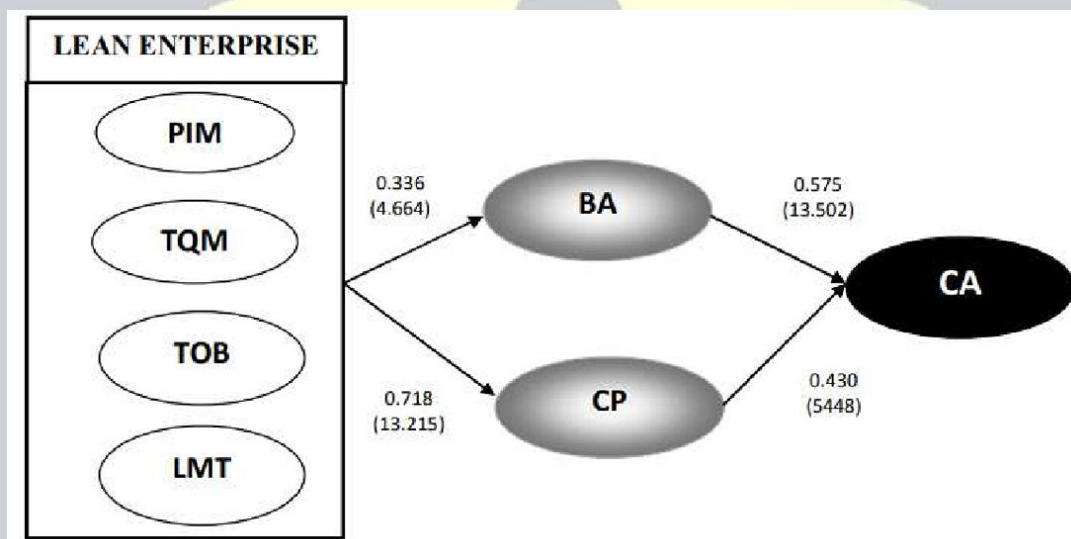


Fig. 4.8 The Lean Enterprise Model

The Lean Enterprise Model Fig. 4.8 illustrates that Benefits Achieved (BA) with a sample estimate value of 0.575 and the Company Performance (CP) with 0.430 strongly determines the firms to achieve a Competitive Advantage (CA)-H8 and H9.

To summarize, the descriptive analysis showed the demography of the firms taken for the study. The cluster analysis classified the firms into two groups. Firms those adopted lean manufacturing practices by implementing all the four lean principles in wide and balanced manner are classified as widespread lean firms and limited lean firms. The discriminant analysis cross validated the results and arrived in classifying the firms. ANOVA test is performed to test the significant

difference between the widespread lean firms and the limited lean firms on the four lean domains for adoption of lean principles. Mean scores of widespread lean firms and limited lean firms are compared for significant difference on each lean principle under four lean domains. The lean principles that have higher influence are ranked. Finally, a lean enterprise model was developed and tested for the proposed domains of lean principles.



Chapter 5: Conclusion

5.1 Conclusion

In light of this investigation of Critical Success Factors impacting execution Measures of SMEs two models are readied. These models are tasks execution and Regression based. Estimation model and auxiliary condition models were first tried for corroborative factor investigation and build legitimacy. Further the inductions between builds of models were drawn from the way coefficients got in auxiliary condition displaying with theory testing.

This investigation finds that activity level Lean execution Measures (manufacturing yield) of SMEs can be estimated as far as two develops, tasks needs of SMEs and development in efficiency. The activities needs are estimated as far as cost, quality, conveyance, and adaptability. Development in efficiency is estimated as far as rate change in yield, rate change in labor profitability, and percent change in material productivity. The finding affirms that Lean Practice execution of SMEs is multidimensional, that manufacturing capacities and tasks needs are emphatically related, and that activities needs decidedly impacts development in profitability.

Indian SMEs, particularly in Gujarat locale need to concentrate on better administration of such basic achievement components of Lean activities, and give a sound premise to asset allotment based on huge components, upgrades will happen in quality, efficiency and at last outcome in improved monetary execution and working cost, worker association, Organization culture and will bring authoritative development for worldwide seriousness.

In particular, the examination study researched basic achievement elements and execution measures for Lean Practice usage. Whenever inspected the connection between Lean Practices and authoritative execution and distinguished the quantity of huge connection between them. The interest in Lean Practice means business results. For this examination determined execution framework in accordance with Lean Practice Tools recognized as center components or Critical Success Factors of Lean Practice activities.

5.2 Recommendation

The four lean domain constructs (PIM, TQM, TOB and LMT) developed in this study has proved that it plays a significant role for successful adoption of lean manufacturing practices. The contributions of these lean domains yields better operational benefits and improve company performances. Each domain has a relationship with the other domains and is interlinked with each other. Hence, it is recommended that SMEs must implement these four lean domains.

Research finding states that the while implementing lean techniques are due to organization culture and largely due to employee related aspects such as Employee training, Employee involvement, Employee participation, Knowledge about LMP implementation, Employee empowerment, Awareness about lean tools, Employee acceptance, and Employee attrition rate. Hence it is strongly recommended that SMEs must set a suitable work environment by adopting the concepts given in TOB lean domain which addresses the employee related aspects.

Employee training, Employee involvement, and Employee participation tops the list and considered important. Reduction in product cost and Delivery Lead Time are the two operational benefits that are ranked first and second. This outcome clearly indicates that SMEs that adopt lean manufacturing techniques in a widespread manner will enable SMEs to achieve this. Further, to compete in the market achieving these two benefits is very essential. Hence, it is highly recommended to SMEs to implement the lean domains mentioned in the model.

Widespread lean SMEs were able gain competitive advantage in terms of excellent delivery performance, supply in high volume, high product quality, and were able to develop new products and more product variety. SMEs can gain a competitive advantage in terms of low cost production which is mentioned in operational benefits.

Delivery performance is a very important measuring parameter when it comes to supply to OEMs. Therefore, Tier I SMEs those supply to OEMs should have high delivery performance. Lean practices help SMEs to meet delivery schedules and improves their vendor rating.

Supply in high volume is possible when companies have good inventory management policy, implementing Just-in-time technique and production planning methods. Competitive market place quality is considered as one of the important parameter a manufacturer should posses. This helps Tier I and Tier II SMEs to win export orders and enter into international business.

New products development leads to newer products variety and process improvement. Winning new orders are possible when customers are satisfied with excellent delivery performance, high product quality and low product cost.

Results of this research study throw light on the fact that limited lean SMEs tend to be one-dimensional in approach towards adopting lean manufacturing practices. It is recommended that a more holistic approach is required in adopting lean manufacturing practices. Implementing the recommended four lean domain principles would help SMEs to adopt lean manufacturing practices in a widespread manner.

At the same time, SMEs should implement the recommended four lean domains giving equal emphasis on each domain in order to achieve a balance in lean practices. In other words, SMEs should not aim to be too good in one domain and be bad in another and are termed as limited lean SME. Hence, SMEs must transform from Limited lean SME category to Widespread lean SME category.

The tools given under lean manufacturing techniques domain will suit the engineering goods manufacturing SMEs for widespread adoption of lean manufacturing practices. It is recommended that the LMT tools mentioned in this study (18 tools) are required by SMEs to implement but, the degree of usage of each tool may vary SME to SME.

To attain a competitive advantage, it is required that SMEs should excel in all domains of lean practices. Hence, it is recommended that SMEs should implement all the four lean domain principles in a balanced approach.

5.3 Future scope of research study

Further Research can be done on practices of Lean Manufacturing in different district of the nation and the consequences of such investigations can be analyzed. To improve the viability of advance philosophy like Six Sigma it ought to be rehearsed alongside Lean Practice Tools and Techniques like Lean Six Sigma drive. The following condition of the investigation is to do the semi organized meetings with a Lean Practice Deployment Champions. This will assist with increasing better knowledge into the Lean Initiative with in Gujarat/Indian industry. The determined Lean Practice Model can be tried in different ventures, for example, handling, medicinal services,

Pharmaceuticals and so forth. Further research can be completed with respect to the commitment of Lean bosses, Lean Six Sigma Black belt in effective arrangement of Lean Practice drive in the association. There is additionally scope for research to be done on enterprises that were not explored right now, model shopper and different organizations (information from just hardware and gear, material/bundling, vehicle and metal handling SMEs is gathered right now). Examination would then be able to be made between the different businesses to comprehend if basic achievement factors are comparable or distinctive across industry segments and nations. Such learning can enable different ventures to create manufacturing systems that may prompt upper hand and business achievement.

Right now, SMEs in Gujarat and close by territories, have been examined. Future research can broaden investigation into various geological regions. Future research can likewise attempt to comprehend if there are distinctive conduct and qualities of organizations, for example, customary and dynamic manufacturing organizations. In the event that the distinction can be affirmed, it can prompt prescribe techniques on how organizations can improve execution. In particular, future research can attempt to comprehend if explicit basic execution components can add to upper hand and business achievement.

5.4 Limitations of research study

To decrease perceptual inclination and manage subjective powerful factors in emotional situations, CFA for factors evaluated utilizing Measurement model are utilized to decide the significance loads of key compelling variables and the conceivable need of fruitful Lean usage. Additionally, all the eleven CSFs and seven PMs have been considered for foreseeing achievement probability of Lean execution in SMEs. More CSFs can be incorporated for foreseeing achievement plausibility of Lean usage in SMEs and rank the major CSFs corresponding to the accomplishment of Lean execution in SMEs. It is important to encourage the estimation of need loads, as the figuring can turn out to be progressively perplexing when more traits are utilized. It is prescribed to create PC program to help diminishing the weight of computation and incorporate more sub-factors to accomplish more noteworthy exactness in expectation. Measurements – All factual strategies have a few confinements and all the restrictions of all the various techniques which have been utilized would apply to this examination. As the case with any exploration study concentrated on overview examination , one of the constraint of this investigation was tied in with getting the

necessary number of reactions from the enterprises .The reactions got from a portion of the ventures like Electrical, Electronics, Textiles, Fertilizers , Consultants are very less. Precision of information relies on the impression of the respondent representatives of the SMEs to which survey are sent, consequently on the off chance that they offer their one-sided input, at that point it can influence the consequences of the examination study. Oneself report nature everything being equal – All information were self-report – they were the two convictions (Likert-scaled) and genuine execution .For the real execution it is smarter to gather these from autonomous perceptions or open records, for example, budgetary reports. A few insufficiencies right now well be tended to and taken consideration while completing examination in future among them are Here, inclinations connection study is acquired through the master framework comprises of academician teacher and hardly any industry specialists working in the field of Lean. It is just abstract judgment and any biasing by the individual who is making a decision about the SEM model may impact the conclusive outcome.



MYTHESIS

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