CHAPTER 6

FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

6.1 INTRODUCTION

In the competitive environment of the global marketplace, firms need to implement new management tools and concepts in order to remain competitive. The increasing competitiveness forces the Indian manufacturing sector to be more productive with less cost. There are various tools and techniques developed over the paradigm of choice. Lean is one such manufacturers’ paradigm of choice. Lean manufacturing helps to gain market leadership and sustainable competitive advantage. In the last decade, many Indian firms are implementing lean techniques to be competitive. But companies fail in implementing lean practices due to negligence in implementing lean tools in other disciplines of manufacturing. Hence it is important to understand areas of lean implementation and its extent use. Although many companies in India have already implemented lean, only few were able to achieve the full benefits in term of operational performance and sustainable competitive advantage. This research is undertaken to study the lean practices adopted by firms in southern part of the country focusing on the engineering good manufacturers.

This study is undertaken for several reasons. Lean manufacturing is practiced by many firms, but still there is no clear-cut understanding about the selection and extent use of lean tools and its benefits. This study as a first attempt aimed to provide a theoretical framework to adopt lean practices with widespread approach and measurable benefits. Further, the study provides a theoretical justification to the relationship between lean practices and operational benefits.
This study explores the compelling factors for firms to adopt lean practices. Many firms have tried implementing lean and discontinued due to internal factors and their ability to overcome the implementation challenges. Few have managed to successfully adopt and implement lean practices. This study examines the selection and use of lean tools implemented by engineering goods manufacturing firms that classifies firms as widespread lean firms and limited lean firms.

Previous studies have focused largely on implementation of lean tools in production processes, sometimes neglecting other disciplines of manufacturing. A premium attempt is made in this study that has given equal importance in implementing lean in all related disciplines of manufacturing with a balanced approach.

The aim of this study is to evolve sector-specific lean manufacturing practices with special reference to engineering goods manufacturing firms, duly validated to show how it would lead to higher volumes of production through minimum use of resources and thus achieve competitive advantage through operational benefits. It aims to measure (i) the lean manufacturing practices adopted by engineering goods manufacturing firms (ii) the lean principles that differentiates widespread lean firms from limited lean firms and (iii) the linkage between widespread lean practices and operational benefits, firms’ performance and competitive advantage.

An attempt has been made to provide a linkage on widespread lean practices and competitive advantage. Based on the data collected from 168 engineering goods manufacturing firms in Tamilnadu, India, a lean enterprise model was proposed and tested using PLS path modeling method using visual PLS software.

6.2 SUMMARY OF RESEARCH FINDINGS

Out of the total 168 respondents, 81 per cent of the manufacturers are either direct suppliers to OEMs or suppliers to Tier I companies. The remaining 19 per cent of the manufacturers are suppliers to Tier II companies.
Based on results arrived using descriptive statistics, it is found that majority of the respondents have agreed that lean techniques have organizational benefits. But, 14.3 per cent of respondents disagree on this statement, which indicate that there is still disbelief on lean implementation by manufacturers.

Results that measured the mean scores on the four lean domain principles showed that only 24 per cent of the firms have achieved the mean score in all the lean domains. This supports the statement that Indian manufacturing firms lag in lean implementation practices. Further, it is found that firms are more oriented towards implementation of TQM and TOB principles than LMT and PIM principles.

Pearson bivariate correlations values confirm that there is strong relationship between the four lean domain constructs. Correlation between TQM and TOB domains are highly correlated with a value 0.742 at 0.01 significance level. Relationship between LMT and TOB domain construct is low with a correlation value 0.541 at 0.05 significance level.

The cluster analysis performed provided clear indication in difference in levels of scores in implementing lean principles by firms. The cluster analysis classified firms into two firm groups. Firms with high level of scores on all the four lean principles are categorized as Widespread Lean Firms. The second group firms with relatively low level of scores in all the four business principles are categorized as Limited Lean Firms.

- 104 firms are classified as widespread lean firms and,
- 64 firms are classified as limited lean firms.

Classification result showed 100 per cent of cases classified correctly. The classification provided a strong support in justifying the theoretical framework proposed in chapter two. The result provides supporting evidence that the widespread lean firms differ significantly in adopting lean principles and practices.
The variation of mean scores for each lean principle arrived using K-means cluster analysis differs for the two groups. In case of widespread lean firms, there is less variation in mean scores of the four lean domains and with a range value of 0.407 and hence these firms are termed as Balanced Lean Firms. Similarly, in case of limited lean firms, there is more variation in the four lean domains and with a range value of 1.228 and hence these firms are termed as Un-balanced lean firms. Further, there is a complete mismatch in the rankings of lean principles PIM, TQM, TOB and LMT between widespread-balanced lean firms and limited-unbalanced lean firms. The above results provide substantial evidence in confirming the classification of firms.

The Chi-Square test carried-out on the data was significant at the 0.05 level of significance ($\chi^2 = 52.55$, df = 2). The outcome of Chi-Square test proved that the growth percentage of firms differ significantly among widespread lean firms and limited lean firms.

The results of the ANOVA test indicated that the two groups differed significantly on the four lean domain principles PIM, TQM, TOB and LMT with F-values 87.65, 140.07, 41.87 and 612.03 respectively. The test results confirmed the statement that widespread lean firms are more competent than limited lean firms.

In order to identify the discriminating power of lean domain principle the output of the discriminating function results, showed that adoption of Lean Manufacturing Techniques, LMT domain principle has highest discriminating power (0.785) followed by Total Quality Management, TQM (0.376), Production and Inventory Management, PIM (0.297) and Total Organizational Buy-in, TOB (0.205), in the above mentioned order.

The canonical correlation value of 0.926 indicates a strong relationship between the four lean principles and the group classification.
The hypothesis test result concludes that both the widespread and limited lean firms are able to foresee the changes that could happen in external environment. This is in contrast with the perception that firms that practice lean extensively are better predictors of external factors and prepare themselves to face the changes.

While testing for the firm’s ability to overcome the obstacles faced while implementing lean techniques, the results indicated that the two groups differ largely in the following aspects in the order Employee training, Employee involvement, Employee participation, Knowledge about LMP implementation, Implementation cost, Employee empowerment, Awareness about lean tools, Employee acceptance, Management support, Employee attrition rate, Role of consultant. The results imply that limited lean firms are lacking in total organizational buy-in domain which addresses more on employee related aspects.

Examining the differences in operational benefits gained by firm groups, the results showed that the two firm groups differed significantly in the following aspects in the order Reduction in product cost, Delivery Lead Time, Lot size reduction, Setup time reduction, Product Cycle Time reduction, Communication Flow, Meeting Customer demand, Machine Downtime, Customer Satisfaction, Wastage Reduction, Employee Morale, Quality Improvement, Productivity Improvement, Process Flexibility, Supplier Lead time reduction, Work Environment, and Reduction in Inventory Level. The results showed that reduction in product cost and delivery lead time topping the list provides clear evidence that firms that adopt lean extensively have an upper hand in reducing the product cost and delivery lead time. This helps the firms to compete in terms and low cost and rapid response.

Determining the differences in firms groups to achieve high company performance, the results showed that widespread lean firms are found to be superior in achieving high company performance in the following order, in terms of increase in Asset value, Market share, Sales turnover, Number of orders, Profit, New customers,
decrease in Sales return and number of employees. There is no difference among firms in terms of increase in number of products and export orders. This should be the notion that both the firm groups focus towards satisfying customers with existing products and export orders.

Confirming that widespread lean practices determine firms to achieve competitive advantage, the firm groups differed in gaining a competitive advantage in the order, in terms of Delivery performance, Supply volume, Product quality, New product development and Product variety. However, firm groups did not differ in gaining a competitive advantage in use of technology and product design.

The proposed lean enterprise model exhibits that all the four lean domain principles such as Production and Inventory Management, Total Organisational Buy-in, Total Quality Management and Lean Manufacturing Techniques has an influence on the operational benefits that a firm achieves, and the company performance as well. The benefits achieved by the firm and the performance of the company have an influence in achieving a competitive advantage.

The lean enterprise comprising widespread adoption all the four lean business principles PIM, TQM, TOB and LMT will help firms to gain better operational benefits (0.336), and significantly improves company’s performance (0.718).

The Lean Enterprise Model 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).

6.3 RECOMMENDATIONS

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 firms must implement these four lean domains.
Research finding states that the firm’s ability to overcome the obstacles faced 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 firms 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. Hence firms should identify and provide training for its employees. Concepts like quality circles and kaizen would lead to employee involvement, employee participation and helps to improve employee morale.

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

Adoption of lean practices on company performance results in increase on asset value, market share, sales-turnover, number of orders, profit, and new customers. All these are very good for the growth of a firm. Firms those adopted lean practices successful where able to achieve these benefits.

Widespread lean firms 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. Firms 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 firms those supply to OEMs should have high delivery performance. Lean practices help firms 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.

Firms can gain a competitive advantage in product quality. In today’s globally competitive market place quality is considered as one of the important parameter a manufacturer should posses. This helps Tier I and Tier II firms 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 firms 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 firms to adopt lean manufacturing practices in a widespread manner.

At the same time, firms 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, firms should not aim to be too good in one domain and be bad in another and are termed as limited lean firm. Hence, firms must transform from Limited lean firm category to Widespread lean firm category.
The tools given under lean manufacturing techniques domain will suit the engineering goods manufacturing firms for widespread adoption of lean manufacturing practices. It is recommended that the LMT tools mentioned in this study (18 tools) are required by firms to implement but, the degree of usage of each tool may vary firm to firm.

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

### 6.4 CONCLUSIONS

Although lean manufacturing is becoming an increasing popular technique for productivity improvement, many engineering goods manufacturing firms are still not certain of its implementation and the benefits they may achieve. These firms generally find it difficult to adopt lean manufacturing practices and transform into a lean enterprise. Firms tend to implement lean manufacturing practices using a one-dimensional approach neglecting other domain areas. Only few studies are done on implementing lean considering other domain areas of manufacturing. Literature review revealed that no study was done on adoption of lean manufacturing practices in a balanced approach. An attempt is made to prove that adoption of lean manufacturing practices in a widespread-balanced manner by implementing the lean domains principles has better operational benefits. The four lean domain principles developed for this study such as Production and Inventory Management, Total Organisational Buy-in, Total Quality Management and Lean Manufacturing Techniques help engineering goods manufacturing firms to adopt lean practices in a widespread-balanced manner. The result supports the proposed hypotheses that the lean domain principles have strong correlation between them. Firms classified under widespread lean firms group are able to attain significant organisational performance. Firms those have not adopted all the lean domain principles are not able to achieve significant operational benefits. Finally,
the Lean Enterprise model proves that adoption of all the four lean domain principles determines the firm to attain operational benefits and organisational performance and paves way to achieve competitive advantage. The study provides a direction for further research to assess the level of balance a firm should possess in each lean business principle and on which it is deficient.

6.5 THEORETICAL CONTRIBUTIONS

The research provides a theoretical framework for firms to adopt widespread lean practices to achieve competitive advantage. This study is the first research on lean adoption focusing the engineering goods manufacturing units in India.

The four lean domain principles discussed in this study encompass all the elements that are required for lean a practice which directs lean implementation with a multi-dimensional approach.

Each lean domain recommends the pattern of lean implementation that helps firms to gain operational benefits and firm’s performances.

This is the first study that suggests widespread lean practices in a balanced manner with supporting evidence that classifies firms as widespread lean firms and limited lean firms.

6.6 KEY CONTRIBUTIONS

This study has identified the lean principles that support for successful adoption of lean practices among engineering goods manufacturers.

This study paves way for a holistic approach in lean adoption by implementing the essential lean domain principles such as, Production and Inventory Management (PIM), Total Organisation Buy-in (TOB), Total Quality Management (TQM) and Lean Manufacturing Techniques (LMT).
Previous studies on lean implementation classified firms into lean firms or non-lean firms. This study used a novel approach to classify firms as widespread lean firms and limited lean firms based on the extent of lean manufacturing practices adopted by the firms.

This research study has empirical evidence that widespread lean firms those extensively implemented all the four lean domain principles has better operational benefits and were able to improve their company performance than limited lean firms.

Outcome of the analysis prove that widespread lean firms are able to overcome the obstacles faced in implementing lean and are also able to gain better operational benefits and attain a competitive advantage.

The study exhibits how firms differ in widespread adoption and balanced adoption. Widespread adoption refers to implementation of the lean principles and balanced adoption refers to the extent of use of these principles.

Results of the study confirm that widespread-balanced lean practices will enable a firm to gain a competitive advantage.

6.7. LIMITATIONS AND FUTURE RESEARCH

Engineering goods manufacturing firms located in the state of Tamilnadu in southern part of India are only considered for the study. Number of samples was restricted due to time constraints.

Limitations are opportunities for future research. This study forms a base to take-up similar studies in other sectors of manufacturing. The set of lean domain principles recommended in the study forms a base for all types of manufacturing units, the items under each principle may vary from sector to sector. Hence, future studies can be taken-up for different sectors with appropriate modifications in the item variables. Further, the model developed could be extended to service
organisations as well. As a whole, this research paves way to explore deeper insight to lean manufacturing practices that could be extended to cross section of industries in the country.