CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This chapter presents summary of research work carried out, findings and recommendations achieved from main survey and experts’ opinion, which focus importance of competitiveness improvement, potential of LMPs to enhance competitiveness, difficulties associated with implementation of LMPs, verification of framework and guidelines for implementation of LMPs. It also presents limitations of the research work carried out following by scope for future work.

7.2 Summary of the Research Work

The research work carried out is summarized as below

- In-depth literature review was carried out in the area of manufacturing competitiveness of India, manufacturing strategies, different quality and productivity improvement practices, significance of lean manufacturing practices, their potential to improve manufacturing performance measures and competitiveness. The objectives of the research were decided by knowing the affected parameters by using LMPs. We proposed a cyclic relationship framework in chapter 3 to improve the MPMs and CDs for Indian Manufacturing Industries using LMPs.

- To achieve the objectives and to check the validity of framework there was a need of primary set of data from the industries. The manufacturing industries of India were considered as sample to receive the feedbacks.

- Various methods were studied and investigated to get the primary data from industries. Questionnaire method was considered suitable as the research method for objectives of this research. Survey tool was developed to send to the industries personal. Before execution of this survey pilot survey was executed to know the critical steps involved in execution of survey. Pilot survey was conducted in service sectors to know the potential of Lean Principles in business functions. After analysis the
main survey was added the Google links to make convenient the feedback process.

- The main survey was supported with other survey of Experts’ Opinion to have in depth knowledge of lean manufacturing practices in the manufacturing field and research in academics. They were also expected to support the validation of cyclic framework evolved through the literature review and feedbacks of industries.

- The respondents industries were classified in four manufacturing groups according to the product they manufacture. Then the responses were analysed based on the survey tool. Hypotheses were developed and analysed to make generalization of the statements. The experts opinions were also analysed keeping in mind the objectives. The cross inferences were derived based on feedbacks of different sections of main survey and experts’ opinion.

- Based on the cross inferences the validation of proposed cyclic framework was done and set of guidelines were evolved that may assist the selection and implementation of LMP(s).

7.3 Summarization and Recommendations

The research was executed in two stages- Main Survey and Experts’ Opinion. The main survey was divided in five sections.

Section I aimed to get the general information about organizations. Such as type of manufacturing, experience, demand pattern of products.

Section II of the questionnaire queried information regarding the current competitive scenario of the organization.

Section III assesses the general awareness and implementation initiatives of lean principles and practices.

Section IV was divided in five parts. Each part contains questions for particular LMP which aimed to assess the improvement in desired MPM, set of helping practice that has been useful to implement LMP or been considered as requirement to implement LMP.
Section V evaluated the role of supportive programs—Total Quality Management (TQM) and Six Sigma ($6\sigma$) in implementation of LMPs.

Experts’ Opinion assessed the present competitiveness in Indian manufacturing industries, popularity of LMPs, effect of LMPs on MPMs and CDs, role of TQM and $6\sigma$ for LMPs implementation.

Justifications of agreement of objectives are as below

**7.3.1 Importance and Possibilities of Manufacturing Industries’ Competitiveness Improvement**

Increased customer awareness, expectations, fast changing technology and its quick implementation are found the factors that had affected the competitive business environment of Indian manufacturing industries. Innovative products, processes and speed to market have been the most critical aspects for improving the competitiveness and for these the organizations are focusing on innovative manufacturing and distribution functions of business. The organizations practice number of programmes like Kaizen, training for employees, brain storming, cellular manufacturing etc. for enhancement of competitiveness. But still the improvement achieved is not equal. The organizations are facing hurdles while initiating and executing such programmes. 5S, TPM and Kanban are the LMPs practised selectively within the premises of industry. Hence the advantages of these LMPs are observed within factory and it limits from getting benefited from vendors and customers.

**7.3.2 Potential of Lean Manufacturing Practices as Competitiveness Improvement Tools and Associated Difficulties**

This objective was analyzed by studying motivating factors for the manufacturing firms to implement lean manufacturing practices.

The industries those practice LMP(s) since last 8 years are found highly motivated for adopting the LMPs for increasing sales turnover, customer satisfaction, improving working condition and morale of employees and improving manufacturing factors.

There are some specific motivational factor for implementing each LMPs such as making realization of JIT is the motivational factor to implement
Kanban, improving productivity is the motivational factor to implement SMED, reduce occurrence of machine breakdown & improved workplace and reduced time to locate the material, and reduction in % defects are found the motivational factors to implement TPM, 5S and Poka-Yoke respectively.

- By identification of the difficulties in implementing lean manufacturing practices

Lack of understanding of the concept and increased workload and resistance to change are found the most critical hurdles. 5S has the maximum and Poka-Yoke has minimum numbers of responses for barriers. It is found that as more organizations practice the LMP(s), the hurdles become more visible. After a specific time span of practising the LMP(s) the barriers effects smoothen out.

7.3.3 Verification of Framework and Evolution of Guidelines for Implementation of Lean Manufacturing Practices

Based on literature review a framework depicting the cyclic relationship among the LMPs, MPMs and CDs was evolved. It had proposed direct relationship between 5S and search time, Kanban and idle time/wait time, SMED and change over time, TPM and equipment utilizations and Poka-Yoke and defects/abnormalities. It had also proposed cyclic relationship between the LMPs and other MPMs (capacity utilization, inventory turnover ratio, over production, unit cost of production, setup time, and material handling time) and CDs (cost, quality, flexibility and delivery).

After conducting the feedback analysis of main survey and experts’ opinion following conclusions had been arrived. These conclusions also validate the framework.

Kanban had improved MPMs of inventory turnover ratio, wait time, idle time of more than 30% and improved competitiveness dimension of delivery by 25%. 5S had improved material handling time and search time MPMs and cost by 50%. SMED and TPM have improved capacity utilization, unit cost of product, cycle time and machine breakdown by 95% and flexibility competitiveness up to 75%. Poka-Yoke had reduced number of defects and over production by 90% and quality competitiveness up to 50%. During the
feedback analysis TQM and Six Sigma were observed as supporting practices to achieve the objectives of LMPs. So in revised framework these practices are included.

The improvement in one measure has resulted in improvement in the competitiveness dimensions through specific LMP(s) so they also sustain the cyclic relationship between them.

7.4 Limitations of the Study

Some of the limitations for this research work can be summed up as bellow.

- The findings and recommendation are based on the responses that represent specific part of the cross section of industry.
- The objectives are of qualitative type so the validation of outcome is difficult but findings are applicable for such types of groups across the industry.
- The generation of questionnaire is based upon the objectives and not upon the analysis technique to be used. But the inferences and cross inferences from different parts of questionnaire fulfil the objectives to quite satisfactory level.

7.5 Scope for Further Work

Each parameter of this study such as competitiveness, lean manufacturing practice, manufacturing performance and their associated aspects have wide scope for future work. All programs and supportive practices have high potential not only to improve the competitiveness and manufacturing performance but also the financial performance. Hence further research may be carried out in areas identified as under.

Present survey was having constraints of time and resources so the same can be extended for
Conclusion and Recommendations

- Getting feedbacks from large number of industries
  - Focusing on specific group of industry by category, type of manufacturing and other aspects
  - Evaluating the objectives for specific lean manufacturing practice
  - Considering the role of specific supportive program for implementation of LMPs

- Formulating of guidelines for implementation with support of simulation tools for specific industry type of group of industries.

- Focusing on limitation of this study for eliminating them.