“Factors affecting Lean Manufacturing”

DISSERTATION II

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By

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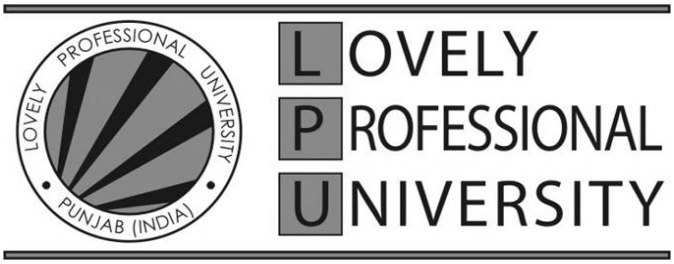
Er. Gurvinder Pal Singh



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CERTIFICATE

This is to certify that ANSHU SHUKLA has completed M.Tech dissertation proposal titled FACTOR AFFECTING LEAN MANUFACTURING under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of the dissertation has ever been submitted for any other degree or diploma.

The dissertation proposal is fit for the submission and the partial fulfillment of the conditions for the award of M.Tech in Mechanical Engineering.

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DECLARATION

I hereby declare that the dissertation proposal entitled, FACTOR AFFECTING LEAN MANUFACTURING submitted for the M.Tech Degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

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Abstract

Lean manufacturing is an innovative business model originated by Toyota Motor Company. This model is highly useful in identification of waste processes which further helps in waste reduction. Lean manufacturing is a technique to improve productivity through waste reduction and enhancement of business processes. Lean manufacturing was originally initiated in an automotive industry which was adopted by rest of the world due to high rate of success. However, there are some key challenges which affect the efficiency of lean manufacturing.

This research is an attempt to identify the factors which affect lean manufacturing and the ways to overcome those challenges which can benefit the organisations implementing this technique.

Acknowledgement

Many people's successful findings and conclusions result the crux of the matter, which embodies the whole as a one successful part. My report is no big achievement, but may be a percentile to the vast Oceanus knowledge. My sincere thanks to many people for their contributions, support and help, without which this project report would not have reached its goals. I am indebted to Er. Gurvinder Pal Singh for giving me this opportunity and to be my supervisor and guiding my dissertational project to fruitful result. I am indeed grateful to respected Er. Ankur Behal (HOS), for blessing me and being all time supporting and motivating in every action for building enthusiasm. Lastly, but above all, I thanks my institute, Lovely Professional University, for giving me this wonderful opportunity to learn new things and gain valuable experience which will be helpful in my role as future manager.

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Chapter 1

INTRODUCTION

Toyota is considered to be one of best car companies when it comes to manufacturing solid vehicles. The multinational company maintains a workforce of over 3 lakh people, spread over different parts of the globe. According to reports, the company was the largest automobile manufacturer by production in 2012 while at present it is the 13th largest company in the world by revenue. Over the years, the company has adopted several manufacturing principles but the stand out philosophy has been 'lean manufacturing'. Lean manufacturing or lean production is a business practice in which the cost incurred on any resource for attaining a particular goal, which is found to be not valuable for the end customer is eliminated. Hence, this philosophy aims to produce a product which is consumed by the customer. Thus, in manufacturing context, the term 'Lean' implies to a business entity, which incorporates specialised machinery and equipment in manufacturing processes to optimise time, human resources and productivity, thereby improving the end quality of the product. Lean manufacturing shares a commonality with Toyota and which is that the car maker follows the same in the production system. Called as Toyota Production System, the company intends to thrive upon a production system in which complete elimination of all waste is done through highly efficient methods.

According to Baka yoke, Lean Manufacturing is defined as; “A manufacturing technique of preventing mistakes by designing the manufacturing process, equipment, and tools so that an operation literally cannot be performed incorrectly; an attempt to perform incorrectly, as well as being prevented, is usually met with a warning signal of some sort”. A never-ending effort to expose and eliminate root causes of problems; small-step improvement as opposed to big-step or radical improvement. The concept of lean manufacturing revolves around customer and the philosophy of lean manufacturing advocates delivering maximum customer value through minimizing waste. In simple words, lean means maximizing customer value with fewer resources or optimum utilization of resources. A lean organization lays its focus on its key processes and works to deliver key processes while processes which are least important are not bothered much. The ultimate goal is to provide perfect value to the

customer through a perfect value creation process that has zero waste. One of the major component of lean manufacturing is approach towards zero waste level which organisation seeks to achieve. This ultimately results in increasing overall efficiency of the organisation thereby minimizing the human efforts. Other resources are also saved in the process of lean manufacturing namely space, capital, assets and technological benefits etc. The term lean for the first time was coined for Toyota by Jim Wommack.

The concept of lean manufacturing incorporates three which stands for:

- Purpose
- Process
- People

Further, lean manufacturing follows a rule of 5S which stands for:-

1. Sort - To clearly distinguish the needed from the unneeded. (Clear out & Classify)
2. Straighten – Keeping needed items in the correct place to allow for easy and immediate retrieval (Configure).
3. Shine - Keeping the workplace swept and clean (Clean & Check).
4. Standardize – Consistency applying 6S methods in a uniform and disciplined manner (Conformity).
5. Sustain - making a habit of maintaining established procedures (Custom & Practice)

Or 5S - refers to the five words,

- seiri,
- seiton,
- seison,
- seiketsu,
- shitsuke

These words are shorthand expressions for principles of maintaining an effective, efficient workplace,

seiri - eliminating everything not required for the work being performed

seiton - efficient placement and arrangement of equipment and material

seison - tidiness and cleanliness

seiketsu - ongoing, standardized, continually improving seiri, seiton, seison

shitsuke - discipline with leadership

Chapter 2

Review of Literature

2.1 General

There is a growing need interest in how management control systems could be modified to tailor to the needs of manufacturing strategies as cityd by Buffa, 1984, Hayes et al., 1988; Kaplan, 1990; Schonberger, 1986). Designing compensation systems to match the needs of lean manufacturing practices is consistent with the strategic compensation literature (Gomez-Mejia & Balkin, 1992; Milkovich, 1988). ‘‘Lean’’ focuses on reducing waste and on maximizing or fully utilizing activities that add value from the customer’s perspective (Ohno, 1988; Womack et al., 1990). Empirical evidence shows that higher organisational performance is often the result of a match between an organisation’s environment, strategy and internal structures or systems. By and large, most studies on management control focus on senior management performance or overall performance at strategic business unit levels (Govindarajan, 1988; Govindarajan & Gupta, 1985; Ittner & Larcker, 1997). Wruck and Jensen (1994) suggest that effective TQM implementation requires major changes in organisational infrastructure such as the systems for allocating decision rights, performance feedback and reward/punishment. In addition, worker empowerment (which is an important part of TQM and JIT) is expected to indirectly improve manufacturing performance via greater intrinsic motivation (Hackman & Wageman, 1995). Womack and Jones in their book by the name of Lean Thinking published in 1996 had explained the concept of lean and determined that it is based on five principles of specific value, value stream, and flow without interpretation, pulled by customer and strive for perfection. Standard and Davis (1997, pg 71) city that the overall goal of lean manufacturing is to achieve the shortest possible cycle time by streamlining the flow of production material throughout the value stream. Womack in 1999 suggested that lean manufacturing helps in reducing overall human efforts, streamline manufacturing activity and half’s the investment in tools and utilities. Spear and Bowen in 1999 illustrated 4 rules of Toyota Production Systems. Jordon in 2001 explained that lean manufacturing is a management philosophy where customer value can be enhanced by focusing on reduction of different types of wastes. Hence, through waste

reduction overall all enhancement in quality can be achieved. Further, Liker in 2003 had described the 4P model adopted by Toyota. These 4P principles enabled Toyota to achieve successful results and enhance its productivity. Lean company identifies each and every action that is necessary to transform its products and/or services from (a) concept to launch; (b) order to delivery; and (c) raw materials to finished goods (or services) in the hands of customers (Womack & Jones, 2003). Application of lean is not limited to the automotive sector only, but, it has also found acceptance in a wide range of manufacturing industries operating under a unionized or a non-unionized environment in the US (Shah and Ward, 2003) or elsewhere (Cua et al., 2001; Anand and Kodali, 2008), and is being applied in big as well as small organizations (White et al., 1999). Chappell (2002) defines lean thinking as applicable to all aspects of a business and positively impacts not just production operations, but the whole range of business processes including product development, design and sales.

As per (Maskell & Baggaley, 2004, p. 77) lean operations and lean accounting are not limited to manufacturing companies. Their principles are also being implemented by service-providing companies. Even for a manufacturer, lean principles are not limited to its production activities. Instead, lean principles apply to all processes, including accounting, research and development, design and engineering, management, sales, administration, and other functions. In a survey conducted by Lean Enterprise Institute in 2004 where respondents were asked a question "What are the biggest trend in your industry right now?" and 32% of respondents answered it to be cost reduction. However, the process of lean manufacturing also suffered with some serious criticism when William in 1992 observed lean manufacturing to be dehumanizing and unequal. Lean manufacturing has helped Toyota achieve the distinction of being the best car manufacturing company in the world (Stewart and Raman, 2007).

In addition to value-stream costing, Lean companies seek to eliminate complex and wasteful processes from their operations (Maskell, 2009, p. 3). At the third level, lean is viewed as congregation of tools and techniques (Shah and Ward, 2003; Pavnaskar et al., 2003; Li et al., 2005; Seth and Gupta, 2005; Hines et al., 1999; Lasa et al., 2008; Basu, 2009) aimed at eliminating waste. Upadhye et al. (2010) presented a model for the implementation of lean.

Staats et al. (2011) find that lean software projects perform better than non-lean software projects for most performance outcomes. Womack and Jones, 2004 defined the term lean. When the organization implement the lean practices only at the inside structures, then it is lean organization. When the lean thinking is applied at all value adding activities within the organization as well as between the organization and its contractors, the authors suggest the term: "Lean enterprise". First of them is lean philosophy, which mainly refers to the appropriate leadership style and commitment of all management levels till the top management. The focus is on perfection in meeting customer requirements and continuous improvement, learning and waste reduction. The second layer is human resource management (HRM), employee empowerment and involvement in lean implantation as the key success factor as the focus is on "teamwork". Sharing the value of lean principles, the employees are those who make things happen. Next are illustrated the supporting activities that shows the need of the company to improve its core processes with the main focus on "waste reduction". Within the organization manufacturing "best practices" are just-in-time (JIT), total productive maintenance (TPM), and total quality management (TQM), which contribute for waste reduction. On the other side are the areas that are non-manufacturing supporting functions that should be influenced and improved by the implementation by the already mentioned practices. This so called "core operations" include marketing, new product development (NPD), partnering with suppliers and customers. The ceiling of the lean house is lean culture that supports the roof – lean goals and results. Lean culture comes with the problem solving in the process of learning going on the path of continuous improvement. Culture is both a result and enabler for sustainable and successful lean operations (Liker, 2004). It has the function of a role model, which guides the employees through the organizational change towards the values of lean thinking. On the top is the achievements reached by implementing Lean – all the goals and results of lean thinking for high performance. The results are related to best quality, lowest cost, shortest lead time, high employee moral, safety working issues, top business results. These results give the company competitive advantage (Womack et. al. 1990).

2.2 Success factors in implementing Lean

A longitudinal case study (Crute et al. 2003) of two plants in the aerospace industry considers five factors significant for a lean implementation. It is argued that lean philosophy and techniques require adoption of the entire system in a holistic manner rather than applying techniques in a piecemeal fashion. Womack and Jones (1996) suggest that managers have drowned in techniques as they tried to implement isolated parts of lean system without understanding the whole. On the other hand this more tentative or piecemeal approach is being adopted mainly as a result of resistance from the employees to the new ideas. The more focused training gives evidence for a better understanding among personnel of the key principles of waste elimination and flow of value.

2.3 Effects of company culture

Changes of mindset gives people an aim in their working life and have the potential to change attitudes, so that the employees begin to think differently and are more willing to contribute to company's improvement initiatives. Stronger management control makes the organization structure bureaucratic, which makes difficult the change from the existing ways of doing things.

2.4 Product focus and Senior management commitment:

Lean changes need to be focused on the specific product value stream, so that the control over resources to be dependent mainly on the improvement team. Consistency in management commitment is emphasized as important element in effective implementation of changes in organizations (Kotter 2007) It is also considered as a significant factor for organizational change. The companies need to be prepared for the lean transformation, but at the same time manage change requires fast reaction with the implementation activities even taking a risk and later deal with consequences. (Crute et al. 2003). A research (Pius Achanga et al. 2006) based on a literature review and data collection from semi-structured personal interviews with managers and personnel at 3 large manufacturing companies and 10 SME's all implementing Lean identifies four key factors for lean implementation. The factors are only at inter-organizational level.

2.5 **Finance**

The financial capabilities of the companies are one of the critical factors for successful implementation of Lean. Financial resources are needed for employee training programs, external consultants, etc. Sometimes even production of firms may be interrupted as a result of the employees training in the new techniques. The managers would rather refuse unnecessary loss of resources especially if they do not anticipate immediate returns. (Pius Achanga et al. 2006 p.467)

2.6 Leadership Organizational culture and Skill and expertise

The study indicates that it is highly desirable to have a certain degree of communication skills throughout the company, long-term focus of management and strategic team while implementation of a new initiative. Organizational culture is an essential element in lean implementation process and high performing companies are those with a culture of sustainable and proactive improvement efforts. Staying competitive requires the use of intellectual capital and ability to innovate and differentiate. Most companies experience difficulties after employing people with low skills levels, who do not foster the ideology of skill enhancement. A multiple case study by (Czabke, Hansen & Doolen 2008) reports results of four case studies of secondary wood manufacturer from Germany and United City. The results outline 3 main factors with great importance for the successful Lean implementation. These are:

1. Communicating the vision of the new initiative at every organizational level
2. Necessary change in the organizational culture
3. Consequently following the new practices and principles.

Most successful change efforts begin when some individuals or some groups start to look hard at a company's competitive situation, market position, technological trends, and financial performance (Kotter 2007). The vision clarifyes the direction in which an organization needs to move. In more successful transformation efforts, executives use all existing communication channels to broadcast the vision.

2.7 Success factors :

1. Strategic initiative of top managers acting as leaders in defining and communicating the vision of change. The process change begins with a strategic initiative. The support from the senior management is needed for the strategic change.

2. Willingness to learn

The goal of learning is to provide positive impact outcomes as a result of effective adaptation to environmental changes and improved efficiency in the process of learning. Adaptation includes appropriate actions in response to technological changes and learning from other organizations achieved the best practices in the industry.

3. Culture readiness

Organizational culture facilitates the integration of individual learning by influencing the organizations' ability to learn, share information and make decisions. Under most circumstances cooperative, interpersonal and group behavior is resulting in superior performance. Open communication promote common culture and innovative behavior within the organization.

2.8 Knowledge sharing

Prescribed process management and change management practices. Corporate transformation requires dissatisfaction with the current city of the organization, a vision for the future and well-managed change process. The management needs to be fully committed to lean implementation and to view the problems they face as opportunities and turn every challenge into a learning experience. Applying best practices should be everyone's responsibility. The authors (Mehta, Shah 2004) also argue about the effect that Lean production principles have over the employees. All defend the opinion that most important for the companies is to provide high quality of work life – work content, relations, conditions of employment, working environment. One side is taken by those who point on the negative effects of lean production such as workflow formalization and standardization, and working under high level of stress to complete the task on time. Others claim for a positive impact of lean production which enables employees to work more efficiently and to feel committed to the organization and a part of the working team. The removal of buffers and continuous flow enables tight coordination between the employees to achieve their final goal. Lean

environment is characterized by detailed standardization of work processes. Parker and Wall (1998) define 5 “core job characteristics”: skill variety, task identity, task significance, autonomy, feedback.

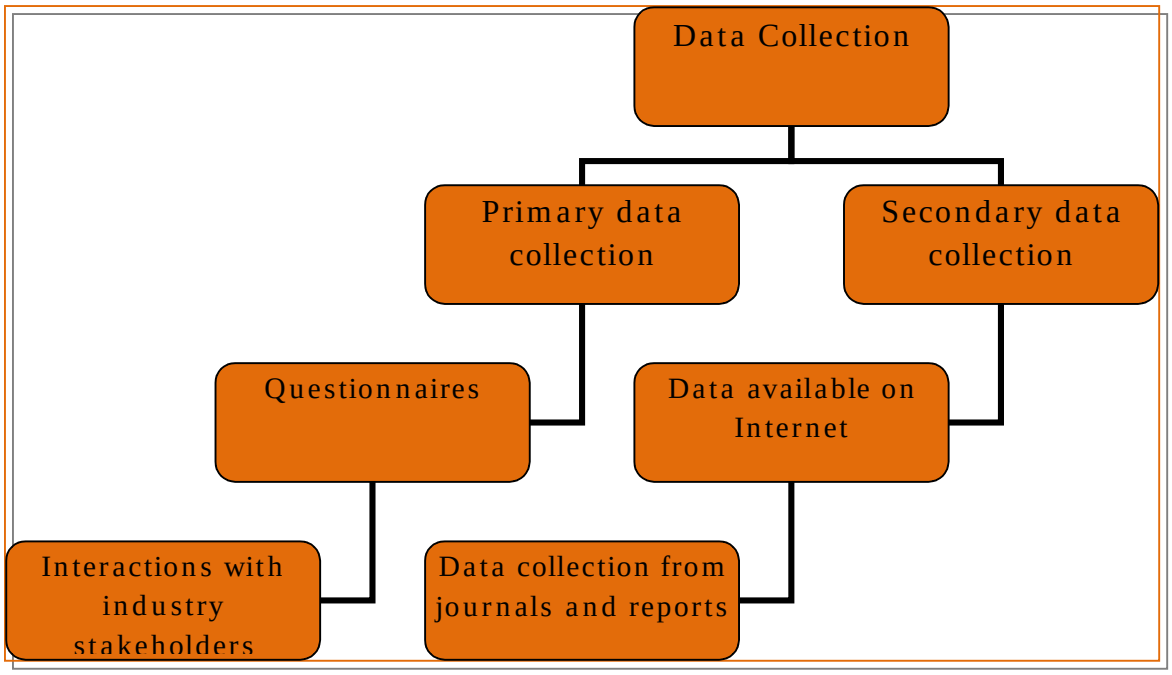
Chapter 3

Research Methodology

3.1 General

Research methodology is a collective term for the structured process of conducting research. There are many different methodologies used in various types of research and the term is usually considered to include research design, data gathering and data analysis. The research will study the importance of lean manufacturing and its overall impact on organization's performance. The data for this research proposal was obtained essentially from primary and secondary sources. The report takes into consideration both primary and secondary data sources. For the primary data both qualitative and quantitative methods have been used. The primary data collection comprises of in-depth field survey through structured questionnaires and discussions with the key representatives of the organizations adopting lean manufacturing in their firms. Structured questionnaire were sent to the selected firms of the small scale sector in Gurgaon so as to extract the key findings and lessons learned from the implementation of the lean process. The respondents in each firm were chosen as per their experience and expertise in lean manufacturing and production areas. The secondary data, which constitutes the source of data, would be gathered from the various secondary data sources such as case studies of organisations adopting lean manufacturing, industry magazines, bulletins, in-house newsletters, annual reports on productivity, books and journals on Lean manufacturing. The collection of secondary data includes sources like websites of national and international organizations, government reports, journals, newspapers and others. During the survey various stakeholders of different organisations would be approached and valuable inputs would be collected through face to face interactions, telephonic interviews, mailing the structured questionnaires. The research anticipates tracing the history of lean manufacturing and its role in enhancing overall performance of the organizations over the last years from secondary sources. The purpose of the questionnaires will be to investigate the awareness of lean manufacturing and the role played by it in waste reduction and making a positive impact on organization's performance. It will be analysed that what are the factors impacting lean manufacturing and thereby impacting the organization at large.

3.2 Mode of data collection



3.3 Sample of the study

The study has considered 60 firms operating in the small scale sector of Gurgaon.

S.No.	Type of firm
1	Auto spare
2	Assembly
3	Electrical & electronics
4	Rubber parts
5	Plastic parts
6	Metal parts
7	Spare parts
8	Artillery
9	Irrigation parts
10	Steel tools

3.4 Preparation of structured questionnaire

In order to carry out the interview we have collected and analyzed secondary literature on lean manufacturing technique, which helped to form part for the questionnaire. Information on the firms located in the city of Gurgaon was extracted before the interview process.

3.5 Analysis and limitations

The interviews were conducted and questionnaires were circulated among the selected firms by us. This allows comparisons and conclusion drawn on the questions. Sensitivity of the information is a main constraint. We have adhered to the request of the firms involved to keep the anonymity of the selected firms for the study. The questionnaire has been so designed to develop an understanding of lean implementation in the small scale sector in Gurgaon and is based on the many issues discussed in the literature review.

The questionnaire so prepared and used were:

3.6 Company Goals:

1. What did you want to achieve with implementing Lean Production?
2. Why did you start to implement continuous improvements?
3. Did you study and compare yourself with other companies before the start of the Improvements?
4. Does the firm have a strategically goal that everybody knows about?
5. How far into the future are these strategically goals?
6. Do all workers know what they should do to support these strategically goals?
7. Do you have some time limited target that you are continuality are following up?
8. Are the work with contentious improvements well support of the board?

3.6.1 The implementation

9. How did you think when you planned the implementation?
10. Which time perspective did you have when you started the work?
11. Did you plan the work in different phases?
12. In which area did you focus on first?
13. How did you educate your staff within continuous improvements?
14. How did you motivate your co-workers when you started?

15. How do you motivate your workers now when the process are rolling?

16. How does your firm share information?

17. Do you face any problems while implementing lean manufacturing in your company?

18. What are the factors which affect implementation of lean manufacturing in your company?

3.6.2 Employees

19. How were you thinking that your employees would contribute?

20. How much time involves continuous improvements?

21. How do you check your work with continuous improvements?

22. Are everybody committed with the Lean work?

23. Are the workers more committed to the work now compared to before?

24. How is the work order from that an idea is born to it are fulfilled?

3.6.3 The Results

25. Have the firm gain any benefits, economical with profit or more commitment from the staff since implementation?

26. Has the work with Lean Production changed the way you have been working?

27. Do you evaluate and develop your system with continuous improvements?

28. How does the impact of these factors vary in case of small as well as large organisations?

3.7 Problem Formulation

The dissertation work aims to study the concept of lean manufacturing and to find out the various factors which affect implementation of lean manufacturing in firms operating in small scale sector of Gurgaon. The dissertation work studies the broad concepts of lean manufacturing. It will closely assess the issues which impact the success rate of lean manufacturing in an organisation. The purpose of lean manufacturing is to enhance the overall productivity of an organisation through waste reduction hence; this study encompasses to find out all the factors affecting the performance of lean manufacturing. The scope of the study is to cover the small scale industries which have implemented the concept of lean manufacturing in their organisations and further investigate the factors impacting the implementation. Also the work would suggest the ways and methods in which the success rate of this concept can be maximized by an organisation. This dissertation focuses on 10

firms working in the small scale sector of Gurgaon and their views on the many issues involved in implementing lean in their respective companies. The study carries relevance as implementation of lean manufacturing in large organisation has been largely studied, however, its implementation in small scale manufacturing firms of Gurgaon has been a studied in our dissertation so as to find the impact (positive or negative) on their performances. The small scale manufacturing firms taken in the study belongs to manufacturing metal parts of automotive industry, automotive assemblers, small scale firms such as assembly, and electrical and electronic.

3.8 Research Objectives

The objectives of the research study are as follows:

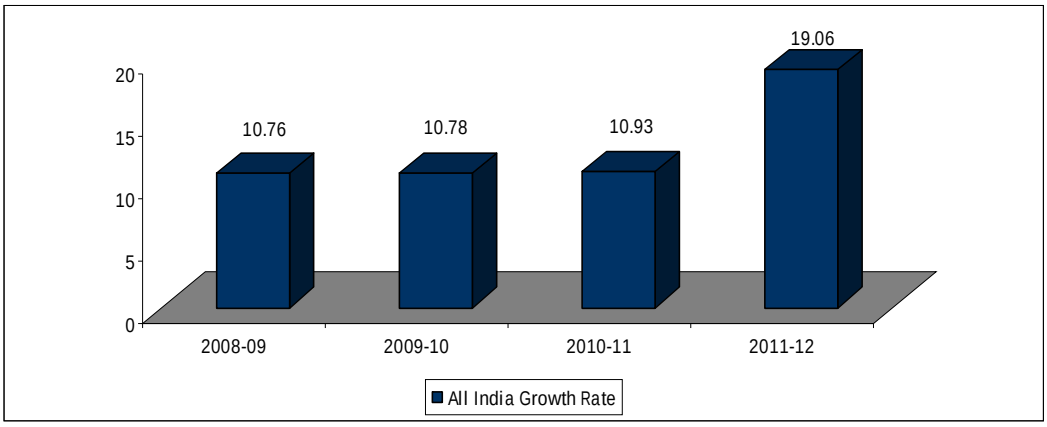
- To determine the main principles of lean manufacturing
- To study the main issues impacting execution of lean manufacturing in manufacturing firms of small scale sector in Gurgaon
- To analyse the different factors affecting the execution of lean manufacturing in selected firms of Gurgaon
- Further, to study and compare the impact of factors affecting the implementation of lean manufacturing in case of small scale industries with respect to large scale industries.

3.9 Micro, small and medium enterprises (MSMEs)

The Micro, Small and Medium Enterprises (MSMEs) today constitute a very important segment of the Indian economy. The development of MSMEs has been viewed as a powerful instrument for accelerating industrial growth, export earnings and is credited with generating the significant employment. MSMEs also play a pivotal role in the growth of economy with their effective, efficient, flexible and innovative entrepreneurial spirit. MSMEs have grown steadily at a rate of more than 10% over the period 2008 to 2011, whereas during 2011-12 the sector marked a growth rate of about 19.1% which is approximately twice of the growth rate recorded for previous years. The MSME sector in India is highly heterogeneous in terms of the size of the enterprises, variety of products and services, and levels of technology. The sector not only plays a critical role in providing employment opportunities at comparatively

lower capital cost but also helps in industrialization of rural and backward areas, reducing regional imbalances and assuring more equitable distribution of national income and wealth.

Graph 1 All India annual growth rates of MSMEs (%)



Source: PHD Research Bureau, compiled from Annual Report 2012-13, Government of India, Ministry of Small, Medium and Micro Enterprises

3.10 Definition of Micro, Small and Medium Enterprises in India

In accordance with the provisions of Micro, Small & Medium Enterprises Development (MSMED) Act, 2006 the Micro, Small and Medium Enterprises (MSMEs) are classified in two classes:

(a) **Manufacturing Enterprises:** The enterprises engaged in the manufacture or production of goods pertaining to any industry specified in the first schedule to The Industries (Development and Regulation) Act, 1951. The Manufacturing Enterprise is defined in terms of investment in plant & machinery.

(b) **Service Enterprises**: The enterprises engaged in providing or rendering of services and are defined in terms of investment in equipment.

The defined limit on investment for enterprises to be classified as micro, small and medium enterprises is as follows:

Table 2 Classification of MSMEs in India

Classification	Manufacturing Enterprises*	Service Enterprises**
Micro	Upto Rs 25 lakh/ Rs 2.5 million	Upto Rs 10 lakh / Rs 1 million
Small	Above Rs 25 lakh & upto Rs.50 million / Rs.5 crore	Above Rs 10 lakh & upto Rs 20 million / Rs 2 crore
Medium	Above Rs 5 crore & upto Rs 100 million / Rs 10 crore	Above Rs 2 crore & upto Rs 50 million / Rs 5 crore

Source: PHD Research Bureau, compiled from Annual Report 2012-13, Government of India, Ministry of Small, Medium and Micro Enterprises,* Investment limit in plant & machinery ** Investment limit in equipment.

Further, amended Khadi and Village Industries Commission Act (KVIC), 1956 redefined "village industries" as, "Any industry located in a rural area which produces any goods or renders any service with or without the use of power and in which the fixed capital investment per head of artisan or worker does not exceed Rs. one lakh (Rs. one lakh and fifty thousand in case of village industry located in a hilly area) or such other sum as may, by notification in the Official Gazette, be specified from time to time by the Central Government".

3.11 Significance of MSME sector in India's economic development

Micro, small and medium enterprises play a very constructive role in achieving the socio-economic benefits of the nation. They lead to the entrepreneurial development and diversification of industrial sector and thus provide depth to the industrial base of the economy. Indian MSMEs have played a very crucial role in country's development through job creation at all levels of income stratum, discouraging monopolistic practices of production & marketing thereby contributing to the growth of economy and foreign exchange earnings of the country. The other significant characteristics of MSMEs include low investment requirements, operational flexibility, location wise mobility, competitiveness in domestic and export markets and also generation of new entrepreneurs by providing

knowledge and training. Over the years, the small scale sector in India has progressed from the production of simple consumer goods to many sophisticated products like electronics control systems, micro wave components, electro medical equipments, etc. MSMEs in the country manufacture over 6,000 products. Some of the leading industries in MSME sector are retail trade (39.9%), others (19.4%), wearing apparel (8.8%), food products and beverages (6.9%), other services activities (6.2%), other business activities (3.8%), hotels and restaurants (3.6%) etc.

Table 5 Respective shares of leading industries in MSME sector

S.No.	Industry name	% Share
1	Retail trade, except of motor vehicle and motorcycles; repair of personal and household goods	39.9
2	Others	19.4
3	Manufacture of wearing apparel; dressing and dyeing	8.8
4	Manufacture of food products and beverages	6.9
5	Other service activities	6.2
6	Other business activities	3.8
7	Hotels and restaurants	3.6
8	Sale maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	3.6
9	Manufacture of furniture; manufacturing N.E.C	3.2
10	Manufacture of fabricated metal products, except machinery and equipment	2.3
11	Manufacture of textile	2.3

Source: PHD Research Bureau, compiled from Annual Report 2012-13, Government of India, Ministry of Small, Medium and

Micro Enterprises Note: Figures have been taken nearest to the single decimal place

3.12 Global outlook of the MSME sector

MSMEs are considered to be the engine of economic growth all over the world. Around the globe MSMEs play a critical role in the respective development of economies by contributing towards employment generation, balanced growth, regional progress and export earnings. Different countries classify their SME sector on different parameters. European Union defines SMEs based on the parameters of employment, turnover and asset size. OECD classifies SMEs based on employment and sales turnover. Some countries have different threshold limits at sectoral level – such as manufacturing, wholesale, retail, and services sectors in Japan; manufacturing, transportation, and hospitality services in China; manufacturing, agro based, and services, in Malaysia.

In OECD economies, MSMEs account for over 95% of the firms, 60-70% of employment, 55% of GDP and generate the largest share of new jobs while in developing countries more than 90% of total firms, outside the agricultural sector, are MSMEs, generating a considerable portion of GDP. Globally MSMEs employ one-third of the working population and the sector has grown at a rate of 6% over the years, with Europe and Central Asia experiencing a growth of 15%. China has a high ratio of MSME employment to total employment at 80%. In view of the important role played by MSMEs in the economy, governments in various countries have established a range of institutions and support programmes to strengthen the SME sector and to make the sector more competitive. The various support provided to the SME sector across the globe are categorized as given,

3.12.1 Technology Support: Governments all over the world provide a range of technological support to their respective SME sectors in order to equip them with the requisite know how to optimize their processes. Some of the best practices followed by countries all over the world are highlighted as under:

- In China, government has set up an innovation fund for small technology based firms to promote technological innovation amongst SME units. Apart from this, a national plan named “Spark Programme” has been launched which aims at promoting the

application of appropriate technologies in the Villages and Township Enterprises (VTEs).

- Japan has initiated a "Small Business Innovation Research" (SBIR) programme to promote new technological product activities including research and exploitation by Japanese small and medium sized enterprises. provide financial support for commercialization of research & development. A special 'Law on Supporting Business Innovation by Small and Medium Enterprises' has also passed in Japan which intends to promote creative development of SMEs.
- In order to build technological capacities among Malaysian SMEs, the Government of Malaysia initiated the "Multimedia Super Corridor" (MSC). Under this programme, venture capital and special grants are provided for developing R&D and risk taking culture among SMEs.
- The government of Italy has introduced a national programme "Startech" to promote industrial research and facilitate contacts between researchers and commercial enterprises. It also boosts setting up of new high tech ventures.
- In South Africa, the "South Africa Business and Technology Incubation Association" (SABTIA) has been set up to foster best practices in technology incubation through links with similar agencies in other parts of world.

3.12.2 Marketing Support: Small and medium sized businesses often do not have the resources to employ adequate number of marketing professionals which impacts business processes. Hence, governments worldwide provide support to MSMEs by designing various schemes and plans as given:

- China has established SME "International Market Development Fund", under the SME Promotion Act, to support the market development and promotional activities of SMEs.
- Japan has set up an "External Trade Organisation" which helps Japanese SMEs in various promotional activities through organizing a number of business partnering events, trade fairs, exhibitions etc.
- The government of Italy has created an agency "The Italian Institute for Foreign Trade" which is entrusted with the promotion of trade, business opportunities and

industrial cooperation. It also conducts public promotion programmes to enhance the image of Italian SMEs through the 'Made in Italy' brand.

- The government of Mexico has devised the "Impulsor as Programme" which provides custom made solutions to inform SMEs about technical specifications, regulations and quality requirements in target markets.

3.12.3 Financial Support: Access to finance is vital in developing a vibrant SME sector in any economy. However, in many emerging markets, access to finance remains one of the major challenges for the growth prospects of SMEs. Hence, governments across the world support SMEs with lot of incentives to overcome financial constraint.

- In China, "The China Banking Regulatory Commission" (CBRC) has been set up to give priority to SME financing through a separate department working on SME financial needs and also through a network of credit guarantee agencies.
- In Japan, low-cost funding is being provided through major government financial institutions such as "Japan Finance Corporation for Small Business" and "Shoko Chukin Bank".
- In South Korea, a "SME Promotion Fund" has been founded for restructuring sick SMEs and to nurture business start-ups.
- In Malaysia, Bank Negara Malaysia has launched new trade finance products such as "Multi Currency Trade Finance" for financing small and medium enterprises.

3.12.4 MSME sector in Gurgaon

The MSME sector is one of the fastest growing and employment intensive segments in the Gurgaon's economy. Since its formation, the government of Gurgaon has undertaken significant initiatives to bring about all round development. The emphasis has been laid on stimulating development in all three sectors of the economy – agriculture, industry and services.

- Main principles of lean manufacturing

Issues impacting execution of lean manufacturing in manufacturing firms of small scale sector in Gurgaon.

- Different factors affecting the execution of lean manufacturing

Impact of factors affecting the implementation of lean manufacturing in case of small scale industries with respect to large scale industries.

3.13 Test of ANNOVA

ANOVA is used to compare differences of means among more than 2 groups. It does this by looking at variation in the data and where that variation is found (hence its name). Specifically, ANOVA compares the amount of variation between groups with the amount of variation within groups. It can be used for both observational and experimental studies. When we take samples from a population, we expect each sample mean to differ simply because we are taking a sample rather than measuring the whole population; this is called sampling error but is often referred to more informally as the effects of "chance". Thus, we always expect there to be some differences in means among different groups. The question is: is the difference among groups greater than that expected to be caused by chance? In other words, is there likely to be a true (real) difference in the population mean. Although it may seem difficult at first, statistics becomes much easier if you understand what the test is doing rather than blindly applying it. Hopefully ANOVA will become clear by following the steps below.

The ANOVA model

Mathematically, ANOVA can be written as: $x_{ij} = \mu_i + \varepsilon_{ij}$

where x are the individual data points (i and j denote the group and the individual observation), ε is the unexplained variation and the parameters of the model (μ) are the population means of each group. Thus, each data point (xij) is its group mean plus error.

3.14 Types of ANOVA

One-way between groups,the example given above is called a one-way between groups model.You are looking at the differences between the groups. There is only one grouping (final grade) which you are using to define the groups. This is the simplest version of ANOVA. This type of ANOVA can also be used to compare variables between different groups - tutorial performance from different intakes.

One-way repeated measures: A one way repeated measures ANOVA is used when you have a single group on which you have measured something a few times. For example, you may

have a test of understanding of Classes. You give this test at the beginning of the topic, at the end of the topic and then at the end of the subject. You would use a one-way repeated measures ANOVA to see if student performance on the test changed over time.

Two-way between groups: A two-way between groups ANOVA is used to look at complex groupings.For example, the grades by tutorial analysis could be extended to see if overseas students performed differently to local students. What you would have from this form of ANOVA is:

- The effect of final grade.
- The effect of overseas versus local.
- The interaction between final grade and overseas/local.
- Each of the main effects are one-way tests. The interaction effect is simply asking "is there any significant difference in performance when you take final grade and overseas/local acting together".
- Two-way repeated measures.
- This version of ANOVA simple uses the repeated measures structure and includes an interaction effect.
- In the example given for one-way between groups, you could add Gender and see if there was any joint effect of gender and time of testing i.e. do males and females differ in the amount they remember/absorb over time.

3.15 Non-parametric and Parametric

ANOVA is available for score or interval data as parametric ANOVA. This is the type of ANOVA you do from the standard menu options in a statistical package. The non-parametric version is usually found under the heading "Nonparametric test". It is used when you have rank or ordered data. You cannot use parametric ANOVA when you data is below interval measurement. Where you have categorical data you do not have an ANOVA method - you would have to use Chi-square which is about interaction rather than about differences between groups.

Chapter 4

Result and Discussion

4.1 Analysis of responses

Respondents were asked whether their firm is implementing lean manufacturing. A majority of respondents (60%) indicated that they were implementing lean manufacturing in their units. While nearly 40% respondents were found to be not involved in implementation of lean manufacturing in their firms. Some of the reasons identified for not implementing lean manufacturing were:

- inflexible machinery,
- forecasting paradigm,
- too much focus on yield and not enough on demand,
- performance measurernent constraints,
- long changeover times,
- inability to control production "off fall" or residues,
- variability of demand

The initial email was sent to 70 target respondents. Of the original emails, 17 emails could not be delivered either the email address was wrong or the person has left the company. The follow-up email was sent a week later to remind the respondent who has not yet responded and thank you for those who have already returned their questionnaire. A total 19 responses were returned, 11 of them were online survey and the remaining seven were sent through email. This actually gave quite a low response rate of 12.7%. However, we were unhappy with the initial response rate and seek other method of telephonic interviews. As a result of this, the number of responses rose to 60 and consequently improved the response rate to 40%.

4.2 Company Background

The first aspect to be investigated was the general background of the companies involved. Table 1 shows the general background of the companies such as types of product produced, company age, company ownership and company size based on the number of employees.

Table 1: General background of the company involved in the study (N = 60)

	n	%
Types of product produced		
Assembly	10	16.7
Plastic parts	11	18.3
Metal parts	27	45.0
Electronic parts	9	15.0
Electrical parts	9	15.0
Rubber parts	2	3.3
Company age (year)		
New (<10)	8	13.6
Intermediate (11-20)	26	44.1
Old (>20)	25	42.4
Company ownership		
100% local	30	50.0
100% foreign	8	13.3
Joint venture	22	36.7
Company size (no. of employee)		
Medium (151-250)	14	23.3
Large (> 251)	46	76.7

As shown in Table 1, the respondents' companies were mostly manufacturing metal parts for automotive industry (45.0%). Meanwhile, 18.3% of the companies are from automotive assemblers. Other types of product produced such as assembly, and electrical and electronic, are 16.7% and 15%, respectively. Majority of the companies are categorised as intermediate and old companies with 44.1% and 42.4% respectively. The intermediate company as defined in this study is the company that has been established between 11 to 20 years. Whereas, the old companies are those with more than 20 years of establishment. New companies which are less than 10 years are only 13.6%. Besides the company age, respondents were also asked about the size and ownership of the companies. As can be seen in Table 1, it shows that respondents were mostly of large companies with more than 250 full-time employees, which totalled 76.7%. In addition, half of the respondent companies are locally owned companies (50.0%).Whereas, 36.7% are joint venture and the remaining 13.3% are fully foreign owned.

Table 2: Mean values for three cluster analysis solutions for lean practices

	Non-lean (A)	In-transition (B)	Lean (C)	ANOVA	
	n=14	n=30	n=16	F	p-value
Process and equipment	2.81	3.50	4.27	57.36	.00
Manufacturing process and control	2.90	3.54	4.44	47.08	.00
Human resources	3.10	3.50	4.39	36.80	.00
Supplier relationship	2.47	3.25	4.05	57.54	.00
Customer relationship	2.74	3.47	4.35	36.51	.00

4.3 Lean Manufacturing Implementation

In order to identify the lean status of each respondent companies involved, cluster analysis was done to classify the companies into lean, non-lean and in-transition lean firm. Cluster means a group that is computed as the average values of the lean practices variables for all the firms and signifies the extent of the lean manufacturing implementation of that group. Companies were classified as being lean, in-transition or lean based on the hierarchical cluster analysis of their mean scores for each individual lean practice using the squared Euclidian distance between variables and Ward's method of optimizing the minimum variance between clusters. Table 2 shows the mean scores for the three cluster solutions. As a result of the cluster analysis, the first group (A) had 14 firms and was characterised by low mean values for all five lean practices variables. This suggests that the firms forming this cluster implemented little lean manufacturing practices and categorized as non-lean firms. The second group (B) had 30 firms, and was characterized by moderate mean values for each of the five variables. This group is categorized as firms in-transition to lean manufacturing system. Finally, the third group (C), which had 17 firms, are classified as lean firms as it characterised by high mean values of each lean manufacturing practices variables. The values suggesting that these firms implemented lean manufacturing practices extensively in their organisation's operation and management.

The results in Table 2 also show one-way independent ANOVA to determine whether the difference between means for cluster non-lean (A), in-transition (B) and lean (C), are significant. The purpose of this test is to examine the cluster predictive validity and consistency with expected practice levels within groups. To test whether the group means are the same is represented by the F-ratio. The results showed that all lean practices indicated $p<0.05$, which were significant, that city the mean scores of lean manufacturing practices

were different across the lean groups. This proved that the ANOVA results contributed to the evaluation of the validity of the cluster analysis. In order to further verify the LM implementation in respondent companies, the tools implemented were also analysed based on the firm status of lean implementation (see Table 2). Non-lean firms had shown to emphasise more on human resources in lean tools implementation. Whereas, firms in-transition and lean firms spend more resources in manufacturing process and control. According to Herron and Braiden (2007), as the companies become stable and more knowledgeable in this field, more advanced lean tools were applied in order to support the end goal of the production system. On the whole, the main aim of this paper was to study the relationship between organisational change (change readiness, production team, leadership and management support, worker empowerment, effective communication, employee training, change agent system, reward system and review process) and lean implementation. The cluster analysis produced three groups named according to their degree of involvement towards lean practices. Lean firms have the highest mean scores of lean practices implementation compared to in-transition and non-lean firms. In addition, it also gives insight into the efforts of organisational change factors that in non-lean, in-transition and lean firms.

4.4 Correlation

The correlation coefficient (a value between -1 and +1) tells you how strongly two variables are related to each other. We can use the CORREL function in Excel to find the correlation coefficient between two variables. - A correlation coefficient of +1 indicates a perfect positive correlation. As variable X increases, variable Y increases. As variable X decreases, variable Y decreases.

Result

S.No.	X	Y
1	0	2
2	10	12
3	2	4

4	12	14
5	6	8
6	2	6

Correlation Value

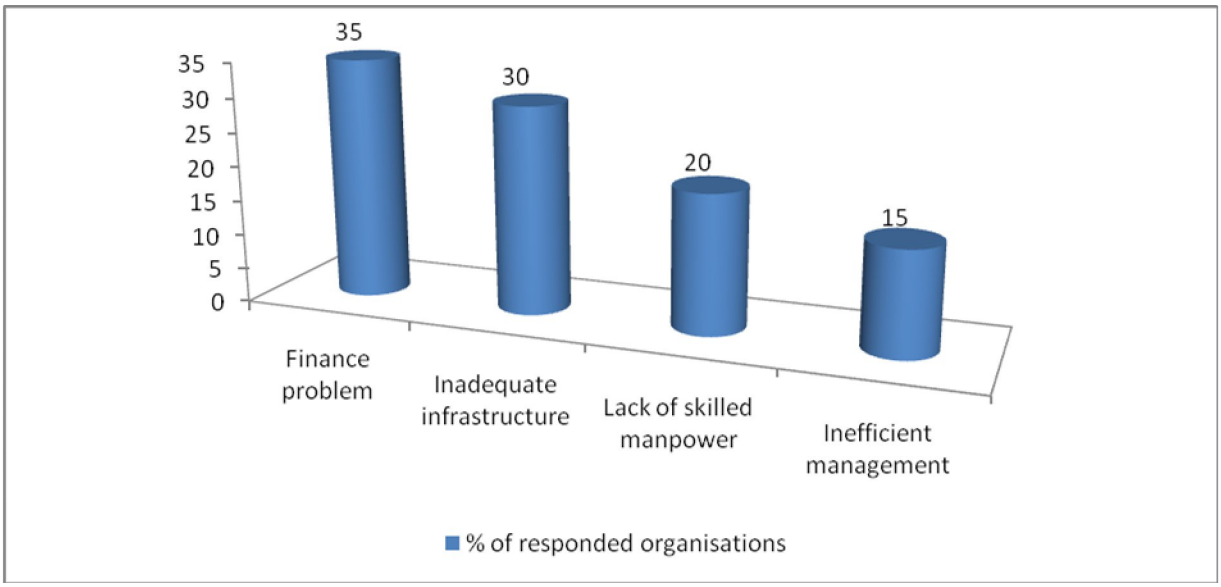
0.986140547

X is defined as waste reduction by lean manufacturing

Y is defined as productivity per unit

4.3.1 Problems while implementing lean manufacturing

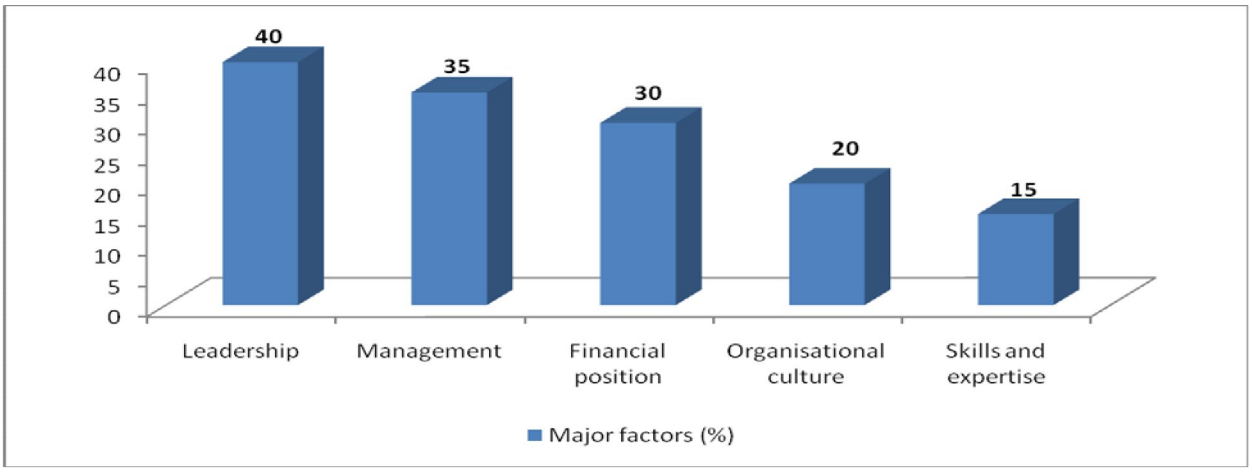
The analysis found that respondents are facing problems while implementing lean manufacturing in their organisations. Nearly 35% respondents faced finance problem followed by 30% respondents with inadequate infrastructure, 20% respondents suffering with lack of skilled manpower while 15% respondents complained of inefficient management.



4.3.2 Factors which affect implementation of lean manufacturing

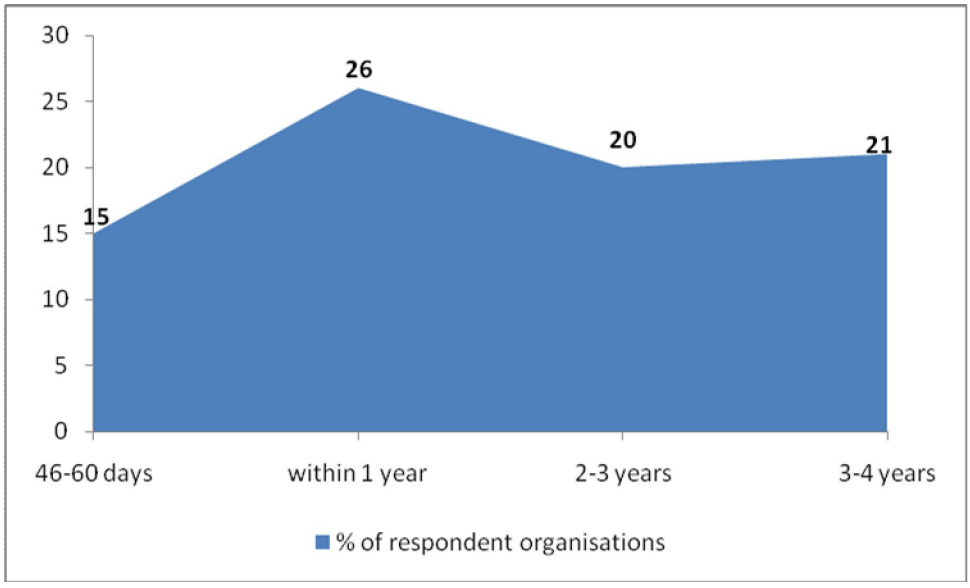
There are various critical factors which define the success of lean manufacturing in a firm. It was found that around 40% respondents were of the opinion that leadership is one such

critical factor followed by management (35%), financial position of a firm (30%), organisational culture (20%) and skills and expertise (15%).



4.3.3 Time involved in lean implementation

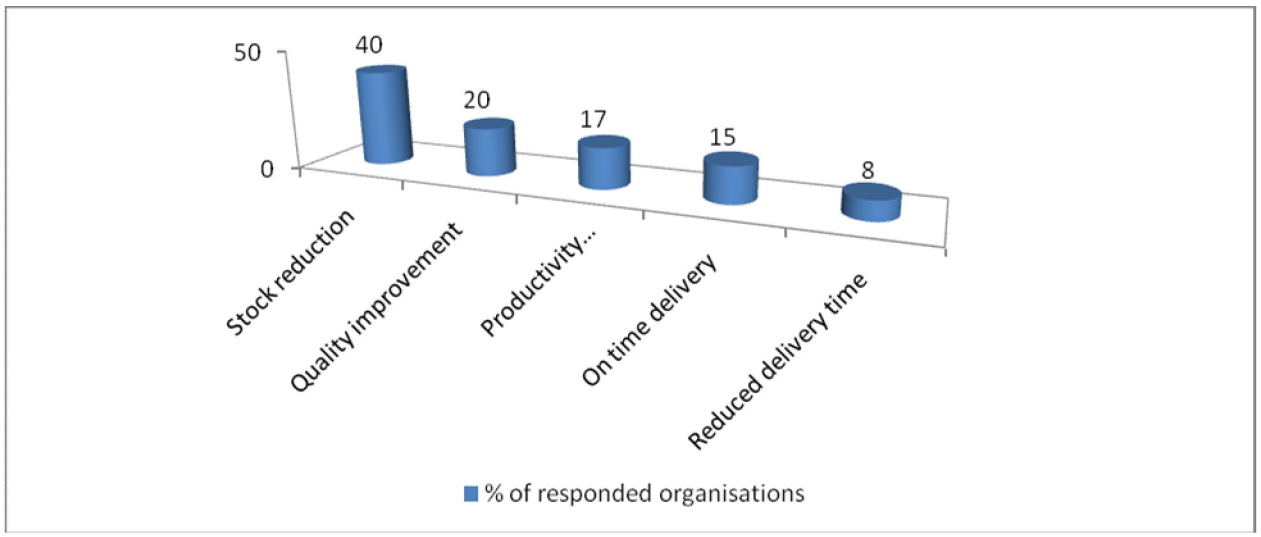
Nearly 26% respondents reported to take nearly 1 year time duration for successful implementation of lean manufacturing followed by 21% respondents taking 3-4 years, 20% respondents taking about 2-3 years while only 15% respondents take around 60 days for the effective implementation of lean manufacturing.



4.3.4 Types of benefits from lean manufacturing

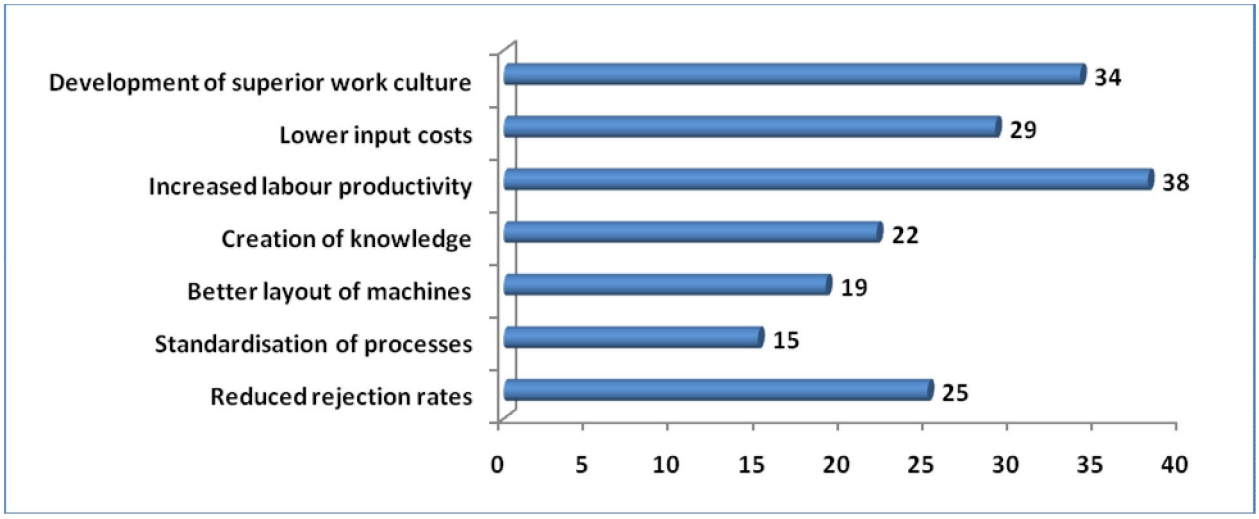
Respondents were found to have benefitted from lean manufacturing. It was found in the analysis that around 40% respondents had stock reduction followed by 20% respondents

experiencing quality improvement, 17% respondents benefitted in productivity, 15% respondents reported of on time delivery while 8% respondents opined of reduced delivery time.



4.3.5 Change observed after the implementation of lean manufacturing

It has been found by the respondents that Lean Manufacturing techniques also lead to reduced rejection rates (25%), standardisation of processes (15%) and better layout of machines (19%). Implementation of LM techniques has spin-off benefits in terms of training of labour, creation of knowledge (22%), increased labour productivity (38%), lower input costs to other industries (29%), introduction of new production equipment and methods of manufacturing, and the development of a superior work culture (34%).



3.3.5 Factors affecting lean manufacturing in small and large scale industries

As large organization have strong resources (finance, manpower, and equipment), they might not facing any difficulties on lean implementation. But, it has been found that small organisations, the implementation of any new management system might face obstacles especially on financial. The implementations of lean manufacturing in small organisation are dependent on their key major customers. Small organisation may feel the implementations of lean practices are beyond them. Any cost implications in the new management system such as the education and training component, is much harder for them. But, the small organisation has advantages such as, they are more agile, it is much easier to get management support and commitment, as opposed to large organizations.

Chapter 5

Conclusion

Manufacturing has been recognized as the main engine for growth of the economy. It has been estimated that in order to achieve a GDP growth rate of 9% per annum, the manufacturing sector has to grow at 12% per annum. The MSME sector, comprising of 114 lakh units has been a significant contributor to manufacturing by accounting for nearly 40% of the total industrial production **(Guidelines for the implementation of Lean Manufacturing Competitiveness Scheme, Development Commissioner, MSME, GOI)**.To achieve a sustained rate of growth, the manufacturing sector needs to build and maintain competitiveness needed to face the challenges posed by globalization. MSMEs can be assisted in reducing their manufacturing costs, through proper personnel management, better space utilization, scientific inventory management, improved process flows, reduced engineering time and so on with the application of Lean Manufacturing techniques. Lean manufacturing is basically a business initiative to reduce "waste" in manufacturing.

The process envisages improvement in the quality of products and lowering of cost, which is essential for competing in national and international markets. Ever changing globalized environment has been posing challenges of competitiveness and survival to all the constituents of the economy. It has been more so for MSME units in the manufacturing sector. It has been noticed that units are so engaged in the day to day management issues that they don't have time and resources to dedicate for a strategic understanding of the need and acquiring means of various techniques which would help them in enhancing their productivity and hence being competitive in the world. Lean Manufacturing is a set of techniques, which have evolved over a long period and are based on various minor to major breakthroughs that help in reducing cost and hence increase productivity. A list of main Lean Manufacturing techniques with brief description of each is given below:

- 5S System: The 5S systems is a workplace organization which helps in getting the "junk" out of the work area and set of procedures to keep it that way. 5S stands for Sort, Set in order, Shine, Standardize & Sustain.

- Visual Control: Visual controls such as cartoons, charts, light signals, Lane marking on floor, Safety instructions, Warning signs, Poka-Yoke instructions etc., can be displayed all over the work place.

- Standard Operating Procedures (SOPs): All verbal instructions should be converted to SOPs to remove dependency on skilled personnel in achieving required product quality level, consistency, effectiveness and efficiency.

- Just in Time (JIT): It's a Japanese manufacturing philosophy to make the right product in right quantity at the right time. This almost results in zero inventory and shortest possible cycle time.

- KANBAN System: In this, components are pulled by assembly or subsequent work centers and the containers are replenished with the right quantities by the previous work center, which reduces the inventory of unwanted components.

- Cellular Layout: In this improved manufacturing system, family wise component completion is aimed at within the smaller self contained cell, which is a part of a big factory, as compared to operation wise completion in traditional functional layout.

- Value Stream Mapping: It covers all activities, both value added and non-value added, and helps in arriving at best layout of all resources required for making the product.

- Poka Yoke or Mistake Proofing: It is again a Japanese technique used to prevent errors occurring at their source of origin, and it finally leads to a 'Zero Defect' situation.

- Single Minutes Exchange of Dies or Quick Changeover (SMED): Applying ingenious methods, set up time is minimized and brought to less than ten minutes; thereby smaller batches as required by the customer can be taken up for manufacturing.

- TPM (Total Productive Maintenance): TPM involves operators, maintenance staff and management working together to improve overall operation of any equipment.

Operators, who first identify noisy or vibrating motors, oil or air leaks, can be trained to make simple repairs to prevent major and costly break downs.

- Kaizen Blitz or Rapid Improvement Process: It is an intense management programme, which results in immediate change and bottom line improvement. Both management staff and workers are involved in this.

The objectives of lean manufacturing is to increase the competitiveness of the MSME sector with an emphasis on :

- Reducing waste;
- Increasing productivity;
- Introducing innovative practices for improving overall competitiveness;
- Inculcating good management systems; and
- Imbibing a culture of continuous improvement.

Large enterprises are capable of taking initiative on their own which essentially involves engaging the services of LMCs. Since the services are time consuming and involved in nature, MSMEs find it difficult to incur cost on Lean Manufacturing techniques. In order to ensure SMEs could sustain in global competitive in the 21st century, we would like to stress that lean manufacturing is the best management technique which can improve their performance. Securing the full benefits of lean manufacturing requires the organization to concentrate to the whole chain value by implementing comprehensive tools (Liker 2004; Sanchez & Perez 2000). Several research studies have shown that lean manufacturing produces higher levels of quality and productivity and better customer responsiveness (Krafcik 1988).Large organisation may not facing any difficulties to adopt the whole set of lean principles but SMEs organisation might face problem due to limited resources. However, Lee (1997) suggested that the SME could implement lean manufacturing by implement the feasible practices and low cost consumption such as 5S, Kanban without computerized system, employee involvement. Apart of that, as immediate action, the SME

also could strengthen the internal capability by appointed lean management representative. He or she will look the overall lean process and conduct in house training for particular principles and practices. Other alternative, the SME should actively participate with main customer on lean practices. The smart partnership between supplier and customer in lean manufacturing could benefit both partners. The research findings indicate that the selected firms have made some great improvements in terms of the value streams of their respective manufacturing plants and also in the reduction in waste and inventory. One of the main benefits that the firms in the city have seen in implementing lean initiatives is continuous improvement that indicates that the firms inclined towards lean manufacturing would be able to have more sustenance. Lean manufacturing is considered a strategic method to achieve competitive position among rival organisations. Although there has been several barriers for the implementation of lean manufacturing however, it can be concluded that lean manufacturing as a concept is not only effective for large scale firms but it is a tool for enhancing efficiency of firms operating in small scale sector also. It has been found by the respondents that Lean Manufacturing techniques also lead to reduced rejection rates, standardisation of processes and better layout of machines. Implementation of LM techniques has spin-off benefits in terms of training of labour, creation of knowledge, increased labour productivity, lower input costs to other industries, introduction of new production equipment and methods of manufacturing, and the development of a superior work culture.

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