

Lean manufacturing in Indian context: A survey

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ABSTRACT

This paper is an attempt to examine the implementation of Lean Manufacturing system in the Indian industries. Predominant elements of Lean Manufacturing, benefits gained after its implementation and obstacles observed by Indian Industry have been recognized. The results of this survey support the opinion that Lean Manufacturing had potential to improve the organizational performance of Indian industries. Nevertheless, Indian industries are required to be passionate to transform their manufacturing by adopting Lean manufacturing to gain the full benefits. A large numbers of literature papers are available on the better side of Lean manufacturing approach and its benefits gained by manufacturing organizations after implementation. But the adverse impacts of Lean manufacturing are not discussed to a great extent. Some drawbacks of Lean manufacturing are also highlighted in this paper.

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1. Introduction

Lean Manufacturing has become a subject of the attention for many manufacturing organizations. Manufacturing organizations are facing global competition by means of changing customer requirements, smaller order size with model mix, shorter product life cycles and fast delivery requirements put forward by global customers (Womack et al., 2004). Lean Manufacturing is an important management subject, which emphasis on reducing waste in the process, working with lower inventories, avoiding unnecessary investment and strengthening the overall business by reducing of non-value adding activities (Nordin et al., 2010). Lean Manufacturing has the ability to reduce the manufacturing lead time, trim down manufacturing costs, reduce material handling and get better quality. It also creates a region of reduced wastage, and shortened delivery time with lower product costs with enhanced customer satisfaction and supports other improvements, which can help companies meet competitive goals (Deif, 2012; Taj & Morosan, 2011). The intention of Lean Manufacturing is to help organization provide the highest values to customers (Shah & Ward 2007).

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Lean Manufacturing is well accepted approach, which has gained the admired position among industry based on measurable benefits accomplished and published by practicing manufacturing organizations (Chan, 2001). Lean Manufacturing can be effectively implemented across several disciplines (Poppendieck, 2002). Lean manufacturing may be defined as a manufacturing philosophy, which focuses on delivering the highest quality product to customer on-time and at the lowest cost (Liker & Wu, 2006). The essential transformation in manufacturing can be achieved and sustained with the retention and utilization of people's knowledge within the organizations. Positive changes with Lean Manufacturing Systems can be continued with a de-centralized knowledge and role-specific approach. This approach can be useful in identifying suitable procedure of knowledge management. Researchers presented management of knowledge as a matter of prime significance in Lean Manufacturing environment (Dombrowski et al., 2012).

Lean Manufacturing has been into practice for more than three decades but, still there is no established definition agreed by everybody. Lean manufacturing is directly associated with the elimination of wastes from manufacturing system to get better results in supplies, process time reduction and quality improvement (Oehmen et al., 2012). Plant not implementing lean manufacturing is likely to face performance issues in contrast with plants who have adopted Lean manufacturing in spite of age and size of the plant (Shah & Ward, 2003).

2. Literature review in Indian Context

India is emerging as a manufacturing hub for the world manufacturing market. This has increased the global competition within Indian manufacturing marketplace (Kumar & Kumar, 2012). The orthodox manufacturing approach of making product available for customer has been replaced by new manufacturing style of meeting the customer specific requirements. Indian manufacturers have started adopting modern manufacturing practices, information technologies and management approaches to meet the requirements of global competition (Antony & Desai 2009). Though a large number of services and manufacturing industries across the country have adopted Lean manufacturing as a tool to improve their organizational performance but still there is a large gap exists in its implementation to gain the full benefits of Lean manufacturing (Narain et al., 2004).

Lean Manufacturing is a strategy adopted to achieve manufacturing excellence with continuous process improvement (Saraswat et al., 2014). Lean Manufacturing got invented in Japan with prime objective to remove waste from manufacturing processes, to improve productivity and quality of product to survive in the competitive market (Chowdary & George 2011). Relevance of Lean Manufacturing implementation was examined in the clothing industry. The outcome revealed that Lean Manufacturing is highly effective in mass production environment of clothing industries in order to achieve superior results by waste reduction, inventory reduction and decrease of defects. Different tools of Lean Manufacturing facilitate to see the built-up waste in the system. In addition to identification of waste, it provides guideline to reduce the same (Silva, 2012).

In the start Lean Manufacturing was invented and exercised by Toyota in the Japan and later it was practiced by different companies looking for manufacturing process improvement to achieve better results by adopting latest techniques (Ferdousi, 2009; Amasaka, 2002). These practicing companies published superior results after adoption of lean Manufacturing and this motivated other companies to adopt Lean Manufacturing to make their processes more efficient (Singh et al., 2010c). Researchers described Lean Manufacturing as a systematic way of waste removal from processes with the help of total employee's involvement within the business (Singh & Dubey, 2013). Researchers described lean manufacturing as a prominent manufacturing approach to survive in extremely competitive environment (Mishra & Garg, 2013). A case study in Indian industry discovered that Lean Manufacturing is the advantageous approach for the stakeholders of the organization (Anand & Kodali,

2008). Researchers revealed that WIP inventory reduction with the implementation of lean manufacturing can keep organizational competitiveness in recessionary times (Singh et al., 2009).

Manufacturing sector is the backbone for growth of economy for any country. With the globalization of manufacturing sector and Indian industries being a major player in global competition it is imperative for Indian industry to improve its competitiveness (Ahuja & Khamba, 2008). It is pragmatic that Indian industry is trying to equip them with the latest tools and techniques to wrestle with global players and due to this scope of Lean manufacturing implementation is becoming broader in the Indian context. These circumstances have motivated Indian industry to adopt revolutionary approach of Lean Manufacturing (Singh et al., 2010). Customer demands are becoming more volatile and customer's expectations are increasing globally and this has increased the challenge of survival into competitive market (Khadse et al., 2013). Japanese companies have developed Lean Manufacturing as a system, which uses lesser resources to create equivalent output with better quality and meets the requirements of customer (Kumar, 2010). Continuous improvement and people participation are some of the best manufacturing practices adopted by Indian industries to up keep their competitiveness (Kumar et al., 2004).

It is observed that organizational performance is improved with the implementation of Lean Manufacturing so lean is considered as a tool to support business objectives (Joshi & Naik, 2012). Business excellence practice are superimpose over conventional manufacturing style to create big improvements in organization (Wong et al., 2009). This transformation process starts when management alters its thought process from orthodox to contemporary. The emphasis is given on education and training of employees, allotment of funds for improvement activities, balanced resources deployment and so on. Although Lean manufacturing like any other system faces many obstacles so management should take well care of for these hindrance for smooth implementation of Lean manufacturing. Major obstacles observed by Indian industries are technical skills, cultural issues, managerial and financials to hinder the implementation of Lean manufacturing (Darabi et al., 2012). Top management issues are identified as major challenges for lean implementation along with top management policies and attitude towards lean implementation in Indian industries (Singh et al. 2010). Researchers have identified some key obstacles of Lean Manufacturing in Indian industries. The prominent barrier of Lean manufacturing is observed as management with lack of focus, being short in providing support, not able to create sense of urgency for lean manufacturing and with short sightedness about potential long tern benefits of Lean Manufacturing. Inadequate consultancy, lack of funds and communication barriers are other obstacles of Lean Manufacturing (Rakesh & Vikas, 2014). The management is responsible for creating a learning culture and find solutions to reduce conflicts between Lean manufacturing and other improvement initiatives for smooth implementation of Lean implementation.

3. Survey of Lean Manufacturing in Indian industries

The process of research consists of series of steps or actions required to perform effective investigation of facts. This study is based on a survey. A survey questionnaire was designed for collecting opinion of industries professionals to collect data on Lean elements, benefits and obstacles. Research methodology model is shown in Fig. 1. Data was collected through one to one survey, emails and posts. In this study, the status of elements, benefits and obstacles have been observed. Adverse impact of lean manufacturing implementation has also been discussed. The list of Lean and continuous improvements practicing companies was obtained from confederation of Indian industry. In this study 131 industries were selected for conducting the survey. A total 59 nos. of Indian industries responded to survey including answering to mails and allowing for one to one survey.

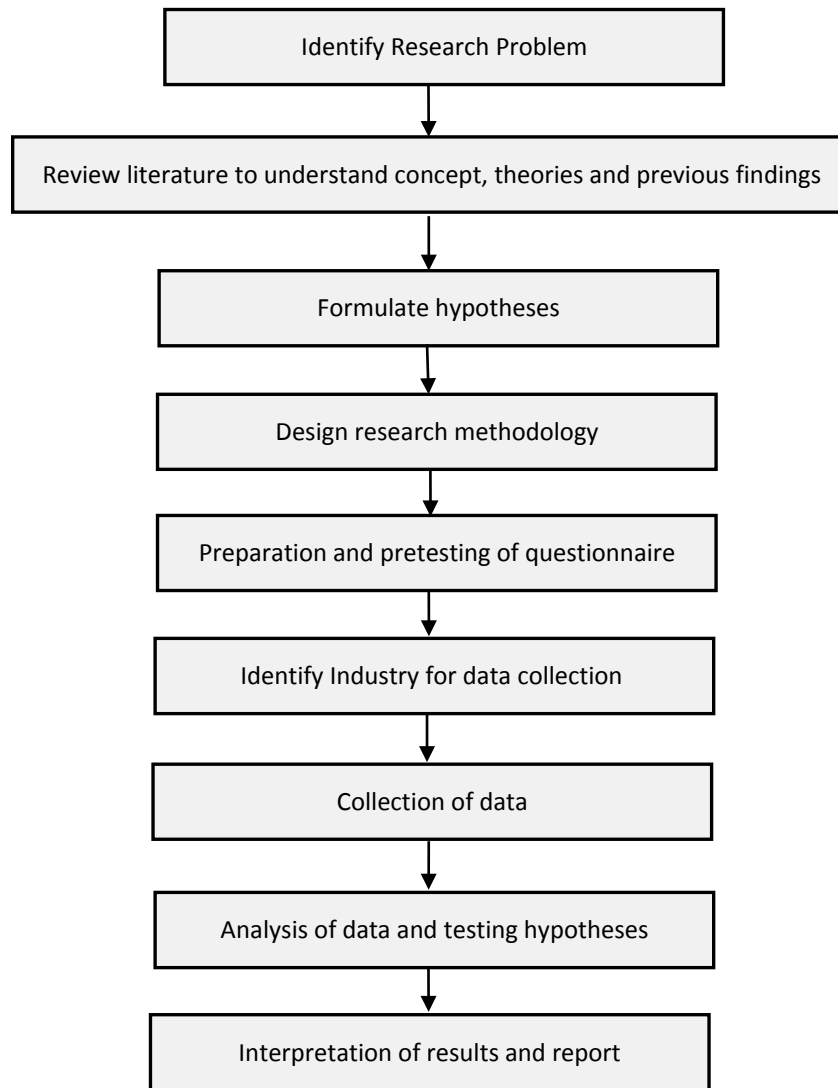


Fig. 1. Illustration of research methodology adopted for study

The respondent industries belong to two-wheeler manufacturing, four-wheeler manufacturing, passenger car manufacturing, automotive engine parts, automotive power transmission parts, rubber parts manufacturing, pharmaceutical, farm equipment manufacturing, refrigerator and air conditioner manufacturing industry and consumer goods manufacturing units. The aim of the study is to determine the subsistence of Lean manufacturing practices in Indian Industry with below objectives:

- I. To establish significance of Lean Manufacturing elements related to Indian manufacturing industry.
- II. To search out the benefits gained by Indian Industry with the implementation of Lean Manufacturing.
- III. To identify significance of major obstacles faced by Indian Industry.
- IV. To identify the adverse impact of Lean Manufacturing implementation in Indian industry.

In this study a five point Likert scale has been used to examine the degree of significance of various Lean elements, benefits and obstacles in the Indian manufacturing industries ranging from 1 as low level of significance to 5 as high level of significance. Mechanism of rating is: 1 for no significance, 2 for slight significance, and 3 for some significance, 4 for partial significance and 5 for full significance of constituent in lean manufacturing.

Lean Manufacturing elements, benefits and obstacles have been discussed by many researchers (Singh et al., 2009; Upadhye et al., 2010; Rahman et al., 2010; Chen & Cox, 2012; Belokar et al., 2012; Nordin et al., 2010; Kumar et al., 2004; Anand & Kodali, 2009; Chen & Tan, 2011; Shah & Ward, 2003; Nordin et al., 2010; Rakesh & Vikas, 2014; Wong & Wong, 2011a). A total of 29 nos. of Lean manufacturing elements, 30 nos. of lean manufacturing benefits and 25 nos. of lean manufacturing obstacles have been considered for study from literature contributed by these researchers. For data collection about adverse impacts of lean manufacturing, respondents were asked to provide open ended comments based on their experiences.

3. Analysis

The two tailed t-test has been carried out at five percent level of significance to examine Lean manufacturing elements, benefits gained and obstacles faced by Indian industry throughout implementation of Lean manufacturing. The following hypothesis was developed.

- I. H_0 : Lean manufacturing elements given in Table 1 are not significant for implementation of Lean manufacturing in Indian industry. If Lean elements under analysis are significant for implementation of Lean manufacturing in Indian industry, the null hypothesis (H_0) will be rejected and alternate hypothesis H_{a1} will be accepted.
- II. H_0 : Lean manufacturing benefits provided in Table 2 are not achieved by Indian industry. If benefits are gained by industry after implementation of Lean manufacturing, the null hypothesis (H_0) will be rejected and alternate hypothesis H_{a2} will be accepted.
- III. H_0 : Lean manufacturing obstacles given in Table 3 are faced by Indian industry during implementation of Lean Manufacturing. If the obstacles faced by industry during and after implementation of Lean manufacturing are not significant the null hypothesis (H_0) will be rejected and alternate hypothesis H_{a3} will be accepted.

Table 1
Significance of Lean manufacturing elements in Indian industry

S. No.	Lean Manufacturing elements	1	2	3	4	5	Std. dev.	t value calculated	Result	S. No.	
1	Inventory reduction	0	1	13	23	22	4.119	0.811	2.0807	H_0 rejected	H_{a1} accepted
2	Total Employee Involvement.	0	1	12	26	20	4.102	0.781	1.9943	H_0 rejected	H_{a1} accepted
3	Error proofing/poka-Yoke	1	8	20	26	4	3.407	0.873	-4.3282	H_0 accepted	
4	Set up reduction.	0	3	15	25	16	3.915	0.857	0.1467	H_0 accepted	
5	Improve OEE.	0	4	13	31	11	3.831	0.813	-0.6463	H_0 accepted	
6	De-bottlenecking	0	1	11	35	12	3.983	0.682	0.9478	H_0 accepted	
7	Line pace	2	15	27	15	0	2.932	0.807	-9.2064	H_0 accepted	
8	Wastage identification	0	1	14	20	24	4.136	0.840	2.1647	H_0 rejected	H_{a1} accepted
9	Equipment uptime	1	20	27	11	0	2.814	0.754	-11.0606	H_0 accepted	
10	Quality at source.	0	2	7	38	12	4.017	0.682	1.3295	H_0 accepted	
11	Takt Time working	2	6	11	30	10	3.678	0.990	-1.7136	H_0 accepted	
12	Small lot size	0	0	9	31	19	4.169	0.673	3.0864	H_0 rejected	H_{a1} accepted
13	Continuous improvement	0	1	9	29	20	4.153	0.738	2.6385	H_0 rejected	H_{a1} accepted
14	Good Housekeeping	0	3	13	30	13	3.898	0.803	-0.0056	H_0 accepted	
15	Manpower reduction	0	1	9	37	12	4.017	0.656	1.3817	H_0 accepted	
16	Load leveling (Heijunka)	0	2	7	33	17	4.102	0.736	2.1175	H_0 rejected	H_{a1} accepted
17	Reduced information barriers	0	11	10	24	14	3.695	1.038	-1.5092	H_0 accepted	
18	Cycle time reduction	0	3	5	34	17	4.102	0.759	2.0531	H_0 rejected	H_{a1} accepted
19	Quick changeovers	0	3	10	27	19	4.051	0.839	1.3909	H_0 accepted	
20	Process control.	0	4	9	34	12	3.915	0.794	0.1583	H_0 accepted	
21	Lead time reduction	0	0	13	28	18	4.085	0.726	1.9662	H_0 rejected	H_{a1} accepted
22	Safe working	0	2	12	28	17	4.017	0.799	1.1356	H_0 accepted	
23	Standardization.	0	0	10	33	16	4.102	0.662	2.3545	H_0 rejected	H_{a1} accepted
24	Reduce variability.	0	5	13	27	14	3.847	0.887	-0.4454	H_0 accepted	
25	JIT deliveries	0	1	10	32	16	4.068	0.716	1.8122	H_0 accepted	
26	Flexible manufacturing.	0	0	11	33	15	4.068	0.666	1.9480	H_0 accepted	
27	Layout improvement.	2	4	10	34	9	3.746	0.921	-1.2772	H_0 accepted	
28	Line Balancing	0	4	10	28	17	3.983	0.861	0.7509	H_0 accepted	
29	Pull System	0	2	14	18	25	4.119	0.892	1.8919	H_0 accepted	
Population mean							3.8989	N=59			

Table 2
Benefits gained by Indian industry after implementation of Lean manufacturing

S. No.	Lean Manufacturing Benefit	1	2	3	4	5	Element Mean	Mean	t value calculated	Result
1	Increase in productivity	0	1	7	27	24	4.254	0.733	2.3252	H ₀ rejected H _{a2} accepted
2	Reduction in unplanned breakdown	1	2	7	18	31	4.288	0.929	2.1147	H ₀ rejected H _{a2} accepted
3	Improvement in OEE	0	2	12	24	21	4.085	0.836	0.4820	H ₀ accepted
4	Reduced rework	2	4	11	25	17	3.864	1.025	-1.2581	H ₀ accepted
5	Reduced scrap	1	2	4	26	26	4.254	0.863	1.9760	H ₀ rejected H _{a2} accepted
6	Reduced cost of poor quality	0	0	15	25	19	4.068	0.763	0.3580	H ₀ accepted
7	Reduced warranty cost	2	2	20	19	16	3.763	1.006	-2.0584	H ₀ accepted
8	Reduction in labor cost	0	1	9	24	25	4.237	0.773	2.0367	H ₀ rejected H _{a2} accepted
9	Reduction in distribution expenses	0	1	14	33	11	3.915	0.702	-1.2804	H ₀ accepted
10	Reduction in inventory cost	0	1	9	24	25	4.237	0.773	2.0367	H ₀ rejected H _{a2} accepted
11	Reduction in utility cost	2	2	12	26	17	3.915	0.970	-0.9265	H ₀ accepted
12	Raw material yield improvement	0	0	19	22	18	3.983	0.799	-0.4733	H ₀ accepted
13	Reduction in tooling cost	0	3	13	27	16	3.949	0.839	-0.7607	H ₀ accepted
14	Improved delivery rating of supplier	0	1	12	27	19	4.085	0.772	0.5222	H ₀ accepted
15	Improved delivery rating to customer	0	2	8	22	27	4.254	0.822	2.0744	H ₀ rejected H _{a2} accepted
16	Reduced throughput time	1	2	4	24	28	4.288	0.872	2.2540	H ₀ rejected H _{a2} accepted
17	Improved flexibility	0	1	10	22	26	4.237	0.795	1.9804	H ₀ rejected H _{a2} accepted
18	Reduced reportable accidents	1	6	25	27	0	3.322	0.730	-7.4763	H ₀ accepted
19	Reduced unsafe practices	1	2	10	25	21	4.068	0.907	0.3009	H ₀ accepted
20	Improved behavioral safety	1	1	5	34	18	4.136	0.776	1.0230	H ₀ accepted
21	Reduced environmental impact	0	6	31	19	3	3.322	0.730	-7.4763	H ₀ accepted
22	Improved legal compliance	0	7	27	23	2	3.339	0.734	-7.2582	H ₀ accepted
23	Improved skills of employee	0	1	11	26	2	4.136	0.776	1.0230	H ₀ accepted
24	Increase in no. of Kaizens per head	1	0	9	22	27	4.254	0.843	2.0404	H ₀ rejected H _{a2} accepted
25	Employees participation in trainings	0	1	9	23	26	4.254	0.779	2.2259	H ₀ rejected H _{a2} accepted
26	Employees participating in quality circles	0	0	11	24	24	4.220	0.744	1.9896	H ₀ rejected H _{a2} accepted
27	Reduced attrition rate	1	2	10	25	21	4.068	0.907	0.3110	H ₀ accepted
28	Increase in profitability	0	1	10	21	27	4.254	0.801	2.2178	H ₀ rejected H _{a2} accepted
29	Increase in overall revenue	0	0	19	31	9	3.831	0.673	-2.4338	H ₀ accepted
30	Improved cash flow	0	1	14	29	15	3.983	0.754	-0.5341	H ₀ accepted
Population mean							4.029		N=59	

Table 3
Obstacles faced by Indian industry during implementation of Lean manufacturing

S. No.	Lean Manufacturing Benefit	1	2	3	4	5	Element Mean	Mean	t value calculated	Result	S. No.
1	Lack of management focus	1	4	13	20	21	3.949	1.007	2.1559	H ₀ accepted	
2	Lack of urge to create sense of urgency	0	8	19	19	13	3.627	0.981	-0.3079	H ₀ rejected	H _{a3} accepted
3	Lack of management support	1	3	16	18	21	3.932	0.998	2.0462	H ₀ accepted	
4	Lack of long term vision	1	6	16	17	19	3.797	1.063	0.9404	H ₀ rejected	H _{a3} accepted
5	Lack of labor resources	0	4	20	20	15	3.780	0.911	0.9546	H ₀ rejected	H _{a3} accepted
6	Lack of capital fund	0	3	17	22	17	3.898	0.885	2.0132	H ₀ accepted	
7	Lack of communication	0	7	23	16	13	3.593	0.967	-0.5816	H ₀ rejected	H _{a3} accepted
8	Lack of idea innovation	1	4	20	24	10	3.644	0.905	-0.1898	H ₀ rejected	H _{a3} accepted
9	Mediocre Consultants	1	5	15	28	10	3.695	0.915	0.2392	H ₀ rejected	H _{a3} accepted
10	Lack of time	0	2	26	19	12	3.695	0.836	0.2617	H ₀ rejected	H _{a3} accepted
11	Lack of training	1	1	18	20	19	3.932	0.926	2.2046	H ₀ accepted	
12	Lack of understanding about Lean	0	4	18	27	10	3.729	0.827	0.5794	H ₀ rejected	H _{a3} accepted
13	Lack of implementation know-how	0	5	15	19	20	3.915	0.970	1.9702	H ₀ accepted	
14	Conflicts with Other Initiatives like TQP,TPM,JIT	0	6	23	24	6	3.508	0.817	-1.4845	H ₀ rejected	H _{a3} accepted
15	Disparate Manufacturing Environments	1	4	17	12	25	3.949	1.074	2.0227	H ₀ accepted	
16	Demand Volatility	2	3	22	20	12	3.627	0.981	-0.3079	H ₀ rejected	H _{a3} accepted
17	Conflicts with ERP Implementations	1	3	15	26	14	3.831	0.913	1.3809	H ₀ rejected	H _{a3} accepted
18	Company culture	1	3	17	16	22	3.932	1.015	2.0116	H ₀ accepted	
19	Employee resist to change	1	9	24	20	5	3.322	0.899	-2.9425	H ₀ rejected	H _{a3} accepted
20	Middle management resistance	1	11	18	20	9	3.424	1.021	-1.8268	H ₀ rejected	H _{a3} accepted
21	No direct financial advantage	1	14	25	7	12	3.254	1.092	-2.8990	H ₀ rejected	H _{a3} accepted
22	Financial benefits not recognized	1	8	21	19	10	3.492	0.989	-1.3583	H ₀ rejected	H _{a3} accepted
23	No financial targets	1	5	12	20	21	3.932	1.032	1.9787	H ₀ accepted	
24	Past experience of failure	0	20	22	11	6	3.051	0.972	-4.8625	H ₀ rejected	H _{a3} accepted
25	Lack of Staying Power	0	13	28	14	4	3.153	0.847	-4.6987	H ₀ rejected	H _{a3} accepted
Population mean							3.608		N=59		

The conclusion of the t-test is represented in Table 1 for lean manufacturing elements, in Table 2 for

benefits gained by Indian industry and in Table 3 for obstacles faced by Indian industries. The scale used was one to five, one for low significance to five for full significance.

Significant lean manufacturing elements: Lean element index was observed as 3.89 in Table 1 based on level of significance. It was observed that lean elements such as Inventory reduction, Total employee's involvement, wastage identification, small lot size, continuous improvement, Heijunka, cycle time reduction, lead time reduction and standardization are identified significant elements in implementation of lean manufacturing in Indian industry based on survey results.

Significant lean manufacturing benefits: Index for lean benefits was observed as 4.029 in Table 2 based on level of significance. Significant benefits gained by Indian industry has been reduced throughput time, increase in productivity, reduction in unplanned breakdown, reduced scrap, reduction in labor cost, reduction in inventory cost, improved delivery rating to customers, improved flexibility, increase in number of Kaizens per head, employees participation in trainings, employees participation in quality circles and increase in profitability.

Significant lean manufacturing obstacles: Index for lean obstacles was observed as 3.608 in Table 3 based on level of significance Significant obstacles faced by Indian industry are lack of management focus, lack of management support, lack of capital fund, lack of training, lack of implementation know-how, disparate manufacturing environments, company culture and no financial targets available for implementation of Lean Manufacturing.

4. Drawbacks of Lean Manufacturing Implementations

As discussed in this paper, organizations can achieve a lot of benefits with the implementation of Lean manufacturing. Despite a number of positive impacts, Lean manufacturing may have some possible drawbacks as a result of inadequate implementation of Lean manufacturing. There was no reference available for different adverse impacts of lean manufacturing. So, industrial professionals were asked to give their inputs about negative impacts experienced by them during practicing lean manufacturing. Collected inputs are summarized with the aim to make Indian industry aware of most significant adverse impacts of Lean manufacturing implementation. It is supposed that Indian industry would take care of following short comings of Lean Manufacturing during implementation.

- I. **Impact of over cost cutting:** Lean manufacturing supports in enhancing profits by optimizing manufacturing processes but a part of this, saving is counterbalanced by direct and indirect additional cost incurred in implementation of Lean manufacturing approach. The majority of business managers are not aware of costing structure of manufacturing process. It leads them sightless about where to focus their efforts to reduce the cost and usually it ends up with cost cutting efforts in the wrong area. Sometimes due to insufficient knowledge lean manufacturing is viewed with narrow focus of cutting cost. Here chances increases to fail to spot the area of investment opportunities for business expansion which is the predominant sign of success for any industry.
- II. **Impact of exceptionally low inventories:** Manufacturing with smaller lot size reduces throughput time and reduced inventory carrying cost but transportation of parts in smaller lots increases transportation cost. Lower inventories and frequent deliveries to customer may increase the risk of stock out situation in the absence of buffer stock which would have work as shock absorber in case of change in demand and any adverse situation.
- III. **Impact of overdependence on Lean guidelines:** With the implementation of Lean Manufacturing most of the time consulting firms come into picture and emphasis on rigid

management culture reducing or eliminating room for expressing basic creativity. Even if someone attempts to exercise brainstorm for new ideas, the cultural and organizational structure dampens down the creativity. Lean manufacturing approach has its limitations in pace of implementation mainly when it is exercised in conflicting workplace culture like limited openness to new ideas acceptance and innovative way of working are questioned. In this type of work culture; information flows with breadth not depth of knowledge. More often engineers feel stuck up in one career path with one company for the reason of their so highly specialized skill sets.

- IV. **Impact on physical and mental health:** With limited knowledge of Lean manufacturing, critical lines for production are stretched from normal to highest pace creating unsafe work environment. Repeated and hasty working on such lines increases the risk of health hazard and creates issues related to operator safety. One of the most cited harmful effects of Lean manufacturing is the pressure of doing job in specific time which has potential of increased level of stress among workers.
- V. **Impact on society:** Reduction of manpower is considered as the prime outcome of Lean Manufacturing. In many cases this is exercised just to achieve goals of manpower reduction and show improved productivity per manpower even though manpower cost is not big in Indian context. This may lead to compulsion of unnecessary investment on automation resulting in lower return on investment and creating unemployment to the society. Quality of employment is always a matter of debate considering stringent requirements and amount of work required for the successful implementation of Lean manufacturing.
- VI. **Impact on product quality:** Quality decisions are to be taken on the spot. In most of the cases worker job is involved with making him responsible for in-process and product quality. Sometimes lower skill set and high production pressure results in wrong decisions over product quality hence increasing chance of higher cost of poor quality.

5. Conclusions and Recommendations

Stiff competition in the market has put pressure over product prices because key of gaining more business is to increase revenues through beating the competition by price and quality. Hence the key for making profits in competitive environment is to reduced product costs, optimizing profit margins and increasing share of business. This may need manufacturing capacity expansion. Additional expansion of capacity needs investment, which may have adverse effect on product cost. Consistently reduced product costs can be achieved by implementation of lean manufacturing to control manufacturing cost by elimination of waste in each area of business through people participative continuous improvement approach.

The empirical analysis is used in this study to establish the significant Lean elements, benefits and obstacles of Lean Manufacturing. This research paper presents benefits gained by Indian industry with implementation of Lean manufacturing elements. The survey supports the notation that the implementation of Lean Manufacturing has measurable positive impact on performance of Indian industry. Lean Manufacturing has the capability to impact positively with improved operational efficiency, quality and improved organizational performance. The outcome of the study concludes that Lean manufacturing is helpful in improvement of overall competitiveness of Indian industry to overcome the global competition. This study suggests that lean manufacturing is a great prospect to put into practice to improve the performance of the industry. Simultaneously it raises some concerns which are likely to happen if Lean manufacturing is not implemented and practiced in a balanced manner. To gain the full benefits of lean by Indian industries one must deal the obstacles with caution and

drawbacks must be well thought-out throughout its execution.

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