Lean and Six Sigma: A Combined Approach for Waste Management in Indian SME's

Harsimran Singh Sodhi[1], Doordarshi Singh[2], Bikramjit Singh[3]

[1]*Ph.D. Research Scholar, PTU Jalandhar, Punjab, India*
[2]*Assistant Professor at BBSBEC, Punjab, India*
[3]*Professor at MMU Sadopur, Punjab, India*

Abstract: **Lean Six Sigma is an approach which focuses on continuous improvement of processes in order to reduce the cost due to poor quality and to make improvements in the bottom line results to create value for the customers. The Basic purpose of this paper is to explore the various critical success and failure factors of LSS approach in various SME's clusters of India. The following research is based upon the systematic literature review of papers published in various reputed journals on techniques like Lean manufacturing, Six Sigma and Lean Six Sigma.**

I. INTRODUCTION

In the recent years of industrialization, a number of waste management techniques have been developed for the purpose of waste management in Indian small and medium industrial sectors. Each and every used in recent past have its own standard procedure of implementation, merits and demerits. Today, Lean and Six Sigma are the most mainstream business systems for empowering consistent change (CI) in the assembling, administration and open areas. CI is the fundamental objective for any association wishing to accomplish quality and operational perfection and to improve execution (Antony et al., 2012a; Thomas et al., 2009). Along these lines, the combination of the two methodologies enhances proficiency and viability and accomplishes prevalent execution quicker than the usage of every methodology in segregation (Antony et al., 2012a).Present study is based on the through survey of literature of all such techniques. The major problem faced by the industrial organizations in incorporating this is to how to choose the best technique which will be best suitable for the organization based upon its size, nature of production and culture. In this paper four major waste reduction techniques i.e. Total Quality Management, KAIZEN, Lean Manufacturing and Six Sigma will be discussed in detail to discuss their effects, concepts, similarities in their approach and various differences.

II. LITERATURE REVIEW

Literature of various people who worked upon Lean Six Sigma has been reviewed and brief summery has been illustrated below. Prieto-avalos (2014) studied that Lean manufacturing provides an approach to identify and eliminate waste and all non-value added activities through continuous improvements. Thanki (2014) concluded a report of pilot study on LSS awareness and implementation using the survey data collected from about 32 industries situated in western and eastern region of India. A survey instrument containing 45 statements was designed to assess respondents' attitude and awareness toward lean practices and to explore the level of lean implementation in the organization. Naveen (2013) indicated that The requirement of Lean six sigma manufacturing has increased due to waste and subsequent increase in cost of the manufacturing goods. According to Hassan (2013) manufacturing plant can enhance the nature of the produced welding wires, decrease the assembling waste and expand the yield of the assembling procedure, by applying the LSS philosophy and waste administration. Khadse (2013) studied the basic incline fabricating components in charge of usage of incline assembling in the Indian assembling segment and afterward to join these elements into a system, which can be speak to the present status of incline practices in Indian commercial enterprises. Siddh (2013) put accentuations on Lean assembling as one of the activities that real organizations all around the globe have been attempting to receive keeping in mind the end goal to stay aggressive in the inexorably worldwide business sector as it can methodically make sense of how to dispense with them and get as near "Zero Defect" as could be allowed.

III. STATUS QUO OF INDIAN SMES

Numbers of SMEs in India are continuously increasing every year. As per data available from Indian equity brand foundation, the numbers of SMEs are increased from 5008 to 7735 from FY07 to FY 11. The rate of increase of the same on yearly basis is shown as under. And as per available data from Ministry of micro small and medium enterprise 55% of SMEs are situated in urban part where as remaining 45% is established in the rural part of India. Contribution of these SMEs is 16% in repair and maintenance, 17% in service sector and 67 % in the manufacturing sector. Even though the Indian SMEs are facing various challenges such as unavailability of modern technology, lack of infrastructural facilities, unavailability of skilled workers etc.

IV. EXISTING TOOLS/TECHNIQUES FOR SCRAP REDUCTION

Lean manufacturing continuously identifies and removes all kinds of Scraps. There are various approaches/techniques which aim at identifying various types of scraps and their sources and then drive methodologies to remove them from the systems on rapid basis. For highlighting the major causes of waste reduction and method to eliminate these, various tools and techniques used are mentioned in table no. 1 as below.

Table No. 1: Tools and Techniques for Scrap Reduction

S.No	Tool / Technique	Brief
1	TOTAL QUALITY MANAGEMENT	Hines and Rich (1997) discussed that TQM is a technique in which an organization continuously increases its ability to provide quality products to its customers.
2	QUALITY CONTROL	Bowman (1993) Quality of product is improved by using seven major tools of quality i.e. Cause and effect diagram (fishbone diagram) , Control chart, Scatter diagram, (alternately, flow chart or run chart), Check sheet, Pareto chart, Histogram, Stratification
3	JUST IN TIME	Prieto (2014) It focuses on reduction of flow times within production along with response times from is suppliers and customers.
4	POKA YOKE	Girish (2012) It is a technique in a lean manufacturing system which aims to avoid mistake made by operator.
5	KAIZEN	Krishnan (2013) KAIZEN stands for continuous improvement. Involving all employees from the CEO to the assembly line workers.
6	LEAN MANUFACTURING	Womack and Jones (2003) said that Lean manufacturing is a technique for waste elimination in a manufacturing process. Lean is aiming on making systematic processes which can add the value of the product.
7	SIX SIGMA	Breyfogle (1999) described Six Sigma as a set of tools and techniques for the improvement of process. There are 99.99966% statistical chances in six sigma technique to produce a defect free product.

V. LEAN MANUFACTURING

Lean and agile are broadly considered as Business Process Improvement (BPI) systems that have encouraged abnormal amounts of maintainable development in numerous assembling commercial enterprises all through the world (Hines and Rich, 1997). Lean Manufacturing wonders endless supply of non-quality included exercises and waste in industry in a deliberate way (Womack and Jones, 2003; Naslund, 2008). Lean is aimed at reducing waste and adding value to production systems so that systems performance is significantly improved and a company "does more with less". figure no 1 represents the various phasis of Lean implementation.

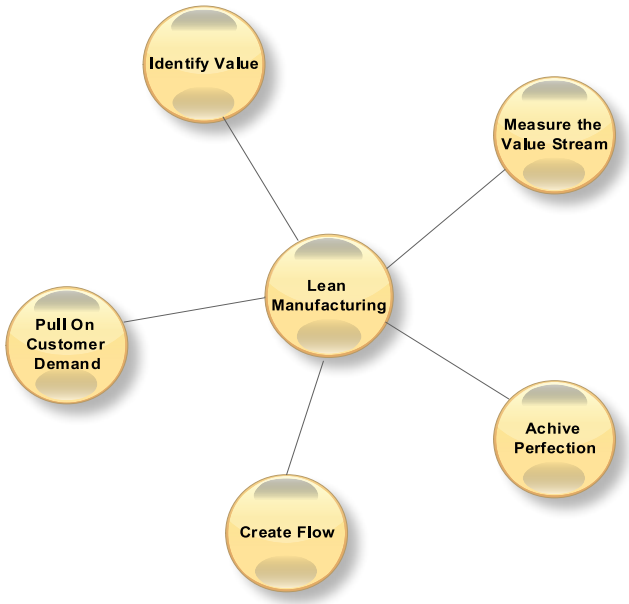

Figure No 1: Phases of Lean implementation are as follows.

VI. SIX SIGMA

Six Sigma is an inner point of view; six sigma gives a method for enhancing forms so that the organizations can all the more efficiently and typically create world-class items and administrations. In the course of recent years or so Six Sigma has been hailed as a key business change approach that is fit for accomplishing noteworthy enhancements in business process execution. Organizations, for example, Motorola and General Electric have based their business procedure methodologies around the Six Sigma idea. Figure no 2 speaks to the different periods of execution of six sigma approach in businesses again six sigma methodology is essentially actualized with the assistance of five noteworthy instruments as specified in fig no 2, this methodology is likewise truncated by DMAIC approach.

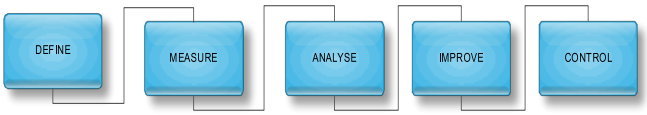

Figure No 2: Phases of Six Sigma implementation.

VII. COMBINED LEAN AND SIX SIGMA: A SUSTAINABLE APPROCH

Lean Six Sigma (LSS) is a methodology that depends on a collaborative effort to improve performance by systematically removing waste. Further lean manufacturing is combined with Six Sigma to eliminate the eight kinds of waste defects i.e. waiting, overproduction, non-utilized talent, transportation, motion, extra-processing inventory etc. LSS is an approach which is highly used in America. Medium and small scale industries of America utilizing LSS approach are highly benefited from this technique in terms of scrap reduction. The main aim of Lean Six Sigma is growth oriented which includes reduction in cost and improvements in quality and productivity. The integration of Lean and Six Sigma is necessary because in general, Lean aims to create value through scrap elimination while Six Sigma aims to meet quality demands as per customers need

The main advantages of using LSS are that it increases the organization's revenue by streamlining processes. In some cases when work is done on prioritized valued processes, manufacturer's faces problems related to delivery speed. Engineering often places multiple gating, detailed processes through combination of different processes and theories and increased non-value added designs to reduce the rejections in production or reworking processes. Enhancing the overall design process also improves the throughput speed. To identify the factors responsible for loss of work done on prioritized valued processes, mostly manufacturers faces problems in delivery speed. Engineering often have multiple gating, enhanced and detailed sophisticated processes with the combination of different value added designs to prevent rejections in production or reworking processes. Enhancing the designed process with lean aims at improving the output speed. Figure no 3 represents circles of Lean manufacturing and Six sigma.

Table No 2: Lean and Six Sigma Approach

Program	Lean Thinking	Six Sigma
Theory	Remove Waste	Variation Reduction
Application Guidelines	1. Identify Value	1. Define
	2. Identify Valve Stream	2. Measure
	3. Flow	3. Analyze
	4. Pull	4. Improve
	5. Perfection	5. Control
Focus	Flow Focused Approch	Problem Focused

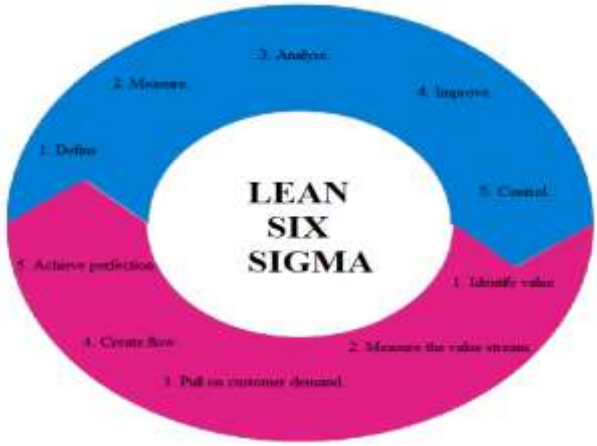

Figure No 3: Lean Six Sigma an Integrated Approach

VIII. CRITICAL SUCCESS FACTORS FOR THE IMPLEMENTATION OF LEAN SIX SIGMA

Lean six sigma approach is basically considered as an approach for continuous business improvement in order to achieve sustainable growth in manufacturing industries. As industrial institutions are continuously looking for reducing the cost of production and at the same time to improve the quality of final product. Some of the CSFs noticed by Ganesh and Mehta (2010) engagement and duty, prize and acknowledgment framework, competency of expert dark belt/dark belt, organization money related capacity, continuous correspondence and evaluation on incline six sigma result, venture prioritization, determination, audits and following, venture examples of overcoming adversity, best works on sharing and benchmarking, successful incline six sigma preparing program, set up incline six sigma dashboard.

IX. OTIVATION FACTORS FOR LSS IMPLEMENTATION

It has been noticed that there is a huge increase in the Lean six sigma approaches in the industrial world, especially in large organizations in countries like America and United Kingdom and in some SMEs in developing countries such as India. There are a number of motivating factors which can contribute in changing the operations and can show positive results. Some of the important factors are such To implement continuous improvement strategies, To improve employees' morale To improve product quality and manufacturing operations, To change the competitive position in the market or to stay in the competition in international market, To increase the bottom line , To reduce cost (cost of poor quality/production cost), To reduce customer returns backlog or support labor, To increase production capacity by reducing machine breakdown time, To improve process efficiency, To discover causes of

variation and waste the process, To enhance business sustainability To reduce defects in production, To increase customer satisfaction, attraction and loyalty, To improve product/process yield rate and To reduce time (cycle time, lead time, etc.). Figure No 4 represents the various motivation factors for LSS implementation.

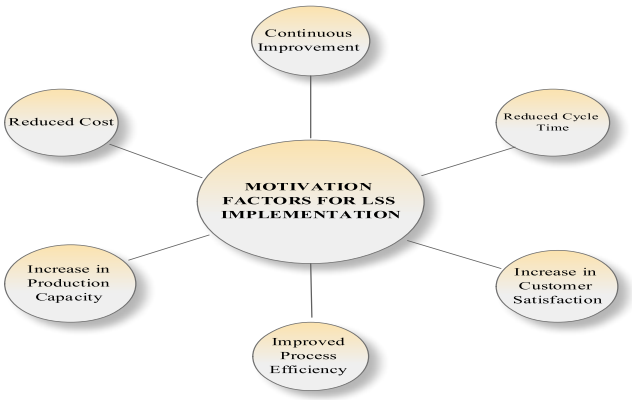

Figure No 4: Motivation factors for LSS implementation

X. BENEFITS OF IMPLEMENTATION OF LSS

Incline Six Sigma is a procedure change approach which joins the advantages of incline assembling and six sigma to make associations to streamline their procedures, to diminish squander and to expand the estimation of item. A portion of the significant advantages incorporates :expanded benefits and monetary investment funds, expanded consumer loyalty, diminished cost; lessened process duration; enhanced key execution measurements, decreased imperfections, decrease in machine breakdown time; diminished stock, enhanced quality; and Increased creation limit.

XI. CRITICAL FAILURE FACTORS FOR LEAN SIX SIGMA

Garg and Garg (2013) and Ganesh and Mehta (2010) have defined CFFs in term of big business asset arranging (ERP) as " the key angles (ranges) where 'things must turn out badly' all together for the ERP execution procedure to accomplish an abnormal state of disappointment". They additionally have characterized disappointment as "an execution that does not accomplish an adequate degree of profitability (ROI) distinguished in the task endorsement definition".According to Al-Mashari (2001) study in ERP too, "system advancement is basic to ERP usage, as its nonattendance has brought about poor results" Moreover, various scholastic papers have focused on CFFs such as the study done by Yeo (2002) in CFFs information system (IS) project. Yeo (2002) has contemplated the association between some elements, for example, hierarchical, monetary, specialized, human and political components which then these elements named CFFs for IS venture. Be that as it may,Yeo (2002) study did not characterize the term CFFs but rather just characterized a few circumstances when venture characterizes as a disappointment.Other study done by Belassi and Tukel (1996) in undertakings administration CSFs/CFFs has just recorded some elements that lead tasks to achievement or come up short with no any definitions for CFFs. Besides, there is by all accounts deficient exploration examination on the basic disappointment elements of Lean, Six Sigma and Lean Six Sigma (LSS). Subsequently, creators contend that this paper will be important in term of distinguishing CFFs of LSS. A segment of the real fundamental components are recorded underneath, absence of top administration state of mind, duty and association, absence of preparing and instruction of specialists. ,poor LSS venture choice and prioritization, absence of assets (monetary, specialized, human, and so forth.), resistance of society change, poor Communication between top administration and lower level, absence of initiative aptitudes and visionary and steady authority absence of thought of the human components, absence of familiarity with the advantages of Lean/Six Sigma, wrong determination of Lean/Six Sigma devices, restricted perspective of LSS as an arrangement of devices, procedures and practices absence of comprehension of the distinctive sorts of clients/VOC, absence of representative engagement and support/absence of group self-sufficiency, absence of procedure thinking and process possession, poor association capacities, high execution cost, absence of involvement in Lean/Six Sigma venture usage.

XII. CHALLENGES BEFORE LEAN SIX SIGMA IMPLIMENTATION

As far as LSS is highly profitable technique in America, but India is facing a number of challenges for its implementation such as : Un skilled workers, Less awareness about LSS: Afraid of getting company culture effected, Supply Chain Issues, Employee Development and other Technological Challenges. Approximately 30 per cent of Indian SMEs have applied LSS in its business and the remaining 70 per cent are not yet engaged with LSS initiative for a number of reasons (Antony and Banuelas, 2002). Fulfillment with other quality and profitability change activities ended up being the most grounded purpose behind not setting out on LSS program, trailed by absence of mindfulness and unsatisfactory quality of the activity to their sort of business.

XIII. MOTIVATION FOR PRESENT STUDY

As India is a developing country as well as the second largest market of the world after China, therefore there is a great scope of the growth of SMEs. As at present most of the SMEs are bearing heavy financial losses due to uneven scrap management. So there is a need of boosting their

financial growth as well contributing towards GDP of India by reducing their huge scraps. As mentioned earlier there are various factors due to which the Indian SMEs are not performing up to their best and bearing heavy loses. Even though various tools and techniques are used till date to minimize the industrial scrap but it has been observed that SMEs are unable to reap best results out of that.

XIV. CONCLUSION

It has been found from literature that manufacturing sector is the second highest contributing factor in the GDP of India therefore LSS methodology can also be implemented in other manufacturing clusters also. Even LSS methodology can also be implemented in service sectors of India such as airports, hospitals etc. With the proper implementation of this technique in the various other sectors, more employment opportunities can also be created as well as proper utilization of energy resources can be done.

REFERENCES

[1]. Hines, P. and Rich, N. (1997), "The seven value stream mapping tools", *International Journal of Operations and Production Management*, Vol. 17 No. 1, pp. 46-54.

[2]. George, M.L. (2002), Lean Six Sigma – Combining Six Sigma Quality with Lean Speed, *McGraw Hill, New York, NY*, ISBN 978-0071385213.

[3]. Breyfogle, F.W. (1999), Implementing Six Sigma, Smarter Solutions – Using Statistical Methods, *John Wiley and Sons Inc., Hoboken, NJ*.

[4]. Amheiter, E.D. and Maleveff, J. (2005), "The integration of Lean Management and Six Sigma", *The TQM Magazine*, Vol. 17 No. 1, pp. 5-18.

[5]. Thomas, A., Barton, R. and Okafor, C. (2009), "Applying lean six sigma in a small engineering company – a model for change", *Journal of Manufacturing Technology Management*, Vol. 20 No. 1, pp. 113-129.

[6]. Garg, P. and Garg, A. (2013), "An empirical study on critical failure factors for enterprise resource planning implementation in Indian retail sector", *Business Process Management Journal*, Vol. 19 No. 3, pp. 496-514.

[7]. Prieto C., Navarro R., and Gonzalez A. (2014)"Reduction Waste by Combining Lean Manufacturing and Six Sigma in an Electronics Industry" *Research Journal of Applied Sciences, Engineering and Technology*, Vol. 8, No.3,pp 1558-1562.

[8]. S.J. Thanki and JiteshThakkar(2013) "Status of lean manufacturing practices in Indian industries and government initiatives a pilot study" *Journal of Manufacturing Technology Management*, Vol. 25 No. 5, pp. 655-675.

[9]. Naveen K, Luthra S and Sanjay K (2013) "Facilitating Lean Manufacturing Systems Implementation: Role of Top Management" *International Journal of Advances in Management and Economics*, Vol. 7, No. 2, pp. 1-9.

[10]. Mohamed K. Hassan (2013) "Applying Lean Six Sigma for Waste Reduction in Manufacturing Environment" *American Journal of Industrial Engineering*, Vol. 1, No. 2, pp.28-35.

[11]. Khadse and Srode (2014) "Lean Manufacturing in Indian Industries A Review" *International Journal of Latest Trends in Engineering and Technology*, Vol. 3, No.1, pp. 175 -181.

[12]. Siddh M ,Gadekar G. (2013) "Lean Six Sigma Approach for Quality and Business Performance" *Global Journal of Management and Business Studies*. Vol. 3, No.6,pp. 589-594.

[13]. Ganesh, L. and Mehta, A. (2010), "Critical failure factors in enterprise resource planning implementation at Indian SMEs", *Asian Journal of Management Research*, Vol. 1 No. 1, pp. 44-57.

[14]. Garg, P. and Garg, A. (2013), "An empirical study on critical failure factors for enterprise resource planning implementation in Indian retail sector", *Business Process Management Journal*, Vol. 19 No. 3, pp. 496-514.

[15]. Abreu TS., Almeida GM., and Luis DR., "A framework for assessing the use of lean production practices in manufacturing cells" *International Journal of Production Research* Vol. 49, No. 11, pp. 3211–3230

[16]. Adnan H., Rahman A. and Noordin M. (2012) "Boosting Lean Production via TPM" *International Congress on Interdisciplinary Business and Social Science*, Vol.1, No.1,pp 485-491.

[17]. Ajay K Solanki, MitPandya, DhananjayBisht (2014) "Lean Manufacturing Application on Welding Defects in Cryogenic Vessel" *International Journal of Emerging Technology and Advanced Engineering*, Vol. 4, No.10, pp. 562-566.

[18]. Akhil kumar (2014) "A Qualitative Study on the Barriers of Lean Manufacturing Implementation: An Indian Context (Delhi Ncr Region)", *the International Journal Of Engineering And Science* Vol. 3, No 4, pp. 21-28.

[19]. Antoni J., and Desai" Critical failure factors of Lean Six Sigma: a systematic literature review", *IJQRM*, Vol. 31, No 6, pp.1012-1030.

[20]. Awasare and Kavade (2014) "A Review of Assembly Line Changes for Lean Manufacturing" *IOSR Journal of Mechanical and Civil Engineering*, Vol. 3, No. 2, pp 01-05.

[21]. Bowman, Edward H. and Dillep H. (1993), "Strategy Through the Option Lens: An Integrated View of Resource Investments and the Incremental-Choice Process", *Academy of Management review*, Vol. 18, No. 4, pp. 760-782.

[22]. Correa, H.L. (1994), "Linking Flexibility, Uncertainty and Variability in Manufacturing Systems: Managing Unplanned Changes in the Automotive Industry" Avebury , London.

[23]. D'Aveni R. (1994), "Hyper competition: Managing the Dynamics of Strategic Maneuvering." *The Free Press: New York*.

[24]. Dangayach, G.S., Deshmukh, S.G. (2001), "Manufacturing Strategy Perspective on Flexibility: A Case of Select Indian Companies" *Global Journal of Flexible Systems Management*, Vol. 2, No. 2, pp. 21-30.

[25]. Dixon, J.R., Nanni, A.J., Vollmann, T.E. (1990), "The New Performance Challenge - Measuring Operations for World-class Competition" *Dow Jones-Irwin, Homewood, IL*.

[26]. Eisenhardt K.M., Martin JA. (2000), "Dynamic capabilities: What are they?" *Strategic Management Journal*, Vol. 21, No. 10/11, pp. 1105-1121.

[27]. E. M. Elsayedand SabaA. E. (2009) "The Electrochemical Treatment of Toxic Hexavalent Chromium from Industrial Effluents using Rotating Cylinder Electrode Cell" *International. Journal of Electrochem Science*, Vol. 4, No. 2, pp 6327-639.

[28]. Eppink, D. Jan. (1978), "Planning for Strategic Flexibility", Long Range Planning, Vol. 11, No. 4, pp. 9-15.

[29]. Girish. C. Pude (2012) "Application Of Process Activity Mapping For Waste Reduction A Case Study In Foundry Industry" *International Journal of Modern Engineering Research* ,Vol.2, No 5, pp-3482-3496.

[30]. Hines, P., Howler, M. and Rich, N. (2004). "Learning to evolve. A review of contemporary lean thinking." *International Journal of Operations and Production Management*, Vol.24, No. 3 pp. 994 - 1011.

[31]. Krishnan Vasudev, Mallika C. (2013) "Comparative Study of Lean Manufacturing Tools Used in Manufacturing Firms and Service Sector" *Proceedings of the World Congress on Engineering*, Vol. 1, No.1, pp. 38-41

[32]. Kumar D., Gowtham Shankar R. (2011)"Analyzing the benefits of lean tools: a consumer durables manufacturing company case study" *Annals of faculty engineering hunedoara – international journal of engineering*,Vol.3, No. 6,pp 335-339.

[33]. Liker, J.K. and Wu, Y.C., (2000),"Japanese automakers, US suppliers and supply chain superiority", *Sloan Management Review*, Vol.42, No. 3 pp. 81-93.

[34]. Lozi M.," Small scale Industries in Jordan in the Globalization", *Journal of social science publication*, Vol.4, No.2, pp.98-102, 2008.

[35]. Mandar M. Sumant (2014) "Identify the Lean Tool for Different Industrial Sectors in India" *International Journal of Engineering Development and Research*, Vol. 2, No 2, pp 2376-2379.

[36]. Mehta R. K. and Mehta D. (2014) "An Exploratory Study on Implementation of Lean Manufacturing Practices, *International Journal of Automobile Engineering*, Vol.6, No. 1.

[37]. Mohamed K. Hassan (2013) "Applying Lean Six Sigma for Waste Reduction in Manufacturing Environment" *American Journal of Industrial Engineering*, Vol. 1, No. 2, pp.28-35.

[38]. Naveen K, Luthra S and Sanjay K (2013) "Facilitating Lean Manufacturing Systems Implementation: Role of Top Management" *International Journal of Advances in Management and Economics*, Vol. 7, No. 2, pp. 1-9.

[39]. Pavnaskar, S.J., Gershenson K. and Jambekar A. (2003),"Classification scheme for lean manufacturing tools", *International Journal of Production Research*, Vol. 41, pp. 3075-90.

[40]. Prieto C., Navarro R., and Gonzalez A. (2014)"Reduction Waste by Combining Lean Manufacturing and Six Sigma in an Electronics Industry" *Research Journal of Applied Sciences, Engineering and Technology*, Vol. 8, No.3,pp 1558-1562.

[41]. Ravikumar M.M, Marimuthu K, and Abdul Zubar H.(2013) "Leanness Evaluation in 6 Manufacturing MSMEs using AHP and SEM Techniques" *International Journal of Mechanical and Mechatronics Engineering*, Vol. 13, No. 06. pp. 29-36.

[42]. Rodriguez ,Dasgupta S. ,Patwardhan A., Mittal H. K., Nagpal S,. Karunakaran.T, Neeraj (2007) "Science and technology for small and medium scale enterprises (SMEs*)", Report for the eleven five year plan* (2007-2012).

[43]. Rojasra P. and Qureshi M. (2013) "Performance Improvement through 5S in Small Scale Industry: A case study" *International Journal of Modern Engineering Research*, Vol. 3, No. 3, pp. 1654-1660.

[44]. Siddh M ,Gadekar G. (2013) "Lean Six Sigma Approach for Quality and Business Performance" *Global Journal of Management and Business Studies.* Vol. 3, No.6,pp. 589-594.

[45]. Serrano, I., Ochoa, C. and de Castro, R. (2008),"Evaluation of value stream mapping in manufacturing system redesign", *International Journal of Production Research*, Vol. 46, No. 16, pp. 4409-30.

[46]. Seth, D. and Gupta, V. (2005), "Application of value stream mapping for lean operations and cycle time reduction: an Indian case study", *Production Planning and Control*, Vol. 16 No. 1, pp. 44-59.

[47]. Singh G. , Belokar R.M. (2012) "Lean Manufacturing Implementation in the Assembly shop of Tractor Manufacturing Company" *International Journal of Innovative Technology and Exploring Engineering*, Vol. 1, No. 2, pp. 71-74.

[48]. Singh B. and Sharma S.K.(2010) "Value stream mapping as a versatile tool for lean implementation: an Indian case", *Emerald Group Publishing Limited*, Vol.63,No3 ,pp. 58-68.

[49]. Singh B. and Sharma S.K.(2009) "Lean can be a survival strategy during recessionary times" *International Journal of Productivity and Performance Management, Emerald Group Publishing Limited*, Vol. 58, No. 8, pp. 803-808.

[50]. S.J. Thanki and JiteshThakkar(2013) "Status of lean manufacturing practices in Indian industries and government initiatives a pilot study" *Journal of Manufacturing Technology Management*, Vol. 25 No. 5, pp. 655-675.

[51]. Tamizharasi and S. Kathiresan (2014) "Lean Manufacturing in Carriage Building Press Shop" *World Applied Sciences Journal*, Vol. 7, No. 4 , pp 1333-1340.

[52]. Uma P., (2013) "Role Of SMEs In Economic Development Of India"*Asia Pacific Journal of Marketing and Management Review*Vol.2, No 6,pp 120-126.

[53]. Vinesh V.,Rakholiya and S. A. Puranik (2012) "COD reduction using modifying industrial effluent treatment flow sheet and low cost adsorbent as a part of cleaner production" Adv. *Appl. Sci. Research Journal*, Vol. 3, No 2,pp 1279-1291.

[54]. Vendan S., Sakthidhasan K. (2010) "Reduction of Wastages in Motor Manufacturing Industry" *Jordan Journal of Mechanical and Industrial Engineering*, Vol. 4, No. 5, pp 579 -590.

[55]. Willis, T. Hillman (1998) "Operational competitive requirements for the twenty-first century," *Industrial Management and Data Systems*, Vol. 98, No. 2, 83-86.

[56]. Xing B. (2006) "Reconfigurable Manufacturing System for Agile Mass Customization Manufacturing" *International Conference on CAD/CAM, Robotics and Factories of the Future*, India, Vol. 7, No. 3, pp. 473 – 482.