

Review on Lean, Six Sigma and Lean Six Sigma

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Abstract - Majority of Companies or any industrial sector works on customer demand and customer satisfaction, otherwise it was difficult to survive in today's competitive market. TQM, lean and six sigma has many similarity like all the three concept origin in Japan but the company are differ. To achieve clear financial result and quality goals industrial sector used lean manufacturing and six sigma technique compared to TQM. Lean and Six- sigma both are complimentary to each other. Lean focuses on non value added activities while six sigma focuses on zero defect .Similarly Lean focuses on flow while six sigma focuses on reduction in variation. Uses of lean in manufacturing sector while Six-sigma in manufacturing and service sector also. Moreover compare to six sigma, lean offers limited flexibility in terms of concept. Lean and six-sigma implementation gives good financial performance and reduces inventory then TQM. When combining lean and six sigma better results can be achieved in terms of money.[1].

Keywords – Lean, Six Sigma, TQM, customer satisfaction, .

I. INTRODUCTION

Jiju Antony take the review on comparison between lean and six sigma methodology from ten leading experts from academic researchers and practitioners belonging to reputed universities of Singapore, South Korea, Ireland, UK, Finland, USA, The Netherlands and Denmark. In this paper he demonstrates the opinion of leading practitioners and researchers on lean as low climb fruit so first implement the basic lean tools like 5S implementation, standardization, value stream mapping, Kaizen and then increase the level of performance and process capability through Six-sigma statistical tools. Six-sigma needs higher amount of investment and training compared to lean. Lean and six sigma both methodology process oriented and management support required for successful implementation [2].

Jiju Antony prepared a readiness factors analysis for higher education sector to reveal the need for lean six sigma. In this paper author prepared a five step readiness matrix to assign the responsibility of top management, leaders towards customer's satisfaction. Figure 1 shows a stepwise methodology should be follow to implement LSS in higher education sector. In this sector lean identifies the non value added activities in terms of waste which leads to customer or student dissatisfaction. Lean six sigma helps to improve the system efficiency and effectiveness in higher education sectors. Lean find application in various educational universities to remove wastes or non productive activities from various universities likely in Scotland, Wales, England and USA[3].

Antony et al.(2012) identify the twelve challenges for LSS implementation in higher education sector. Customer variety, cultural change, poor leadership and communication between departments, limited resources and funding are the major barriers for LSS implementation in higher education sector. They also demonstrates seven CSFs for LSS implementation in higher education sector are top management support and commitment, organizational awareness and readiness, strategic leadership, project selection and organization culture, skill and resources for implementation, effective communication between departments. Author also identify the various tools from LSS like process mapping through VSM, cause effect diagram, visual management, rapid improvement workshop and project charter in UK universities[4].

From last two decades foreign industries spends thousands of money for lean and six sigma training in their manufacturing sector for quality improvement. Black belt expert understand the industrial problem easily and apply his knowledge to give a practical solution as well as train industrial workers and supervisors also. There were several misconceptions related to lean like lean or mean, Layoff from non working employees, works in Japan only with certain environment like Continuous large batch production or small batch production and last in manufacturing sector only. However lean can be applied in service sectors like bank, hospital, call centre and higher education sector also with changing the mind set of non working employee to working towards quality job with standardization in processes. Lean focuses on elimination of waste by

variability reduction from demand, manufacturing and supplier as well as lead time reduction drastically. There was several misconception related to six-sigma like zero defect quality concept only actually it offers quality, customer satisfaction, reliability, delivery, service and maintenance component also. For lean implementation KAIZEN principle utilized first and then value stream mapping should be applied by applying lower climbing fruit principle. Similarly for before six-sigma implementation Pareto analysis should be applied. According to customer view lean gives better valued product than Six sigma while from producer's point Six

sigma offers a low cost good quality product then lean .To take the benefits of both technology Emerging lean Manufacturing and six-sigma methodology as LSS [5].

Lean offers a smooth journey towards waste elimination by continuous improvement system while six-sigma applied in worst problem by identified a variation in standards using D-M-A-I-C.for LSS implementation one black belt and several yellow belt expert needed in a small scale industry .Black belt expert should spend 2 to 3 days and half of his time on site only. Figure 1 shows benefits of six sigma methodology and figure 3 shows a benefits of lean Manufacturing[6].



Figure 2: Benefits Of Six Sigma Methodology

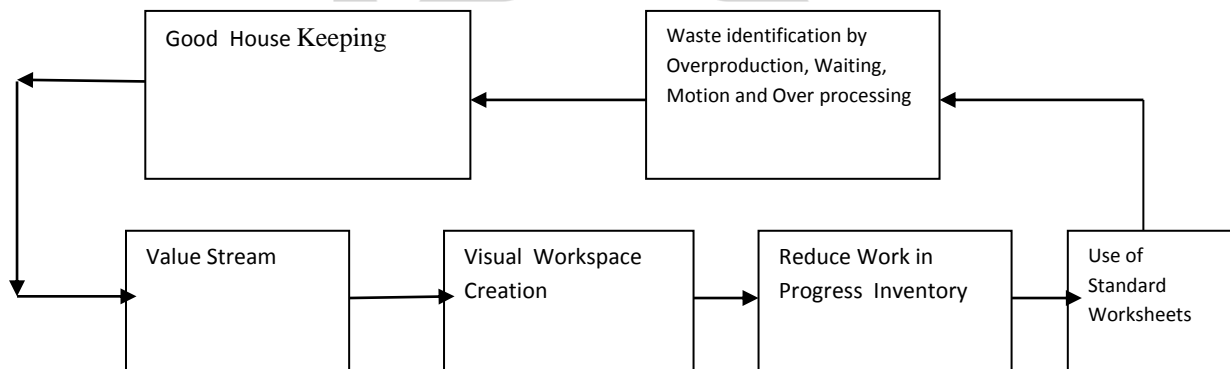


Figure 3: Benefits Of Lean Manufacturing

Vinodh and Swarnakar(2015) have demonstrate a fuzzy model for LSS implementation in an automobile manufacturing unit and defect per piece reduced by 40 percent ,equipment effectiveness increased by 25 percent ,lead time can be reduced by 25 percentage and production can be improve 40 percent per day. so overall productivity can be improved and they initially selected 5 projects but 3rd project is most suitable for LSS implementation so before actual implementation of LSS we make sure from available factory and implement LSS in most suitable industry only .Effort can be saved and fruitful result may be achieved with in a time bound effect[7].

Yadav and Desai(2016) prepared a critical review on Lean six sigma from 1046 research articles found from keyword LSS and they filtered these articles by inclusion of only journal article so 458 article found ,re filtered by English language only so 410 article remaining and then 3rd filter of value added research publication from Springer, Emerald ,science direct ,Taylor Francis so finally 189 articles found for Literature survey On LSS .They used 52 percentage

articles from International journal of lean six sigma ,Emerald publication .They select research papers from year 2001 to 1014. Only 16 papers reported till year 2007 then research work increases and every year publication volume increase from 10,15, 20 ,25, 30,40 and so on. Majority of research work about 42 percent on manufacturing and engineering sector and 32 percent on service sector, 18 percent of healthcare sector and only 8 percent in other sector. Majority of the research papers based on case study and on conceptual model. As shown in Table 1 countrywide research on LSS, India is the 3rd country in world with 24 research papers published on LSS and 7 researcher's works on LSS implementation in India. Table 2 shows a LSS implementation according to manufacturing sector wise .As shown in table 2, 14 papers reporting on automobile sector, 12 papers reporting on electronics and healthcare sector and 10 papers on logistics and supply chain [8].

Table 1 Distribution of LSS research Papers according to countrywide(Source Yadav and Desai 2016)

Name	Number of Articles
United States of America	51
United Kingdom	38
India	24
Sweden	11
Netherland	9
Malaysia	8
Italy	7
Australia	5
Canada	5
China	5
Brazil	4
Iran	3
Taiwan	3
Greece	2
Thailand	2
Egypt	1
Ireland	1
Jordan	1
Kenya	1
Korea	1
Libya	1
New Zealand	1
Portugal	1
Spain	1
Turkey	1
UAE	1
Germany	1

According to Table 1 U.S. Researchers published 51 number of article, U.K. published 38 research papers on lean six sigma and India published 24 research papers on LSS. Other developing Countries like Egypt, Ireland, Jordan, Kenya, Korea, Libya, New Zealand, Portugal, Spain, Turkey, UAE and Germany published 1 paper on LSS. Majority of work done in an automobile sector and electronic sector.

Table 2 Industry wise distribution of LSS research papers (Source Yadav and Desai 2016)

Name of Industry	Frequency
Automobile Industry	14
Electronics Industry	12
Hospital Industry	12
Logistics and Supply Chain	10
IT and Software Industry	8
Education Industry	6
Insurance and Finance Industry	6
Process Industry	5
Construction Industry	4
Pharmaceutical Industry	4
Aerospace Industry	4
Textile Industry	4
Marine Industry	3
Food Industry	3
KPO/BPO Industry	3
Accounting	3
Foundry Industry	3
Publishing and Printing Industry	2
Tyre Manufacturing	2
Air Purifiers	1
Furnishing Operations	1
Rotary Switches Industry	1
Welding Industry	1
Banking Industry	1
Metal Working	1
Semiconductor	1
Power Generation	1

II. CONCLUSION

In this paper author described Lean ,Six-Sigma and Lean Six Sigma methodology with their benefits and comparison with TQM. Use of LSS in higher education sector of U.S. There is a big gap of LSS implementation in Foundry Industry. only 3 papers reporting foundry sector worldwide. In India no one has selected or worked on LSS in foundry sector So author selected a foundry sector for LSS implementation.

III. REFERENCES

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