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An Application of Lean Six Sigma: A review

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***Abstract*— Lean is about controlling the resources in accordance with the customer's needs and to reduce unnecessary waste. Six sigma is defined: as a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction by some of its proponents. The fusion of Lean and Six Sigma improvement methods is required because: Lean cannot bring a process under statistical control. Six Sigma alone cannot dramatically improve process speed or reduce invested capital. Both enable the reduction of the cost of complexity. Lean six sigma (LSS) is a business strategy and methodology that increases process performance resulting in enhanced customer satisfaction and improved bottom line results. Six Sigma is usually used to address complex problems for which the solution is unknown. In this paper, the brief review of LSS application in different area. Based on literature, the paper is alienated into conventional approaches such as Lean and Six sigma and recent LSS techniques applied to improve organization performance in terms of quality, through put, productivity improvement, with enhancing overall production efficiency.**

Keywords— Lean, Six Sigma, Lean Six Sigma, LSS Application

I. INTRODUCTION

LSS has been equally beneficial both for manufacturing or service concerns and Large or small scale organizations. It is quite beneficial for different industries with little modifications as per industry requirement. Literature indicates there is vast scope for detail study of Indian Industry.

A. Lean thinking and its limitations:

Lean is about controlling the resources in accordance with the customer's needs and to reduce unnecessary waste (including the waste of time). The concept was introduced at a larger scale by Toyota in the 1950, but not labeled lean manufacturing until the now famous book about the automobile appeared in 1990.Lean principles are fundamentally customer value driven, which makes them appropriate for many manufacturing and distribution situations.

1. Value-added activities do not take into account the size, complexity or manufacturability of a product.
2. This seems to stem from a lack of understanding, direction and/or commitment from management, not helped by the heavily unionized culture of the industry. Management and their communications provide the backbone of any continuous improvement effort, while employees require transparency from management and their own education and empowerment in the change process [1].

B. Six Sigma mMethodology and its limitation:

Motorola was the first company to launch a six sigma program in the mid-1980s.Today, a number of global organizations have developed six sigma program of their own and six sigma is now established in almost every industry. Six sigma is defined: as a business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction by some of its proponents.

1. There are two major improvement methodologies in six sigma, one for already existing processes and one for new processes. The first methodology used to improve an existing process can be divided into five phases, Define, Measure, Analyze, Improve, and Control. The second methodology is often used when the existing processes do not satisfy the customers or are not able to achieve strategic business objectives, this can also be divided into five phases; define measure, analyze, design, verify. The similarities and difference between Lean and Six Sigma are shown in Table 1. Do not focuses on customer value stream, not create standard work sheet, do not focus on creating a visual workplace.

2. Do not focuses on waste identification and attacks work in process inventory.

3. Requires effective tranning , require sig sigma role structure [10].

4. Requires standard certification and strong organizational structure [3].

5. Emphasis only on quality and variation.

6. Six sigma focuses project work on the identified variation from the proposed standard, which in itself does not entirely focus on the customer requirements, instead it is sometimes a cost-reduction exercise that can lose sight of the customer if not implemented alongside lean [5],[15].

Table 1 Similarities and differences between six sigma and lean

Concepts	**Six sigma**	**Lean**
Origin	The quality evolution in Japan and Motorola	The quality evolution in Japan and Toyota
Theory	No defects	Remove waste
Process view	Reduce variation and improve processes	Improve flow in processes
Approach	Project management	Project management
Methodologies	Define, measure, analyse, improve (redesign), control (or verify)	Understanding customer value, value stream, analysis, flow, pull, perfection
Tools	Advanced statistical and analytical tools	Analytical tools
Primary effects	Save money	Reduce lead time
Secondary effects	Achieves business goals and improves financial performance	Reduces inventory, increases productivity and customer satisfaction
Criticism	Does not involve everybody, does not improve customer satisfaction, does not have a system view	Reduces flexibility, causes congestion in the supply chain, not applicable in all industries

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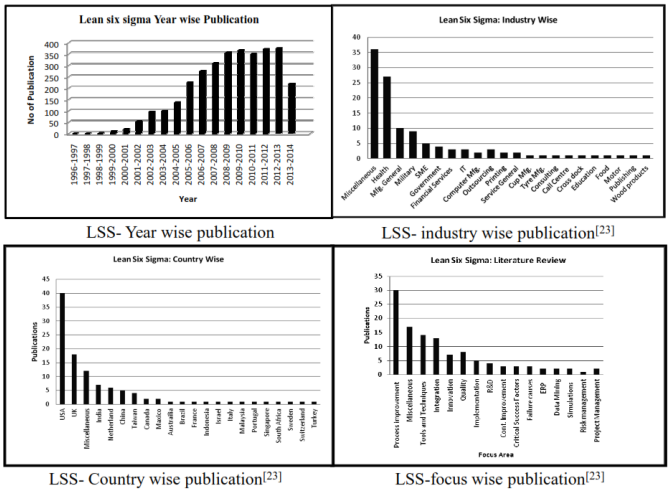
II. REVIEW ON LSS APPLICATION

This section reviews thorough literature review on LSS. Studies on some critical issues are reviewed to meet the challenges in analysis and Survey and to perform case studies

LSS is a business improvement approaches that aims to expand investor value by improving quality, speed, customer satisfaction and costs. It has been achievable by integration tools and principles from lean and Six Sigma methodologies (George, 2003). Pepper and Spedding (2010) have presented the integration of lean principles with Six Sigma methodology as a consistent approach to constant enhancement, and also offer a conceptual model for their successful integration. The lean production and Six Sigma methodology are examples of new alternative of Total Quality Management (TQM) with focus on human factor and needed company culture (Dahlgaard and Dahlgaard-Park, 2006). The lean approach is faintly dissimilar from TQM and Six Sigma methodology. Andersson et al. (2006) have recommended combining TQM, lean and Six Sigma to enhance the process improvement. Six Sigma and lean are exceptional road-maps, which might be applied individually or combined, together with the values in TQM. Based on the space in time among both JIT and lean, and TQM and Six Sigma; the novel method such as LSS will be best option to filled this gap by BRP/reengineering. The need for a process-based approach to organizational improvement efforts is examined by Naslund (2008). The lean and Six Sigma are prime industry process approaches which are used by organization to improve manufacturing performance. Thomas (2009) has presented the design, development and implementation of a LSS model in small engineering company to gain significant improvements in the company's product quality cost and delivery. The various perfection requirements that involve the objectives and techniques enclosed in the lean and Six Sigma methodologies have been uncovered By Snee (2010). It is also initiated that deployment and sustaining improvements are major issues that can be overcome by developing a sustaining infrastructure and production improvement in business process. Critical issues include using LSS to generate cash in difficult financial period, advance of data-based progression organization systems and the employ of functioning on development as a management progress implement. The benefits of reducing the operational costs, better processes and product quality, improved efficiency, which lead to boost of productivity, the quickness and flexibility obtained by the organization, greatly outweigh the expenses have been accomplished by implementation of LSS (Delgado et al., 2010). Call centres are progressively more significant for several companies and are constantly under pressure of delivering a superior service at a lower cost. The LSS is able to improve the process of a call centre, through an augment in first-call resolution, a decreasing in call centre operators' turnover and streamlining the underlying processes by eliminating unnecessary operations (Laureani and Antony, 2010). Antony (2011) has presented the basic and decisive dissimilarities between Lean and Six Sigma; the most powerful methodologies in a process superiority proposal in several organisation. The high disparity in LSS certification standards formulates it extremely difficult to moderator the authentic capability of a certified Belt and to estimate a LSS program in organisations. Laureani and Antony (2010) have addressed the need for a worldwide

recognized certification standard is identified, similar to what is already in rest for supplementary businesses. Hilton and Sohal (2012) have suggested the identification of technical and interpersonal qualities of Black Belts and Master Black Belts as well as the factors for success in deploying LSS. The combination of Design for Six Sigma and Lean Product Development has a potential of supporting radical, as well as incremental, improvements in product development (Gremyr and Fouquest, 2012).

The utilization of the observation tool of lean concept helps to increase the speed as well as eliminating waste. Furthermore, it helps to discover the root causes of deviations in the output quality characteristics, whose reduction is the key goal of LSS (Aurumugam et al., 2012). There is a common lack of a mathematical advance to facilitate LSS practitioners to recognize parts of their business that are conducive to the methodology. To overcome this shortcoming, the cluster evaluation helps the deployment champion make out key region inside the business to focus the LSS deployment (Duarte et al., 2012). Gibbons et al. (2012) have introduced a management Value Improvement Model (VIM) as a clear and systematic framework facilitating managers to understand, evaluate and improve repetitive processes within their businesses complementing the existing Lean and Six Sigma intangible frameworks. It is unfeasible to use only one standardized approach to improvements in one company. The uninterrupted smaller improvements and larger improvement projects demand different formulas. Assarlind et al. (2013) have suggested using Lean and Six Sigma in parallel through intelligent cross-fertilization, such as taking disparities in project complexity into deliberation. Lean sigma and Six Sigma are two powerful and effective strategies, enabling the organisation to overcome their weakness and for retaining their improvement (Chen and Lyu, 2009; M. Kumar et al. 2006). The implementation of the integrated lean sigma framework presents impressive improvement in chief metrics and considerable financial savings to be generated by the organisation (Vinod et al., 2014). Gupta et al. (2012) have presented some key insights to the successful implementation of LSS tools in Indian industries, where lean practices are still in the very hopeful phase and very small literature is existing in this framework. In LSS implementation, the control phase acts a vital role in supporting the gains accomplished from the improvement stage. The process control has been expanded by revising the process dominance pattern. Sarkar et al. (2014) have provided guideline of the control procedure and tools depending on control pattern. An inclusive summary of select contemporary contributions in the field of LSS is described in this section.



LSS- Year wise publication

LSS- industry wise publication[23]

LSS- Country wise publication[23]

LSS-focus wise publication[23]

Figure 1Timeline of Lean Six Sigma publication

III. CONCLUSION

In this paper, the research and implementation on LSS is presented. Afterward research is continuously increasing as organizations know better about the successful stories of world top performing organization using LSS. Also LSS research is indifference to developed and developing countries. USA is leader in LSS related research following is the UK. Includes different other countries with comparatively less research on LSS. And LSS is mainly implemented in the Health sector where the defects are less tolerable. Health sector basically includes pharmaceutical, clinical and drug discovery research practices.

Literature shows that

1. There is a vast scope for detail study of Indian Industries in terms of LSS implementation.
2. There must be research on building up a complete picture of integration of these two methodologies
3. Need to explore the tools and techniques of LSS making it complete fit in different sectors.
4. The need is to build up some generalize implementation model
5. Need to build up mathematical model
6. Limited perspectives on Culture wise investigations of failure causes are still needed

LSS has been equally beneficial both for manufacturing or service concerns and Large or small scale organizations. It is quite beneficial for different industries with little modifications as per industry requirement. Literature indicates there is vast scope for detail study of Indian Industry.

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