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LITERATURE SEARCH CONSISTING OF THE AREAS OF LEAN SIX SIGMA USAGE IN INDIAN SMES

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Abstract

Many organizations nowadays implement many concepts for quality management, such as Total Quality Management (TQM), Six Sigma and Lean concepts. In this paper Total Quality Management (TQM), Six Sigma & Lean concepts are mainly discussed, also issues for its applicability in different SMEs in India. Hence, the motive of this paper is to focus on current scenario of Lean Six Sigma usage in Indian SMEs and the evaluation of the Lean Six Sigma Philosophy in the development of practices through a systematic Literature Review.

Keywords- Lean Six Sigma, DMAIC Methodology, Six Sigma.

1. INTRODUCTION

In order to remain competitive in the market, organizations look for ways to improve their production, manufacturing & management processes. This calls for ways to improve product quality, reduce production cost & enhance productivity. Therefore, in order to cater the customers with high quality products at low price, the organizations must utilize all the available resources efficiently & effectively. In consequence, researchers all over the world proposed several improvement strategies and tools to satisfy the organization's needs. Such initiatives include: Total Quality Management (TQM), Quality Awards, Total Preventive Maintenance (TPM), Lean & Six Sigma(Mandahawi, Fouad, & Obeidat, 2012).

Overall operational excellence is one of the most significant key requirements of any business to have global competence with sustained growth. Indian industries are not the exception to this. For global competitiveness, many improvement measures are being tried by Indian industries. The majority of the measures being tried by them are efficient enough of producing the desired results but trouble remain with their implementation and longer time span to realize the benefits. The requirement is for a break through strategy, which can deliver multidirectional benefits in relatively shorter duration of time(Desai, Antony, & Patel, 2012). "Medium Small and Micro Enterprises (SMEs) have always been the backbone of an economy in general and secondary sector in particular. For a capital scarce developing country like India, SMEs are considered as panacea for several economic woes like unemployment, poverty, income inequalities and regional imbalances" ("Role and Contribution of SMEs in Indian Economy - General Awareness," 2015). In the industrial development of the country, the contribution of small & medium scale industries has been astonishing. It has a share of 40% in the industrial production. 35% of the total manufactured exports of the country are directly accounted for by this sector (Uma, 2013). The contribution of Small Scale Industries (SSI) to the indian economy can't be ignored. SSI sector is strategically placed in the industrial population of the country and in the global economy as a whole. Owing to growing importance of supply chain management issues in the global market environment, large firms are heavily dependent on small-to-medium-sized enterprises (SMEs) for the provision of high quality products and/or services at low costs. The increasing demand for high-quality products and highly capable busiess processes by large organizatons has left no choice on the SMEs to consider the introduction of Six Sigma & Lean business strategies(Desai, 2006).

According to Schroeder(Schroeder et al, 2008), Six Sigma is "an organized, parallel-meso structure used to reduce variation in organizational processes by employing improvement specialists, a structured method, and customer-oriented performance metrics with the aim of achieving strategic objectives." Schroeder (Schroeder et al., 2008) note that "companies may choose variations of this base definition when implementing Six Sigma in order to customize it to their situation". Lean Six Sigma is a business strategy and methodology that increases process performance resulting in enhanced customer satisfaction and improved bottom-line results ($). It is also being widely recognized that Lean Six Sigma is an effective leadership development tool(Snee, 2010).

2. RESEARCH OBJECTIVES AND METHODOLOGY

The fundamental objective of this study is to capture the current scenario of Lean Six Sigma usage in Indian SMEs. To achieve the overall objective of the research, the authors have systematically reviewed the literature. As reported by Okoli & Schabram (2010),a systematic literature review is "a systematic, explicit, comprehensive and reproducible method for identifying, evaluating and synthesizing the existing body of completed and recorded work produced by researchers, scholars and practitioners."

The specific objectives of this study are as illustrated below:

1. Macro level objective: To capture the current scenario of Lean Six Sigma usage in Indian SMEs
2. Micro level objectives:

- To capture the Critical Success Factors (CSFs) for Lean Six Sigma implementation in Indian SMEs.
- To evaluate the benefits of implementing Lean Six Sigma & Six Sigma.
- To evaluate challenges of implementing Lean Six Sigma & Six Sigma.
- To find out mistakes frequently made by organizations while deploying Lean Six Sigma.

This paper is an attempt to capture the current state of Lean Six Sigma usage in Indian SMEs and the evaluation of the Lean Six Sigma philosophy in the development of practices through a systematic literature review. The following research is based on a review of 67 articles that were published on Lean Six Sigma, Six Sigma and VSM in the international and national journals from 1994 to 2016. Many issues have been emerged in this paper and important themes have cited which are: DMAIC, VSM, CSFs, Benefits & Challenges of Lean Six Sigma. The analysis of 29 case studies in the manufacturing sector has resulted in significant benefits cited in this paper. However many gaps and limitations need to be explored in the future research. Fig 1 shows the classification of articles which have been used for literature review.

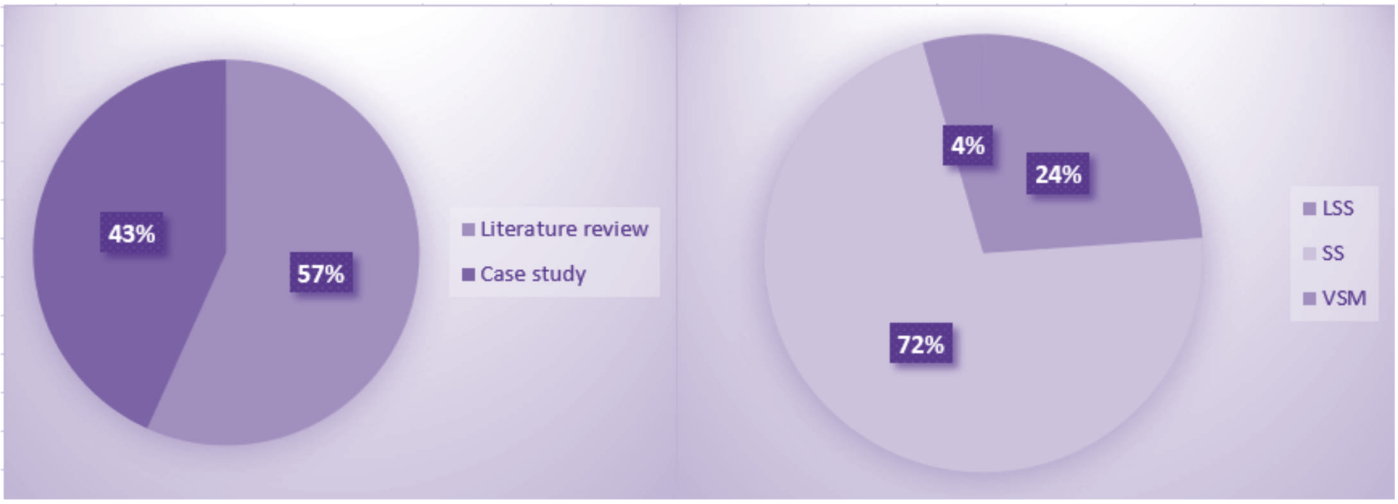

Fig. 1 Classification of articles

3. LITERATURE REVIEW

3.1. Six Sigma

A Motorola engineer, Bill Smith, has developed the Six Sigma program in mid-1980's. He has initiated this program as a response to the requirement of reducing the defects and improving the quality of their products. Bob Galvin, the CEO of Motorola was impress by the early successes, and then Motorola has begun to apply Six Sigma across the organization under his leadership and the focus was on manufacturing processes and systems. This concept of Six Sigma was tremendously successful at Motorola (D. C. Montgomery & Woodall, 2008). "Six Sigma is a quality program that, when all is said and done, improves your customer's experience, lowers your costs, and builds better leaders"-Jack Welch. The focus of six-sigma is to cut down the variability in key product quality characteristics to the extent at which failure or defects are extremely unlikely(D. Montgomery, 2009).

3.2. Lean Six Sigma – What and Why?

Lean Six Sigma, a business strategy and methodology that increases process performance resulting in enhanced customer satisfaction and improved bottom-line results ($). It is also being widely recognized that Lean Six Sigma is an effective leadership development tool (Snee, 2010). It is not possible to remove all types of wastes from the process by implementng Six Sigma in isolation and also adopting Lean Management in isolation can not ensure to control the process statastically and remove variation from the process (Albliwi, 2015). So, some companies have decided to merge both concepts to overcome the weaknesses of these two continuous improvement methodologies. See fig. 2, integration of these two approaches can help the organization to improve efficiency to achieve superior performance faster than the implementation of each approach in isolation(Albliwi, 2015).

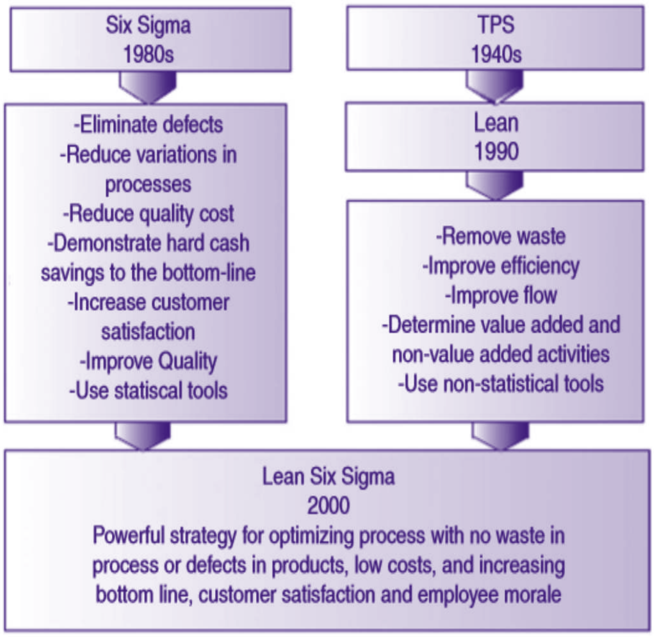

Fig. 2 [Source: (Albliwi, 2015)]

Lean Six Sigma is vital as organizations and individuals require a strategic methodology for process improvement and to solve different quality and productivity improvement issues. Processes do not get better by themselves. Veritably processed descend over time if they are not being improved on periodic basis as 2^{nd} law of thermodynamics says "Things become more variable if not interfered with" (Snee, 2010). Fig 3 shows the improvement objectives and needs of an organization [source: (Snee, 2010)].

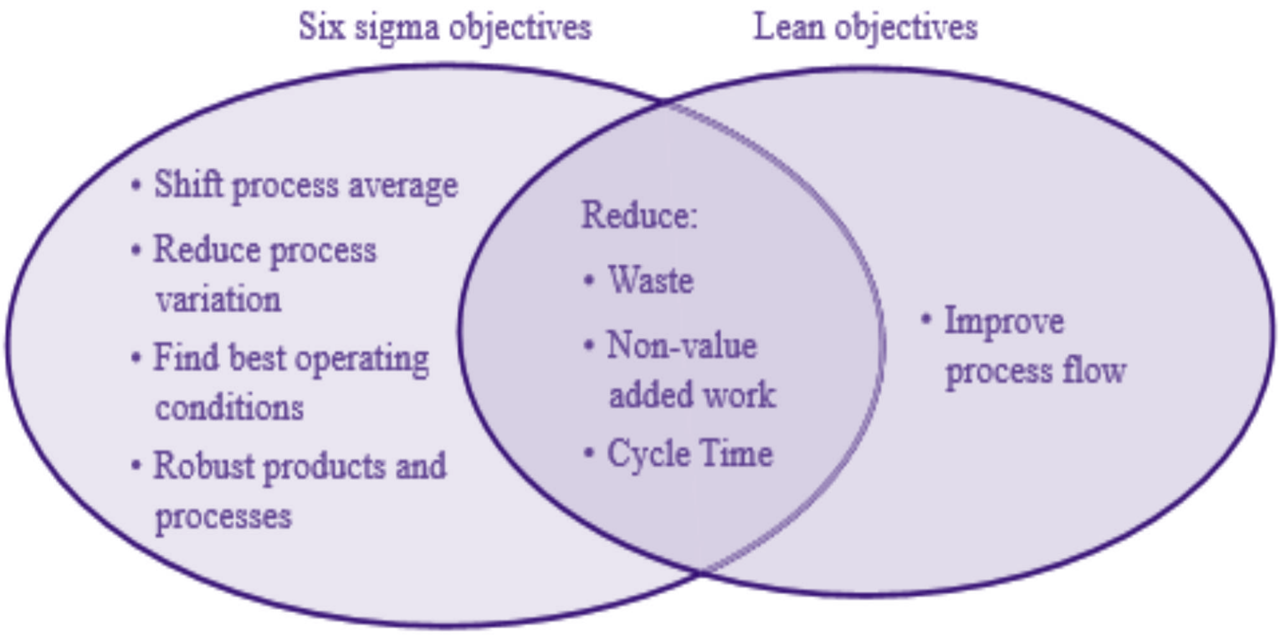

Fig. 3 Improvement objectives

Lean Six Sigma works because the eight key characteristics reported by Snee (2010), are built into the approach which are as follows:

1) Creates bottom line results ($),
2) Active senior management leadership,
3) Uses a disciplined approach (DMAIC),
4) Rapid project completion (3-6 months),
5) Clear definition of success,
6) Infrastructure created,
7) Focuses on customer and processes, and
8) Sound statistical approach.

These characteristics all relate to the deployment of Lean Six Sigma.

3.3. Small and Medium-sized Enterprises

SMEs are the crux of the modern economies. The importance of SMEs to the economy of India and the industrialised world as a whole cannot be over emphasised. In accordance with the provision of Micro, Small & Medium Enterprises Development (MSMED) Act, 2006 the Micro, Small and Medium Enterprises (MSME) are classified in two Classes: 1). Manufacturing Sector and 2). Service Sector. Table 1 shows the classification of enterprises based on the investment in plant and machineries.

Enterprises	Investment in Plant and Machinery	
	Manufacturing	Service
Micro	Upto Rs. 25 Lakhs	Up to Rs 10 lakhs
Small	Between 25 lakhs to Rs 5 crores	Between 10 lakhs to Rs 2 crores
Medium	Between Rs 5 crores to 10 crores	Between Rs 2 crores to 5 crores

Table 1 Classification of Enterprises

A short summary of relevant statistics available from MSME-Annual Report 2014-15, Government of India Ministry of Micro, Small and Medium Enterprises, shows the vital role that SMEs play: (refer Table 2)

- ✓ There were estimated 288.46 lakh SMEs in 2013-14.
- ✓ In 2013-14, total employment provided by MSMEs is 1114.29 lakh & market value of fixed Assets of Rs. 1,363,700.54 lakhs
- ✓ In 2013-14, the share of MSME manufacturing output in total manufacturing output is 37.33%.

SMEs act as suppliers to large organisations and therefore the "footprint" of SMEs is much larger than may be seen at a first glance (Antony, Kumar, & Madu, 2005). SMEs form the foundation upon which the economy of India is based. As discussed earlier,due to growing importance of supply chain management issues, SMEs should provide high quality product or services at low cost to larger firms. This can be achieved by the adopting the quality management and Lean principles.

Table 2 Performance of MSME, Employment and Investments

Sr. No.	Year	Total Working Enterprises (in Lakh)	Employment (in Lakh)	Market Value of Fixed Assets (Rs. In Crore)
1	2006-07	361.76	805.23	8,68,543.79
2	2007-08	377.36	842	9,20,459.84
3	2008-09	393.7	880.84	9,77,114.72
4	2009-10	410.8	921.79	10,38,546.08
5	2010-11	428.73	965.15	11,05,934.09
6	2011-12	447.64	1011.69	11,82,757.64
7	2012-13	447.54	1061.4	12,68,763.67
8	2013-14	488.46	1114.29	13,63,700.54

Source: MSME Annual Report 2013-14.

3.4. Phases of Lean Six Sigma

Andrew J. Thomas has given the conceptual development of the Lean Six Sigma framework. The main phases of integrated Lean Six Sigma approach are: (Thomas et al., 2008)

1. Define –What is the problem? Does it exist?
2. Measure –How is the process measured? How is it performing?
3. Analyze –what are the most important causes of defects?
4. Improve – How do we remove the causes of the defects?
5. Control -How can we maintain the improvements?
6. Implement 5S technique.
7. Application of Value Stream Mapping (VSM)
8. Redesign to remove waste and improve value stream.
9. Redesign manufacturing system to achieve single unit flow (SUF)
10. Apply Total Productive Maintenance (TPM) to support manufacturing functions.

3.4.1. DMAIC Phases

The process concentrates on a simple five phases methodology called DMAIC. As shown in fig. 4, DMAIC identifies the major steps within the methodology namely define, measure, analyses, improve, control.

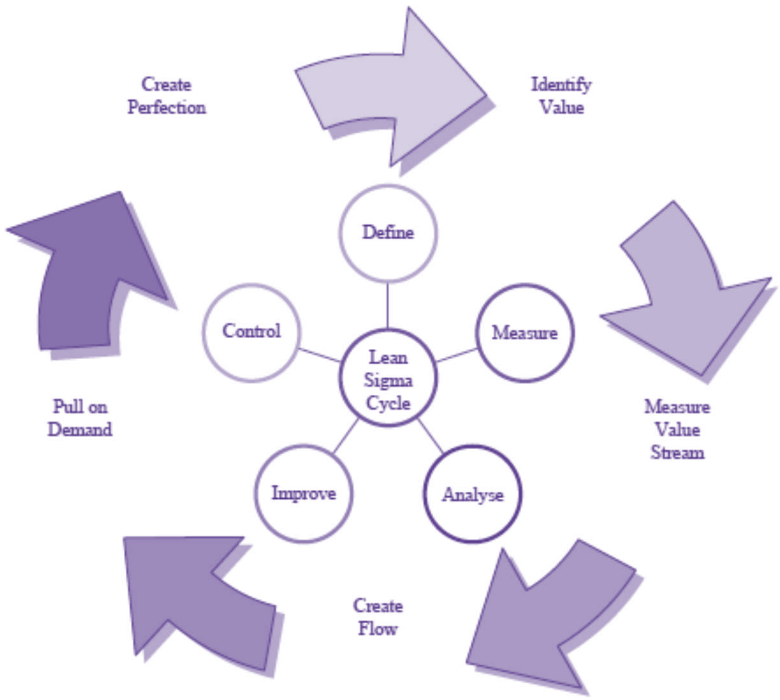

Fig. 4 Lean Six Sigma cycle
Source: (Thomas et al., 2008)

Following table 3 illustrates five stages of DMAIC approach and step wise actions to be taken in each step, tools to be used and deliverables.

Table 3
DMAIC steps, tools & Deliverables

DMAIC steps	Steps to be taken	Tools to be used	Deliverable
Define	Define customers and requirements (CTQs)	Project charter	Fully trained team is formed, supported and committed to work on improvement project, Customers identified and high impact Characteristics (CTQs) defined, team charter developed, business process mapped
	Develop problem statement, goals and benefits	Process flowchart	
	Identify champion, process owner and team	SIPOC diagram	
	Define resources	Stakeholder analysis	
	Evaluate key organizational support	DMAIC work breakdown structure	
	Develop high level process map	CTQ definitions	
Measure	Define defect, opportunity, unit and metrics	VOC	
	Detailed process map of appropriate areas	Process flowchart	Key measures identified, data collection planned and executed, process variation displayed and communicated, performance base lined, sigma level calculated
	Develop data collection plan	Data-collection-plan/example	
	Validate the measurement system	Benchmarking	
	Collect the data	Measurement-system analysis	
	Begin developing Y = f(x) relationship	VOC	
	Determine process capability and sigma baseline	Process sigma calculation	
Analyze	Define performance objectives	Histogram	Data and process analysis, root cause analysis, quantifying the gap/opportunity
	Identify value/non-value-added process steps	Pareto chart	
	Identify sources of variation	Time series/run chart	
	Determine root cause(s)	Scatter plot	
	Determine vital few x's, Y = f(x) relationship	Regression analysis	
		Cause and effect diagram	
		Whys	
		Statistical analysis	
		Non-normal data analysis	
Improve	Perform design of experiments	Brainstorming	Generate (and test) possible solutions, select the best solutions, design implementation plan
	Develop potential solutions	Mistake proofing	
	Define operating tolerances of potential system	Design of experiments	
	Assess failure modes of potential solutions	Pugh matrix	
	Validate potential improvement by pilot studies	House of quality	
	Correct/re-evaluate potential solution	FMEA	
		Simulation software	
Control	Define and validate monitoring and control system	Process sigma calculation	Documented and implemented monitoring plan, standardized process, documented procedures, response plan established and deployed, transfer of ownership
	Develop standards and procedures	Control charts (variable and attribute)	
	Implement statistical process control	Cost savings calculation	
	Determine process capability		
	Develop transfer plan, handoff to process owner		
	Verify benefits, cost savings/avoidance, profit growth		
	Close project, finalize documentation		
	Communicate to business, celebrate		

Source: (Zare Mehrjerdi, 2011)

3.4.2. Value Stream Mapping (VSM

Value Stream Mapping (VSM) is an enterprise improvement tool to help in visualizing the entire production process, representing both material and information flow. Value stream is defined as collection of all activities: value added as well as non-value added that are required to bring a product or a group of products that use the same resources through the main flows, from raw material to the end customers (Singh et al., 2011). According to(Singh & Sharma, 2009), "Value Stream Mapping is about eliminating waste wherever it is". Singh & Sharma (2009) has stated six principles which are the backbone of the VSM are as follows:

1. Define value from your customer's perspective,
2. Identify the value stream,
3. Eliminate the seven deadly wastes,
4. Make the work flow,
5. Pull the work rather than push it,
6. Pursue to perfection level.

According to Singh & Sharma (2009), major steps in VSM are as follows:

1. Various process symbols of VSM are drawn representing customer, supplier and production control, with sufficient space in between them.
2. All pertinent data related to existing stage of manufacturing such as lead time, process time, change over time and no. of shifts are shown by data boxes below the VSM symbols.
3. The monthly/daily requirements of product along with the number of containers and kanbans required are obtained.
4. Movement of product is shown with arrows including shipment and receiving data.
5. In between two workstations WIP is shown with proper inventory icons.
6. Major gap areas are identified from the current state map.
7. With the application of lean tools various gap areas are bridged in order to prepare proposed map.
8. Future state map is prepared and improvements achieved are highlighted.

It is proven by Singh & Sharma (2009) that VSM is a powerful tool for lean manufacturing and allows firms to understand and continuously improve its understanding towards lean. It links people, tools, processes and even reporting requirements to achieve lean goals. It provides clear and concise communication between management and shop floor teams about lean expectations, along with actual material and information flow.

3.5. Critical Success Factors (CSFs)

Critical Success Factors (CSFs) are very crucial for successful implementation of any quality improvement initiatives such as TQM, Six Sigma, Lean Management & Lean Six Sigma etc. While developing an appropreate implementation plan for quality improvement programme, identification of such factors will encourage(Desai et al., 2012).

Many authors have highlited some most important critical success factors for successful implementation of Lean Six Sigma concept which are as follows : (Tyagi, 2014), (Kwak & Anbari, 2006), (Marzagão & Carvalho, 2016), (Antony & Desai, 2009)

1. Management commitment, Involvement and participation,
2. Linkage between Lean concepts & Six Sigma,
3. Linkage between Six Sigma and employee,
4. Communication,
5. Linkage between Six Sigma and customer,
6. Project prioritization and selection,
7. Linkage between Six Sigma and supplier,
8. Linkage between Six Sigma and business strategy,
9. Management skill,
10. Infrastructure of an organization,
11. Training and education,
12. Cultural change,
13. Knowledge of Six Sigma Methodology,
14. Leadership for Lean Six Sigma.

As reported by Antony & Desai (2009), Management commitment, involment & participation and Infrastructure of an organization are the most improtant factors for succesful implementation of the programme. This is followed by Linking Six Sigma to customers and Linking Six Sigma to business strategy. The factors such as Linking Six Sigma to employees and Linking Six Sigma to suppliers doesn't have much importance(Antony & Desai, 2009).

3.6. Benefits of implementing Lean Six Sigma & Six Sigma

Kwak & Anbari (2006) has reported benefits of implementation of Six Sigma in Manufacturing sector, Financial sector, Healthcare sector, Engineering & construction sector, Research & development sector, etc. Following Table 4 shows reported benefits and savings from Six Sigma in manufacturing sector.

Table 4
Reported benefits and savings from SS in manufacturing sector

Sr. No	Company/Project	Metric/Measure	Benefits/Savings
1	Motorola (1992)	In-process defect levels	150 times reduction
2	Raytheon/aircraft integration systems	Depot maintenance inspection time	Reduced 88% as measured in days
3	GE/Railcar leasing business	Turnaround time at repair shops	62% reduction
4	Allied signal (Honeywell)/laminates plant in South Carolina	Capacity cycle time, Inventory on-time delivery	Up 50% Down 50% increased to near 100%
5	Allied signal (Honeywell)/bendix IQ brake pads	Concept-to-shipment cycle time	Reduced from 18 months to 8 months
6	Hughes aircraft's missiles systems group/wave	Quality/productivity	Improved 1000%/improved 500%
7	General electric	Financial	$2 billion in 1999
8	Motorola (1999)	Financial	$15 billion over 11 years
9	Dow chemical/rail delivery project	Financial	Savings of $2.45 million in capital expenditures

10	Dupont/Yerkes plant in New York (2000)	Financial	Savings of more than $25 million
11	Telefonica de espana (2001)	Financial	Savings and increases in revenue 30 million euro in the first 10 months
12	Texas instruments	Financial	$ 600 million
13	Johnson and Johnson	Financial	$ 500 million
14	Honeywell	Financial	$ 1.2 billion

Source : (Kwak & Anbari, 2006)

After reviewing the literature, Table 5 shows the summary of benefits gained after successful implementation of Lean Six Sigma and Six Sigma.

Table 5
Summary of Benefits of LSS and SS implementation

Sr. No.	Author Details	Method Used	Supporting Tools	Results
1	(Mandahawi et al., 2012)	Lean Six Sigma	High level process map, ABC Analysis, Cause-Effect Analysis,	OEE for printing & cutting machines has increased by 21.6 % and 48.45 % respectively
2	(Gijo, Scaria, & Antony, 2011)	Six Sigma DMAIC	CTQ tree, Pareto diagram, Cause-Effect analysis, ANOVA	Rejection level of distance pieces after the fine grinding process has been reduced to 1.19 % from 16.6 % and Annualised savings – 2.4 million US$
3	(Desai, Kotadiya, Makwana, & Patel, 2015)	Six Sigma DMAIC	CTQ tree, 5 why analysis, Cause-Effect analysis, Pareto Analysis, Why-why analysis	Rejection rate was brought down to 50 % and Annualised savings – 8,00,000 INR
4	(Patil et al. 2014)	Six Sigma DMAIC	CTQ tree, Histogram, Pareto analysis, Time Series Plots, Fishbone diagram, FMEA	1/3rd cycle time reduction of grinding process is achieved
5	(Desai, 2006)	Six Sigma DMAIC	VOC, CTQ tree, High level process map, Pareto analysis, 5 why analysis, Cause-Effect analysis,	Firm has reported around 25% increase in their turnover by satisfying existing customers & developing new business
6	(Su, Chiang, & Chang, 2006)	Lean Six Sigma	VOC, CTQs, Kano analysis, Value Stream Mapping, Process Map, Cause-Effect analysis,	Average service processing time was reduced by 47.5 % and Annual saving of 1,21,303 US$
7	(Prasada Reddy & Venugopal Reddy, 2010)	Six Sigma DMAIC	SIPOC, Pareto analysis, Fishbone diagram	The application of Six Sigma methodology brought up the sigma level from 4.04 to 4.44 and the rejection level from 2.2% to 0.65%. This yields a financial benefit of $1,200,000 per annum. Defects in bore diameter also brought down from 65% to 35%.
8	(Patel, 2014)	Six Sigma DMAIC	Cause-Effect Analysis, ANOVA, DOE	Reduced tool expenses for 40 %, Reduced costs of poor quality for 55 %, Reduced labours expenses for 59 %, Production time reduction for 38 %, and Index cost/volume reduction for 31 %
9	(Shanmugaraja, Nataraj, & Gunasekaran, 2011)	Six Sigma & Taguchi	DOE, ANOVA, OA, DMAIC	The defect rate got reduced by 12.42% and productivity got improved by 10.74% with marginal cost of quality control, Sigma level from 2.51 to 3.03, and Percentage savings is 10.74%
10	(Yadav & Sukhwani, 2016)	Six Sigma DMAIC	Flow chart, Pareto analysis, Cause-Effect analysis	Rejection of clutches reduced from 15 out of 220 to 2 out of 220 in single shift, which is a huge reduction of 87%, Reduction in DPMO from 68181to 9090.9, Increase in process sigma level from 2.99 to 3.86, which is increased by 30%.
11	(Gijo et al., 2011)	Six Sigma DMAIC	SIPOC, Cause-Effect analysis, ANOVA	Yield has improved from 88% to 100%. The sigma rating of the process showed improvement from 2.67 to 6.0, Cost associated with scrap, repair and tool has come down drastically. The annualised savings estimated from this project was about $US124,000
12	(Malek & Desai, 2015)	Six Sigma DMAIC	CTQs, Control Charts, Fishbone diagram, Cause-Effect matrix, Regression Analysis, Why-Why analysis, DOE	The performance of the pressure die casting process was improved from 3.1σ to 3.7σ by reducing the rejection rate from 15.50% to 4.47% which is 71.2% improvement and the estimated annual savings generated from this project were at least INR 18,27,402.
13	(Srinivasan, Muthu, Prasad, & Satheesh, 2014)	Six Sigma DMAIC	Pareto analysis, Likert Scale, Cause-Effect analysis, ANOVA, OA	sigma level from 3.31 to 4.5
14	(Nabhani & Shokri, 2008)	Six Sigma DMAIC	SIPOC, Pareto analysis	The number of customer complaints associated with the late delivery has been reduced by 60 percent resulted in 30 percent reduction in total number of delivery related customer complaints and reflecting nearly £30,000 potential benefits for the company which is substantial figure for a SME with £5.5000 yearly turnover

3.7. Challenges of implementing Lean Six Sigma & Six Sigma

According to Bakås et al. (2011), despite the fact that there exists several characteristics of SMEs that provide a suitable environment for succeeding with lean, there are also obstacles and barriers that can be identified. Based on the study of literature followings are found as barriers for implementation of Lean Six Sigma in SMEs, main based on Achanga et al., (2006),Kwak & Anbari, (2006), Snee (2010) and Bakås et al., (2011).

1. Unfamiliar with Lean Manufacturing: The company must be familiar with the Lean production philosophy and its techniques. Unless managers in the company know about the potential in Lean, improvement initiatives are less likely to be initiated.

2. "Not for us" - misunderstanding of the lean concept. There exist some misconceptions that Lean requires significant financial investments or is only fit for specific industries.

3. Lack of roadmap to follow: This should not be a problem today because there are a number of roadmaps that can be adapted to specific organizational needs

4. Not sufficient resources: Not all SMEs have sufficient resources to allocate personnel to lean improvement projects. Training budgets and staff development programs are often limited due to a focus on reaching short-term objectives.

5. Staff resistance to lean production: There is an inherent resistance to change in most humans. For instance, the implementation of 5S will affect the way shop floor staff organize their daily working routines. A lean improvement initiative can also be perceived by employees as a way to get ridof work force by increasing productivity.

6. Implementing lean without adapting it to the company specific setting: Lean production has gradually developed based on Toyota's specific environment. When Lean is implemented it needs to be adapted to the specific requirements of that company and the requirements of the customers of that specific company. This can be the reason why many larger companies are now adapting Lean to become their own company specific production system.

7. Issues in Lean Six Sigma training program

8. Issues in training (Belt program): While deploying Six Sigma projects, training is the key success factor and it should be part of an integrated approach. Selection of less-capable employees for Black Belt assignments is directly associated with challenges to six sigma projects.

9. Lack of understanding of Lean Six Sigma: Resistance due to lack of understanding of Lean Six Sigma and a lack of belief that it will work.

At the end, table 6 is the rationale for combining lean with six sigma and shows benefits and challenges of lean & six sigma are described.

Table 6
Benefits & challenges of lean & Six Sigma

Methodology	Six Sigma	Lean
Benefits	Productivity Improvement	Productivity Improvement
	Product/Service development	Shorten delivery time
	Customer satisfaction	Cycle time reduction
	Market share growth	Cost reduction
	Uniform process output	WIP reduction
	Cost reduction	Less human effort
	Culture change	Less equipment needed
	Defect reduction	Space shaving
Challenges	System interaction is not considered because processes are improved independently	Process incapability and instability
	Lack of specific speed tools	Statistical or system analysis not valued
	Long project duration	People issues

Source:(Su et al., 2006)

3.8. Mistakes made while deploying the program

Snee (2010) has settled some mistakes frequently made by many organizations while deploying Lean Six Sigma improvement initiative. The problems that are found primarily in two areas, the pitfalls of which are listed below:

I. The management system required to administer and monitor the overall improvement program:

- ✓ little leadership from top management including deployment plans - strategy, goals, etc.;
- ✓ poor or infrequent management reviews;
- ✓ top talent not used;
- ✓ poor support from finance, IT, HR, maintenance, and QC Lab.;
- ✓ focus is on training, not improvement;
- ✓ poor communication of initiative and progress; and
- ✓ lack of appropriate recognition and reward.

II. The selection and management of individual

improvement projects:

- ✓ projects not tied to business goals and financial results;
- ✓ poorly defined project scope, metrics, and goals;
- ✓ wrong people assigned to projects;
- ✓ project leaders and teams do not have sufficient time to work on projects;
- ✓ many projects lasting more than six months;
- ✓ little technical support from improvement master (MBB);
- ✓ large project teams - more than four to six persons per team; and
- ✓ infrequent team meetings.

While moving through the deployment, regularly ask yourself whether you have fallen into any of the above traps.

4. CONCLUSION

Lean Six Sigma among the SMEs is a much awaited movement, which can strengthen their bottom lines ($) vis-à-vis contributing for uplifting the global economy and LSS has already emerged as one of the most effective business strategies in large organisations, worldwide. Many issues have been emerged in this study and important themes have been cited which are: CSFs, benefits, challenges of impelmetation of the stated approach. The analysis of literature review has resulted in significant benefits cited in this paper. SMEs have been facing problems like lack of understandings of LSS, lack of road map to be followed, people's mind set such as "Not for us", etc. One of the challenge of implementation of Lean Six Sigma is the lack of Road map to follow. This should not be a problem as there are number of road maps that can be adopted. Suggestions for development of implementation Road map for different sectors on SMEs are required as SMEs are capable of adopting LSS as breakthrough strategy but they need to show the road map.

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