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ROADMAP TO IMPLIMENT LEAN SIX SIGMA IN FOUNDRY INDUSTRIES: SME's

Prof. Darshana K. Dave[1], Dr.H.S.Trivedi[2]

[1]Department of Production Engineering, Government Engineering College, Bhavnagar-364002, Gujarat, India.
Email id[dave_dars@yahoo.co.in]
[2]Department of Production Engineering, Shantilal shah Engineering College, Bhavnagar-364002, Gujarat, India.

Abstract

In a current scenario, due to globalization, there is a more pressure on manufacture to provide a value added, qualitative, innovative product according to the requirements of customer specification at optimal cost. Today we have number of good quality concepts as well as philosophies available like TQM, LEAN Manufacturing, SIX SIGMA, KAIZEN, Just In Time (JIT) and Business Processes Re-engineering(BPR). We can summarize all this nicely with an illustration of six blind men and an elephant. Each of them have its own advantages, limitations and practical application .so all this techniques/concepts are under the umbrella of quality improvement programmed .From all these tequniques Lean and six Sigma are best.

In this paper we collect the papers from Science direct, Taylor and Francis, Emerald ,Springer link , Elsevier Science and similar ,then review the paper according to lean manufacturing(81), six sigma(90) and Lean six sigma(72).from this database we plot a chart of review methodology and statistic of Lean ,six sigma and Lean six sigma. Further we classified papers reporting the Lean Six Sigma in to three categories: first papers based on concept and view point, second papers based on literature review and third papers based on case studies .Middle of this paper we discuss about the history, origin, growth and application of lean six sigma in various fields. Lean six sigma in foundry industries is a newer approach in small and medium scale industries. Before conclusion we gave a roadmap to implement lean six sigma in foundry industries.

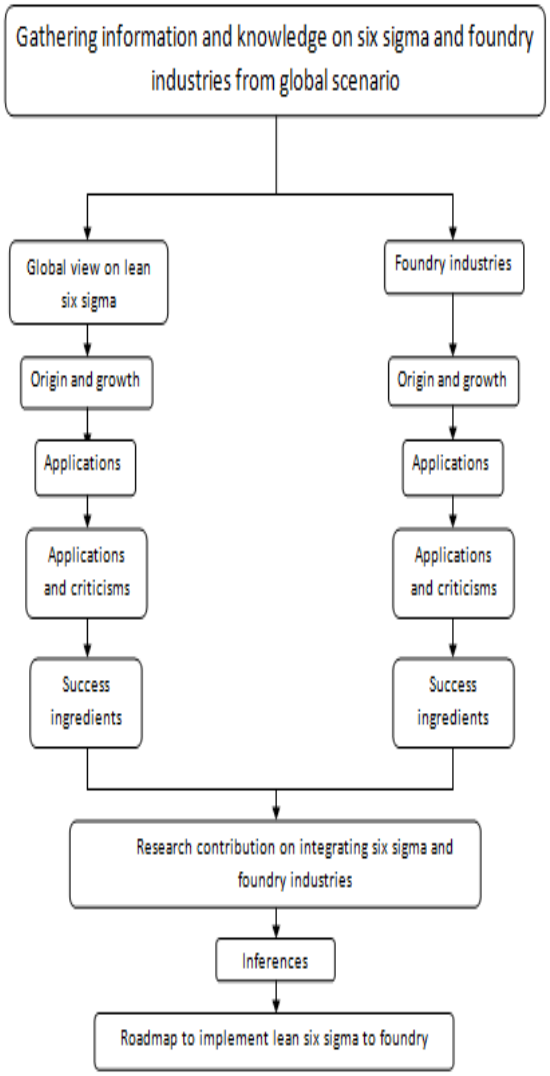
Keywords- lean; Six Sigma; Lean Six Sigma; Foundry Industries; kaizen

I. INTRODUCTION

Two major approaches, Lean and Six Sigma have dominated the quality field in past years along with a newer hybrid approach: "Lean Six." (Gregory Nemec 2010) and basically there are three arms to achieve world class performance namely, variation, complexity and customer requirement. Customer satisfaction is the main goal of any organization whether it is a manufacturing or service organization. We achieve this goal by identifying the non value added activity in any organization and try to eliminate the waste. Six sigma is not only philosophy but it is a methodology with statics to find root cause of quality related problems and how it is being implemented in a small to big company(Crompton corporation). In this paper our aim is to present the history and evolution of LSS from its beginning to till date.

II. Review Methodology

The methodology adopted to review and thereby to gather global views on lean six sigma and foundry industries depicted in Figure1. As shown, this literature review was begun by gathering information and knowledge on lean six sigma and foundry industries .We completed this task by collecting a database of resent published research papers in Emerald, science direct, Taylor &Francis and Inderscience. This was complimented by gathering information from well known and reputed websites. By making this database, the research and practices on Lean Six Sigma and Foundry Industries were globally viewed .while viewing globally the research and practices of Lean Six Sigma, its origin and growth were traced. Then successful deployment of Lean Six Sigma was gathered. Similar work is carried out to globally view the research on foundry industries. The research contributions of integrating Lean Six Sigma in Foundry Industries were also checked. The research contributions of implement Lean Six Sigma in Foundry industries were also reviewed. Finally, inferences were used to propose a roadmap for implementing Lean Six Sigma in Foundry Industries.



"Figure 1 Review methodology"

2 .1 Literature review on Lean Manufacturing

By adopting a lean manufacturing, we dramatically improve the performance of industry by eliminating non value added activity from the shop floor .(Gary Conner et al 2006, Mark Ruhland et al, 2008) as a compounding key to survival (Matcon Group Ltd.2008) and Beefs up the margin(Dan Beachum et al. ,2005) by meet the deburring challenge(Dave Davidson et al,2009).Implementation of lean manufacturing (Andrew Erridge and J. Gordon Murray,1998) gave a lean application to local government of Belfast City Council for purchasing.(Rajesh Nellore et al, 2000) bridging between the lean model and global sourcing. Ronan Mcivor 2001 describes a lean to design and cost reduction technique. V Crute et al **,** 2003 implement the Lean in aerospace including the ,challenges , assumptions and understanding the challenges for the same. Sakura Kojima et al,2004 uses a lean production index into auto sector of a south Africa . Adrian Vais et al,2005 implement a concept of lean and green in Romanian secondary tissue paper and board mill industry Toni L. Doolen et al,2005 describes six impact factors of lean manufacturing namely, Manufacturing Equipment and Processes , Shop-Floor Management, New Product Development, Supplier Relationships, Customer Relationships and Workforce Management to electronics manufacturers. David J. Meade et al, 2006 demonstrates hybrid simulation modeling in the financial analysis of a theoretical lean manufacturing. Farzad and Kaun 2010 evaluate the lean performance in a manufacturing by a fuzzy function which is innovative and dynamic. Akalpit Gadre et al ,2011 creates a virtual learning environment through a lean education. Noor Azlina Mohd.Salleh et al, 2012 combined Lean Manufacturing with TQM in forming process of Malaysian automotive companies. Ahmad Naufal et al, 2012 developed a kanban system of local manufacturing company in Malaysia . Rahani AR and Muhammad al-Ashraf 2012,a case study on value stream mapping .

2.2 Literature review on Six Sigma

In project the first step is to identify customer need and specifications. It's a long term commitment from upper management. According to financial times six sigma initiatives as "a programmed aimed at the near elimination of defects from every product, process and transaction." In U.S. Ford introduced this concept in Motorola in 1987.Staticsically in six sigma not more then 3.4 DPMO (Defects Per Million Opportunities) in any product, processes and services. Impact of Six sigma is a glimpse in to future of statistics(Gerald J. HAH et al,(1999). Crompton Corp, The Dow Chemical Co, et al (2004) and Andrew Lee-Mortimer (2006))defines Six Sigma as a Philosophy as well as methodology to improve the quality by root cause analysis. Six Sigma equally beneficial to big and small company (Jennifer Markarian,(2004), Jiju Antony et al,(2005), Andrew Thomas and Richard Barton,(2006)), a business process to change the framework of chemical industry(Jaideep Motwani et al,2004) ,by implement the Japanese 5S technique in U.K (Stephen J. Warwood and Graeme Knowles,2004) with the use of software development and simulation (Rupa Mahanti and Jiju Antony,2005) .six sigma must be applied in right problem and in right environment(Andrew Lee-Mortimer,2006) in a service industry(Jiju Antony,2007) .When comparing the various quality practices in U.K(Maneesh Kumar and Jiju Antony ,2008) Six sigma with lean and TQM(Jung-Lang Cheng,2008, Tony Bendell, 2006) we are able to finding the common myths and realities of six sigma (Maneesh Kumar and Jiju Antony,2008) to improve cost and quality using DMAIC (Sameer Kumar and Michael Sosnoski,2009) and reduction of lead time in food industry(Farhad Nabhani and Alireza Shokri,2009) .while reviewing the literature of Six Sigma(B. Tjahjono and P. Ball et al,2010) we identify the implications of future research (Mohamed Gamal Aboelmaged ,2010)for a different size of company(Maneesh Kumar and Jiju Antony,2009) to form a integrated solutions(Florian Johannsen and Susanne Leist,2009) and developed a TALEVAS model(Amit Kheradia,2011) .

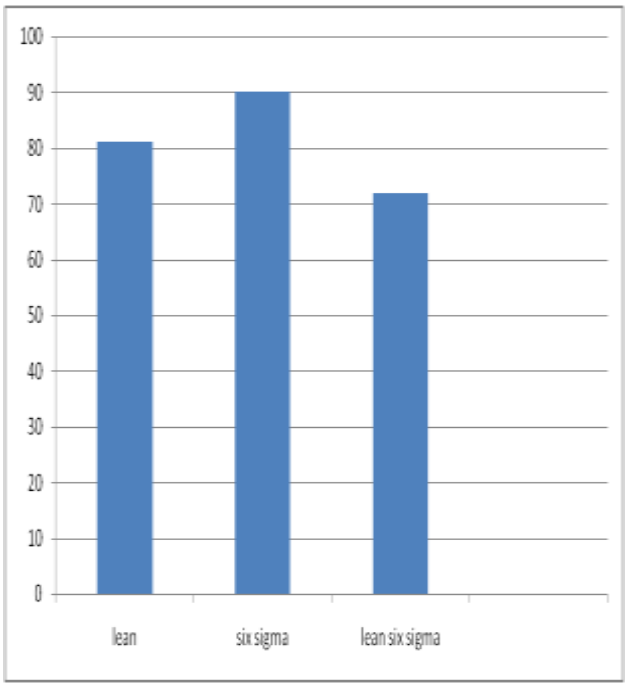
2.3 Literature review on Lean Six Sigma

Lean Six Sigma: A Literature Review by (Qun Zhang (Corresponding Author), Muhammad Irfan, Muhammad Aamir Obaid Khattak, Xiaoning Zhu,2012) including

overview of continuous improvement: from the past to the present(Nadia Bhuiyan and Amit Baghel,2005) to getting better all the time (Ronald D. Snee,2010) in Project portfolio selection in continuous improvement(Bernard J. Kornfeld and Sami Kara,2011) by Monitoring quality goals through lean Six-Sigma insures competitiveness(Vipul Gupta, Padmanav Acharya and Manoj Patwardhan,2011) because the fact Systems of Systems: Pure, and Applied to Lean Six Sigma (Ben Clegg and Richard Orme,2010).

III Statistics

In this section, the statistics of the papers reviewed to study the researches and practices on Lean , Six Sigma and Lean Six Sigma. Moreover Lean Six Sigma is classified into the three categories of research paper based on concepts, literature review and on case studies. After categorizing the paper from three perspectives ,their statistics have been drawn. From chart it is found that the pace of carrying out research and practices on Lean Six Sigma in foundry industry. While majority of papers reported case studies on healthcare only few of them on concepts and viewpoints. In this context, a search was made to identify papers reporting Lean Six Sigma in foundry industry. This research indicated the appearance of only four paper in the literature of Indian industry namely case study on company manufacturing rotary switches in Tamilnadu, Implementing the Lean Sigma framework in die-casting process, Implementing lean sigma in an Indian rotary switches manufacturing organization, Implementing lean sigma framework in an Indian automotive valves manufacturing organization. So there is a more attention required to carry out a Roadmap of lean six sigma implementation in Indian foundry SME'S



"FIGURE 2:Statistics of the paper reviewed on lean, six sigma and lean six sigma"

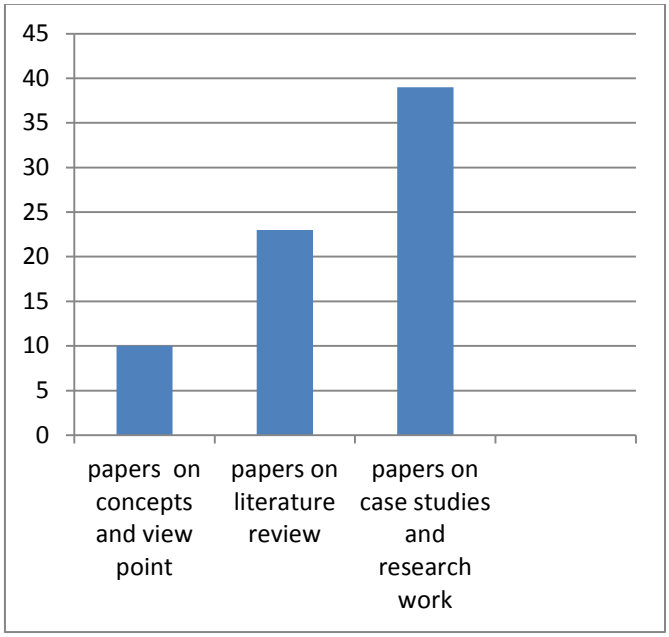


FIGURE 3:Statistics of the paper reviewed on Lean Six Sigma

IV History and evolution of Lean Six Sigma

Scientific management was attains important from late 1800s to early 1900s. "Training Within Industry" concepts was developed by U.S.Government during 2nd world war to boost up the industrial output .This concepts is gradually introduced in Japan by quality management Gurus like Deming, Juran, and Gilbreth . Japanese developed their own ideas, and quality control, which involving participation of everyone in an organization (Imai, 1986).this concept is widely accepted as "TQM"(total quality management).According to Deming "improvement initiatives that increases success and reduces failures" .In the early 1990's Robert Kaplan and David Norton developed a " Balance Scorecard". it is a combination of measurement system of measurement, strategic measurement and communication tool to categorized the organizational objectives in to four categories namely financial, customer, internal business process and learning and growth. Ohno pioneered the lean manufacturing or Toyota Production System throughout the world(Womack et al,1990).Six sigma gain popularity in 1986 in U.S. by measuring the product quality using statistical process control in Motorola .After achieving the quality goals by Motorola in 5 years ,they launched this process world wide as Six Sigma Program .Many top organizations such as ABB,GE,FORD,SONY,HONDA have follow the Six Sigma to achieve business excellence. However single quality program is not enough to solving the different issues of an organization. so hybrid methodology was developed around 2000.Lean Six Sigma is the most well known hybrid methodology of lean manufacturing and six sigma to achieve higher production rate ,higher quality with lower amount of waste. In Lean Six Sigma first we remove the waste and then reduce the variation to achieve the fastest rate of improvement in customer satisfaction, invested capital ,process speed, lead time, quality and cost.(Georage,2002).LSS helps organization to maximize their potential for improvement.

V Growth and application of Lean Six Sigma

V.1 Growth of Lean Six Sigma

Each approach is based on previous approach with modification in previous method, concept and tool to remove the identified limitation of previous approach. Process excellence is the ultimate goal of six sigma methodology. Six sigma was developed by Bill Smith an engineer of Motorola in the mid 1980's.GE introduces six sigma in R&D as DFSS(design for six sigma)in late 1990's. According to George 2002,2003 Lean is not integrated with Six Sigma until the late 1990s and early 2000s.Lean six Sigma is a methodology to improve the bottom line results with customer satisfaction (Snee Associates ,2010).According to Juran(1989) "improvement happens project to project and in no other way". Project selection is more important in Lean Six Sigma namely quick hit projects, KAIZEN projects and Six Sigma projects. From these three type cost and resource required in Quick hit and KAIZEN type project is very less compared to six sigma projects. Six Sigma typically completed in 3 TO 6 month. Using Lean Six Sigma we reduces cycle time, waste and non value added work.

Dag Kroslid(2001) ,gave an example from a Scandinavian manufacturing company is provided that explains how Six Sigma and Lean Manufacturing can be used in a beneficial way for companies to reach world-class performance. Dario Pranckevicius et al (2008) presents an application of the Lean Six Sigma DMAIC model to improve a plastic cup manufacturing process. Souraj Salah, et al (2010) primarily define both of the systems lean and six sigma in detail and describe the basic elements and the outline the benefits for integrating them. S. Karthi, et al,(2011) gave a unique approach of integrating the three main management models, namely Lean, Six Sigma and ISO 9001:2008 standard based Quality Management System, as a single framework benefiting contemporary organizations. Amrik Sohal(2012) examine the relationship between the successful deployment of Lean Six Sigma and a number of key explanatory variables that essentially comprise the competence of the organization.

V.2 Comparison between Lean and Six Sigma:

Description	Lean Manufacturing	Six Sigma
Origin	Motorola	Toyota
Objective	Reduce Waste	Reduce variation
Methodology	Stream, Analysis,flow,pull,perfection	DMAIC-existing product DMADV –New product
Tools	Analytical tools	Advance statistical and analytical tools
Primary effect	Reduce lead time	Save money
Secondary effect	Increase productivity and customer satisfaction with reduction in inventory	Improvement in financial and business goal
Criticism	Reduction in flexibility and not applicable in all industry	Does not involve everybody ,does not have a system view

V.3 Application of lean six sigma

Area of application	Papers reporting the application in the corresponding area in which lean six sigma is applied
chemical	Michael (2011). Cournoyer et al.(2011)
Manufacturing	Mandahawia et al (2012),Dario et al.(2008)
an Aviation Technology	Johnson & Dubikovsky(2008)
Automobile	Vinodh et al. (2011), Habidin and Yusof (2012)
Business Excellence	Corbett(2011)
Call centre	Laureani, Antony and Douglas(2010)
Computer and software	Chena and Lyu(2009)
corporate communications	Barnes and Walker(2010)
Creativity, and Innovation	Hoerl and Gardner(2010), Byrne et al. (2007),Yamamoto and Bellgran(201
Electrical	Chen , Li and Shady (2010)
Electronics	Vinodh et al.(2012),K. Jeyaraman and Leam Kee Teo(2010)
Financial Services	Delgado, Ferreira and Branco (2010), Laureani and Antony(2010)
Forensic DNA	Melinda (2011)
Healthcare	Dulin and Knapp (2000), Langabeer et al.(2009), Lent, Sanders and Harten(2012)

ISO 9001:2008	Karthi, Devadasan and R. Murugesh, (2011)
Maritime	Besseris(2011)
medical science	Bucourt & Busse (2010)
OEE measure tool	Gibbons and Burgess(2010)
Outsourced Organization	Ray and Boby John(2011)
Printing and Publishing	Roth and Franchetti(2010), Mandahawi, Fouad, Obeidat(2012),Koning et al. (2010)
Public Housing Authorities	Kumar and Bauer(2010)
SME's	Gnanaraj et al.(2012),M. Kumar et al.(2006), Thomas, Barton, Chuke-Okafor(2009)
Team Learning	Leon et al. (2012) , Felix Güttler et al(2011)

VI Challenges to implement Lean Six Sigma

1 Resistance to change for both employer and employee

2 Failure to identifying need for a change.

3 set up a new working environment.

VII Reason to implement Lean Six Sigma

Following are the five key reasons to implement lean six sigma in any organization .
1, To achieve bottom line results
2,Developing great leaders for leading change
3,Systematic statistical approach to improve customer satisfaction, cost, quality and delivery.
4, Rapid project completion from 3 to 6 months
5, Level of infrastructure created (MBB,BB,GB)

VIII. Research works on integrating Lean **Six Sigma and Foundry Industries.**

The literature review shoes only one paper is available die casting with LSS.The idea of combining LSS and foundry industry is newer and effective process improvement tool.Ennovation and excellence achieved using Lean six sigma in foundry industry is depicted as a roadmap in figure. it indicates the way to amalgamate the Lean Six Sigma's DMAIC methodology and belt based training system required for process based statistical model .It requires only few changes as well as lesser investment to implement LSS in Foundry Industries. The role and responsibilities of the belt personnel have to be determined and appended as an additional sub clause in the management responsibility clause. the belt based training infrastructure requirements have to be included in resource management clause. this combined approach will aid to implement LSS in Foundry Industries. Figure 5 shows a roadmap to implement lean six sigma in foundry industries

X .CONCLUSION

Lean management aims to eliminate /reduce waste in an organization, and six sigma aims to process improvement through reduction in a process variation. The Hybrid technique known as 'Lean Six Sigma' (LSS) is a newer approach to Indian industry. Research on LSS is on initial stage. The result of literature review indicates that till date, there is no work on integrating lean six sigma and foundry industries. hence it is concluded that the foundry industries (SME'S) is to be amended with the ideals of Lean Six Sigma .In order to carry out this task ,a roadmap is contributed in this paper.
Statistics shows very little work is carried out on lean six sigma in Indian industries. By implementing lean six sigma in foundry industries we receive a higher safety levels, less variations in output , less amount of rejection at a same time we achieve higher amount of profit within a year. Lean six sigma is hybrid approach to improve productivity in small and medium scale of foundry industries with lower variation and waste in output .Lean implementation gives a elimination of waste in all the activities started from raw material to finish product on the other hand six sigma focuses on minimization of variation in product output.

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