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A LITERATURE REVIEW ON LEAN SIX SIGMA

Vikas Malviya

M.Tech Scholar, RGPM, Bhopal

Arun Kumar Bhuneriya

Professor (Mechanical), RGPM, Bhopal

ABSTRACT

The world that companies operate in today competitive forces them to continually seek out and strive for new cost savings and where possible create a competitive advantage Lean, Lean Thinking and Lean Six Sigma has seen tools and methods applied in a manufacturing environments over the years that have proved effective. This present paper takes one of the new thinking called Lean Six Sigma. An exhaustive literature is being studied and review of those important papers is being concluded.

1. INTRODUCTION

Liker (1997) refers to mass production and lean production as a way of thinking about how production should occur within a specific factory, more specifically how solutions are arrived at on how people, equipment, material and funds are organised to build products that people will pay a price for. Mass production, which originated from the Ford production system, reflected the culture of that time. Similarly, a new method evolved from post World War II Japanese manufacturing industry which sought to find further efficiencies on an effective mass operation.

This resulted in a new solution to the manufacturing question, the Lean Solution.

Lean evolved from the Toyota Production System, the development of which has been accredited to Sakichi Toyoda, who founded the Toyoda Group in 1902, Kiichiro Toyoda who headed the automobile manufacturing operation between 1936 and 1950, Eiji Toyoda, Managing Director between 1950 and 1981 and Chairman between 1981 and 1994, and Taiichi Ohno, the Father of the Kanban System (Becker, 2009).

2. PRINCIPLES OF LEAN

The principles of Lean detail the method that should be used to implement Lean. Womack and Jones (1996) first documented their Five Steps, which was later expanded by Liker (2004).



2.1 FIVE STEPS

The principles of Lean as documented by Maskell and Baggaley (2003) which were derived from Womack and Jones (1996) are:

1. **Value:** Lean starts with a precise definition of what constitutes value from the customer point of view in terms of the product features and characteristics that are valued by the customer
2. **Value Stream:** The sequence of processes through which a product is transformed from raw material to delivery at the customer's site
3. **Flow and pull:** The production process is designed to maximize the flow of product through the value stream, initiated by the pull of customer demand
4. **Perfection:** Defined as 100 percent quality flowing in unbroken flow at the pull of the customer
5. **Empowerment:** The system of measurements and controls that provides each employee with the information and authority to take the necessary action at the time it is required

2.2 LEAN SIX SIGMA

Lean Six Sigma is an evolution of the methods employed by Lean and Six Sigma; it can also be referred to as Six Sigma Lean (Byrne et al, 2007). They assert that Lean Six Sigma improvements are not just about doing things better, but about doing better things. It is not just about getting data right the first time, being accurate and having a streamlined process, it is also about asking the right questions, 'should we do this?', 'is this necessary?', 'what does the customer want?' and 'how does the customer want it? Jing (2009) states that Lean and Six Sigma convey a wide scope of meaning as they are used differently depending on the context, such as initiatives, programmes, processes, systems, methods, tools or simply activity. According to Rampersad and El-Homsi (2007) the Six Sigma methodology is structured around understanding the customer needs, while identifying key processes linked to the customer needs. Statistical and quality tools are used to reduce variations in the key process which can sustain the process over time. Improvement projects utilizing Six Sigma methodologies follow the Define, Measure, Analyse, Improve and Control improvement process, or DMAIC (Rampersad and El-Homsi, 2007).

2.3 SIX SIGMA

As has been extensively documented by the previous literature, Lean (Ohno, 1988) is an improvement approach primarily focused on reducing waste and improving efficiency.



According to Jing (2009) Six Sigma is an improvement methodology that is primarily aimed at improving process capability by reducing variation, variation is reduced by being consistent.

Magnusson et al (2003) define Six Sigma as a business process that allows them to monitor everyday business activities and design ways that minimize waste and number of resources which will improve their profitability, and all while increasing customer satisfaction. Antony (2006) discussing Six Sigma with reference to service processes is of the opinion that the term sigma is a measure indicating the deviation in the performance characteristic of a service from its mean performance. Therefore, the basic goal of a Six Sigma strategy is to reduce variation within the tolerance or specification limits of a service performance characteristic.

2.3.1 Decision Making

The previous section has provided an overview of the tools and techniques that exist within the Lean toolbox, but how are they applied to assist with decision making within the work environment? One of the methods used that was developed at Toyota as part of their fourteen principles (Liker, 2004), is Nemawashi. Nemawashi translates “to prepare a tree for planting”. When nemawashi is used decisions are made slowly via a group consensus, considering all options, but once a decision is made implementation is rapid, but cautious. According to Liker (2004) the process of nemawashi involves discussing problems and potential solutions with all those affected. The process, while time consuming, results in a broader search for solutions. The main purpose of nemawashi is to get the maximum benefit from the human assets within the organisation (Jackson & Tomioka, 2004). Kogut (1993) characterises this form of decision making as decentralised and bottom-up consenses seeking, which has proved to be very effective in domestic Japanese organisations.

2.3.2 Lean Thinking

According to Dinero (2005) Lean thinking, has evolved from Lean philosophy as applied to manufacturing organisations. Lean thinking is the change in focus of the improvement process from manufacturing areas to the whole organisation. Womack and Jones (1996) refer to this as the Lean Enterprise, and detailed five steps for Lean business logic which are the output of their research of fifty companies around the world in a variety of industries. The five steps are:

1. Define value precisely from the perspective of the end customer in terms of a specific product with specific capabilities offered at a specific price and time.
2. Identify the entire value stream for each product or product family and eliminate waste
3. Make the remaining value-creating steps flow



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4. Design and provide what the customer wants only when the customer wants it

5. Pursue perfection

Murman (2002) refers to Lean thinking as an enterprise wide process that strives to remove waste with the goal of creating value through a dynamic and knowledge-driven process which is heavily customer focused. A common thread is visible through Murman's definition and the five steps of Womack and Jones (1996), that is customer focused, eliminates waste and creates value. Lean thinking was utilized by Toyota after the failure of their highly automated Tahara plant. They returned to much lower levels of automation in final assembly and a reorganization of the assembly line so that related activities – for example the electrical system - are installed and tested in one focused area. This shows that the use of cross functional co-located teams improve the process (Womack & Jones, 2003).

2.3.3 Lean Office

Lean office (Tapping, 2002) evolved from Lean manufacturing processes. Lean office utilises the same techniques and tools that have been designed for Lean Manufacturing. Tischler's (2006) found that with the application of lean principles in the office can result in real, visible and quantifiable savings for service departments and the organisation as a whole. According to Tischler (2006) Lean is a better methodology because:

- Fewer initial tools must be learned by each participant in the improvement process
- The improvement process can be accomplished very quickly
- The results can be more powerful than any single traditional quality improvement effort.
- The value stream is a richer concept than the process, as built into the value stream is a focus on customer value and the idea of a stream or flow of activities

The output of Tischler's (2006) lean office project saw real benefits realised. These included the time from the beginning of the process to the end being reduced from two or three weeks to less than one day, and the admissions directorate, a highly paid faculty were no longer involved. This allowed faculty to focus on teaching and research rather than making phone calls, thus improving the university's quality of education and image. Most inquirers received a call within hours or minutes of sending their inquiry and the campus mail system was less burdened which also resulted in \$500 worth of paper saved annually. There are many positive effects of applying Lean principles in an office environment; these positive effects include changing the manner in which work is done. For example, financial month end occurs every month. Why is there a rush in every company at this time to get things done, activities left unchecked until after 'the books have closed' – Why? Take batch processing, that is, business processes that are carried out just once a month. Why not carry



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them out once a week, or multiple times a week, or even every day? The third step in Womack and Jones (1996) five steps to Lean Enterprise – Make the remaining value-creating steps flow means that performing a task or activity once a month is not adhering to the third step that the process should flow. Also, an effect of working in a batch mode results in work building up across the month; this means that there are large amounts of wait time, and large amounts of work in progress. If the activities are done more frequently, or the work is levelled across the month wait time and work in progress reduce, and information quality improves. According to Locher (2007) impressive improvement is realised when there is a successful implementation of Lean processes within the business, these improvements can see a 90% reduction in lead time and up to a 40% decrease in process time.

2.3.4 Lean Six Sigma

Lean Six Sigma is an evolution of the methods employed by Lean and Six Sigma; it can also be referred to as Six Sigma Lean (Byrne et al, 2007). They assert that Lean Six Sigma improvements are not just about doing things better, but about doing better things. It is not just about getting data right the first time, being accurate and having a streamlined process, it is also about asking the right questions, ‘should we do this?’, ‘is this necessary?’, ‘what does the customer want?’ and ‘how does the customer want it? Jing (2009) states that Lean and Six Sigma convey a wide scope of meaning as they are used differently depending on the context, such as initiates, programmes, processes, systems, methods, tools or simply activity. According to Rampersad and El-Homsi (2007) the Six Sigma methodology is a structured around understanding the customer needs, while identifying key processes linked to the customer needs. Statistical and quality tools are used to reduce variations in the key process which can sustain the process over time. Improvement projects utilising Six Sigma methodologies follow the Define, Measure, Analyse, Improve and Control improvement process, or DMAIC (Rampersad and El-Homsi, 2007).

2.4 Define Measure Analyse Improve Control (DMAIC)

The methodology used to improve an existing process in Six Sigma is the DMAIC process, which is divided into five stages:

Stage Process

Define which process or product that needs improvement. The most suitable team members to work with the improvement The customers of the process, their needs and requirements, and create an as-is map of the process that should be improved Measure Identify the key factors that



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have the most influence on the process, and decide upon how to measure them Analyse The factors that need improvement Analyse The factors that need improvement Improve Design and implement the most effective solution. Cost-benefit analyses should be used to identify the best solution

Control Verify if the implementation was successful and ensure that the improvement sustains over time. There are many tools that are used during each phase of the DMAIC process; some have been documented in Table 1 – Examples of DMAIC tools.

Table 1: Examples of DMAIC Tools (Adapted from George, 2003.)

Define	Measure	Analyse	Improve	Control
Project Selection Tools	Operational Definitions	Pareto Charts	Brainstorming	Control Charts
PIP Management Process	Data Collection Plan	C&E Matrix	Benchmarking	Standard Operating Procedures
Value Stream Map	Pareto Chart	Fishbone Diagrams	Total Preventive Maintenance	Mistake Proofing
Financial Analysis	Histogram	Brainstorming	5S	Plan-Do-Check-Act Cycle



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Project Charter	Box Plot	Detailed As-Is process maps	Kaizen	Implementation Plan
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BENEFITS OF MERGING LEAN AND SIX SIGMA

Together Lean and Six Sigma combine their independent approaches to form a Lean Six Sigma approach that seeks to improve efficiency and capability primarily by removing wastes and variation (Jing, 2009). Liebesman (2009) supports this definition of Lean Six Sigma, finding that the basic goals of LSS (Lean Six Sigma) are a simplification of the processes by removing nonvalue added activities and a reduction in variability and defectives during operations. Liebesman also found that combining Lean and Six Sigma improves the bottom line of a company and provides value to its customers.

Table 2: Similarities and Differences between Six Sigma and Lean (Adapted from Andersson, 2006.)

Concept	Six Sigma	Lean
Origin	The quality revolution in Japan and Motorola	The Quality revolution in Japan and Toyota
Theory	No Defects	Remove Waste
Process View	Reduce variation and improve processes	Improve flow in processes
Process View	Reduce variation and improve processes	Improve flow in processes



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Approach	Project management	Project management
Methodologies	Define Measure Analyse Improve (or design) 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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Andersson et al (2006) found that the concepts of Lean and Six Sigma are complementary; they are excellent road-maps that can be used one by one or combined. George et al (2003 cited in Andersson et al 2006) state that Lean Six Sigma continues to help companies flourish in a new world where customers expect zero defects and fast delivery at the minimal cost. The similarities and differences between Lean and Six Sigma have been documented in Table 2.5 – Similarities and

Differences between Six Sigma and Lean. Bhuiyan and Baghel (2005) point out that Lean and Six Sigma separately cannot achieve improvements at the rate that Lean Six Sigma can. Lean Six Sigma also addresses important issues that are overlooked by Six Sigma and Lean manufacturing individually: the steps in the process that should be first tackled; the order in which they should be applied and to what extent and the ways in which significant improvements can be made in terms of cost, quality and lead times. The fusion of the two helps organisations maximise their potential for improvement. An analysis of Caterpillar's use of the Lean Six Sigma methodology, carried out by Byrne et al (2007) highlighted a number of characteristics that distinguished their approach to the program from that of other companies. These distinguishing characteristics included:

- An innovation vision based on factual customer and market insights
- Their leadership was committed to perpetual innovation
- Alignment of effort across the extended enterprise
- Growth of capabilities within the organisation that made innovation routine

This positive feedback on the harmonisation of Lean and Six Sigma methodologies is also shown by George (2002) when he found that the combination of Lean and Six Sigma focussing on the highest-value projects and supported by tight performance improvement infrastructure would produce remarkable results and is the most powerful engine available today for sustained value creation by not speeding up the workers or the machines, but by reducing unneeded wait time between value added steps. Devane (2004) has detailed the advantages of combining the two philosophies, Lean and Six Sigma, instead of selecting one:

- The speed of implementation increases
- More improvement projects can occur in parallel, which increases profits faster
- Senior management expend less time and energy, than if implemented individually
- Faster and more effective adaptation to external events

2.5 Lean Six Sigma – the Holy Grail?



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Is Lean Six Sigma the Holy Grail of improvement methodologies for organisations? Devane (2004) believes this not to be the case, as he proposes taking a further step in the development of the ideal improvement methodology – Lean Six Sigma and High-Performance Organisations. Devane (2004) believes that the combination of Lean Six Sigma and High-Performance Organisation can achieve sustainable and dramatic results by integrating the simple improvement principles and tools of Lean which focus on the elimination of waste; reduce variation by using Six Sigma’s statistical methods; plus the cultural focus, creation of accountability, energy and ownership through a new structure and principles that High-Performance Organisations will provide. The combined disciplines have not yet been widely implemented, but there have been a number of successful implementations, such as StorageTek’s implementation in 1995 which saw increased group productivity of four combined departments by sixty percent (Devane, 2004).

2.6 SUMMARY OF LITERATURE REVIEW

From the literature review there is clear knowledge and research of the use of Lean Six Sigma tools and methods in a manufacturing environment, but very little research into their specific use, success and applicability within non-manufacturing environments such as administration and accounting.

Therefore, the focus of this dissertation will be to look at the effects of using one of these Lean Six Sigma tools, Visual Process Controls, in an accounting environment. The focus for the researcher will be to find out if this is an effective process improvement tool in this specific environment – an accounting department.

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