

A Way Forward to Attain Lean Manufacturing Status through Transformational Leadership

Syed Athar Masood

Department of Mechanical Engineering
International Islamic University
Islamabad, Pakistan
athar.masood@iiu.edu.pk

Abstract

Lean system is among the most extensively implemented business strategy, for quality and cost effectiveness. With roots in 1960's Toyota Production System (TPS) and Just-In-Time (JIT), Lean focuses on customer satisfaction. The goal is to produce exactly what customer wants, when and in what amount. For achieving the goal, principles like waste elimination, empowered employees and continuous improvement are employed.

Transformational leaders activate higher-order needs in followers. Research by Krishnan [13] suggests that superior performance is possible only through stimulating and motivating followers to higher levels of performance through transformational leadership. Superior performance is possible only by transforming followers' values, attitudes, and motives from a lower to a higher plane of arousal and maturity.

The intention throughout this research is how to gain the lean status through transformational leaders. Results of this research shows that transformational leaders were more facilitating in achieving the lean status for an organization than non transformational leaders

This paper also highlights the strengths and weaknesses of the system by reviewing the research papers. Modern trends in the lean system are also mentioned for further research. Recommendations are given considering the common problems faced by organizations in lean transformation.

Keywords

Lean System, Organizational Change, Productivity, Transformational Leadership

I. INTRODUCTION

Lean is now-a-days considered as a concept, and it is adopted and implemented in a number of ways in the manufacturing organizations and it is a commitment, a strategy for continuous improvement that ensures significant improvement in the manufacturing organization's stability, profitability and competitive advantage. Lean can resolve many organizational problems by focusing on several change initiatives and gain profit for business [1]. Lean manufacturing is a concept driven from the famous Toyota Production System (TPS) and emphasizes on understanding the customer and providing exactly what customer wants.

Lean manufacturing is usually preferred because it encompasses a unified and mutually reinforcing set of principles, linking management to shop floor for a holistic view of the enterprise operations [2]. Lean manufacturing, with an ability to incorporate techniques and adapt to process improvement requirements, follows a simple approach to problem solving to be effective [2].

Lean's main objective is to increase the profit and return on investment for the organization which is achieved by following the philosophy of eliminating Ohno's seven wastes, respecting the people of organization and continuously improving the process. A number of tools and techniques are used to achieve the stated objective of being Lean. Lean operations contribute to competitive advantage for the practicing organization by setting rules for all concerned people and areas including suppliers, employees, layout, inventory, scheduling, quality and maintenance. To help in gradually transforming into lean system a number of tools have been in practice like 5S, Kaizen, Pull system, Jidoka and others.

Lean system like other management systems has both strengths and weaknesses. Although its strengths overcome the weaknesses but still organizations must be well aware of what they are opting for and be ready to tackle any problems that might come their way.

With the passage of time original lean operations have been developed into a complete lean system with specific tools and techniques for attaining the status of being lean achieving the goal of being a lean organization. Many new concepts have been introduced like lean thinking, lean audit, agile and leagile manufacturing. lean-six sigma (LSS) and lean value management (LVM).

The objective throughout this paper is to review the literature on lean operations and understand the philosophy behind its concepts and principles. A number of lean tools have also been studied in terms of their contribution towards becoming a lean organization and a relationship has been identified between lean system and transformational leadership in manufacturing organizations. Limitations on the lean implementation are discussed with strengths and weaknesses. Literature was reviewed for modern trends in lean operations. In the end recommendations are given for improvements in the lean implementation.

II. BACKGROUND

Origin & Development Of Lean System

American system of mass production was commonly in use after World War II. Mass production involved large amount of inventories, space requirements, over-standardization of products resulting in inflexibility to customer demand and changes in design. Materials were produced in large batches which resulted in sacrificing the quality. Henry Ford then introduced the concept of continuous moving assembly line for improving the production and workers performance. Fredrick Taylor, the founder of scientific management, supported mass production concept of manufacturing with high product volumes, low cost per unit and job standardization [3].

The mass production system was not questioned till Japanese, Taiichi Ohno, introduced Toyota Production System (TPS) in 1960s. Due to lack of resources and poor demand for Toyota automobiles, at that time, TPS gained significant appreciation with smaller batches and fewer inventories. Just-In-Time (JIT) was also introduced to reduce inventory and improve throughput.

The term Lean Production was first introduced in 1988 by John Krafcik, in his article "Triumph of the Lean Production System," a quality engineer at Toyota-GM joint venture. In the year 1990, Womack, Jones and Ross also written about Lean Production in their book "The Machine That Changed the World: The Story of Lean Production". Lean concept was drawn initially from Toyota Production System (TPS) as well as from Just-In-Time (JIT) systems. It basically identify wasteful processes and forced them for elimination of waste in the production processes and only recommend the processes that satisfy customer demands.

In reality, there is a little difference between TPS, JIT and Lean systems. Although

- TPS focuses on employee learning and employee empowerment on the shop floor
- JIT focuses on forced problem solving
- Lean systems focuses understanding the customer

Implementation of all these three system gives a competitive advantage and results in overall returns [4].

Lean Definitions

Edwards described Lean manufacturing as an innovative techniques keeping in view of the philosophy of craftsmen period, in line with modern era of work standardization, an assembly line technique and glued with teamwork for better measure [5]

Todd explains lean production to be an initiative with the goal of minimization of waste through human work, inventory management, time management and layout of shop floor, to enable the organization to gain the status of world class quality products with high efficiency and low cost (Todd 2000 as cited in [3]).

Deming argued that lean manufacturing involved changing and improving processes as the prime principle, which in turn bring change in terms of waste minimization, it also requires "re-engineering of the whole process, which makes the system more stable with less variation on account of common causes" [3].

Lean Principles

Liker [6] in his book “The Toyota Way” has given fourteen principles to become a lean organization. It is believed that to achieve a lean status an organization has to focus on a particular philosophy and management style like the concept of “4P” model i.e., Philosophy, Process, People, Partner and Problem solving [3]. Another concept is that lean production consists of eight principles, i.e., waste elimination, continuous improvement, zero defects, multifunctional teams, delayering, pull scheduling, team leaders, and vertical information systems. However the five principles by Womack and Jones [7] are known to be the most important in successful implementation of Lean system as follows:

- a. Define Value
First principle is to specify the value from the standpoint of customer not from your assets and organization. Value flow should be ensured across all the departments of organization to avoid wrong product or service resulting in loss to organization.
- b. Map Value Stream
Second principle is to identify the value stream through product definition, information management and physical transformation to create and deliver each product and eliminate wastes [3]. Challenge all non-value adding steps and add nothing than value.
- c. Create Flow
Third principle is to control the flow of value creation process. In general, flow should be smooth and quick.
- d. Pursuit Perfection
Fourth principle is to pursue perfection through continuous improvement in product, process and value stream.
- e. Establish Pull
Fifth principle is to establish pull system among all the processes wherever continuous flow is running. Flow should be directed by the pull of customer.

All these principles support each other by influencing the outcome, so they should be performed together.

Lean Philosophy

Lean system has its roots in Japanese environment. Lean philosophy was developed considering the Japanese working standards and culture. But now many companies use lean as their preferred approach as there is nothing culturally inherent in the system. Following four philosophies are the main building blocks of lean operations [4].

1. Waste Elimination - Due to lack of space and lack of natural resources, leanness was focused on reduction of waste in all processes. In a lean system, anything that does not contribute value addition in the final product with respect to customer perspective is assume to be wasteful activity and should be eliminated, and value added activities should be incorporated. Taiichi Ohno list down seven most common types of wastes that contribute for the loss of resources, i.e., Overproduction, Queues, Transportation, Inventory Motion, over processing, and Defects.
2. Respect for People – Lean system believes in utilizing the full capacity, mental as well as physical, of the workers and suppliers to improve the operations. They are recruited, trained and treated as knowledge workers. Lean system introduced the idea of employee empowerment to make improvements and stop the process in case of quality problems. Lean operations ensure employee participation through quality teams, suggestion systems and others form.
3. Continuous Improvement – Third philosophy of lean systems is to work on continuous improvement of all processes. Lean systems strive for perfection in all processes. There is always some room for improvement in the process no matter how good it is [8].
4. Improving Profits and Return on Investment – Previous three philosophies, waste elimination, utilization of workers and continuous improvement, are only means of achieving the real objective of lean system which is improving profits and return on investment. The theme of lean production is to manufacture the right

quality and quantity of products at the right time and the right place that satisfy customers' requirement as shown in figure-1.



Figure 1: Philosophy behind Lean Objective

Elements of lean Production

There are six elements of lean production. Integrating them together is necessary for overall success of the organization (Schroeder).

- Small Size Lot Production
- Reduced Setup
- Pull System Production
- Standardized Operations
- Proper Equipment Maintenance
- Implementation of Group technology

It is established that lean operations provide an organization with competitive advantage in terms of winning orders because of quick response to customer at lower cost as well as high quality. Just-In-Time techniques help in overcoming almost all the problems in overall process from supplier to customer integration. Lean implementation, involving TPS and JIT, results in rapid throughput, waste reduction through quality improvement, pricing flexibility through cost reduction, variability reduction and rework reduction [4].

Lean Suppliers

Establishing a supportive partnership with the supplier with open communication aimed towards removing waste and cost reduction. Suppliers should be educated to satisfy end customer needs. Mutual understanding and trust are two main pre-requisites to partnership. Following are the characteristics of lean suppliers:

- Removal of unnecessary activities like inspection and paperwork.
- Reduction in in-plant inventory by delivering directly to concerned department
- Reduction of in-transit inventory
- Improvement of quality and reliability (on time deliveries)

Lean Layout

Better layout reduces the waste of movement on factory floor which adds no value to the product. Layouts should be flexible to reduce movement of people and material. Following are the characteristics of a flexible layout:

- Distance reduction through work cells for families of products, Group technology, U-shaped assembly line and multi-operation machines.
- Increased flexibility in machines to adjust for changes in volume, product improvement and new designs. Moveable and modular equipment is used for increased flexibility. Workers are cross-trained to add flexibility.
- Improved employee communication results in efficiency and opportunities for improvement.
- Reduced space and inventory due to distance reduction.

Lean Inventory

Inventory is a waste which adds to cost of the process. In lean system inventories are required to be at minimal level. Inventory can be reduced by using a pull system, ordering small lots and JIT delivery methods. Lean inventory has following characteristics:

- Reduced variability in production by uncovering problems
- Reduced setup cost and time

Lean Scheduling

Lean system requires effective schedules be communicated within the organization and to the suppliers. Better schedules can be achieved by level scheduling, Kanban's, freezing part of schedule and seeking one-piece-make and one-piece-move. Scheduling characteristics are:

- Improved ability to meet customer demand
- Inventory reduction through smaller lot sizes
- Reduced work-in-process

Lean Maintenance

Equipment maintenance is another important part of lean system. It requires daily scheduled maintenance. It is operator's responsibility to maintain its workstation and equipment. Operator should follow the instructions from manual, keep the equipment clean and report performance. Equipment maintenance results in:

- Empowered employees and involvement in the process
- Equipment ownership
- Standards for measuring equipment effectiveness

Lean Quality

Unlike mass production, lean ensure quality within all processes and products through process control, fail-safe methods like poka-yoke and employee empowerment. Lean quality characteristics are:

- Reduction in cost of good quality by reduction in inventory, as inventory hides bad quality and lean exposes it.
- Improved quality because of early warning system for quality problems

Lean Empowerment

Employee empowerment is vital for the continuous improvement process in lean system. As employees know more about their job than anyone else so they should be given power to make changes for the improvement of process and product quality. Job should be made challenging through constantly improving job design and increasing responsibility. Employee empowerment gives:

- Flexibility in the system
- Ideas for quality improvement, process improvement and reduction in setup time

Lean Commitment

Commitment of all stakeholders is necessary for the implementation of a lean system. Lean system requires support of management, employees and suppliers. They all should be integrated in a system for better process. Success requires full commitment and complete involvement of all the team member.

Lean Tools

Lean tools help organizations to transform from mass producers to lean exemplars. Lean has a very extensive collection of tools and concepts. Any organization can start with implementing a tool that best resonates with the culture. The attraction of these tools is that they can be implemented in isolation without changing the whole organization and management approach. They can be implemented by staff improvement teams or outside consultants at many points within an organization (Jim Womack).

Some of the most widely used tools for lean implementation are:

5S

Its purpose is to quickly see if anything is abnormal at workplace. It eliminates waste resulting from poorly organized work area.

Elements of 5S are:

- a. SEIRI- Sort (eliminate which is not needed)
- b. SEITON- Straighten (organize remaining items)
- c. SEISO – Shine (clean and inspect work area)
- d. SEIKETSU – Standardize (make standards for above)
- e. SHITSUKE – Sustain (regularly apply these standards)

All benefits of 5S fall within lean methods as they eliminate wastes in one form or another.

- Improves efficiency & productivity
- Better quality and shorter lead times
- Responsible workers
- Positive impression on customers

JIT

Just-In-Time (JIT) is a tool for forced problem solving. JIT supports lean production through pull system and provides/produce necessary amount of product at the right place and at the right time. Goal of JIT is to reduce waste and variability, continuous improvement and provide flexibility. JIT ensures minimum inventory, deliveries in small quantities, small lot sizes, short setup runs and long term partnership with few vendors. Advantages of JIT include:

- Increased equipment utilization
- Reduced space requirements
- Reduced scrap & rework
- Reduced wastes and setup times
- Satisfied customers
- Increased market share and profitability
- Faster response at lower cost and higher quality

Kanban

Kanban is a Japanese word meaning “signal” or “visual card”. It is a scheduling system for determining what, when and how much to produce. Kanban orders small lot sizes through pull system. A card is the authorization of next container of material to be produced. There are many types for kanban e.g. P-Kanban for production authorization, T-Kanban for transportation similarly material and supplier kanbans.

A card is normally used when both producer and customer are not in direct contact. When there is a visual contact a light, flag or an empty floor is enough.

Advantages are:

- Quick visibility of problems
- Less labor required

- Reduces inventory and waste
- Brings flexibility in production
- Less stock outs and overflows

Kaizen

Kaizen is referred as continual improvement process involving all employees to work together for achieving continuous improvements on regular basis in the processes. The idea is to combine all talents to build a system for eliminating all wastages.

PDCA

It is an iterative methodology for implementing improvements. It was proposed by Deming as PDCA cycle.

- Plan (establish plan and expected results)
- Do (implement plan)
- Check (verify expected results achieved)
- Act (review and assess; do it again)

Poka-Yoke

Poka-Yoke is an automated device for the detection of errors/rejected items. It is very time consuming and tedious job to find the defects through inspection, Poke-yoke error detection and prevention method are designed for the production process to achieve the goal of zero defects.

SMED

Single Minute Exchange of Die (SMED) is a setup time reduction tool. It reduced setup time (change over) to less than 10 minutes by following three steps:

- a. Identify the external and internal changeover activities (where internal activities require production to stop)
- b. Shift activities, as many as possible, from internal to external activities
- c. Streamline the remaining internal activities.

SMED requires cross-trained employees, better communication means and more number of workstations. Advantages by SMED are:

- Shorter lead times and work-in-process
- Small lot production
- Reduction in inventory
- Improves customer responsiveness

Analysis of Lean Manufacturing System

Like most management systems lean manufacturing has both: advantages and disadvantages. It is important to analyze the system by its strengths and weaknesses. The idea is to give a clear picture of the system and help organizations to choose the system or any tool carefully. Let first look at the strengths of lean system:

Strengths

Implementing Lean manufacturing has immense benefits to the business and these benefits are sustainable if it is integrated into the culture and slowly shifted towards lean thinking. By implementing lean system, an organization may gain following benefits:

1. Its efficiency increases more rapidly, competitive cost and quick customer response.
2. Its inventory level will be minimize because it allows a firm to work on just-in-time basis, that ultimately reduces inventory and holding costs.

3. Useful approach to operational, administrative and strategic improvement
4. Provides a major competitive advantage over traditional processes
5. Improves morale and participation of employees
6. Encourages innovation
7. Reduces the cash tied up in stock and borrowing from bank by reducing the amount of WIP and finished goods
8. Reduced waste and defects reduces cost and adds to profits

Weaknesses

Lean, although most appreciated by experts and widely used, has some weaknesses too. It is not necessary that all organizations will face problems while implementing lean but it is vital for an organization to predict when problems may occur with the lean system and do detailed planning. Some of the weaknesses that became problems for the organizations are:

1. Interdependent processes make the supply chain very costly and less responsive.
2. There may be risks associated in situation like worker strikes, stock outs, market fluctuations, interrupted production and supply lines, and communication gap in supply chain system.
3. There may be not enough buffer inventories to make the system running.
4. Does not work in unstable and unpredictable customer demands
5. Communication breakdown at any level disrupts the whole process
6. Health and safety issues due to repetitive tasks
7. High cost of implementation due to expensive machinery and training sessions
8. Difficult to measure the extent of implementation within the organization

III. MODERN TRENDS IN LEAN SYSTEM

Lean Audit

In past, most of the organizations that adopt lean manufacturing as process improvement model faced problem of measuring the extent of implementation within the organization. A structured audit approach is now used to measure the implementation of lean practices in the organization. The audit has a scope, management system and a questionnaire structure. A rating system is used for each lean characteristic.

This audit usually is a questionnaire comprising of questions structured around best practice of lean manufacturing. The results of the audit provide a gap analysis of where an organization currently is and where it needs to be in order to be considered world class in terms of Lean Manufacturing (Kobayashi 1995 as cited in Taggart [2]. That means to use lean audit as a source of benchmarking to improve.

Audit structures are well developed with many independent trained auditors to minimize auditor bias. The structure of the audit, the audit scope, the audit frequency and the audit method influence the effectiveness of the audit. Although these audits are really helpful in implementing lean concepts but still there is a need to audit the entire enterprise than to just focusing on shop floor or manufacturing operations [2]

Lean Thinking

Lean philosophy is now considered as a concept as well as a process and it is not like a series of different techniques that can be adopted without considering the Lean Thinking philosophy. Organizations are now shifting the focus from lean production, which was associated with cost reduction and waste elimination, to lean thinking which is to create value. Modern world requires engineers to move from the production floor where the main focus is on waste reduction to more focus on identifying and enhancing value for customers [9].

Lean philosophy is equally applicable to all the aspects of a business processes and not just for production operations, e.g., product development, product design, sales and marketing [10]. Lean thinking is an integrated management approach impacting the whole organization including suppliers, customers and other partners.

IV. TRANSFORMATIONAL LEADERSHIP AND LEAN STATUS

Bass [11] has defined transformational leadership as those leaders who have a good vision, metaphoric, and excellent impression management talents, and they use these expertise's to build strong emotional relationships with their followers. Burns [12] also defined transformational leadership as a process through which 'leaders and followers raise one another to higher levels of morality and motivation'. Transformational leaders look for raising the perception of followers by requesting to better ideals and good moral values like freedom, justice, fairness, peace, and caring, and not to negative emotions like fear, greed, resentment, or hatred. Krishnan [13] research found that extra ordinary performance by followers is achievable only by motivating and inspiring followers through transformational leaders. Extra ordinary performance by followers is achievable only by transforming followers' ideals, feelings, and motives from a lower to higher levels of encouragement and development.

V. RESEARCH CONTEXT

For exploring the link between transformational leadership and lean system, a survey was conducted in five different manufacturing organizations. Leaders were identified in terms of transformational leadership characteristics by using Podsakoff et al., questionnaire to measure transformational leadership characteristics, which was composed of 23 questions to be answered by followers about their leaders. Eighty nine followers from five manufacturing organizations were requested to respond to the transformational leadership questionnaire and it was analyzed using to identify transformational leaders.

VI. RESULTS AND CONCLUSION

It has been observed that organizations where transformational leaders were working, lean system was successful and implemented. Followers were more responsive to lean concept by making minimum wastages in their work, reduced rejection, rework and transportation. It was observed that organizations where transformational leaders were employed at the shop floor were facing little or no hurdle in implementing lean concept and their productivity and profitability was better than where non transformational leaders were employed.

References:

- [1] Atkinson. P. (2004). "Creating and Implementing Lean Strategies". Management Services. Philip Atkinson Consulting.
- [2] Taggart. P. (2009). "The Effectiveness of Lean Manufacturing Audits in Driving Improvements in Operational Performance". Research Report. University of Witwaterstrand, Johannesburg.
- [3] Valentinova. K. A. (2010). "Challenges in Lean Implementation: Successful Transformation towards Lean Enterprise". Master Thesis. Aarhus School of Business.
- [4] Heizer. J, Render. B & Rajashekhar. J. (2011). Operations Management. 9th Edition. Pearsoned Publications.
- [5] Edwards W. Deming (2000). Out of the crisis (1. MIT Press ed.). Cambridge, Mass.: MIT Press. p. 88. ISBN 0262541157
- [6] Liker. J. (2004). "The Toyota Way: 14 management Principles from the World's Greatest Manufacturer".
- [7] Womack P and Jones (1996). Lean Thinking: Banish Waste and Create Wealth in Your Corporation. Free Press, New York, 10020
- [8] Mefford, R.N. 2009, "Increasing productivity in global firms: The CEO challenge", Journal of International Management, vol. 15, no. 3, pp. 262-272.
- [9] Baines, T., Lightfoot, H., Williams, G.M. & Greenough, R. 2006, "State-of-the-art in lean design engineering: a literature review on white collar lean", Proceedings of the Institution of Mechanical Engineers Part B-Journal of Engineering Manufacture, vol. 220, no. 9.
- [10] Chappell, L. (2002). Lean culture takes commitment. Automotive News, Vol. 76, pp. 471-3.
- [11] Bass, B. M. Leadership and performance beyond expectations, 1985 (Free Press, New York).
- [12] Burns, J. M. Leadership, 1978 (Harper&Row, New York).
- [13] Krishnan, V. R. Value systems of transformational leaders. Leadership Orgn Dev. J., 2001, 22(3), 126-131.

BIOGRAPHY

Syed Athar Masood is an Associate Professor, in the Department of Mechanical Engineering at International Islamic University Islamabad, Pakistan. He earned his B.E. in Mechanical Engineering from NED University of Engineering and Technology,

Karachi, Masters in Mechanical Engineering from University of Engineering & Technology, Taxila, Pakistan and PhD in Mechanical and Manufacturing Engineering from Loughborough University, UK. He has published a number of international journal and conference papers. Dr Athar Masood has more than twenty years of industrial experience in engineering management, manufacturing and quality assurance at Heavy Industries Taxila, Pakistan. He has more than seven years of teaching/research experience at National University of Science & Technology (NUST EME College) and University of Engineering & Technology, Taxila, Pakistan. His research interests include manufacturing, production, quality, simulation, optimization, reliability, scheduling, and lean. He is life member of Pakistan Engineering Council and member of Institute of Mechanical Engineers, UK.