THE JOURNEY OF LEAN

Saurabh Tiwari
Lecturer
University of Petroleum & Energy Studies
Dehradun

Rameshwar Dubey
Secretary & Head- Asian Council of Logistics
Management Centre of Supply Chain Excellence

Nishi Tripathi
Assistant Professor
Faculty of Business studies
Sam Higginbottom School of Agriculture, Technology and Sciences

ABSTRACT

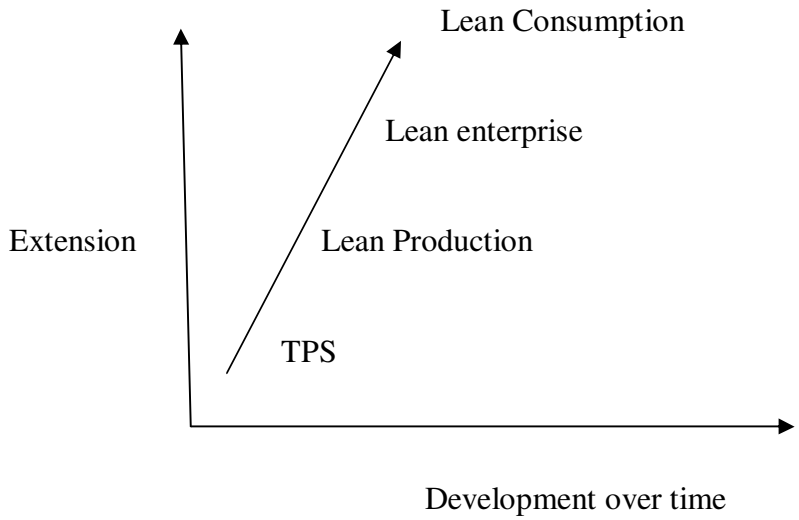
Lean production has transformed manufacturing & its application has made a significant impact both in academic & industrial circles over the last three decades. It has also been known by various other names like Toyota Production system, just in time, Pull manufacturing, total quality management. But the definition of Lean becomes more & more refined as the time passes & what we know as Lean today is not really any of these more. Its application has been spread to logistics, & from there to the military, to construction, to service industry & to consumption. The principles of Lean are universal & have been applied successfully across many disciplines. This paper tries to follow the journey of lean from its inception as a newly developed manufacturing paradigm to its current state.

Keywords : TPS,TQM,JIT

INTRODUCTION

Lean is the westernization of a Japanese concept that has carried several names. It has variously been known as the Toyota Production System, JIT(Just in Time), Pull manufacturing, TQM(Total Quality Management), and by various other names. Each of these names incorporates some aspects of lean, and vice versa. What we know as "Lean" today is not really any of these any more. Three decade ago when the lean production models was proposed by Womack et al. (1990), Shingo (1989) and Krafcik (1988) it was viewed as a replacement alternative to traditional manufacturing. Katayama and Bennett (1996) declare that today it is arguably the paradigm for operations. What we call lean today should not be viewed in the narrow sense as merely a set of tools, techniques and practices, but rather as a holistic approach that transcends the boundaries of the shop floor thus affecting apart from the production itself almost to all the operational aspects, e.g design, development, quality, maintenance etc., as well as the entire organisation and management of the company and now a step ahead & moved even on the customer choice of consumption also.

Lean has the point of attraction for so many years between researchers & practitioners. So many researchers have tried to define lean concept (e.g., Lewis, 2000; Hines et al., 2004; Shah & Ward 2007),. Bhasin & Burcher(2006) viewed lean as a philosophy & as a long term journey The purpose of the paper is to follow the evolution of the philosophy, which dates back to the introduction of the Toyota Production system(TPS) and extends to its current state in the form of lean enterprise to lean consumption.



ORIGINS OF LEAN MANUFACTURING

The objective of this section tries to find out the origins of Lean manufacturing & how this concept has developed & its association from Toyota Production System & Just in Time philosophy.

TPS

During and after the World War II companies were facing fierce competition imposed by mass production systems of American companies. The companies of Japan were especially facing this problem because of lack of natural resources, which makes it necessary for them to import vast amounts of raw materials from other parts of the world. Thus Japanese companies where under tremendous pressure & disadvantageous condition in terms of cost of raw materials as compared to their counterparts companies of American & European. This forced them to think somewhat different from the rest of the world if indeed they want to sustain in this fierce competition. The only solution that Japanese industries find in order to overcome this problem is by putting their best efforts in order to produce better quality goods having higher added value

and at even lower production cost as compared to other countries. This led The Toyota Motor Company (TMC) made a thorough study of the production system of the American automobile industry and in particular Ford now also known as(the Ford Production System – FPS). In the 1930s, Toyota transferred Ford's practices to its assembly lines; however, Kiricho Toyota's goal was cost reduction without economy of scale. Toyota could not afford huge capital investments, so mass-production practices were adapted to Toyota's capabilities. Taiichi Ohno, an assembly-shop manager, brought additional elements from his experience with the textile industry. Setup time reduction, workstation layout, and reduction in inventories were gradually tested on Toyota's assembly line.

The solution & changes offered by Toyota after testing on its own assembly line led to a complete reconstruction of the company and soon gave way to the introduction of an alternative & unique production system referred to as the TPS (Ohno, 1988), which aimed at directly attacking any form of waste in the production process. As soon as the success of this system was proved to the global manufacturing industry, a great number of companies worldwide adopted this system.

JIT

One of the most distinctive features of TPS is the Just-in-time production(JIT), especially important in an assembly industry such as the automotive manufacturing. The unique feature of this system is that only the necessary products, at the necessary time, in necessary quantity are manufactured and the addition stock on hand is held down to a minimum. JIT system framework was developed exactly out of the need of the Japanese industry to survive in the post global World war II market. Soon this system become so popular that most of the companies of worldwide implemented this system in their own production system (Monden, 1998; Sanchez and Perez, 2001). JIT is perhaps the most basic & fundamental element of the TPS. With the evolution of the JIT system as a concept soon led to the development of a number of other parallel complementary elements such as shift from batch system to small lot size production, set-up time reduction through SMED, the Kanban system, andon cards etc. These newly developed elements soon became integrated parts of the JIT system a fact that possibly led to the perception of the JIT system in "its totality" as a complete manufacturing philosophy

THE LEAN MANUFACTURING/PRODUCTION PHILOSOPHY

The popularity of the TPS with its unique features system attract more & more worldwide companies to implemented JIT system, & this led to development of a new dynamic system (Fujimoto, 2000) by the name of Lean manufacturing or lean production. Cost reduction was achieved by using fewer resources to compensate for the lack of growth. This third wave of production system change of research was encountered in the early 1980s. This time, the focal point of the research was "Lean Manufacturing". LM is regarded not merely as a set of tools or guidelines but is considered as a manufacturing philosophy that if adopted and carefully implemented can undoubtedly brings unmatching global manufacturing excellence. This is one point where both researchers and industry people those who are practicing LM philosophy agree. Bhasin & Burcher(2006) considered lean as a philosophywhich should be viewed as along term journey. Lean is a term coined by Krafcik (1988) at that time leading researcher in the International Motor Vehicle Program (IMVP) conducted at the Massachusetts Institute of Technology (MIT). The outcome of this project that it identify significant performance gap between western & Japanese automotive industry. In his landmark paper Krafcik introduced the term Lean as

. . .compared to mass production it uses less of everything-half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever
growing variety of products

In the famous book The Machine that Changed the World (Womack et al., 1990) , offer perhaps the most solid proof that the relationship that exists between leanness and the Toyota production system . The authors acknowledge that the Toyota Motor Company should be given the credit of initiating the Toyota Production System and the famous JIT philosophy and clarified that Lean is nothing but the outcome of the IMVP programme conducted in five years & has no such intention to present Lean Manufacturing system superior than TPS or LM has been developed to compete with TPS but rather Lean manufacturing or Lean production is nothing but the westernised version of Toyota Production System, & has been derived from TPS with some refinements and modifications. To support the view that Lean manufacturing is similar to TPS or JIT philosophy & nothing but refined & advanced version of the later is through literature published in the 1990's. From the literature published during this time on Lean(Feld 2001; Hampson, 1999; Standard & Davis, 1999; Liker, 1998; Steudel & Desruelle 1992; Womack et al, 1990) & JIT(Monden, 1998; Bicheno, 1994; Harrison, 1992; JMA, 1989; Shingo, 1989; Ohno, 1988) it can be easily concluded that both the systems has different tools & techniques, & at some places they are overlapping also but there aims are similar when implemented is to reduce the time from customer order to delivery by eliminating sources of waste in the production flow.

The principles of lean addresses the following wastes as suggested by Philips (2002), Maskell (2000), Nystuen (2002), Meier (2001), Standard and Davis (2000), Womack and Jones (2003), Parker (2003), Olexa (2002a, b),Siekman (2000), Dimancescu et al. (1997), Liker (1996), Taylor and Brunt (2001), Prizinsky (2001) and Oliver (1996):

- over production;
- waiting;
- transportation;
- inappropriate processing;
- inventory;
- unnecessary motions; and
- defects.

These are also known as the seven deadly wastes or sins Sutherland & Bennett (2008)

Katyama & Bennett(1996) defined the important aspect of this system as shown in figure 2that it requires fewer resources as inputs for manufacturing system(less material, fewer parts, shorter production operations, less unproductive time needed for set-ups, etc.) & at the side there is a higher pressure for for producing higher output(better quality, higher technical specifications, greater product variety, etc.). The output thus results in greater satisfaction to the customer & provides the lean company an opportunity to grab a large market share & helps in long run for the company.

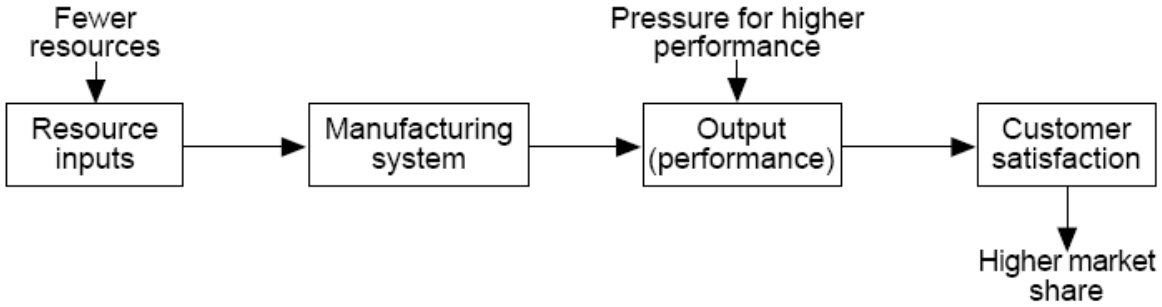


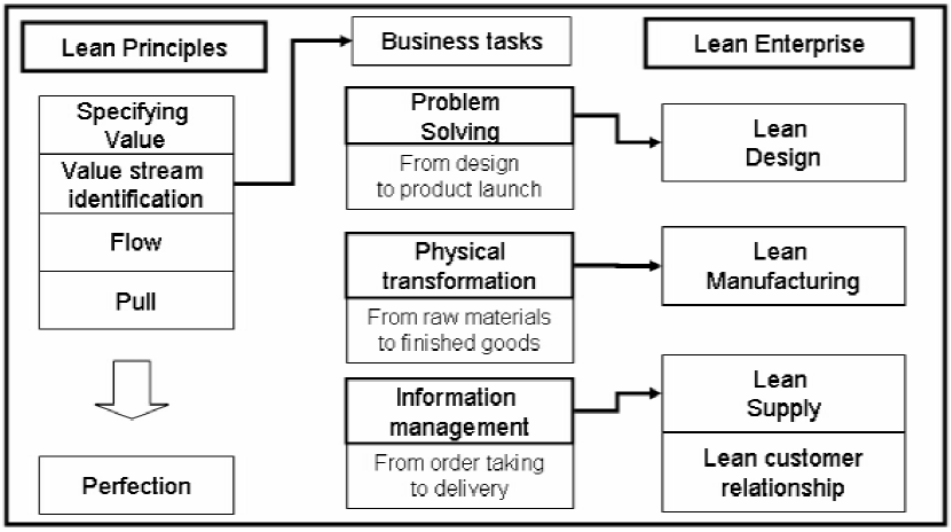
Figure 2. Lean production system (Katyama & Bennett, 1996)

LEAN ENTERPRISE

The initial acceptance of lean model was considered fit only for manufacturing organization. But as the popularity of this system increases & it has proved itself its tools & techniques were applied to the entire

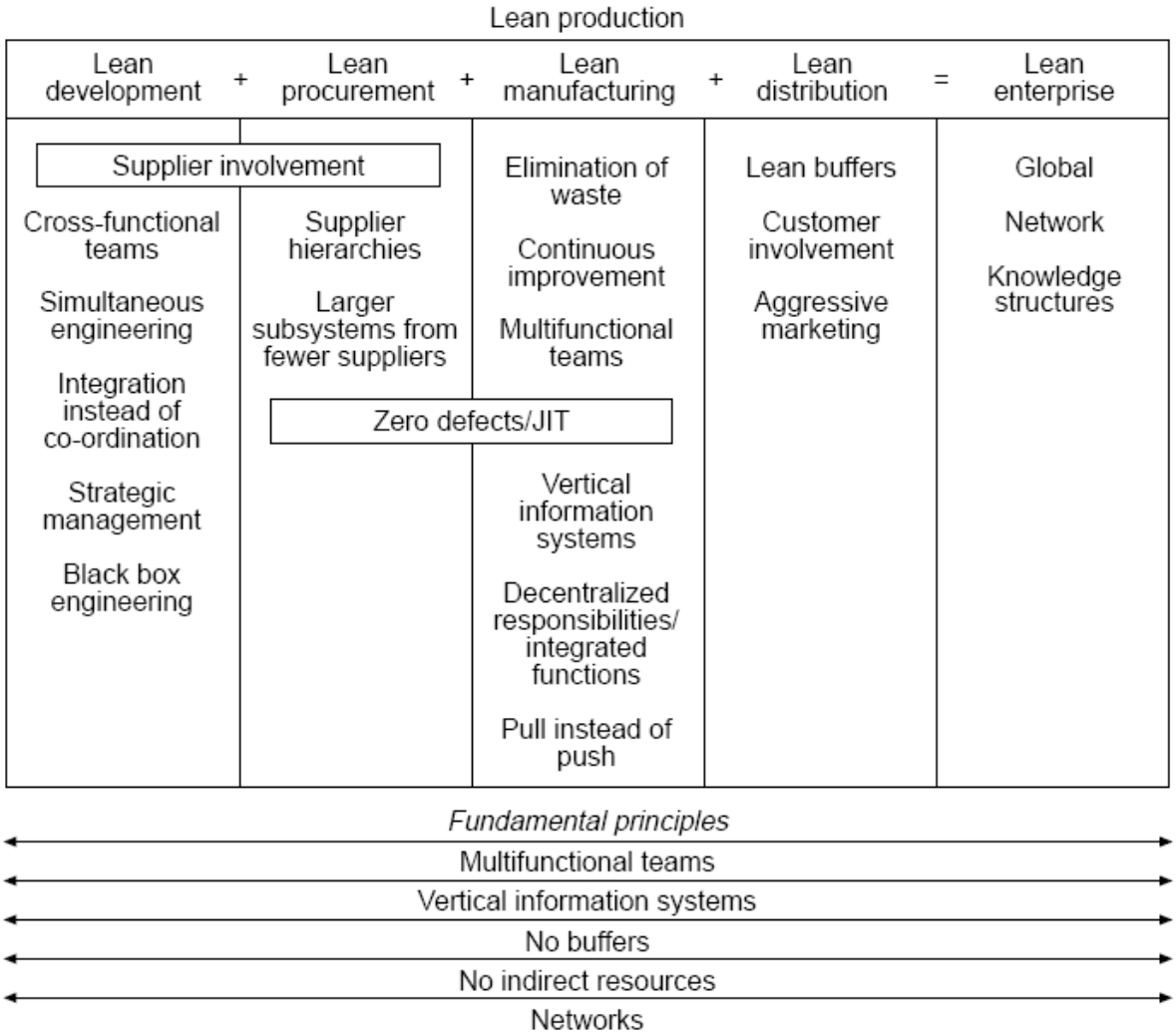
enterprise level. The term enterprise here refers to every element in the organization starting from the suppliers to the customers i.e., it includes every member in the supply chain. A lean enterprise "is a business organization that delivers value to its stakeholders, with little or no superfluous consumption of resources (materials, human, capital, time, physical plant equipment, information, energy)" (Helling, 2001; MIT, 2000; Richards, 1999). Womack et. al (1990) was the first to used the term "Lean Enterprise" and describe it as the extension of the lean manufacturing approach to outside the boundaries of the organization. The lean enterprise concept basically consists of five fundamental principles of value, value stream, flow, pull and perfection as discussed by Womack & Jones(1996). Womack's publication addressed each of these principles separately in their book "Lean thinking". These lean principles are nothing but a problem solving approach to eliminate waste & can be used in any industry.The principles are

- Value: Value is something that the ultimate customer can determine & can except a combinations of goods & services. If there is value that means no waste has been created, & this determines the first principle.
- Value stream : Value stream is the path the product follows from the raw materials to the finished product or in other words assessing the actions of converting the raw material to finished product that are required to deliver the product as specified by the customer.. It involves three business processes: problem solving(from design to product launch), information management(from order booking to delivery) and physical transformation(conversion of raw material to finished good). Once value stream is completed it will show steps that are immediately removable. This is an industry wide study rather than company-wide and therefore should involve the assessment of the relationship with the suppliers of goods & services.
- Flow: It is the interactions between various stages of value stream. The basic concept of flow is to change the perception of process focussed efficiency to product focussed efficiency in which how the interaction between various process play a major role along the supply chain
- Pull: Pull is considered as important element because of the induction of JIT. It is considered as the driver for enabling the value stream. Pull works only when there is a need from the customer side or pull makes the end customer responsible for initiating the production process & works in synchronization with the value stream for satisfying the customer.
- Perfection: It is nothing but the continuous search for identifying waste & due to which the synchronized flow of production doesn't breaks. Lean production solves problems immediately and effectively so they will not recur as in case of traditional manufacturing.



Source: Lean Thinking & the Lean Enterprises(Womack & Jones , 1996; Womack, Jones & Roos, 1990)

Allen (2000), Nanni et al. (1995) and Oliver (1996) insist that there is no right hand thumb rule to explain each step of the lean process and exactly how to apply the tools within an organization. It varies and changes as per requirement of the organization or from process to process . Lathin (2001), Hall (1995) and Lathin and Mitchell (2001a, b, p. 2), insist that quality improvements are only possible if companies implement comprehensive change management programs addressing "both the organisational and technological aspects of quality management" i.e., within the entire enterprise. Bicheno (1999), argues lean needs to apply to every aspect of the value chain so as to keep the system efficient. Karlson and Ahlstrom (1996), insist lean ranges from an organisation's product development to its distributional logistics:
Lean development + lean procurement + lean manufacturing + lean distribution



Source: Karlson and Ahlstrom (1996)

The work by Karlson and Ahlstrom (1996) tries to find out the the important principles contained within lean production. The determinants that were evolved were able to reflect changes in an effort to become lean.

Lean principles are applied to the military, to construction, to service industry. The principles of Lean are universal & have been applied successfully everywhere. Here are few examples from different industries how the lean principles can be applied.

Swank(2003) has defined how lean principles can be applied to a full-service life insurance and annuities company with $31 billion in assets & approximately 3700 employees improve operations & increases revenue. Czabke, Hansen & Doolen(2008) describes how by applying lean principles U.S & German secondary wood product manufacturers be more profitable. Hook & Stehn(2008) examined the applicability of lean principles & practices to industrialized housing in Sweden taking the production culture into considerations. Staats & Upton(2009) use the lean principles in software services & find that lean projects have better schedule & effort performance than non lean projects. Grant (2005) shows how UK aerospace industry via the LAI has adopted similar principles, and in doing so has established a lean enterprise framework for quantifying performance across the entire supply chain.

LEAN CONSUMPTION

Womack & Jones(2005) lean consumption doesn't mean that consumers are buying less or starts consuming less or about reducing the amount customers buy or the business they bring. Rather, it's about providing the full value that consumer's desire from their goods and services, with the greatest efficiency and least pain. Womack et al.(2005) states that for consumption the decision about purchasing a specific product can't be taken in isolation, but as a continuing process linking many goods & services to solve consumer problems. When a customer wants to buy a product he does so many difficult & tedious job of searching catalogues & on internet, consulting with friends & well-wishers or those who are using the product, finding the nearest place from where they can get it, upgrading themselves & finally going for the purchase. For manufacturers or sellers(whether employees, managers or sellers) to achieve lean consumption processes basically requires how well they can linked all the business activities, especially across firms & how well they provide information or attract customers so as to meet customers requirement without much effort, time & resources. This is not a easy task because it requires tight integration & streamlining of various processes & channel members. For achieving lean consumption the major shift that is required is the way the retailers, service providers, manufacturers & suppliers think about the relationship between provision & consumption & the role that the customers play in the processes. Customers & providers must start work in a collaborative way to minimize total cost & wasted time to create new value.

The question that arise at this point of time that when everything is moving as per demand of customer or called the pull process why we are talking about lean consumption now. The answer to this question is that with the way globalization has done & the whole world is like a village & as a result of which the regulated economy is contracting & consumers have more choices at competitive prices and to support this the companies are also customizing their products to the minutes of the customer demand. With the support of information technology the time between consumption & production has been blurred. Consumers are doing a big chunk of job free of cost for the companies by doing entering the data into web based order forms & by tracking the progress of their orders. In order to meet this changing demand Womack et al.(2005) defined six simple principles underlying lean consumption:

- Try to solve all the customers' problem regarding goods & service which includes the search for obtaining, installing, integrating, maintaining and dispose of them over an extended period.
- Don't waste the customers time
- Provide exactly what the customers wants
- Provide what exactly customer want & where it's wanted
- Provide what, where exactly customer want & when it's wanted
- Continuously tries to work together to find solutions to reduce the customers time & hassle

The lean consumption can be achieved somewhat through postponement strategy for example a two wheeler automobile manufacturer has launched 99 variants colour of its product, now for a automobile

dealer to handle a stock of this much variant is very difficult & almost impossible because it requires lot of size & huge investment. So company has decided that only some parts of the two-wheeler would be coloured & the rest part will be based on modular manufacturing. The local dealer has tie-up with the nearest body paint shop so when a customer is demanding for an unusual colour vehicle model that part can be sent to paint shop & the painted part get assembled to the vehicle & the two-wheeler can be delivered to the customer within prescribed time period. This can only be possible when all the channel members are working for the provision & consumption.

Consumers also play a very vital role in lean consumption, the consumption problem of consumers will be solved completely, getting just what they want, when they want, where they want, and at an attractive price from a small number of providers, without not wasting time, hassle free work and with no unpaid work and this can be possible it they work in coordination with the other member of the supply chain. The biggest challenge lies with retailers, service providers, manufacturer and suppliers that are not looking at total cost from the standpoint of the consumer & seeing only from there own convenience & profitability but the real profit lies when they work for the real consumers who is ultimately going to consume the product & the biggest challenge is that they are even less accustomed of working with customers.

CONCLUSION

The lean principles have travelled a long way from shop floor to the entire enterprise to the final consumer's hand. This principle is universal & can be applied to any operation process. The universality of lean should help motivate an adaptational approach to implementing the concept. The major difficulties companies encounter in attempting to apply lean is a lack of direction, planning & adequate project sequencing. In implementing lean principles in any organization the most important thing that should be taken care is view lean as a long journey, requires continuous improvement & numerous cultural changes embracing empowerment & sponsor the lean principles through-out the value chain.

References:

REFERENCES:

Bhasin ,S. & Burcher, P.(2006). Lean viewed as a philosophy. Journal of manufacturing Technology Management, Vol. 17 No. 1, 2006

Czabke J., Hansen E. & Doolen T.(2008). A multisite field study of Lean thinking in U.S and German secondary wood products manufacturers. Forest Products Journal Vol.58, No.9

Grant B. Susan(2005). Supply chain restructuring in UK aerospace. Marketing Management Journal, Fall 2005

Karlsson, C., & Ählström, P. (1996). Assessing changes towards lean production. International Journal of Operations and Production Management, 2(16), 24– 41

Katayama, H., & Bennet, D. (1996). Lean production in a changing competitive world: A Japanese perspective. International Journal of Operations and Production Management, 16(2), 8–23.

Krafcik, J. (1988). Triumph of the lean production system. Sloan Management Review, 30(1), 41–52

Hook. M & Stehn L(2008). Applicability of lean principles and practices in industrialised housing production. Construction Management & Economics(October 2008) 26, 1091-1100

Lathin, D. (2001), "Lean manufacturing", American Society for Quality Journal, December, pp. 2-9.

Lathin, D. and Mitchell, R. (2001a), "Learning from mistakes", Quality Progress, June, pp.1-8.

Lathin, D. and Mitchell, R. (2001b), "Lean manufacturing: techniques, people and culture", Quality Congress Proceedings, Milwaukee, WI, June, pp. 2-6.

Lewis, M. (2000). Lean production and sustainable competitive advantage. International Journal of Operations and Production Management, 20(8), 959–978.

MacDuffie, J. (1995). Human resource bundles and manufacturing performance: Organizational logic and flexible production systems in the world auto industry. Industrial and Labor Relations Review, 48(2), 197–220

Monden,Y. (1983). Toyota Production System: Practical approach to production management. Norcorss, GA: Industrial Engineering and Management Press

Ohno, T. (1988). Toyota Production System. Cambridge, MA: Productivity Press

Papadopoulou, T.C. and Ozbayrak, M. (2004), "Lean enterprise: evolution and critical review", School of Engineering & Design, Brunel University, London

Shah, R., & Ward, P. (2003). Lean manufacturing: Context, practice bundles, and performance. Journal of Operations Management, 21, 129–149

Staats R. Bradley & Upton M. David(2009). Lean principles, learning & software production: evidence from Indian Software services. Working paper 08-001 Harvard Business School. March 2009

Swank C. (2003) The lean service machine. Harvard Business Review. October(2003)

Warnecke, H., & Hüser, M. (1995). Lean production. International Journal of Production Economics,41, 37– 43.

Womack, J., & Jones, D. (1996). Lean thinking. New York: Simon & Schuster.

Womack, J., Jones, D., & Roos, D. (1990). The machine that changed the world. New York: Macmillan.

Womack, J.& Jones, D., (2005). Lean Consumption. Harvard Business Review March 2005.
