A FRAMEWORK TO DEVELOP TOOLS & TECHNIQUES REQUIREMENTS METHODOLOGY FOR IMPLEMENTING LEAN MANUFACTURING

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A FRAMEWORK TO DEVELOP TOOLS & TECHNIQUES REQUIREMENTS METHODOLOGY FOR IMPLEMENTING LEAN MANUFACTURING

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Abstract:

Increased global competition and customer demands that are looking for better quality product with less cost seem to force companies into implementing lean tools and techniques in their production line. This can lead them to keep or strengthen their competitive position by eliminating the waste of non value added activities and producing value to product that meet customer requirements without affecting the actual quality of the product produce. Example can be found in the automotive industry, electronic industry, aerospace industry, but also the service industry.

The deployment of tools and techniques of lean manufacturing became important factor in implementing LM in manufacturing industry. This tools and techniques must be deploying properly so it can bring continuous improvement and sustainability in manufacturing perspective.

This PhD proposal aspires to research the main question of how to determine the appropriate tools and techniques requirement methodology for an organization to implement and what are the tools and techniques that need to be deployed to achieve successful implementation. The literature review concerning this area of research has established that there were gaps in the knowledge that required further research. These research gaps with research scope are presented in detail in this paper. The overall specifications of the proposed methodology are also discussed.

Keywords:

Lean Manufacturing, Tools and Techniques, Sustainability Change.

1 Introduction

After World War II, Japanese manufacturers, particularly in the automotive industry, were faced with the dilemma of shortages of material, financial, and human resources. Eiji Toyoda and Taiichi Ohno at the Toyota Motor Company in Japan pioneered the concept of the Toyota Production System, or what is known today in the US as "Lean Manufacturing." The basic idea behind the system is eliminating waste. Waste is defined as anything that does not add value to the end product from the customer's perspective. The primary objective of lean manufacturing is to assist manufacturers who have a desire to improve their company's operations and become more competitive through the implementation of different lean manufacturing tools and techniques. Quickly following the success of lean manufacturing in Japan, other companies and industries, particularly in the US, copied this remarkable system. The term "lean" as Womack and Jones (1994) define it denotes a system that utilizes less, in terms of all inputs, to create the same outputs as those created by a traditional mass production system, while contributing increased varieties for the end customer. Lean is to manufacture only what is needed by the customer, when it is needed and in the quantities ordered. The manufacture of goods is done in a way that minimizes the time taken to deliver the finished goods, the amount of labor required, and the floor-space required, and it is done with the highest quality, and usually, at the lowest cost.

A study that was done at the Massachusetts Institute of Technology of the movement from mass production toward lean manufacturing, as explained in the book "The Machine That Changed the World" (Womack, Jones and Ross, 1990), awoke the US manufacturers from their sleep. The study underscored the great success of Toyota at NUMMI (New United Motor Manufacturing Inc.) and brought out the huge gap that existed between the Japanese and Western automotive industry. The

ideas came to be adopted in the US because the Japanese companies developed, produced and distributed products with half or less human effort, capital investment, floor space, tools, materials, time, and overall expense (Womack et al., 1990).

The term "lean" as Womack and his colleagues define it denotes a system that utilizes less, in term of all inputs, to create the same outputs as those created by a traditional mass production system, while contributing increased varieties for the end customer (Panizzolo, 1998). This business philosophy goes by different names. Agile manufacturing, just-in-time manufacturing, synchronous manufacturing, world-class manufacturing, and continuous flow are all terms that are used in parallel with lean manufacturing. So the resounding principle of lean manufacturing is to reduce cost through continuous improvement that will eventually reduce the cost of services and products, thus growing more profits. "Lean" focuses on abolishing or reducing wastes (or "muda", the Japanese word for waste) and on maximizing or fully utilizing activities that add value from the customer's perspective. From the customer's perspective, value is equivalent to anything that the customer is willing to pay for in a product or the service that follows. So the elimination of waste is the basic principle of lean manufacturing. For industrial companies, this could involve any of the following (Womack et al., 1990; Ohno, 1997; Monden, 1998; Shingo, 1997; Mid-America Manufacturing Technology Center, 2000):

- ***Material:*** Convert all raw materials into end products. Try to avoid excess raw materials and scrap.
- ***Inventory:*** Keep constant flow to the customer and to not have idle material.
- Overproduction: Produce the exact quantity that customers need, and when they need it.
- ***Labor:*** Get rid of unwarranted movement of people.
- ***Complexity:*** Try to solve problems the uncomplicated way rather than the complex way. Complex solutions tend to produce more waste and are harder for people to manage.
- ***Energy:*** Utilize equipment and people in the most productive ways. Avoid unproductive operations and excess power utilization.
- ***Space:*** Reorganize equipment, people, and workstations to get a better space arrangement.
- ***Defects:*** Make every effort to eliminate defects.
- ***Transportation:*** Get rid of transportation of materials and information that does not add value to the product.
- ***Time:*** Avoid long setups, delays, and unexpected machine downtime.
- ***Unnecessary Motion:*** Avoid excessive bending or stretching and frequently lost items.

In achieving the above goals by eliminating the waste, deployment of tools and techniques of lean manufacturing become the backbone of lean manufacturing success to identify and eliminate the non-value added activities. Therefore it is important for us put more emphasis on implementation and deployment of this tools and techniques towards sustaining the change.

This proposal aspires to research the main question of how to determine the appropriate lean tools and techniques requirement methodology for an organization to implement and what are the tools and techniques that need to be deployed to achieve successful implementation.

2 Literature Review

One of the initial objectives of this research was to identify the main issues that the manufacturing industries need to consider prior to deciding on whether or not to implement specific lean tools and techniques. Moreover, it was important to identify the resources and factors that are likely to have an impact on sustaining the change after implementation. Therefore, a comprehensive literature review concerning this area of research was carried out to achieve this objective.

Papadopoulau and Ozbayrak (2006) stated that in this dynamic nature, leanness has undergone and still is undergone a process of continuous and never ending evolution. Since the introduction of the Toyota Production System, the lean concept has spread all over the world. The apparent success of Toyota in implementing a lean manufacturing system has led many of the world's automotive industries to try to implement this new idea of "lean" at their own companies. In this new era the application of lean manufacturing is seen in almost all companies in the automotive industry in Japan, Europe and North America. Most of the lean manufacturing ideas have been applied at the component assembly level, especially in discrete manufacturing. In the automotive industry the bulk of the work involved in making a car is carried out at the assembly level. This is due to the huge number of parts involved in building a car. These individual parts are first assembled at the component plants and then the final assembly of these parts is carried out at the assembly plant (Womack et al., 1990). The success of the

Toyota production system has led the way for many companies in the discrete manufacturing industry to become lean in order to reduce cost through waste reduction and continuous improvement. The lean manufacturing concept is now being widely used in component assembly operations in a variety of industries, e.g., automotive, electronics, and cameras (Dimancescu et al., 1997). In the United States many other companies particularly in the discrete industry have adapted lean manufacturing tools and techniques. These include industries like shipbuilding, telecommunication equipment, office furniture, appliances, and computer part assembly. Other areas that have implemented lean manufacturing, particularly in Europe, include motorcycles and scooters, clothing, amusement park equipment, construction of vacuum pumps, air conditioning systems for cars, and bicycle components (Panizzolo, 1998).

In a study done by Industry week in 2001, a survey was conducted on the adoption of lean manufacturing tools and techniques. The study included 313 telephone interviews and 2,511 responses from mail surveys (Strozniak, 2001). The results of the survey illustrate that 32% of manufacturers use predictive or preventive maintenance, an increase from 28% in 2000 and 20% in 1999. Also 23% of manufacturers are using continuous-flow production, up from 21% in 2000 and 18% in 1999, and 19% of manufacturing firms have adopted cellular manufacturing, an increase from 17% in 2000. Less than 20% of manufacturers adapted other lean tools such as lot-size reductions, bottleneck/constraint removal, and quick-changeover techniques (Strozniak, 2001). Another lean manufacturing tool that has been widely used in the discrete industry is JIT. The automotive industry has been strongly influenced by the fundamental concept of JIT. Toyota for example led the way in using JIT where JIT principles have been used with its suppliers (Womack et al., 1990). In the fifties, the Japanese shipyards implemented JIT in their steel deliveries from steel mills (Schonberger, 1982). White (1992) states that JIT practices have been implemented in industries like electronic/electric, transportation equipment, health and medical components, and machinery.

Published literature highlights number of successful factors in implementing lean manufacturing in various types of organizations. Motwani (2003) by means of a case study, discuss a successful lean manufacturing implementation experience at a medium-size automation manufacturing company in the Midwest region of the USA. Specifically, he examines the factors that facilitated and inhibited the success of Lean Manufacturing at the case study company. Another study by Bhasin (2006) who has found a cocktail of factors for lean success is focus not only necessary to implement most of the technical tools but an organization's culture needs transforming too.

Bhuiyan and Baghel (2005) stated in their overview of continuous improvement that little focus has been directed towards developing a framework or model that would enable an organization to identify the CI methodology that best suits its needs, given certain budget for such programs. Furthermore, they have suggested topic to pursue in the filed of CI is how to determine the appropriate CI methodology for an organization to implement and what are the tools and techniques that need to be deployed to achieve successful implementation.

2.1 Discussion of the Literature Review

Although a number of authors discuss the issues outlined above, they fail to provide requirements methodology that guides the organization through the decisions that need to be taken before implementing lean tools and techniques. Moreover, despite literature suggesting 'what' an organization needs and have practice, it fails to state 'why' it is being practice, and 'how' it should be implemented to make it sustaining change.

The literature often fails to consider that companies are different sizes, have different financial turnovers, and have different levels of resources available. There would therefore be little point in attempting to implement Lean tools and techniques if insufficient finances and resources were available to support it.

3 Research Scope

The literature review presented in section 2 indicated that there were two gaps in the knowledge that required further research. The first gap concerns the absence of a structured methodology that can guide an organization through the requirements that needs to take prior to implement lean tools and techniques. The second gap concerns the question of how an organization can determine the appropriate lean tools and techniques and deployed base on requirements to achieve successful

implementation. That is, how can the organization able to sustaining the change after implementing lean tools and techniques? It is clear, therefore, that developing a framework requirements methodology to fill these gaps should prove useful to manufacturing Industry. The gaps led to the development of the research aim, which was to develop a methodology that can guide manufacturing industry the requirements that need to be taken when implementing lean tools and techniques. In order to achieve the research goals, information needed to be gathered from sources such as literature, case studies and questionnaires survey. The information was obtained by following a research methodology that included literature reviews and interviewing. The adopted methodology will be discussed in the next section

4 Research Methodology

A research methodology that satisfies the demands of both academia and industry has been chosen. The methodology is divided into the following four phases, as illustrated in Figure 1. The first phase will be to carry out a review of published literature, focusing on lean tools and techniques implementation, deployment, strategy and their requirements. (the review was presented in section 2). Published literature will be reviewed in order to identify any gaps in the knowledge of the current research area for which further research is required.

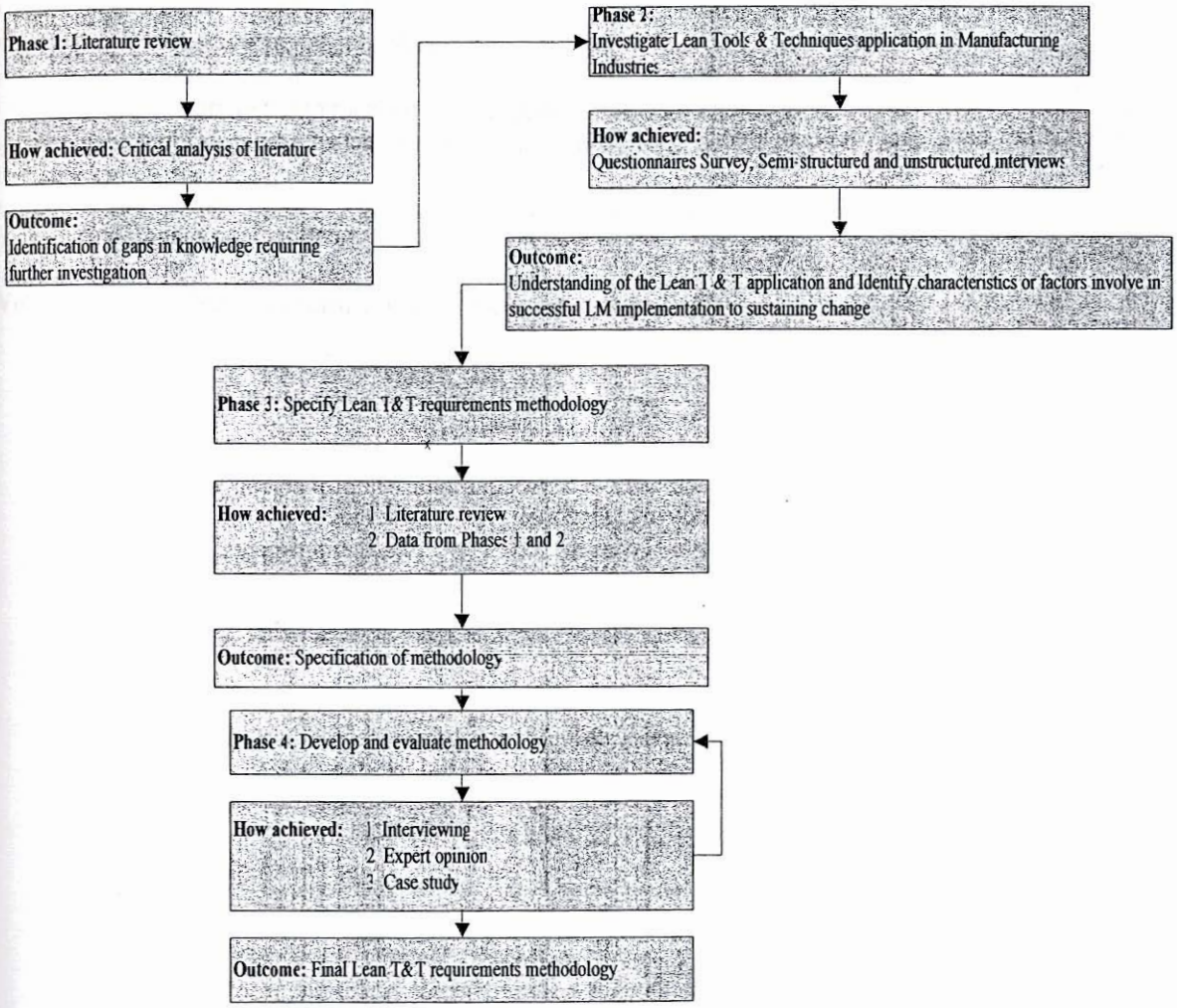

Figure 1: Research methodology adopted

The second phase will be to carry out an investigation of Manufacturing Industry. The aim will be to gain an overall understanding of the environment in which the manufacturing industry are operating, and to identify their lean tools and techniques requirements. The primary focus will be on their implementing strategy to sustaining the change within the industry, and the problems that have arisen. The third phase will involve specifying the requirements methodology. The specification will be derived from information obtained by completing both the first and second phases. The fourth phase

will involve the development and evaluation of a methodology that can be used by manufacturing industry.

5 Main Characteristics of the Proposed Methodology

Identifying the required specification of the requirements methodology was the first stage of the development process. The specification was based on issues that arise from the literature review presented in section 2 and from feedback obtained from questionnaire survey to various manufacturing industries. The literature review and the company survey helped to identify the contents to be included within a requirements methodology for implementing lean tools and techniques. It was emphasized that the methodology should begin by focusing on following characteristics in implementing lean tools and techniques (Feld, 2001):

- Committed management
- Winning employee commitment
- Empowering employees(responsibility and accountability at the lowest level)
- Optimized equipment reliability
- Measurement (lean performance) system
- Plant-wide lines of communication
- All processes and workflows defined
- Making and sustaining cultural change
- Team based organization
- Continuous improvement practiced in all departments and at all levels
- Flatter organizational structure (less middle-level management)
- Measures of performance used
- Balanced production(not maximum and not overproduction)
- Quality the first time and every time

Without them, any lean transformation is ultimately doomed to failure.

Conclusion

This paper presented a framework of a proposed lean tools and techniques requirements methodology for implementing lean manufacturing within manufacturing industries. Research gaps concerning this area of research have been identified. These were based on literature review. A research methodology that satisfies the demands of both academia and industry has been selected. The research methodology was divided into four phases. The main specifications of the proposed requirements methodology were identified. Although the proposed requirements methodology will be developed in collaboration with world class manufacturing industries within the aero composite, electric and electronic, automotive product Industries, companies of other size and industries will also find it useful.

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