Exploratory Study on Lean Manufacturing Tools and Techniques in Selected Manufacturing Firms in Metro

Eric Santos Parilla
University of Asia and the Pacific

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ABSTRACT

This study explored the awareness, usage and problems encountered by manufacturing companies for tools and techniques of lean manufacturing. It surveyed 61 manufacturing companies. The results showed moderate awareness of the different companies of lean manufacturing tools and techniques. It was also revealed that the two most commonly used or implemented lean manufacturing tools are standardized work and PDCA. Finally, the problem that most manufacturing companies faced in the implementation of lean manufacturing is backsliding to the old ways and processes.

Keywords: lean manufacturing, operations, manufacturing, management

1. INTRODUCTION

The most significant operations and supply management approach for the past 50 years is lean production or manufacturing. Lean production or manufacturing refers to a focus on eliminating as much waste as possible. Examples of such will be moves that are not needed, unnecessary processing steps and excess inventory in the supply chain. Some of the experts of the industry have coined the term value chain to refer to the concept that each step in in the supply chain processes that delivers products and services to customers should create value. If it does not create value, then it should be removed from the process. Lean production supplies the customer with exactly what the customer wants when the customer wants it, without waste, through continuous improvement. Lean production is driven by workflow initiated by the pull of the customer's order. Lean operations encompass all related approaches and techniques of both just-in-time and Toyota-production system. Regardless of the approach and label, operations managers address three issues that are fundamental to operations improvement: eliminate waste, remove variability, and improve throughput because according to the study of Tresnawati,et.al. (2017), costs of efficiency and quality significantly influence profitability of a company.

Lean manufacturing is an integrated set of activities designed to achieve production using minimal inventories of raw materials, work-in-process and finished goods. Parts arrive at the next work station just-in-time and are completed and move through the process quickly. The basis of lean thinking came from the just-in-time production concepts pioneered in Japan at Toyota. Even though JIT gained worldwide prominence in the 1970s, some of its philosophy can be traced to the early 1900s in the United States. Henry Ford used JIT concepts as he streamlined his moving assembly lines to make automobiles.

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If the LEAN principles are properly set in the organization, the financial benefits are highly significant. A satisfied customer will make any business operate smoothly. The reduction in waste and defects adds additional money which should be set into quality improvement and the better product quality ensures higher profit. The money saved on product storage and inventory management adds additional cash flow in the company. However, less employees means additional training for workers but with clear work instructions and standardized work the job is easily and more eagerly performed. Managing satisfied workers is easily conducted and makes any business prosper on the long run.

In this study, it explores the tools and techniques of lean manufacturing used by selected manufacturing companies in Metro Manila. It studies the extent of awareness and usage of the different tools and techniques in lean manufacturing. Moreover, it examines the department/s where these tools and techniques are used. Lastly, it describes what are the common problems encountered by people using tools and techniques in lean manufacturing.

2. STATEMENT OF THE PROBLEM

Generally, the main purpose of this study is to determine the tools and techniques in lean manufacturing of manufacturing companies located in Metro Manila.

Specifically, it answers the following questions:

1. What is the level of awareness of lean manufacturing practices in the organization?
2. What is the level of implementation of lean manufacturing tools and techniques in selected manufacturing companies in Metro Manila?
3. What is the level of implementation of lean manufacturing tools and techniques in the different areas of the organization?
4. What are the different problems encountered in the implementation of lean manufacturing tools and techniques?

3. REVIEW OF RELATED LITERATURE

The concept of LM was pioneered by a Japanese automotive company, Toyota, during 1950's which was famously known as Toyota Production System (TPS). The primary goal of TPS were to reduce the cost and to improve productivity by eliminating wastes or non- value-added activities (Womack *et al.*, 1990). During 1980's there was an intense interest on LM implementation among the western manufacturers because of growing Japanese imports. It became a serious concern to the western producers (Holweg, 2007). LM consists of a large number of tools and techniques. Shah (2003) identified twenty two LM practices that are frequently mentioned in literatures and categorised them into four bundles associated with Just-in-Time, Total Quality Management, Total Preventive Management and Human Resource. Some other researchers also categorised the lean tools and techniques according to the area of implementation such as internally and externally oriented lean practices (Olsen, 2004; Panizzolo, 1998; Shah and Ward, 2003). For example Panizzolo (1998) divided the lean practices into six areas which are process and

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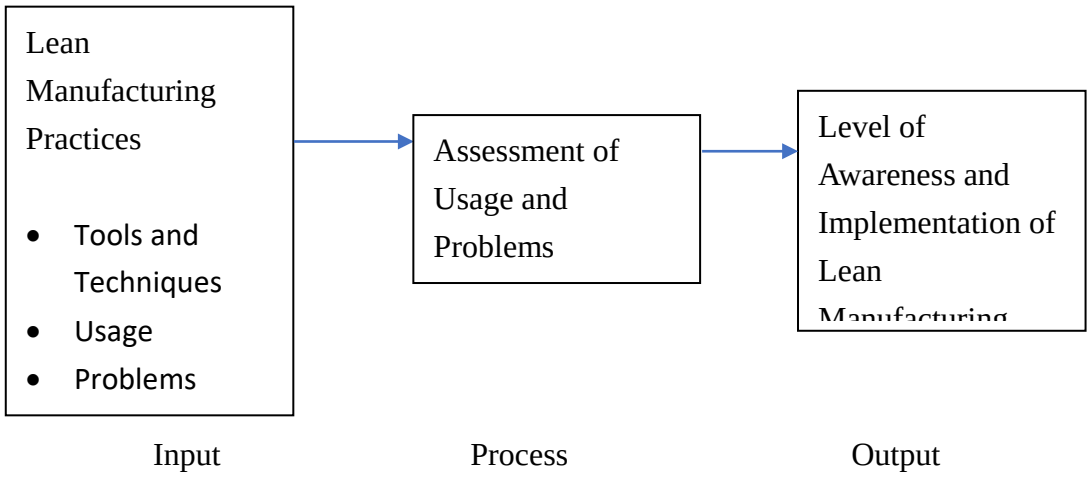
equipment; manufacturing, planning and control; human resources; product design; supplier relationships; and customer relationships. The first four areas are grouped as internal oriented lean practices, whereas supplier relationships and customer relationships are under external oriented lean practices. This study also confirms that, many firms seem to have difficulty in adopting lean tools that concern with external relationships with suppliers and customers even for high performance firms. Empirical results from this study also prove that lean tools in internal areas are adopted most widely in the firms, where the operation and management methods are more direct.

In a study by Kumar (2012), it was found out that most of the employees are aware of lean manufacturing practices in the automobile sector industry of India. It was also revealed that kaizen is being used the most followed by 5s. Kaizen can play a leading role in making lean process successful one as it helps the organization to meet the challenge of doing more with the same or less resources. This is achieve by eliminating unnecessary steps in achieving that end. The main impediment of automobile industry in India in implantation of lean manufacturing practices is the dependency on traditional system of working and organizations lack the training and experience of staff.

On the other hand, in a study by Nordin (2011), the lean manufacturing tools that are commonly implemented by the automotive industry in Malaysia are also Kaizen, 5s and preventive maintenance. On the other hand, the three main barriers in non- lean firms are the lack of lean understanding, lack of senior management and middle management attitudes. On the other hand firms which are in- transition towards lean system, most of their barriers are in the lack of lean understanding and employees' attitude.

Lastly, a study by Tortorella (2017) suggest that overall, in companies with higher levels of LM practices implementation, the contextual variable that must be mainly observed by senior managers and directors is the number of followers that both Middle Managers and Frontline Leaders are responsible for. Despite results show that this association may not always happen as expected, senior management must take into account this variable and the current phase of the lean implementation in order to better comprehend the desired behaviors of these hierarchical levels.

4. CONCEPTUAL FRAMEWORK



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The figure suggest that the input variables includes the different tools and techniques in lean manufacturing and the problems encountered. The researcher assessed the usage and problems to come up with the level of awareness and implementation of these lean manufacturing practices.

5. RESEARCH METHODOLOGY

The questionnaire based survey methodology is applied to answer the specific questions of this study. This report has its focus on lean manufacturing tools and techniques in manufacturing firms in Metro Manila. The purpose of this is to explore on the lean manufacturing tools and techniques. Initially, data is gathered using the survey and subsequently, an interview is conducted to some manufacturing firms in Metro Manila. This project report is based on data analysis.

6. POPULATION AND SAMPLE

The sampling method used in this study is a combination of convenience sampling and judgment sampling. The researcher selects the sample based on judgment. The sample size of the study was 61 respondents. The method used for sample technique was random sampling method. This method was used because it was not known previously as to whether a particular person will be asked to fill the questionnaire. Also, the basic aim of doing the research was academic; hence most convenient way was selected.

7. INSTRUMENT DEVELOPMENT

In this research both the primary and secondary data has been used. Primary data has been collected through survey method. The researcher has used a structured questionnaire. The questionnaire was designed on an extensive review of the literature, research papers and relevant studies on lean manufacturing processes.

8. DATA COLLECTION

The primary data was collected on the responses received from the given questionnaire. The respondents include operations managers, owners and executives of different manufacturing companies in Metro Manila. The researcher with the help of his students initially distributed 100 questionnaires but only 79 was returned. The remaining 28 questionnaires were not returned. Out of 79 questionnaires, 61 were filed up properly and completely.

The first part of the questionnaire was demographic profile. The second part was about the organizational profile of the respondents. The third part was about lean manufacturing tools and techniques

9. DATA ANALYSIS AND INTERPRETATION

Q.1 What is the level of awareness of lean manufacturing practices in the organization?

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Table 1. Level of Awareness of Lean Manufacturing Practices

Response	Frequency	Percentage
Highly Aware	16	26.23
Moderately Aware	21	34.43
Slightly Aware	19	31.15
Not Aware	4	6.56
Total	61	100.00

The table highlights that 34.43% or 21 respondents are moderately aware or acquainted about the processes and functions of lean manufacturing which is being practiced by the organization. Contrary to this, only 4 or 6.56% of the respondents are less informed or unaware about it. It is very revealing to note that some employees are slightly aware or unaware about a system that can help the organization grow and that it can aid for the betterment of the organization. It is noteworthy to emphasize that almost 1/3 of the respondents are unaware of lean manufacturing tools and techniques. This means that it should be given sufficient trainings on lean manufacturing tools and techniques.

Q.2 What is the perception of the respondents about lean manufacturing processes?

Table 2. Perception about Lean Manufacturing Processes

Response	Frequency	Percentage
Waste Reduction	27	44.26
Continuous Improvement	10	16.39
Tools and Techniques to improve operation	8	13.11
Headcount Reduction	2	3.28
A System to organizing and managing product development, supplier and customer relations	9	14.75
Toyota production system	2	3.28
A fully integrated management philosophy	6	9.84
A way of life	4	6.56
Total	61	100.00

Table 2 presents the perception of respondents about lean manufacturing. The study reveals that most respondents perceived lean manufacturing as waste reduction with a total of 44.26% followed by continuous improvement. It is known fact to the respondents that lean manufacturing is eliminating waste in the production processes. It is maximizing the resources and is achieved by eliminating unnecessary steps in achieving the desired output or end.

Q.3 What is the level of implementation of lean manufacturing tools and techniques in selected manufacturing companies in Metro Manila

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Table 3. Level of Implementation of Lean Manufacturing Tools and Techniques

Response	Mean	Verbal Interpretation
5S	2.75	MI
Andon	1.77	SI
Bottleneck Analysis	2.43	SI
Continuous Flow	2.67	MI
Gamba (The Real Place)	1.89	SI
Heijunka (Level Scheduling)	1.93	SI
Hoshin Kanri (Policy Deployment)	2.10	SI
Jidoka (Autonomation)	1.97	SI
Just-In-Time (JIT)	2.87	MI
Kaizen (Continuous Improvement)	2.87	MI
Kanban (Pull System)	2.20	SI
KPIs (Key Performance Indicators)	2.90	MI
Muda (waste)	2.43	SI
Overall Equipment Effectiveness (OEE)	2.69	MI
PDCA (Plan, Do, Check, Act)	3.11	MI
Poka Yoke (Error Proofing)	2.48	MI
Root Cause Analysis	2.89	MI
Single Minute Exchange of Dies (SMED)	1.87	SI
Six Big Losses	1.93	SI
SMART Goals	2.92	MI
Standardized Work	3.21	MI
Takt Time	2.30	SI
Total Productive Maintenance (TPM)	2.64	MI
Value Streaming Mapping	2.21	SI
Visual Factory	2.31	SI
Legend: **1.00-1.75 Not Implemented** **1.76-2.50 Slightly Implemented** **2.56-3.25 Moderately Implemented** **3.26-4.00 Highly Implemented**		

The study revealed that among the tools and techniques in lean manufacturing, standardized work is being used mostly (x=3.21) with a verbal interpretation of Moderately implemented followed by PDCA (x=3.11), SMART goals (x=2.92) and KPIs (x=2.90). The foundation of the everyday operation in Toyota Production System is Standardized Work which means standardized procedures that regulate every single work step in the entire process of producing an automobile. Concentrating on human movements, Standardized Work sets up the best work sequence for each manufacturing and assembling process. Once the most efficient sequence has been determined, it is always repeated in exactly the same way, thereby avoiding unnecessary motion and wasted effort, maintaining quality, assuring safety, and preventing damage. Manufacturing firms in Metro Manila follow the standardized work system. In an interview

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by the researcher to one of the manufacturing firms, the most significant aspect of Work Standard is that it is established on-site, at the worksite by very people who follow the rule after they themselves set them. Each worksite manager is in charge of standardized work for his group. Thus, all the people in the organization must help each other to achieve the objectives of standardized work.

Q.4 What is the level of implementation of lean manufacturing tools and techniques in the different activities of the organization

Table 4. Level of Implementation of LM tools and Techniques In Different Activities

Response	Mean	Verbal Interpretation
Scheduling	3.64	HI
Inventory	3.49	HI
Material Handling	3.44	HI
Equipment	3.43	HI
Work Processes	3.46	HI
Quality	3.56	HI
Employees	3.15	MI
Layout	2.95	MI
Suppliers	3.03	MI
Customers	3.16	MI
Safety and Ergonomics	3.03	MI
Product Design	3.02	MI
Management and Culture	2.95	MI
Tools and techniques	3.23	MI
Legend: **1.00-1.75 Not Implemented** **1.76-2.50 Slightly Implemented** **2.56-3.25 Moderately Implemented** **3.26-4.00 Highly Implemented**		

The present study highlights that the main activity where lean manufacturing is implemented is scheduling activities with a mean rating of 3.64 and verbal interpretation of Highly Implemented. It is followed by quality (x=3.56), inventory (x=3.49) and work processes.

Lean manufacturing benefits extend to inventory, scheduling and production control. The functional layout presents severe scheduling and inventory control difficulties. Production planning in a lean environment requires smoothing out the peaks and valleys in the production schedule. This aids to maximize the utilization of the production facility. Levelled production aims to run a constant quantity of all the operations, hence without the levelling system, there would be great difficulty in dealing with uncertain demand fluctuations. Unless there is a surplus of labor, capacity and large quantities of inventory, the concept of a levelled schedule is required. The benefits of this constant production and levelled schedule are reduced overall waste.

Q.5 What is the level of implementation of lean manufacturing tools and

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techniques in the different departments of the organization?

Table 5. Level of Implementation of LM tools and Techniques In Different Departments

Response	Mean	Verbal Interpretation
Production	3.56	HI
Quality Control	3.48	HI
Purchasing	3.18	MI
Sales	3.03	MI
Planning	3.20	MI
HR	2.66	MI
Research and Development	2.74	MI
Maintenance	3.25	MI
Finance	3.03	MI
Marketing	2.59	MI
Legend: **1.00-1.75 Not Implemented** **1.76-2.50 Slightly Implemented** **2.56-3.25 Moderately Implemented** **3.26-4.00 Highly Implemented**		

The present study highlights that production department of the selected manufacturing firms is the department which implements lean manufacturing tools and techniques the most with mean rating of 3.56 and verbal interpretation of highly implemented. It is disclosed also in the study that the quality control department (x=3.48) and maintenance department (x=3.25) are also quite watchful about the implementation of lean manufacturing.

The main idea of Lean Manufacturing is to increase the efficiency of a process by working smarter, not harder and without increasing the workload. This can be done by eliminating different kinds of wastes (non-value adding activities). In production and quality departments of any manufacturing firms, it is necessary that wastes should be reduced or even eliminated. These departments cater to the inventories and finished goods of the organization, and reduction of wastes would yield to big savings for the organization.

Q.6 What are the different problems encountered in the implementation of lean manufacturing tools and techniques?

Table 6 Problems Encountered In the Implementation Of LM Practices

Response	Mean	Verbal Interpretation
Lack of top management support	2.05	S
Failure of past lean projects	2.18	S
Financial benefits not recognized	2.20	S
Does not practice what is preached	2.18	S

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Lack of time	2.30	S
Lack of know-how to implement	2.44	S
Company culture	2.28	S
Budget constraints	2.34	S
Employee resistance	2.48	S
Backsliding to the old ways of working	2.69	O
Legend: **1.00-1.75 Rarely** **1.76-2.50 Sometimes** **2.56-3.25 Often** **3.26-4.00 Always**		

This study attempted to mark the impediments which are often faced by the organization while implanting lean manufacturing practices. The main problem according to the respondents is backsliding to the old ways of working with a mean rating of 2.69 and a verbal interpretation of Often.

With the business environment experiencing so much change, organizations must then learn to become comfortable with change as well. Therefore, the ability to manage and adapt to organizational change is an essential ability required in the workplace today. Yet, major and rapid organizational change is profoundly difficult because the structure, culture, and routines of organizations often reflect a persistent and difficult-to-remove "imprint" of past periods, which are resistant to radical change even as the current environment of the organization changes rapid. Learning lean manufacturing and making it a way of life is a radical step thus making it acceptable to the employees would be a big challenge to the organization. However, making the employees aware of the benefits of lean manufacturing, will be making it easier for them to accept.

10. CONCLUSION AND RECOMMENDATION

Lean is a continuous improvement philosophy which is Synonymous with **Kaizen** or the **Toyota Production System.** The history of lean management or lean manufacturing is traced back to the early years of Toyota and the development of the Toyota Production System after Japan's defeat in WWII when the company was looking for a means to compete with the US car industry through developing and implementing a range of low-cost improvements within their business. In brief, lean management seeks to implement business processes that achieve high quality, safety and worker morale, whilst reducing cost and shortening lead times. This in itself is not unique to Japan. What sets lean management apart, and makes it particularly effective, is that it has at its core a laser-sharp focus on the elimination of all waste from all processes.

In the Philippines, lean manufacturing awareness is not yet established as evidenced by a low awareness of the different practices and tools in lean manufacturing. Employees, even that of top level management, still needs seminars and awareness to fully appreciate lean manufacturing. They view lean manufacturing as a technique in

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reducing wastes especially production wastes. In terms of the tools and techniques, employees of manufacturing firms in the Philippines are more aware of the standardized work, PDCA , SMART goals and KPIs which they implement in their production and quality control departments. The main predicament of implementing lean manufacturing is the acceptance of employees of these techniques and backsliding to the old ways of working. Thus, acceptance of a new system is still not acceptable to the employees.

Lean Manufacturing is a business improvement philosophy that has developed over many years (as well as a collection of lean manufacturing tools), it is a method to better focus your business on the true needs of the customer to help you prevent waste from being built into your system. In addition to this lean will reduce your internal costs, your processes will be more efficient, less wasteful. You will have less of your businesses cash tied up in wasteful inventory and work in progress enabling you to spend it where you want. Lean will improve your staffs morale as they become more and more involved in your business and improving what you do, their motivation will improve dramatically.

With these benefits of lean manufacturing, it is necessary to improve usage of lean manufacturing tools and techniques in the Philippines. And companies should customize its communication programs to take employees well beyond their day-to-day perspectives and move them to understand. It is necessary to improve on their awareness. This can be done through seminars and trainings about lean manufacturing. These seminars should present the benefits and advantages of lean manufacturing. Lastly, the top-level management should support such moves and make it a way of life for the organizations.

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