Study of Select Issues in the Implementation of Lean Manufacturing in UAE: An Empirical Study

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***Abstract* - The paper attempts to identify the key issues in the implementation of lean manufacturing system (LMS) in the United Arab Emirates. The paper also discusses the various outcomes expected from the successful implementation of LMS. Extensive literature review has been done to find out the various critical issues and the key issues selected for the study.**

Keywords* - *Lean manufacturing, waste reduction, critical issues, top management commitment, customer satisfaction

I. INTRODUCTION

Dubai's total manufacturing trade reached AED 1tn in 2014 accounting for almost 80% of Dubai's non-oil trade. Imports accounted for 63.4% while exports and re-exports accounted for 36.6% of Dubai's total manufacturing trade. Electrical machinery and equipment accounted for 40.8% of manufactured imports and 41.5% of manufactured exports and re-exports for 2014. A high degree of concentration in a few key sub-sectors highlights the potential for the growth of, and diversification within, the manufacturing sector. The manufacturing sector is the fourth largest sector in Dubai's economy, recording a share of 13.9% of total GDP in H1 2014 and accounting for roughly 15% of Dubai's total workforce. There are eight major sub-sectors of the manufacturing economy. Dubai's manufacturing license issuance increased by 6% y/y in 2014. Between 2010 and 2014 net manufacturing license issuance increased at an average of almost 5% per year. A steady increase in the number of manufacturing licenses is symptomatic of growing interest among manufacturing firms to establish operations in Dubai. [This research was carried out to identify the key critical issues for the implementation of Lean manufacturing in a manufacturing setup.The term lean was coined by Womack et al. to define the Japanese system, which consumes the minimum of everything to achieve a better product, ultimately achieving customer satisfaction by fulfilling his needs. [2]. the concept of lean manufacturing was introduced in Japan, and the Toyota production system was the first to use lean practices. Lean manufacturing is different from traditional manufacturing. The traditional manufacturing concept focuses on the inventory of the system, whereas lean manufacturing opposes this concept. The 'Lean' concept considers inventory as a waste in the organization. [3] The research seeks to identify the key critical issues which affects the implementation of LMS as well as to relate it with the improvement in select performance areas. Detailed literature review has been carried out along with and discussions with experts in the field to decide the key issues. A questionnaire of twenty two was designed to seek the firsthand information from the persons working in manufacturing sector in UAE. The result of the empirical study highlighted the key critical issues, helping the decision makers to focus on them while implementing LMS in their organization. LM has become a widely acceptable and adoptable best manufacturing practice across countries and industries [4]. The implementation of lean in UAE industries is at its initial stage and this research will definitely provide a base for clear understanding of LMS.

The research was focused to seek the answers to the following questions:

RQ1. Which is the key critical issues for the implementation of LMS in UAE manufacturing sector?

RQ2. What will be the performance improvement areas in the manufacturing sector in UAE after the implementation of LMS?

II. LITERATURE REVIEW

The literature review has been carried out with the intention to provide a clear understanding on lean manufacturing system as well as select key issues important for its successful implementation. The performance areas also discussed.

A. Lean Manufacturing System

Lean manufacturing has recently become pervasive as the primary strategy for manufacturing performance enhancement as the consistent and disciplined application of LM strategies with the emphasis on waste elimination and process streamlining can offer a steady path towards business excellence [5].

Lean Manufacturing System (LMS) is defined as a set of principles used to minimize manufacturing costs by reducing inventories, identifying waste at every stage of supply chain and eliminating it, improving order to supply time and thus improving quality at every level and profit of the organization with employee involvement. In Japan waste is considered as an activity which consumes resources but creates no value to the end product from the customer's perspective. The basic ideas behind LMS are waste elimination, cost reduction, and employee empowerment [6]

The Lean principles can be applied in any situation. It is suitable for both manufacturing as well as service sector. Eliminating waste in manufacturing however cannot be achieved solely through efforts in manufacturing. It requires

changes in other functions such as product design, materials section, marketing etc. A company-wide integrated effort is needed for process improvement and waste reduction. In most processes, the biggest detractor from reliability and stability is uncontrolled process variability in production schedules, procedures, materials, tools, and machine functioning and workers skill. Lean provides procedures and tools for identifying and eliminating the sources of variability. As long as Lean Manufacturing System is in place, it will deal with new sources of variability. In any manufacturing plant it is easy to find such variability causing waste in the form of product defects, inventory, overproduced components, idle workers and machines and unnecessary motions. Lean manufacturing system helps the shop floor teams to identify the sources of these wastes and eliminate them. In every case shop floor worker plays a central (significant) role. The output of LMS can be measured through many parameters, few are listed below:

1. Reduction in total throughput time and inventories
2. Cost of quality
3. Reduction in Manufacturing cost for the product
4. Reduced Design cost and time for a product

The high quality product produced by Original Equipment Manufacturer (OEM) has put tremendous pressure on suppliers and the vendors to understand and implement JIT / Lean Manufacturing System.

A. Issues affecting the implementation process of LMS in manufacturing organizations

There are various issues play a key role in the implementation of LMS. Following are key issues selected from literature review and opinion of experts in this field. Some of the following issues were studied by author for interpretative structural modeling of Lean issues [7].

a. Independent Variables

- Top Management commitments (TMC)
- Total Quality Management (TQM)
- Total Productive Maintenance (TPM)
- Total Employee Involvement (TEI)
- Use of latest technology
- Use of Information and Communication technology (ICT)

b. Dependent Variables

- Inventory reduction
- Lead time reduction
- Cost Reduction
- Customer Satisfaction

Dependent Variables

1. Top Management commitment and Support

Top management's commitment and support provides the strong foundation for the successful implementation of any improvement strategy. To prove this there are many examples of Indian organizations like, Tata, Birla, Infosys, Wipro, Maruti etc. Top management should have a proactive and positive mindset, the passion to win and the ambition to achieve, continuous hunger to learn and willingness to support employees. The role of top management to provide training to employees in various functional areas like Statistical process control, computers, performing set-ups, carrying out maintenance etc. [8]. Top management commitment drives all other issues and influences them, while it is not dependent on them. In JIT / TQM environment, management allows the workers to try and, if they fail, to learn from these failures [9]. Top management's commitment, effective communication and training are necessary for implementing LMS.

1. Total Quality Management (TQM)

Quality control methods based on random sampling had a major impact on quality control. These techniques provide quality assurance which is less costly and time consuming. To achieve "Zero defect" statistical quality control is the first step [10] Production System (TPS) attempts to improve the quality and productivity without a loss in the human dignity of the worker [11]. The conflict between improvement and human concerns are resolved by initiating positive improvement through small groups called quality control circles (QC circles). The improvements are varied: refinement of manual operations to eliminate wasted motion, introduction of new equipment to avoid the uneconomical use of manpower and improved economy in the use of materials and supplies. Ref [12] presented a case stating that quality improvements are seen as the result of JIT and that quality is an important component of JIT. Total Quality Management can be described as the art of continuous improvement with customer's requirements and the measurement of standard [13]

2. Total Productive Maintenance (TPM)

One of the reasons for existence of inventory is downtime of machines. It can be minimized through preventive maintenance [10]. TPM extends the practice of preventive maintenance with the concepts of total quality control and total employee involvement. TPM is a company-wide equipment maintenance program that covers the entire equipment life cycle and requires participation by every employee. A key element of TPM is autonomous maintenance where the operators are responsible for maintaining their own equipment [14] Preventive maintenance and lower defects are needed to achieve lower safety stocks and he further emphasized that preventive maintenance and lower defects are needed to achieve lower safety stocks [15].

3. Total Employee Involvement (TEI)

JIT requires a work culture that allows the worker to become a participant in decision making and thus necessary putting trust and responsibility in the hands of the workers, to become the same interest group by way of having long term relationships [16]. Reference [17] describe that workers play a central role in LMS. Ref [18] explained that flexible machines are expensive and lead to high fixed costs. Use of manual operations can make productions systems both flexible and adaptable. The major characteristics of lean manufacturing are continuous improvement and molding work organization in order to gain flexible and effective organizational structure [19]. Employees in lean organization

believes that improving quality is their responsibility [20]. Today's organization prefer a group or a team to take part in the key decision making process. Better cooperation and collaboration among the group drives an organization towards perfection and provides a wide range of advantages by sharing information, generating ideas, making decisions and reviewing the effects of the decisions [21]

4. Technology / Automation / Flexible lines

Ref. [22] described that automation is valued in Japanese firms as it facilitates consistent quality. Instead of high-tech automation Toyota tried to mechanize selected tasks by relatively simple machinery [23]. Also a change is made from mass production towards more flexible production through simple forms of mechanization, using kaizen- suggestions and multi-skilled workforce.

5. Information flow / Information Technology

Ref [24] stated through relevant literature the importance of computer simulation to study JIT implementation, performance comparison with traditional approaches and selection of a manufacturing setting in a real JIT environment. The information and communication technology (ICT) is an increasingly powerful tool for participating in global markets, promoting accountability, improving the delivery of services and enhancing development opportunities [25].

6. Inventory reduction / Just in Time (JIT)

Inventory Reduction: Inventory is a list for goods and materials, held available in stock by a business. Inventory is further classified into raw materials; work in process (WIP), finished goods, Spare parts etc. Inventory is considered as necessary devil, since it counts as an asset on the balance sheet, but it also blocks money that can be used for other purposes and requires additional expense for its protection. There are three basic reasons for keeping an inventory i.e. Time, Uncertainty and Economies of scale. The high cost of inventory has forced organizations to find ways to develop efficient and effective supply chain management and quality management. Ref [26] discussed the kanban system which was developed to regulate repetitive production and to control in-process inventory. Ref [18] described the key feature of LMS as fewer resource inputs are required i.e. less material, fewer parts, shorter production operations, less unproductive time needed for set-up etc. Ref. [8] described that most important source of waste is inventory, as keeping parts and products in stock does not add value to them and should be eliminated. The Value stream mapping is used to design inventory systems for continuous flow in any manufacturing system [21].

7. Lead time / Throughput time (Better delivery performances)

Ref [27] described lead time as a total time required to manufacture an item and consists of planning, set-up, run, move and queue. In a repetitive batch manufacturing queue time often represents 80 percent of the total throughput time. The queue time is proportional to the amount of work in progress (WIP), so to reduce queue time it is necessary to reduce WIP. Lead time is the time between the starting of any process and the completion of that process. Shortened lead times are necessary to allow operators and suppliers to adjust to changed schedules [28]. Ref [11] described that shortening of the production lead time (the time interval from production dispatching to delivery of completed products) is necessary to have the flexibility to respond to market demand and the stability of smoothed production. Ref [29 and 30] mentioned that LMS system employed good management systems of constraints to achieve high rates of on-time completion of orders at lowered cost. In a survey conducted by ref [30] more than 70 % respondents accepted that the three was improvement in on-time deliveries due to the implementation of Lean / JIT. Ref [31] presented a case study in which the lead time is reduced almost by 50 % in a service sector by the application of JIT philosophy.

8. Cost Reduction

The only way to increase profit is to reduce costs; hence cost reduction activity should have the highest priority. Toyota has reduced the selling price by reducing cost and elimination of waste [10].

The ultimate goal of implementing lean manufacturing is to increase productivity, enhance quality shorten lead times and reduce cost etc. [8].

9. Customer Satisfaction

Parsuraman et al. (1991) described that response time, reliability, tangibles, assurance of quality; concerns are few of the important attributes of customer satisfaction in service industry. Customer satisfaction can be achieved by total quality control, continuous process improvements and JIT [28]. Lean philosophy consumption provides the full value to a customer whom he desires from the product and services, with the greatest efficiency and least pain [2]. In India the customer awareness is increasing due to rising number of middle class customers who are vary value demanding value for their money while not ready to compromise on quality of the products. This scenario has put tremendous pressure on supply chains to reduce costs without compromising quality [33].

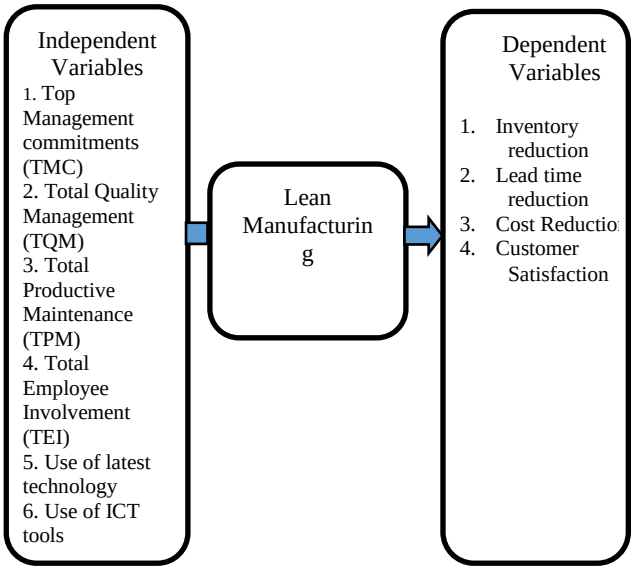
The performance issues in the manufacturing industriesGenerally the performance of a manufacturing organization is measured in the terms of quality, productivity, lead time and cost reduction (profit).Many researchers discussed that only focusing on one performance issues will not serve the purpose of any organization.

III. FRAMEWORK

A. Model

To pursue the research following model shown in Fig. 1 was be used in the study.

Fig. 1 Research Model



IV. METHODOLOGY

A 5-scale 22 questions survey was distributed to 85 people of supervisory, middle and top management level. All respondents answered the full survey. After checking 82 were found suitable for the analysis. Two questions were asked about each variable in addition two questions were about the personal information of the respondents. The demographics details of respondents are shown as under:

Table 1: Experience of respondents

Sr. No.	Experience	Numbers
01	00-05 years	08
02	05-10 years	16
03	10-15 years	35
04	15-20 years	19
05	More than 20 years	04
	Total	82

Table 2: Position in the organization

Sr. No.	Position / level	Numbers
01	Supervisor	27
02	Middle management	32
03	Senior management	18
04	Owners	05
	Total	82

Analysis

The total no. of respondents whose responses were found suitable consists of 82 personnel in which 5 are owner of the company, 18 are from senior management, 32 from middle management and supervisors were 27. Their experience was also very rich as 4 have more than 20 years' experience, 19 have 15 to 20 years, the major portion of respondents i.e. 35 persons have experience of 10 to 15 years, while 16 have 5 to 10 years and only 8 persons were new in the field and have less than 5 years' experience.

Data collected from survey are analyzed by using statistical tools and for that statistical testing SPSS (Version.17.0) software is used. A descriptive analysis was made and the mean and standard deviation for each issue was calculated and tabulated in Table 3:

Table 3: Statistical Values of the Survey

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Top Management commitments (TMC)	82	1	5	4.82	0.612
Total Quality Management (TQM)	82	1	5	4.69	0.690
Total Productive Maintenance (TPM)	82	1	5	4.41	0.782
Total Employee Involvement (TEI)	82	1	5	4.75	0.623
Use of latest techno9logy	82	1	5	4.10	0.794
Use of Information and Communication	82	1	5	4.35	0.745
Inventory reduction	82	1	5	4.56	0.591
Lead time reduction	82	1	5	4.51	0.653
Cost Reduction	82	1	5	4.30	0.706
Customer Satisfactio	82	1	5	4.62	0.597

Internal consistency is a measure based on the correlations between different issues in the same survey results. It measures whether several issues that propose to measure the same general construct produce similar scores. Internal consistency reliability is the accuracy or precision of a measuring instrument, which is the extent of uni-dimensionality, i.e. the detailed items (questions) measure the same thing. Inter item analysis is used to check the scales for internal consistency or reliability. Cronbach's coefficient alpha is calculated for each scale, as recommended for empirical research in operation management. SPSS software is used for calculation of Cronbach's alpha. Cronbach's alpha values of each item are calculated for all responses received. Cronbach's alpha values more than 0.7 are considered adequate for an exploratory study like this. The reliability results of the all issues were above the acceptable threshold (0.70) [34, 35, 36 and 37].

V. RESULTS

a. Discussion: The study emphasized that top management commitment and support is the topmost issue for the implementation of Lean manufacturing. Also customer satisfaction is considered as the number one dependent issue. The study will provide to the top management basic blueprint

for the implementation of lean manufacturing. The top management must realize that their commitment and support for the implementation of LMS will create the initial spark for any advanced manufacturing philosophy. At the same time the expected outcome of lean implementation is the customer's satisfaction, which is very important for their business. It is recommended that more research on LMS to be performed in UAE and GCC region in all kinds of businesses.

VI. CONCLUSION

This main focus of this research was to study selected key issues for the implementation of LMS in UAE. The objective of the research was to examine the important critical issues required to impellent the LMS as well as the benefits of implementing LMS. A detailed literature review was conducted and also opinion from experts were taken to comprehend the lean philosophy and to develop the issues related to the main objective. A theoretical framework was developed to see which independent issues of lean implementation are moving dependent issues. The research moved to the methodology once the framework was established. The results clearly described that top management commitment is the independent issue and customer satisfaction is the main outcome of the Lean implementation.

Limitations: The result of the study are matching with the previous research results explained by various researchers, and applicable in UAE industries. In future research in more organizations to be performed to develop more issues for the successful implementation of LMS in the UAE.

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