

## Assessment of Lean Manufacturing in Medium Scale Enterprise

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**ABSTRACT:** Manufacturing high variety of products leads to increase of demands in global market. So it is essential for reducing cost in manufacturing, lesser lead time and perfect quality. In order to increase the production and competitiveness among the industry, lean manufacturing strategy is used. Lean manufacturing is a technique to identify and eliminate waste in the working environment. The implementation of lean manufacturing is followed by lean assessment. Initially the questionnaire is developed for the assessment of leanness in the industry. From the lean assessment the gap is identified. In order to fill these gaps proposals were drawn. These proposals are implemented in the industry to fill the leanness gap.

**Keywords:** lean manufacturing, lean assessment, production and questionnaire.

### 1 Introduction

Lean manufacturing (LM) is one of the production control technique being implemented in industries with an aim for minimizing the wastes and reduce the cost by eliminating non value added activities. Lean manufacturing is a process that aims at elimination of waste through continuous improvement and strives for perfection [1]. Lean manufacturing concepts also focuses on reduction of cost by eliminating the Non Value Added activities (NVA) and reduction of Necessary Non Value Added activities (NNVA). Value added activity means that which physically changes the material while non-value added activity means that which takes time, space and material but does not change the physical material. Lean is concerned with eliminating all types of wastes. Major 7 types of wastes are overproduction, time, transportation, over processing, inventory, motion and defective

products. All the lean tools work towards common goals of eliminating these wastes in order to bring the most value to the customers. To eliminate these wastes some of the lean tools are used. Such lean tools are lean assessment, visual management, policy deployment, standardized work, just-in-time and improvement methods (5s, TPM, poka-yoke, Kanban, cellular manufacturing, kaizen, value stream mapping). The work reported in this paper was carried out to by using simple assessment tool [2]. Accordingly a tool called 15 lean manufacturing (LM) criteria assessment tool. Using this tool, the total leanness level in medium scale enterprises is assessed.

### 2. LITERATURE REVIEW

William et al. (2014) had introduced a value stream mapping (VSM) tool, it is an important technique

used in the manufacturing of lean to identify the environmental and societal impacts. The mainstream of these exercises had concentrated on adding energy-related metrics to VSM although many other studies discussed to 'sustainable' Value Stream Mapping. [1].Dombrowski et al. (2010) had studied Small and Medium-sized Enterprises (SMEs) that they were facing each day the hard rivalry of worldwide markets and higher necessities of the customer. A lean manufacturing offers an methodology for eliminating the waste in procedures, to accomplish high item and process quality, and to decrease lead times [2].Nallusamy and Adil Ahamed (2017) explained that Value Stream Mapping (VSM) helps in finding out waste, removing and eliminating waste in manufacturing, production and business processes. He said that if the speed of the process increases then the value adding activities time is increased. The increase in value added time is because of the elimination of waste in the manufacturing processes. The changed process enhances effectiveness and efficiency of industry [3].According to Rohac and Januska (2015), Value stream mapping (VSM) helps in making small and continuous improvements. It also helps with the growth strategies of the company. Value stream mapping (VSM) directly contributes to the company to direct in the correct path towards attaining its goals, in adherence to its mission statement and achieve its vision [4].Nikunj and Chetan (2015), explains the in-depth of Lean is based on the continuous pursuit of improving the processes, a process of eliminating all non- value adding activities and reducing waste within an organization. The Value adding activities are simply the things the customer is willing to pay. Everything other than that is waste, and it should be eliminated, simplified, reduced, or integrated. However it is important that lean is viewed from a total system perspective. Otherwise, a company risks in putting all of its efforts into the wrong areas [5]

### 3. RESEARCH METHODOLOGY

Figure 4.1: Research Methodology

The figure 4.1 shows the research methodology. Based on literature review the lean assessment tool is formed [9]. The lean assessment tool consists of leanness enablers and 15 criteria. From literature review 4 lean enablers are identified. Under which 15 criteria is chosen for lean assessment. For this the questionnaire has been developed and responses were collected for the study. The leanness has been identified by using scoring method. Finally suitable suggestions are provided.

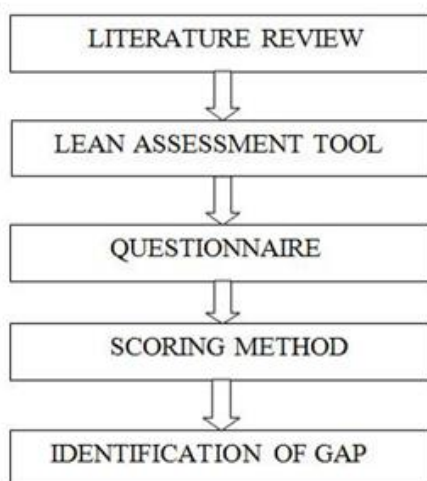
### 4. LEAN ASSESSMENT TOOL

As this research work is primarily carried out for the industries of medium scale enterprises are largely involved in providing components to large scale enterprises, large scale enterprises are assumed to be customers. Hence lean manufacturing for medium scale enterprises should be based on expectations of large scale manufacturing enterprises as regards to production. In other words, before deciding lean manufacturing for medium scale enterprise, it is necessary to know as to what is expected from them by large scale enterprises. For this lean assessment tool is used. The implementation of lean manufacturing is followed by lean assessment.

### 5. ASSESSMENT OF LEANNESS

Leanness assessment was carried out using 15 criteria lean manufacturing assessment tool in HTL industry [13] HTL industry is a medium scale industry consists of more than 1000 employees. HTL industry is in the process of implementing lean manufacturing strategy like 5s, kaizen, TPM, etc. these existed a need for organization to measure leanness. The assessment of leanness is carried out as follows

- Questionnaire preparation
- Questionnaire analysis
- Scoring method
- Gap analysis



For this study a questionnaire consists of 4 enablers and 15 criteria [8]. The assessment was begun by exposing the developed 15 criteria lean manufacturing (LM) assessment tool to General Manager, Factory manager, Maintenance engineer of HTL industry [6]. Subsequently questions concerning lean manufacturing (LM) criteria were supplied to these personnel [12]. These questions were so simple that experienced respondent has no difficult in responses to these questions. The sample Questionnaire is given below.

I. ORGANISATIONAL STRUCTURE

1. What type of organizational structure exists in your company?
  - a) Flattened
  - b) Vertical
2. How many peoples are employed in your company?
  - a) Above 1000
  - b) Between 500 to 1000
3. How does the communication work in hierarchy?
  - a) Formal
  - b) Informal
4. Decision making in your organization
  - a) Exclusive (by individual)
  - b) Participative decision making

The above figure shows the sample questionnaire for lean assessment. The questionnaire consists of four enablers they are

- Management
- Technology
- Manufacturing management
- Manufacturing strategy
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These four enablers are further classified to form 15 criteria. Management is the first enabler it consists of 3 criteria. They are organizational structure, employee status and performance appraisal. The technology is the second leanness enabler consists of 4 criteria. They are cost management, visual management, automation and TPM [3]. The manufacturing management is the third leanness enabler. It consists of 5 criteria. They are 5S, continuous improvement, pull raw material, supplier feedback and elimination of wastes [4]. The manufacturing strategy is the fourth enabler. It consists of 2 criteria [11]. They are status of quality and productivity.

1.	Organizational structure	1	20	5
		2	15	10
		3	20	5
		4	5	20

Table 5.1: Marks allotted for organizational structure. Likewise, the marks are allotted for all the criteria. By using these marks, the questionnaire is evaluated for total leanness.

LEANNESSE ENABLERS	LEANNESSE CRITERIA	MAX MARKS	RESPONDENT			AVG MARKS
			R1	R2	R3	
Management	Organizational structure	100	55	60	50	55
	Employee status	50	20	25	30	25
	Performance appraisal	50	25	20	30	25
Technology	Flexibility	100	60	55	50	55
	Cost management	100	55	60	45	53.33
	Visual management	50	30	20	25	25
	Automation	50	20	30	30	26.67
Manufacturing management	TPM	50	25	30	25	26.67
	5S	50	30	25	20	25
	Continuous improvement	100	60	55	50	55
	Pull raw material	50	15	10	10	11.67
	Supplier feedback	50	20	25	30	25

No	Criteria	Q.no	a	b

Elimination	50	30	25	20	25	
of wastes						
Manufacturing	Status of quality	100	60	55	50	58.333
strategy						
Status	50	25	30	20	25	
Of productivity						
Average marks					516.664	

Figure 6.1: Lean enablers

The figure 6.2 shows the gaps under lean manufacturing (LM) criteria. As total leanness at HTL industry was found to be 0.517. It can be inferred that HTL industry has also potentials to increase the leanness level of their industry. In order to identify these potentials, the gap analysis of 15 lean manufacturing (LM) criteria was carried out [7]. Figure 6.1 shows the gaps between the actual and goal computed in terms of percentage under the four lean enablers. Figure 6.2 displays the gaps prevailing in each lean criterion in terms of percentage. As shown in Figure 6.1 lean enablers such as employees and manufacturing strategy has more leanness gap compare to another two lean enablers. Among all criteria 5S, feedback, pull raw material, automation, employee status, cost management and visual management are less than 55%. In addition to that pull raw material is less than 30%. However to overcome these leanness gap

Table 5.2 Scoring method

The above table 5.2 shows the scoring method. In which the total leanness (TL) is identified as 51.6%. The calculation of total leanness in HTL is given below

$$TL = \text{total average marks}/1000$$

$$TL = 516.664/1000$$

$$= 0.517 \approx 51.7\%$$

## 6. GAP ANALYSIS

The gap is analyzed by using the below formula For the 4 lean enablers the gap is identified by

$$\text{Actual mark (\%)} = \frac{\sum \text{Average marks of criterion}}{\text{No. of criteria}}$$

$$\text{Leanness gap (\%)} = \text{Maximum \%} - \text{Actual marks}$$

For example refer figure 6.1 table in which the leanness gap of management is calculated by

$$\text{Actual mark (\%)} = \frac{55+25+25+55}{4}$$

$$= 40\%$$

$$\text{Leanness gap (\%)} = 100-40$$

Accordingly the leanness for all the enablers are calculated and depicted in figure 6.1

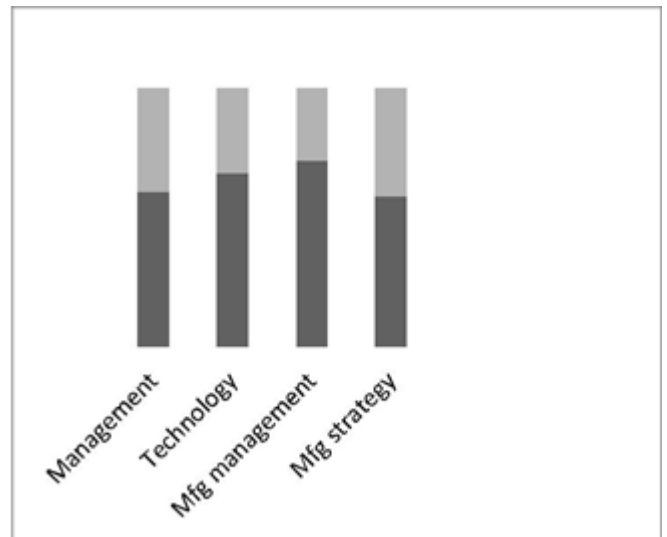


Figure 6.2: Gaps under LM criteria in percentage suitable improvements are proposed to management.

suggested improvement method in HTL enterpr7.

SI.No	Weak factors	Improvement method	Opinion of MD in words
1	Streamlining of processes	Adoption of value stream mapping [5]	Yes, we try to adopt
2	Regular meeting	Conduct regular meeting to convey the clear objective	Always not possible
3	No job rotation system	Job rotation makes employee multi skilled	Partially existed
4	Training	Training enhance the knowledge of new technology	Always not possible
5	Automation	Incorporate automation	Lack of initial investment
6	Pull raw material	Implement pull raw material to reduce inventory	Try to implement
7	Performance appraisal	Reward scheme	Ok
8	Education	Educate the employees to increase the skills	Always not possible

Table 6.1: Improvement methods The above table 6.1 shows the weak factors and

## CONCLUSIONS

Despite this fact, not all companies have been able to fully capture the lean characteristics. They assess that the efforts that have to be exerted by them to acquire lean management (LM) capabilities. A simple and effective lean assessment tool with 15 criteria has been contributed in this paper. Using this tool, leanness of HTL enterprise has been calculated. This lean assessment indicated that the total leanness of HTL enterprise is 51.7%. This would mean that the HTL has acquired 51.7% of lean manufacturing capabilities. A 15 criteria lean management (LM) assessment tool contribute percentage implement of lean in HTL enterprise. After that suggestions were proposed to overcome the leanness level in the industry. For evaluating the leanness level in industry, this leanness assessment tool can be used. This kind of leanness assessment helps to improve the production thereby minimizing the wastes (Non value-added activities).

## 8. SCOPE FOR FUTURE WORK

For the assessment of lean manufacturing 20 criteria and by extending criteria may help in assessment of lean manufacturing more precisely. In proposed assessment of lean manufacturing, the weak factors are solved by using value stream mapping. By implementing the value stream mapping, the leanness can be calculated in further studies. However, this lean assessment tool can be applied to various sectors in different countries.

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