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Analysis of Readiness Level and Comparison in Automobile Industry of Gujarat by Identification of Critical Success Factors

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Abstract: *The main purpose of this study is to identify the critical success factors within automobile industry of Gujarat. This study helps to find out the whether the organizations have the foundation to implement the lean tools and techniques. A survey is conducted within the automobile parts manufacturing organization of the Gujarat. The present study illustrates the reliability of the data obtained from the survey and analysis of the available data in terms of the critical success factors within the organization. Ultimately this study illustrates the present scenario of the awareness of the lean manufacturing in the organization as well as the primary tool needed to be considered while initiating the lean manufacturing implementation. Lean manufacturing offers waste-reducing strategies like the elimination and identification of the waste and also enhancing their productivity and competitiveness.*

Keywords: *Lean Manufacturing, Automobile Industry, Critical Success Factors, Cronbach's alpha, SPSS.*

I. INTRODUCTION

Lean is based on learning from Toyota who increased market share by improvement in their design mostly in the shop floor rather than in design and development [1]. The main idea behind the use of this tool is to eliminate waste or non-value added activities. For example, traditional Toyota tools valued stream mapping (VSM), cellular manufacturing, Kanban, 5S, and Kaizen. These tools have been used in the various manufacturing industries [2]. Lean success is occurring only if company achieve major strategic components of lean such as employee autonomy, management commitment, information transparency and cultural fit. These all parameters are the major parameter to support the operational and tactical aspects of the lean [3]. Womack et al., 1990 wrote a book entitled "The machine that changed the world". It illustrates that how Japanese manufacturer was manufacturing the product within the given time frame of customer demand with less cost [4]. Then after the US manufacturing implement some of the principles. As a result of it, the rapid adoption of the process, principles, and practices had given the US manufacturing a firm chance to improve and compete with their Japanese counterparts [5]. Competitiveness of the manufacturers from the different company much depicts by Manufacturing Productivity Growth rate. For India, these Growth rate is 5 percent in contrast to 7.31 percent for china and 8.65 percent for Pakistan. [6]. to face these challenges manufacturer from the India, need to implement the advanced manufacturing systems. A very few of the Indian manufacturing organization have succeeded in getting total benefits from the lean philosophies implementation. However, many manufacturing companies have failed in the implementation of the lean due to lack of understanding regarding the Implementation of the lean philosophy. Anand and Kodali (2010) have discussed how LM framework helps to implement a novel set of principle in an organization [7].

In the literature, many researchers have proposed various LM frameworks in different contexts. This study tries to find the suitable LM framework for the automotive manufacturer in Gujarat. Naga Vamsi et al., 2016 have done the reliability test for developing the respective field of research which is related to the automotive manufacturer in Gujarat [8]. Ultimately this study helps the researcher for further improvement in the specific segment of the automotive manufacturer in Gujarat.

II. OBJECTIVES

- 1) Identification of the critical factors influencing a lean manufacturing in the automobile industry.
- 2) To carry out the survey data collection and find out the actual level of lean practices within the automobile parts manufacturing organization in Gujarat by statistical analysis.

3) To find the primary lean tool for implementation of lean in a various group of the organization.

III.LITERATURE REVIEW

Due to the popularity of lean principles across the industries as well as the world of academia, many academics and consultants have published their studies in various operation research journals. Automobile firm is considered to be a most important industry in the manufacturing sector with 60 million new vehicles product per year. The automotive industries play a vital role in the revolutionary change in manufacturing process [9]. With the use of Lean principles, Henry ford starts the mass production. The LM principles mostly concentrated on finding waste activities in terms of non-value added practice and procedures [10][11]. According to Ohno's [1988] waste or non-value added activities can be categorized in seven different types [12]. These seven different type of wastes are known as Motion, Waiting, Defects, Over-processing, Overproduction, Transportation, and Inventory.

Ultimately LM framework should be designed in such a way that it can easily identify the Lean waste. Because most of the company fails to implement the lean because of the improper sequence of the lean tool implementation.

Many researchers have struggled hard to differentiate the Framework with the model. The definition of the framework given by the Lean is a tool which discusses the picture of the management from the objective to the important methodology including the goals of the organization [13]. Many researchers have derived the guideline for the purpose of the establishment of the LM framework.

IV.METHODOLOGY

This study aims to evaluate that how far the automobile industries in Gujarat practicing the principles of lean manufacturing. A survey questionnaire was used to test the Lean manufacturing framework within the automotive manufacturing organization. Survey questionnaires have been developed from the literature review. The study has also conducted a pilot study to perform content validity of the questionnaire. A survey research methodology is a scientific tool in operations management, which can provide quantifiable, reproducible results. The study has taken 134 samples about the understanding of the questionnaire. The questionnaire contains four sections called Section A, Section B, Section C. Section A of the questionnaire captures general organizational data and personal information of the respondents such as a number of employees, attributes, volume and type of operations. Section B of questionnaires contains the approach of LMT such as awareness, implementation, current scenario and benefits of the lean manufacturing techniques. Remaining the Section contents the critical success factors within the organization. The questionnaires in the Sections C are captured from the literature survey for improving the effectiveness of the questions. These section content the scale ranges from 1 to 5 where the importance of particular factors increases in ascending order. Around 18% of response rate is adequate for research in manufacturing industries [5]. Questionnaires have been sent to around 500 companies and out of it, 134 responses have been obtained for further analysis.

V.DATA ANALYSIS

Internal consistency analysis consists of the two different criteria which Reliability and validity. Reliability is the extent to which a variable or set of the variable is consistent in what it is probable to measure [14] [16]. Cronbach's alpha is used as an indicator to measure the internal consistency. [15] It can be calculated by using a standard commercial package called as a statistical package for social science (SPSS). Using SPSS reliability analysis procedure, the Cronbach's alpha has been evaluated separately. The Cronbach's alpha value for total scale was 0.989, indicating a high degree of internal consistency among the scale. This

Cronbach's alpha is derived from the data of the critical success factor and its value is much higher than 0.8, so it is reliable to conclude from the obtained data.

Table 1. Reliability analysis for the critical success factor (Cronbach's alpha)

Cronbach's alpha	Cronbach's alpha based on Standardized Items	No. of Items
.989	.989	30

In undertaking the survey, data has been obtained from the 134 different automotive industries from the Gujarat region. It is needed to understand the obtained data from the primary level so that the different company has been categorized in its attributes and number of employees working with the organization has been tabulated below Table 2 and Table 3.

Table 2. Attributes of the Company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	OEM	3	2.2	2.2	2.2
	TIER 1	55	41.0	41.0	43.3
	TIER 2 or higher	76	56.7	56.7	100.0
	Total	134	100.0	100.0	

Table 3. Number of Employees in the Company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 100	60	44.8	44.8	44.8
	101 or more	1	.7	.7	45.5
	101 - 200	50	37.3	37.3	82.8
	101 - 500	6	4.5	4.5	87.3
	201 - 300	13	9.7	9.7	97.0
	301 - 400	2	1.5	1.5	98.5
	More than 500	2	1.5	1.5	100.0
	Total	134	100.0	100.0	

The statistics of the individual sector responses are given in the below Table 1. This statistics shows the awareness of the LM with respect to the implementation of the Lean manufacturing. From the Table 4, it has been observed that 32.34 percent of the companies from the automotive sector are still unaware from the Lean manufacturing and from the companies those are having awareness of the Lean manufacturing 20.45 percent company are still awaited to implement the lean manufacturing.

Table 4. Cross Tabulation of the Awareness and Lean Implementation

		Implementation		Total
		NO	YES	
Awareness	NO	46	0	46
	YES	18	70	88
Total		64	70	134

Among the 134 companies, 42.53 percentage of the company have observed that Lean manufacturing gives zero effect on the returning of the value, but it is very important to note that the company attributes and the gaining benefits after the implementation of the Lean manufacturing having the relation which is tabulated in below Table 5.

Table 5. Cross Tabulation of the Attributes and Benefits Gained by the Company

Count		Attributes * Benefits Cross tabulation									
		Benefits									
		1-5 %	11-15 %	6-10 %	If > 15 % please give figure in following box, 20%	If > 15 % please give figure in following box, 75%	If > 15 % please give figure in following box, 80%	Zero effect	Total	Benefit more than 1%	Percent for Benefits more than 1%
Attributes	OE M	0	1	0	0	0	1	1	3	2	66.66
	TIE R 1	12	7	21	1	0	0	14	55	41	74.54
	TIE R 2 or higher	23	1	9	0	1	0	42	76	34	44.73
Total		35	9	30	1	1	1	57	134	77	57.46

The “critical success factors” plays important role in the implementation of the lean manufacturing in the organization. Total 30 parameters considered as critical success factors for the survey questionnaires design, on the basis of detailed literature review. The Weightage from 1-5 point rating scale have been assigned by the organization depending upon the observed importance. Critical success factor with the highest mean gives the exact idea regarding the prime consideration given by the most of the organization in order to achieve the success in implementation of the Lean manufacturing. Among these 30 parameters, 5 parameters as a most effective and critical success factor with the highest mean from the available survey data have been plotted in the graph as shown in Figure 1.

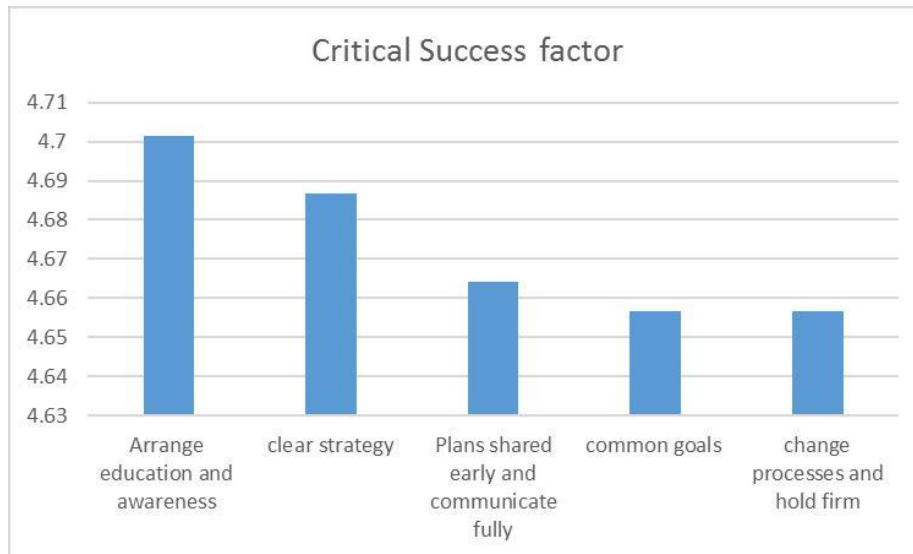


Figure 1. Graph for the critical success factor

The above graph shows the five most significant critical success factors for the implementation of the lean manufacturing given by the 134 automotive parts manufacturer companies. Around 42.53 percentage of the total companies have no result even after the implementation of the lean manufacturing so it should be observed that the critical success factor given by these 42.53 percentage company will not be feasible or it will result in the production of the noise within the survey data. So it is important to note that rather than focus on the whole survey data, the main consideration should be the company who have gained the maximum benefits after implementation of the lean manufacturing. Ultimately 41.79 percent of the survey data has been not considered because of the “Zero effect” in the organization in order to find the correct Critical success

factor in the lean manufacturing implementation. Among them, 78 survey samples have been taken into consideration who have gained the benefits from the LM. Critical success factors given by the company who have gained maximum benefits has been plotted in the below Figure 2.

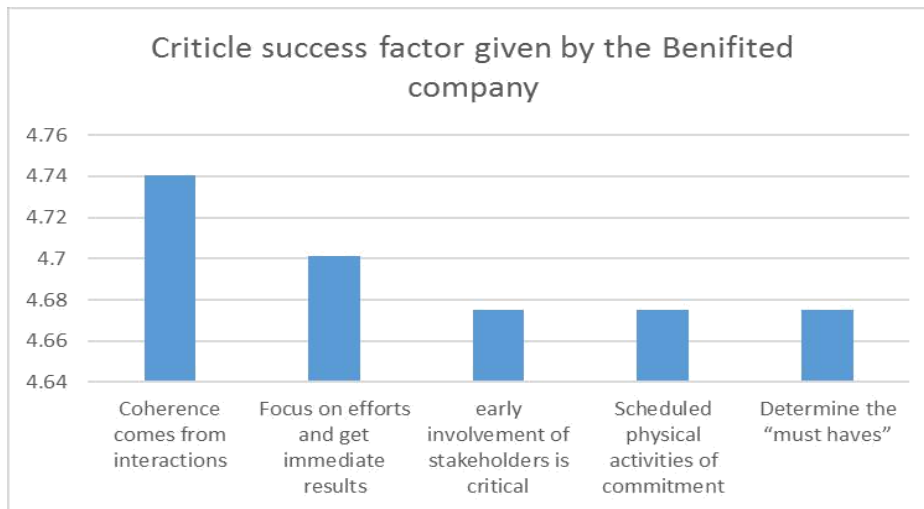


Figure 2. Graph for the Critical success factor given by highly gained company

A complete framework for the lean manufacturing gives the most significant success factor as well as primary tools and techniques for the implementation of the lean manufacturing. The companies who are having zero effect after implementing the lean tool have been suppressed from the data for getting the effective and actual result. The tools and techniques which have been most significantly considered have been tabulated as below with the percentage benefit obtained by the industries. With the help of the lexical analysis of the available data in the form of the simple paragraph, it can be converted into the required format using Python 3.5. The most significantly used five tools with its usage in the different industries has been plotted on the graph in below Figure 3.

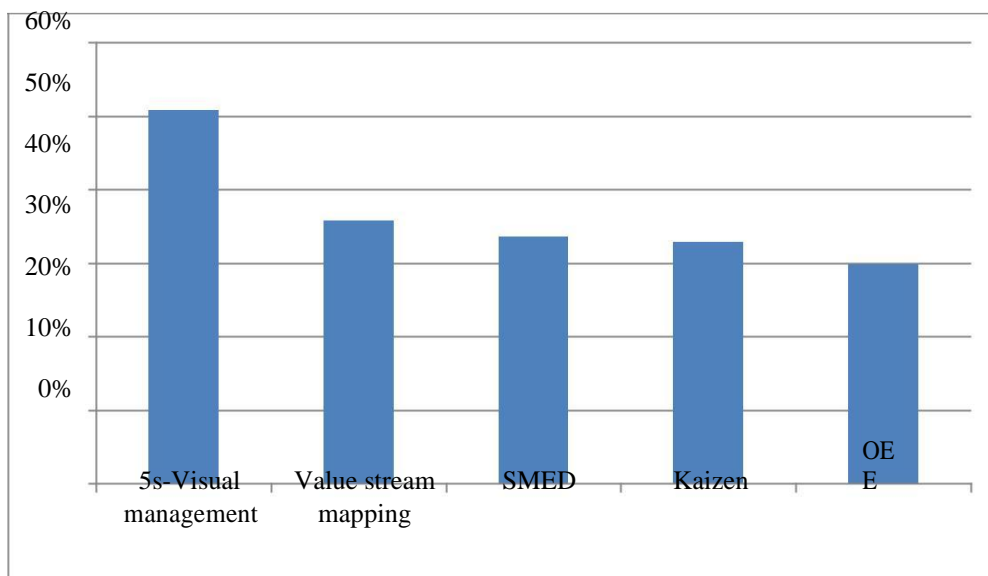


Figure 3. Graph for most significant Used Lean tool

CONCLUSION

Gujarat is a hub of the automotive sector in India. Hence, it must have expertise in manufacturing segment but due to unawareness of the Lean manufacturing, the automotive sector is far away from its actual potential of manufacturing. There are the main critical success factors which should be taken into consideration are as below

Coherence comes from interactions

- Focus on efforts and get immediate results
- Identify stakeholders and recognized as having justified claims - early involvement of stakeholders is critical
- Scheduled physical activities of commitment
- Determine the "must haves"

The main problem regarding the failure in implementation of lean is due to lack of framework of lean manufacturing. This study also helps to conclude the most effective and primary tools that must be implemented at the initial stage of Lean manufacturing is as described below.

- 5s -Visual management
- Value stream mapping
- SMED
- Kaizen
- OEE

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