Study of Critical Success Factors of Indian Manufacturing Industries: A Case Study

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Abstract

Now a days in the era of competitive, Globalization and privatization manufacturing industries throughout the world are interested to apply lean manufacturing techniques to fight with the challenges of current market trends. In developing countries like India mainly manufacturing industries including SMEs are playing a vital role of providing employment and boosting the economics of the country. But all the manufacturing industries are facing so much of problem which results shortages of production and quality issues. Our research has been focused to find out the critical factors after a through critical review of literatures. The questionnaire has been developed by considering the selected critical factors and survey has been carried out. We have surveyed different departments in an Automobile manufacturing industry which has Fabrication, Vehicle Assembly, Maintenance and Logistics departments and total numbers of 88 employees to determine the significance and sequence of priority of the different critical success factors. The result is being carried out by using different analysis like descriptive statistics, Distribution pattern of employees view, Correlation and regression analysis and also using certain quality tools like Fish bone diagram, histogram.

At the end of the study the top three critical success factors are discussed and bottom factors are highlighted. This study will help the management of Indian manufacturing industries and various researchers in the field of application of lean manufacturing in the industry for improvement in quality of product with customer satisfaction

Keywords

Crtical Factors, KAIZEN, Fish Bone Diagram, Descriptive Statistics

I. Introduction

Past few decades Lean system concept have made a tremendous impact in industries. Now a days organizations basically manufacturing industries are looking for implementation of lean systems rather than depending on R and D to eliminate wastes as well as to increase productivity and decrease cost. The main objective of implementation of lean system is to increase efficiency of production with elimination of waste in all its form (Abdul Raman and Jamaludin,(2008).This lean system if properly implemented in the industry then it could take the industry towards global manufacturing excellence. It have been found from past 4 decades researchers and Lean system practitioners have covered the topic in different aspects but lean system practice within the SMEs is not so explored. According to Bakås et al. (2011) only 16 journal articles which refers lean system within the SMEs have been published for last 20 years. Some of the research papers covered areas of lean system like lean practices ,lean benefits in SMEs in various countries like US Australia Canada Europe Saudi Arabia The term lean is defined as in today"s situation is it is a system which mainly aims to identify and eliminate wastes through a continuous improvement process also it includes some

concepts such as Just-in-Time production (JIT), Total Quality Management (TQM), Six Sigma, Total Productive Maintenance (TPM) and specific human resource management (HRM) practices This paper focused on one of the most successful tool in lean system is KAIZEN (Kai-Good, Zen- Change) is a Japanese term which means continuous improvement in process. KAIZEN defines how to run your business as well as continuously improving quality and efficiency. Kaizen mainly focus on Top management, Team work, cooperation and communication which lead to employee satisfaction, working environment improvement. Another thing is flows happening in an industry like material flow, communication flow and service flow are not only controlled by top level management but also by lower level of workers so kaizen focused on modification in way of thinking which means cultural change that results production growth, reducing inventory and reduction of time collectively kaizen is a system that requires team work, loyalty, Trust, self- control, mutual understanding and process problem solving these are the above basic critical factors for implementation of kaizen .As it is previously said that a number of organizations are implementing these lean system after second world war but majority of the organizations not able to get success with their implementation of lean techniques.According to Vermaak (2010), each and every country as well as each and every organization should apply a specific form of lean system to avoid such kind of failures. So for an organization to implement the lean system it is advisable to first know the key success factors like Critical Success Factors (CSFs), principles etc. Lean system comprises of numbers of tools and techniques and also many researchers describes about critical success factors but it is very important for an organization to identify which success factor is necessary according to their requirement, and then it should choose the tools and techniques which will be best fit for its situation.

Both White et al (1999) and Shah & Ward (2003) they studied that US manufacturing companies basically large manufacturing companies are more successfully implemented lean techniques as compared to small and medium scale industry due to large companies have resources as compared to small companies. So therefore it is more interesting to know what are the challenges faced by manufacturing industries and what should be the critical success factors to be implemented to achieve success.

This paper focuses on a case study of an Automobile manufacturing industry where the company gave the importance on the continuous improvement in their day to day process of production. The process which is bottle neck of the production system is the tank to tunnel assemble cell which is otherwise known as final weld station where the tank shell is welded by a robot through metal inert gas welding. The cycle time of that process was about 360 sec per product where by applying KAIZEN that cycle time reduced to 224 sec per product.
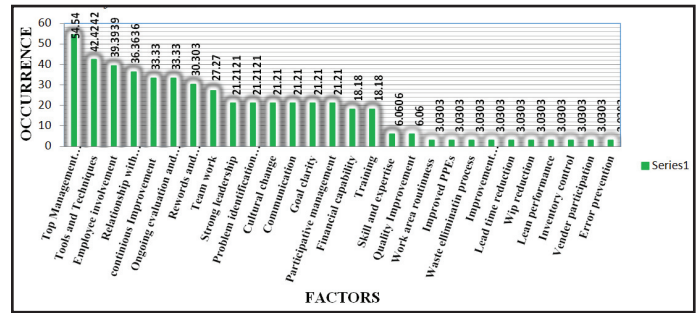
II. Literature Review

Table 1: Critical Success Factor

AUTHOR	FACTORS
Rahani AR*, Muhammad al-Ashraf	Tools and techniques, top management commitment, communication, employee involvement, strong leadership, team work, problem identification and solving capabilities
EnricoDel Fabbro*et. al(2016)	Work force management, Cultural change, Error prevention, financial capabilities,
R.Sundara, et.al(2014)	Top management commitment, lean tools and techniques, ,financial capabilities, goal clarity, problem identification and solving, participative management, team work
Nor Azian Abdul Rahmana*et.al(2013)	Top management commitment, vendor participation, inventory management and quality improvement.
Omogbai Oleghe,et.al(2016	Lean performances, Training, Quality management, WIP reduction , TPM
Jafri Mohd Rohania et.al(2015)	Tools and techniques, Team work, Product selection, Goal Clarity, problem Identification and solving, communication, Training and education.
Zélio Geraldo dos Santosa,	Work force management, Top manager commitment, Participative
et.al(2015)	management, Tools and Techniques, cultural change
Sri Hartinia*et.al(2015)	Lead time reduction, positive relationship, improved operational performance
Suzilawati Muhamud-Kayat et.al(2014)	Tools and techniques, Top management commitment, organizational culture, Team work, ongoing evaluation and monitoring and assessment, Strong leadership.
1Rajesh Gautam, et.al(2012)	Training and educations to employees, Top management commitment, Skilled and expertize management, problem identification and solving, employee involvement
Mayank Dev Singh,et. al(2015)	Tools and techniques, Top management commitment, Employee involvement, team work, Problem identification and solving ,goal clarity, communication

AUTHOR	FACTORS
1Jignesh A. Bhoi et.al(2014)	Tools and techniques, Team work, clear goal , Participative management, financial capability, strategic quality plan, communication
U. Dombrowski et.al(2014)	Employee thinking capability, Problem solving , waste elimination process, work force management,
Sri Indrawati,et.al(2015)	Top management commitment, process problem solving, monitoring and evaluating the process, tools and techniques.
Orville Sutari et.al(2015)	tools and techniques, team work , top management involvement, Financial capability, process problem solving, employee motivation
R. Radharamanan et.al(1996)	Communication, improved PPEs, management commitment and involvement, financial capability, Team work, employee education and training.
Mile´ Terziovski a et.al(2000)	Continuous improvement, management involvement, management initiatives.
Dharun Lingam K, et.al (2015)	Lean tools and techniques, Team work, motivation to employees, rewords and recognition.
P.G. Saleeshya*et.al(2012)	Tools and techniques, work force empowerment, team work, goal clarity.
Vincent S. Palmer(2001)	Top management commitment, Team work, Goal clarity, Tools and techniques, workforce empowerment.
Jennifer A.Farris.et.al (2009)	Internal process, Goal clarity, Management involvement Team work, commitment, strong leadership, work area routineness, tools and techniques.
Jeremy Huwe.et.al(2008)	Managerial involvement and support.
Jennifer A. Farris(2006)	Managerial involvement and support, continuous improvement.
Paul H. Meredith et.al(1991)	Top management commitment, Strong relations with suppliers and customers, Training,
Panizzolo (1998)	Management commitment ,communications ,Organizational culture, Relationships with, customers and suppliers
Achanga et al. (2006)	Skills and expertise ,Management, Financial capabilities, Organizational culture

Golicic and Medland(2007)	Relationships with customers and suppliers
Kumar et al. (2009)	Top-management involvement and commitment ,Strong leadership ,Training and education for employees ,Communication with employees, and employee involvement, Cultural change
Mefford (2009)	Employee involvement, Organizational culture change, Management commitment, communication.
Zu et al. (2010)	Top-management commitment ,Workforce management Supplier and customer relations

Taking foundation of our literature reviews and getting perception from the American Automobile industry our paper discusses the following questions.

What is the level up to which the lean manufacturing critical factors are being followed by Automobile manufacturing industry in Delhi NCR?

Do the Indian manufacturing industries are going to be follow the critical success factors found by researchers from other nations which has already implemented successfully in lean manufacturing system?

From the above found 33 factors which factors are going to be given prioritized in manufacturing industry view pint so that they are able to implement it successfully?

The problems may get faced during the application of these lean tools?

Research Objective

There is no study of importance of KAIZEN in manufacturing industry particularly in Indian context and also there is few research papers about the significance of the factors affecting the KAIZEN. This research may be a guideline for the decision makers of manufacturing industry for their sustainability.

The research objectives are to Study the different critical factors of KAIZEN affecting the performance of manufacturing industries. Determine the sequence of critical factors to measure the significance.

III. Critical Factors

From the above 34 literature reviews it is found 30 critical success factors from different industries of different countries. Different research papers focused on various critical success factors or dimensions according to their way of analysis and improvements in manufacturing industries. So the questionnaire was developed from 30 critical success factors by the calculation of percentages of occurrences for each of the selected critical success factor Putting emphasis on more percentage critical success factor 16 critical success factors were selected. These 16 factors are as follows: Management support, Tools and techniques, Employee involvement, Continuous improvement, Relationship with customer and supplier, Ongoing evaluation and monitoring assessment, Rewards and recognition, Team work, Strong leadership, Problem identification and solving, Cultural change, Communication, Goal clarity, Training and Education, Financial capability and Participative management.

Adminstration of Questionnaire

The survey is conducted during the month of October 2015 to February 2016 (5months).The questionnaire formation is a very important thing and special care was taken to keep the questionnaire as simple as possible. The questionnaire were formed by selecting five top most factors which are again divided into sub- factors. Finally the questionnaire were finalized by experts and lean practitioner. These questionnaire were so clearly formed that the participators could feel easy to provide their responses. And can give their responses precisely. A total of 88 employees were participated in the survey. A 5-point Likert scale is used to collect the responses of the employees. These data were analysed by various statistical tools like Flow chart, Cause and Effect diagram or Fish Bone diagram, Pie/Bar chart, Histogram, Pareto analysis and control chart. The questionnaire is mainly divided into two sections:

1. Personal and organisational details of the respondents.
2. Factors affecting quality management practices in the SMEs

Table No 2: Details of Questionnaire

Topics	No of questions	Contents
General information		
Personal Details	4	Shows name, designation , educational qualification, experience etc
Organizational Details	5	Firm name, workforce size, type of industry etc
Influencing Factor		
Management support	6	Indicates management view on quality improvement policy & plans
Tools and techniques	5	to implementation of tools, effects of use of tools and techniques
Employee Involvement	5	It took the employee perception or how he/she feels working in the environment
Relationship with customer and supplier	7	It refers to the collection of customer''s feedback, satisfaction and his/her response. Supplier selection, program to improve supplier quality.
Continuous improvement	5	Indicates labels, signboard, cleanness
Process evaluation and monitor	4	Corrective counter measures, Audits, and target review
Rewards and recognition system	3	Indicates awarding employee for improvement remuneration

The survey applied five-item Likert scales to find out the limit of company adopted the lean technique. This 5-likert scale is used to let the employee to put their ratings. The scale is as follows: (1). Strongly Disagree, (2). Disagree, (3). Not Sure, (4). Agree, (5). Strongly Agree. The aim of the study is not to harm the sentiments of the employees. The propose of the study work is to find all possible factors affecting lean manufacturing of manufacturing industries. After the final preparation of the questionnaire that was sent to various Department of the Automobile Manufacturing Industry, top level management of company and they are really interested to join to our survey work.

Table 3: Number of employees in different departments

Type of Department	Number of Employee
Fabrication	20
Logistics	34
Line/Vehicle assembly	25
Maintenance	9
Total	88

Table 4: Number of employees according to work force

Type of Department	Number of Employee
Fabrication	20
Logistics	34
Line/Vehicle assembly	25
Maintenance	9
Total	88

Table 5: Number of employees according to experience (In Years)

Work experience(Years)	Frequency
0 to 3	62
03 to 08	13
08 to 14	8
14+	5
Total	88

Table 6: Number of Employees According to Job Profile

| Job Profile	Frequency	% of respondent
MD/GM	6	6.818%
Managers/supervisor	32	36.36%
Junior staffs/Team Associates	50	56.81%
Total	88	100

IV. Data Analysis

This data analysis section represents the details of the analysis of the data which are collected through questionnaire. There are two sections of data analysis one section describes the fishbone diagram/Ishikawa diagram and descriptive statistics and the other section describes the distribution pattern of employee views grounded on questionnaire. Also there are two analysis one is correlation and second one is regression.

A. Fishbone Diagram/Ishikawa Diagram

The fish bone diagram is a quality control tool which let an industry analyses the root cause of the problem through the process problem solving method. Fish bone diagram use for the brainstorming issue

where root cause is analyzed. In this study the questionnaire was prepared which contained 7 factors and these factors are divided into 35 sub-factors. Now from the point of data analysis these factors are taken and assembled which has the most significant effects on the application of lean manufacturing. By the application of certain quality control tools like fish bone diagram, histogram and flow chart these things are represented. The factors are shorted out according to their mean and their utility in the industrial use. so after the sub-factors are sorted out, based on the employees views the factors which are to be taken in to account is decided for the improvement process in the industry. The analysis of the sub factors are described below in the fish bone diagram.
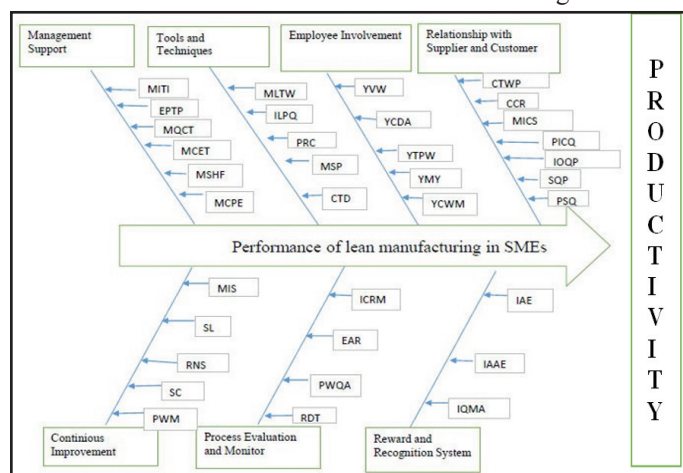
B. Descriptive Statistics Factor
Table.7: Descriptive Statistics of Factor

Factor	Full Form	Mean	Median	Std. Deviation	Variance
MITI	Management involvement towards identification of project quality goals	4.2273	4	0.7385	0.5455
EPTP	Encouraging and providing training on problem-solving techniques	3.864	4	1.116	1.246
MQCT	Management emphasizes quality with compare to Cost and time.	3.739	4	1.023	1.046
MCET	Management is committed to put its efforts towards quality.	3.7955	4	0.9366	0.8772
MSHF	Management is trying its best to allocate sufficient resources like Human resources and Financial resources	3.2955	3	0.8862	0.7853
MCPE	Management is communicating its plans and Policies to the employees.	3.6136	4	0.8364	0.6996
MLTW	Management involvement for implementation of Lean tools and techniques in work area.	3.9432	4	0.9016	0.8128

ILPQ	Implementation of lean methods affects production As well as quality	3.8523	4	0.8781	0.771
PRC	Process Problem solving and root cause analysis conducted weekly by HR.	3.284	3	1.061	1.125
MSP	`Managers respond towards solving of problems Which causes during process.	3.1932	3	0.8422	0.7094
CTD	Counter measure are taken against monthly Top Three/five defects.	3.8864	4	0.8767	0.7685
YVW	your feelings valued for the work you do	3.568	4	1.026	1.053
YCDA	you have the opportunity to contribute to decisions that affect you	3.4432	3	0.8558	0.7324
YTPW	you feel proud to tell people where you work	3.807	4	1.071	1.146
YMY	your manager inspires you	3.7273	4	0.8674	0.7524
YCWM	our feeling about coming to work every morning	3.42	3	1.036	1.074
CTWP	Combination of training criteria to work processes	3.5795	4	0.7983	0.6373
CCR	Collection of customer response.	3.8636	4	0.7758	0.6019
MICS	Methods to identify customer satisfaction.	3.4432	3	0.8691	0.7554
PICQ	Program to improve customer service quality.	3.5227	4	0.8574	0.7351
IOQP	Involvement of high level officials in quality planning.	3.9091	4	0.8528	0.7273
SQP	Selection of supplier as per the quality provided.	3.6591	4	0.8007	0.6411
PSQ	Program to improve supplier service quality.	3.659	4	0.945	0.894
MIS	Methods for item sorting	3.5795	4	0.9312	0.8672
SL	Signboards and labels.	3.2727	3	0.8805	0.7753
RNS	Records management system.	3.7614	4	0.8022	0.6435
SC	Sanitary/cleanness	3.6136	4	0.85	0.7226
PWM	Programs on waste management.	3.7841	4	0.8761	0.7689
ICRM	Implementing caution measures for repair and maintenance.	3.7159	4	0.8016	0.6425
EAR	Employee acceptance to regulations.	3.8409	4	0.8007	0.6411
PWQA	Periodic work stations and quality audits.	3.5227	4	0.8967	0.8041
RDT	Review of departmental targets.	3.2955	3	0.7902	0.7902
IAE	Improvement awards to the employee.	3.625	4	0.975	0.95

IAAE	Incentives and allowance to employees.	3.739	4	1.077	1.161
IQMA	Involvement in quality management association.	3.386	4	1.179	1.389

Now taking the mean values of all the sub factors of each factor it is found that Management support is a very crucial factor for the implementation of lean manufacturing technique which has the mean value of 3.755816667 comparatively highest among all the 7 factors. the involvement of top level managers in identifying the project quality goal has a mean value of 4.2277, which has the highest mean value comparatively the other sub factors it means it is most important for the top level managers to decide the quality goals in the industry for the continuous improvements in the industry. Next sub factor is encouragement of employees and providing training on the process problem techniques which gave the mean value of 3.86. as management decided to achieve a goal which is only possible with the encouraging the people to join as a team to achieve the goal for which it is most important for the managers to provide training on process problem techniques, the next sub factor is the commitment of management to put its 100% effort on achieving the goals which has the mean value of 3.795. Next is management should focus on the quality of the product compared to cost so that it will lead to customer satisfaction which has the mean value of 3.738. The two sub factors are management should communicate all its plan and policy to the employees so that they are able to get a clear knowledge about the goal and can able to contribute their 100% effort which has the mean value of 3.61. Finally management should allocate human resources and financial resources to achieve the goal which has the mean value of 3.295.

The flow chart found the top 7 critical success factors which are Management support, Relationship with supplier and customer, Tools and techniques, Continuous improvement, Process evaluation and monitor, employee involvement and rewards and recognition.
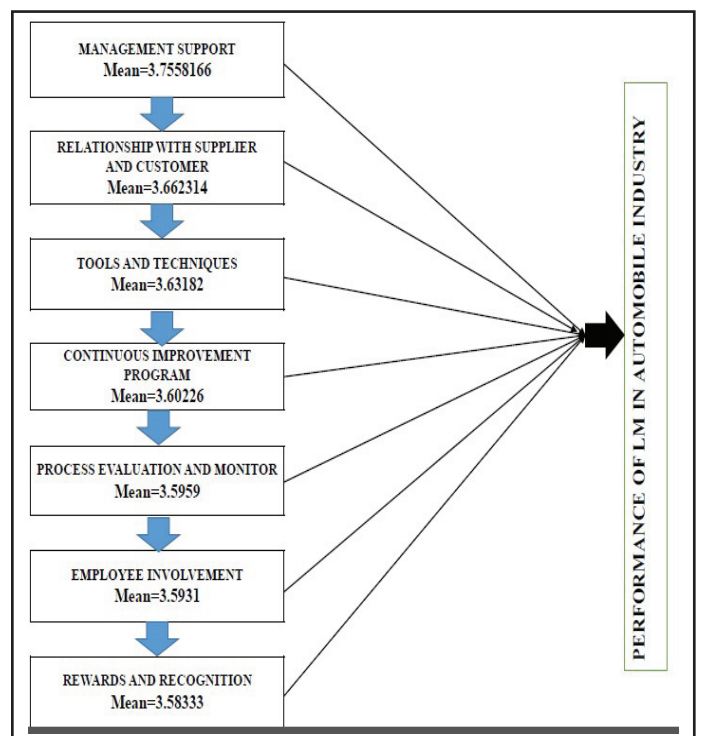

Fig. 12: Flow Chart of Major Critical Success Factors.

1. Correlation and Regression Analysis

Correlation and regression are statistical methods that are commonly used in the literature to relate two or more variables. Correlation measures the association between two variables and quantifies the strength of their relationship. Regression employs the existing data to define a mathematical equation which can be used to predict the value of one variable established on the value of one or more other variables and can therefore be used to generalize between the existing data. The regression equation can therefore be used to predict the outcome of observations not previously seen or tested.

Table 8: Pearson Correlation between Factor and Sub Factors of Management Support

	MITI	EPTP	MQCT	MCET	MSHF	MCPE
EPTP	0.428					
MQCT	0.595	0.190				
MCET	0.989	0.956	0.484			
MSHF	0.247	0.274	0.833	0.184		
MCPE	0.827	0.679	0.890	0.175	0.020	
MS	0.818	0.901	0.793	0.391	0.505	0.163

Table 9: Pearson Correlation between Factor and Sub Factors of Relationship with Customers and Suppliers

	CTWP	CCR	MICS	PICQ	IOQP	SQP	PSQ
CCR	.278						
MICS	0.790	0.295					
PICQ	0.157	0.965	0.217				
IOQP	0.248	0.413	0.815	0.239			
SQP	0.217	0.400	0.203	0.279	0.358		
PSQ	0.173	0.171	0.186	0.380	0.864	0.255	
RSC	0.424	0.471	0.715	0.738	0.412	0.844	0.742

2. Regression Analysis

Regression analysis mathematically describes the dependence of the Y variable on the X variable and makes an equation which can be used to predict any value of Y for any value of X. It is more specific and provides more information than correlation. Unlike correlation, however, regression is not scale independent plus the derived regression equation depends on the units of each variable involved. Regression (also named as simple regression, linear regression, or least squares regression) fits a straight line equation of the form to the data given below:

Regression Equation:
OR = OR = - 0.545 + 0.261 FABRICATION + 0.235 LOGISTICS + 0.374 LINE+ 0.265 MAINTENANCE
Where fabrication, logistics, line/vehicle assembly, and maintenance are 4 dimension.
The model is being acceptable as the R-sq value is more than 90% (98.4%) and R-sq (adj) is 95.1%. and the P value all the dimensions are less than 0.05 except two departments that is line/vehicle assembly and logistics.

Table 10: Mean Values Of Factors from Various Departments of Industry

| FACTORS	FABRI-CATION	LOGISTICS	LINE	MAINTE-NANCE	OR
MS	4.1	3.83	3.52	3.6	3.7
TT	3.18	3.67	3.9	3.8	3.6
EI	3.33	3.57	3.9	3.64	3.6
RSC	4	3.62	3.7	3.412	3.63
CIP	3.24	3.7	3.84	3.733	3.6
PEM	3.27	3.713	3.71	3.527	3.5
RR	3.6	3.166	3.94	4.11	3.7

Below table shows the ranking of factors with overall response from regression analysis

Table 11: Rank of Various Factors

| Rank	Factors	Overall Response (OR)
1	MANAGEMENT SUPPORT	3.695
2	RELATIONSHIP WITH CUSTOMER AND SUPPLIER	3.637
3	TOOLS AND TECHNIQUES	3.57
4	CONTINUOUS IMPROVEMENT PROGRAM	3.56
5	PROCESS EVALUATION AND MONITOR	3.53
6	EMPLOYEE INVOLVEMENT	3.514
7	REWARDS AND RECOGNITION	3.47

C. Distribution Pattern of Employees View

This section describes the distribution pattern of the opinion of the employees on the surveyed factors and their sub-factors.
From the fig no 3 given below the illation of the data is given as follow. Maximum 41% of the employees are strongly agreed on the management involvement towards the identification of project quality goals and like this 50% of the employees are agreed on the program to involve supplier service quality and providing training with combination to work processes. 23.8% of employees are disagree with the conduction of weekly program on process problem solving and root cause analysis by HR and finally 6.81% of employees are strongly disagree with the involvement in quality management association.
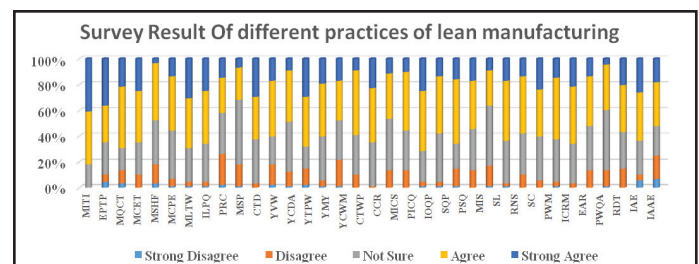
Now considering the lowest percentage of the sub-factors 3.4% of the employees are strongly agree with the management trying to allocate sufficient resources like human resources and financial resources. 25% of the employees agreed the response provided by the managers or supervisors towards problem if it occurs during ongoing process. Likewise 17% of employees are not sure about if

the management is emphasizing quality of product with compare to cost of the materials and other charges also 17% of people are not feeling proud working with the organization.at last no employees are disagree with the management involvement towards the identification of project quality goals and strongly disagree with improvement award to the employee and Periodic work stations and quality audits, Employee acceptance to regulations, Programs on waste management, cleanness, Methods for item sorting, Program to improve customer service quality, Methods to identify customer satisfaction, Collection of customer response, Combination of training criteria to work processes, Counter measure are taken against monthly Top Three/five defects, Management is committed to put its efforts towards quality and Management involvement towards identification of project quality goals.
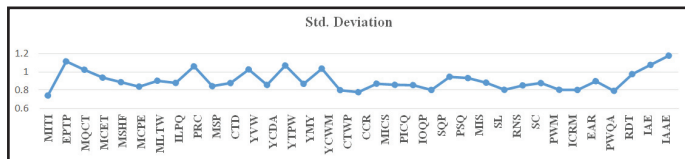
Standard deviation is a great statistical tool to check the reliability and acceptability of the result found from the data collected. From the above figure it may be explained that the standard deviation of the sub-factors are in the range of 0.6 to 1.2. That result shows that the sub factors don''t deviate from each other so largely as well as from the survey it is found most of the employees are agreed with the factors affecting the lean manufacturing in their organization. Major amount of care is being taken in implementation of lean manufacturing in the organization by the respective management team.

V. Conclusion

In the present market scenario of high competitiveness and fluctuation, manufacturing industries are greatly relying on cost savings where lean manufacturing practices gives a platform to achieve this cost cutting measures and improve product quality. The main objective of this study is to calculate the top most critical success factors which will affect the lean manufacturing process in the industry and Ranking of the factors using various analysis process.By using various problem solving methods like fish bone diagram, histogram, and using different analysis like correlation and regression and the result came from questionnaire survey it is found that the industry is trying to cope with the present situation with increase in productivity and decrease in cost. So on a broader picture it may be said that top management support gives a path for the continuous improvement in the industry with a clear goal clarity and also emphasizing quality as compare to cost with providing training on problem solving techniques to the employees. Management support will be stronger factor if emphasis will be given on the commitment of managers to put effort towards goal and communication between the top level managers and the employees will be firm. So more focus should be given to these sub-factors that will leads to strong management support.as customer is everything for the sustaining of the industry relationship with the customer is also playing a vital role.so to know about customer''s feelings and perception about the product, top level officials should try to get feedback from its customers by conducting programs on collecting customers response as well as apply methods to identify the customer satisfaction and accordingly providing training to the employees with the ongoing process. Focusing on stronger relationship with the customer and

supplier if training will be provided to the employees at the work process and management will involve in the quality planning then this factor will be stronger success factor in the application of lean manufacturing. The result indicates that lean manufacturing holds the key to achieve competitive advantages in the manufacturing firms.so various quantitative techniques like application of lean tools and techniques, employee involvement, continuous improvement in the shop floor with evaluating and monitoring of process should be prioritize to create a better lean environment. This study presented here will help the production and top level managers in identifying the areas in which they needs to focus their attention in order to improve productivity of the firm including customer satisfaction and resource utilization.

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