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AN IMPROVED METHODOLOGY TO FIND THE IMPACTS OF LEAN MANUFACTURING CONCEPTS ON THE DISTRIBUTION INDUSTRIES

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Abstract: This Lean manufacturing to consist of different tools and techniques and it will be used in the appropriate industry according to the problems faced by the industry of various sectors. It mainly depends upon the types of industry where the lean concepts were implemented. Different methodologies were prepared according to the problems. It will take a separate time for preparing the methodology for the each industry. In order to reduce the time taken for the preparation of a new methodology each time, we are going to prepare a generalized methodology for the implementation of lean concepts. That is starting from approaching the industry to implementation stage and analyzing the impacts. So this will be an as a generalized methodological platform for the companies that are going to implement the lean concepts in the distribution industries sectors in future and it also helps the researchers those who are doing research in the lean implementation platform.

Index Terms **- Lean manufacturing, methodology of study, pilot implementation, survey analysis.**

I. INTRODUCTION

In this paper it will reveal how an impact of lean concepts on the particular industries under the particular zone/location. It also reveals an improved generalized methodology during the lean implementation according to the challenges faced by the selected distribution industries. It also based on the industry capability. That is whether the company can withstand the process and implementation or not. Although it is implemented the company will follow it or not also considered when preparing the methodological structure. So, keeping all these problems we have planned to develop a generalized methodology for distribution industries planning for the implementation of lean concepts. The developed methodology will reduce the time taken for preparing a unique methodology during every new lean implementation in distribution industries [1]. This paper doesn't say that the developed methodology suits 100% for all lean distribution industries. It tells that the developed generalized methodology can be taken as a basement and slight modification can be made on the developed generalized methodology mainly according to the industry's scenario. This paper also deals with the major challenges and problems faced during the implementation period of generalized methodology into the distribution industries under the selected zone/location [2].

II. METHODOLOGY OF THE STUDY

A location for the implementation of lean should be selected. Then a distribution industry should be selected under the selected location. That is a proper list of industries selected for the lean implementation. (A file should be prepared and all the distributors under the particular location to be entered with the following requirements like, Name of the industry, Distribution type, Address, Contact number. A questionnaire should be prepared to find the awareness about lean manufacturing concepts among the selected industries in the particular location. By using the questionnaire results, the level of lean awareness/lean impacts on the industries will be clearly known. Then as a next step all the companies should be segregated and arranged in the ascending order according the awareness lean percentage or rating[3]. Then a lean awareness program should be conducted in the industries which have been segregated. It will give an exposure to the lean concepts and awareness to the employees working at the industry. Then the problems should be identified by the effective lean tool like gemba and a gemba walk into the industry and also from the management. Then the lean tools should be selected according to the problems arose. One more important thing is if there is no problem found in the industry means, we have to implement the basic lean implementation like, Lean leadership concepts to the all levels of management which will be used by the top management as an effective tool for communicating the shop floor employees and they can also use the leadership techniques if any problems or misunderstanding with the employees at any situation..5S implementation, Gemba walks, Kanban etc. Then as a next step the methodology for lean implementation according to the problems and by using the selected appropriate tools should be prepared. The schedule for the

implementation should also be prepared when preparing the step by step methodology [4]. Before the implementation processes / processed the employees that are going to work in the particular lean environment and with the lean techniques should be given a proper training regarding the process during the implementation and after the implementation process. The training sessions will clarify all the doubts about / as to the employees if any. Then the implementation process should be started according to the planned schedule. Then it should be monitored periodically after the implementation process of a certain period in order to know the impact and results of the lean implementation in the distribution industries. Then after the time period ends we have to analyze the results like, before and after implementation of lean. Then the impact on lean on the distribution industries also was analyzed according to the results and by a separate questionnaire created for the distribution industries in order to find the feedback from the industries after the lean implementation [5].

III. PILOT IMPLEMENTATION

By keeping the above methodology as a basement we have pilot implemented the developed generalized methodology into a private automotive lubricant distribution industry. Starting from the industry selection process to the final result analysis about lean impacts on the distribution industry. The major problems we find during the implementation of the generalized methodology are the employee involvement. That is the employees working in the industry were accepting the new lean concepts into their industry or not. It was the major problem normally faced while implementation of new concepts in an industry because, the employees may think that the new and improved concepts may affect their job of the industry. So as a first step when approaching the employees their suggestion is need of new concepts. In order to overcome this problem we have planned to conduct an awareness programme at the industry. This should be an interactive session between the lean experts and the employees of the industry. Which will clearly say that the new and generalized methodology and the lean concepts won't affects their jobs in the particular industry. It also tells them that how they can improve their current working scenario of the updated work environment [6].

IV. QUESTIONNAIRE FOR THE INDUSTRY WHERE WE MADE A PILOT IMPLEMENTATION (BEFORE LEAN IMPLEMENTATION)

GENERAL QUESTIONNAIRE

1. Are you aware of lean manufacturing and tools and techniques

   YES **NO**

   Answer: YES

2. Whether you were using it before

   YES **NO**

   Answer: No but we haven't used it before.

3. Any reasons behind why you haven't implemented lean manufacturing concepts at your industry

   YES **NO**

   Answer: Yes the main reason time taken for the implementation.

4. Have you pilot implemented lean concepts in any specific department of your industry.

   YES **NO**

   Answer: No we haven't implemented in our industry.

V.QUESTIONNAIRE FOR THE INDUSTRY WHERE WE MADE A PILOT IMPLEMENTATION (BEFORE LEAN IMPLEMENTATION)

TECHNICAL QUESTIONNAIRE

1. Have you used lean manufacturing concepts before — See Graph

Options	Response Percentage	Responses
Yes	50%	10
No	50%	10
Other	0%	0

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0		
Mean: 1.5	**Std. Deviation:** 0.5	**Satisfaction Rate:** 25	**Variance:** 0.25	**Std. Error:** 0.112

2. Do you remember the tagline associated with lean manufacturing concepts — See Graph

Options	Response Percentage	Responses
Yes	50%	10
No	50%	10

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0		
Mean: 1.5	**Std. Deviation:** 0.5	**Satisfaction Rate:** 50	**Variance:** 0.25	**Std. Error:** 0.112

Fig. 1. Survey analysis of question 1 and 2.

3. Are you familiar with lean manufacturing — See Graph

Options	Response Percentage	Responses
Yes	79%	15
No	21%	4

Total Responses: 20	Answered Responses: 19	Skipped Responses: 1		
Mean: 1.211	**Std. Deviation:** 0.407	**Satisfaction Rate:** 21.053	**Variance:** 0.166	**Std. Error:** 0.093

4. Have you known any industries succeeded after lean implementation — See Graph

Options	Response Percentage	Responses
Yes	59%	10
No	41%	7

Total Responses: 20	Answered Responses: 17	Skipped Responses: 3		
Mean: 1.412	**Std. Deviation:** 0.492	**Satisfaction Rate:** 41.176	**Variance:** 0.242	**Std. Error:** 0.119

Fig. 2. Survey analysis of question 3 and 4.

5. Where did you last heard about lean manufacturing

Options	Response Percentage	Responses
email	10%	2
Facebook	0%	0
Internet	35%	7
industry people	60%	12
Other	25%	5

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0		
Mean: 4.8	**Std. Deviation:** 1.512	**Satisfaction Rate:** 67.308	**Variance:** 2.286	**Std. Error:** 0.297

6. Have you visited a lean implementation industry

Options	Response Percentage	Responses
Yes	30%	6
No	70%	14

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0		
Mean: 1.7	**Std. Deviation:** 0.458	**Satisfaction Rate:** 70	**Variance:** 0.21	**Std. Error:** 0.102

Fig. 3. Survey analysis of question 5 and 6.

7. When you think of lean concepts what is the first thing comes to your mind

Options	Response Percentage	Responses
Efficient methodology	85%	17
Slightly efficient	15%	3
Not efficient	0%	0
Other	5%	1

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0		
Mean: 1.35	**Std. Deviation:** 0.703	**Satisfaction Rate:** 9.524	**Variance:** 0.494	**Std. Error:** 0.153

8. Which segment of the industry do you think lean manufacturing and it's concepts meant for

Options	Response Percentage	Responses
Service industries	0%	0
Manufacturing industries	35%	7
Distribution industries	0%	0
All the above	70%	14
Other	0%	0

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0		
Mean: 3.5	**Std. Deviation:** 0.958	**Satisfaction Rate:** 58.333	**Variance:** 0.917	**Std. Error:** 0.209

Fig. 4. Survey analysis of question 7 and 8.

9. Which industry income bracket do you think lean manufacturing and it's concepts meant for — See Graph

Options	Response Percentage	Responses
Low scale industries	0%	0
Medium scale industries	15%	3
High scale industries	20%	4
All the above	70%	14
Other	0%	0

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0

Mean: 3.7	Std. Deviation: 0.752	Satisfaction Rate: 63.095	Variance: 0.566	Std. Error: 0.164

10. Do you think lean manufacturing and it's concepts will be useful for your industry — See Graph

Options	Response Percentage	Responses
Yes	95%	19
No	5%	1

Total Responses: 20	Answered Responses: 20	Skipped Responses: 0

Mean: 1.05	Std. Deviation: 0.219	Satisfaction Rate: 5	Variance: 0.048	Std. Error: 0.049

Fig. 5. Survey analysis of question 9 and 10.

VI. QUESTIONNAIRE FOR THE INDUSTRY WHERE WE MADE A PILOT IMPLEMENTATION (AFTER LEAN IMPLEMENTATION)

1. How would you rate the overall experience of lean implementation in your industry? — See Graph

Options	Response Percentage	Responses
1	0%	0
2	18%	3
3	12%	2
4	71%	12

Total Responses: 17	Answered Responses: 17	Skipped Responses: 0

Mean: 3.529	Std. Deviation: 0.776	Satisfaction Rate: 84.314	Variance: 0.602	Std. Error: 0.188

2. What should be change in our lean implementation in order to live up to your expectations.Suggest any?

Options	Response Percentage	Responses
Answered	41%	7

Total Responses: 17	Answered Responses: 7	Skipped Responses: 10

Fig. 6. Survey analysis of question 1 and 2.

3. Rate our lean implementation methodological structure?

See Graph

Options	Response Percentage	Responses
Highly satisfied	57%	8
Satisfied	36%	5
unsatisfied	0%	0
Highly unsatisfied	14%	2

Total Responses: 17	Answered Responses: 14	Skipped Responses: 3		
Mean: 1.857	**Std. Deviation:** 1.005	**Satisfaction Rate:** 24.444	**Variance:** 1.011	**Std. Error:** 0.26

4. Satisfaction with the range of our service?

See Graph

Options	Response Percentage	Responses
Highly satisfied	65%	11
Satisfied	29%	5
Unsatisfied	0%	0
Highly unsatisfied	6%	1

Total Responses: 17	Answered Responses: 17	Skipped Responses: 0		
Mean: 1.471	**Std. Deviation:** 0.776	**Satisfaction Rate:** 15.686	**Variance:** 0.602	**Std. Error:** 0.188

Fig. 7. Survey analysis of question 3 and 4.

5. How do you feel while working with the lean environment?

See Graph

Options	Response Percentage	Responses
Easy	100%	17
Tough	0%	0

Total Responses: 17	Answered Responses: 17	Skipped Responses: 0		
Mean: 1	**Std. Deviation:** 0	**Satisfaction Rate:** 0	**Variance:** 0	**Std. Error:** 0

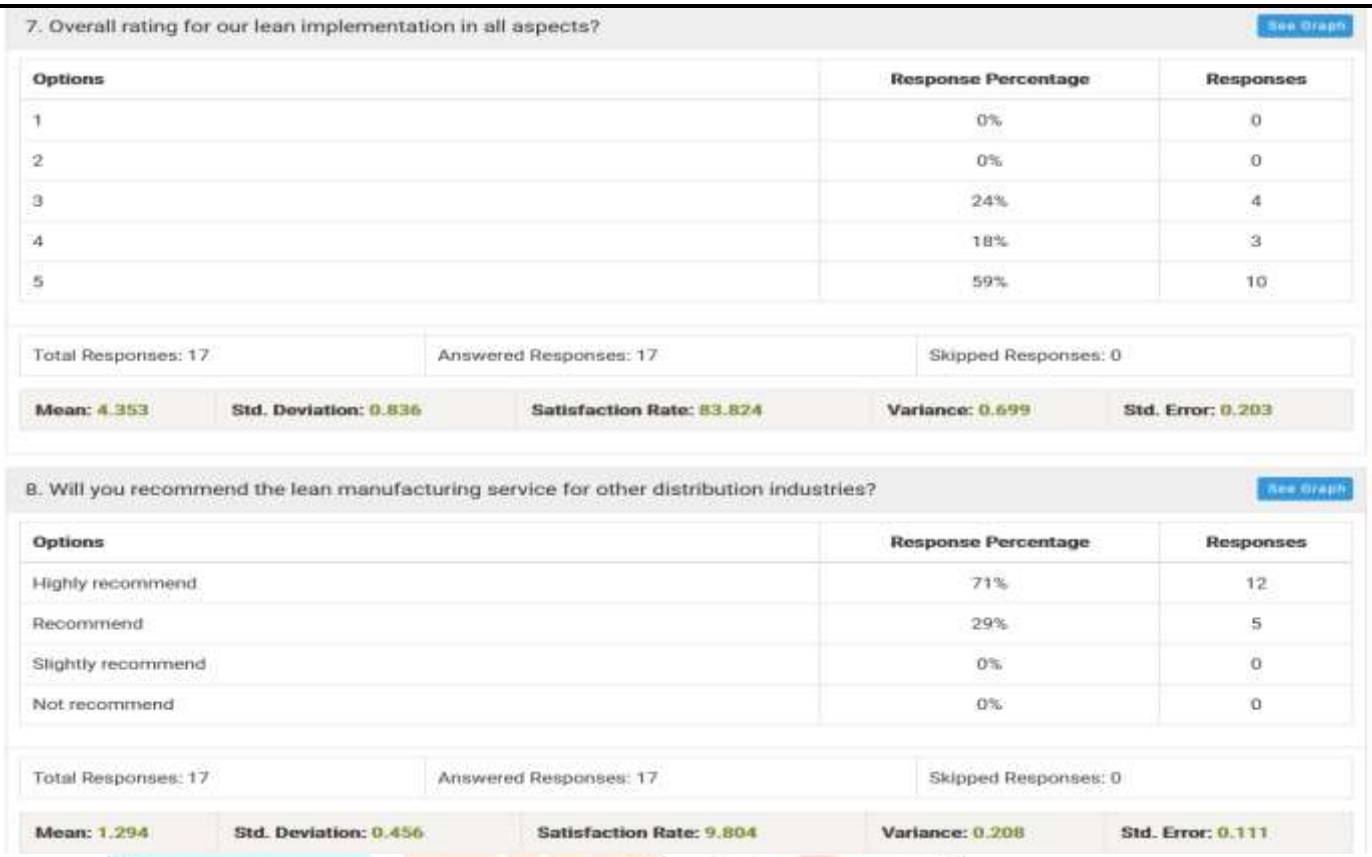
6. What do think about the quality of lean implementation?

See Graph

Options	Response Percentage	Responses
Highly satisfied	53%	9
Satisfied	41%	7
Unsatisfied	0%	0
Highly unsatisfied	6%	1

Total Responses: 17	Answered Responses: 17	Skipped Responses: 0		
Mean: 1.588	**Std. Deviation:** 0.771	**Satisfaction Rate:** 19.608	**Variance:** 0.595	**Std. Error:** 0.187

Fig. 8. Survey analysis of question 5 and 6.



7. Overall rating for our lean implementation in all aspects?

Options	Response Percentage	Responses
1	0%	0
2	0%	0
3	24%	4
4	18%	3
5	59%	10

Total Responses: 17 | Answered Responses: 17 | Skipped Responses: 0

Mean: 4.353 | Std. Deviation: 0.836 | Satisfaction Rate: 83.824 | Variance: 0.699 | Std. Error: 0.203

8. Will you recommend the lean manufacturing service for other distribution industries?

Options	Response Percentage	Responses
Highly recommend	71%	12
Recommend	29%	5
Slightly recommend	0%	0
Not recommend	0%	0

Total Responses: 17 | Answered Responses: 17 | Skipped Responses: 0

Mean: 1.294 | Std. Deviation: 0.456 | Satisfaction Rate: 9.804 | Variance: 0.208 | Std. Error: 0.111

Fig. 9. Survey analysis of question 7 and 8.

QUESTIONS	MEAN	STANDARD DEVIATION	SATISFACTION RATE	VARIANCE	STANDARD ERROR
QUESTION 1	1.5	0.5	25	0.25	0.112
QUESTION 2	1.5	0.5	50	0.25	0.112
QUESTION 3	1.211	0.407	21.053	0.166	0.093
QUESTION 4	1.412	0.492	41.176	0.242	0.119
QUESTION 5	4.8	1.512	67.308	2.286	0.297
QUESTION 6	1.7	0.458	70	0.21	0.102
QUESTION 7	1.35	0.703	9.524	0.494	0.153
QUESTION 8	3.5	0.958	58.333	0.917	0.209
QUESTION 9	3.7	0.752	63.095	0.566	0.164
QUESTION 10	1.05	0.219	5	0.048	0.049

Table. 1. Survey analysis values of technical questionnaire before lean implementation

QUESTIONS	MEAN	STANDARD DEVIATION	SATISFACTION RATE	VARIANCE	STANDARD ERROR
QUESTION 1	3.529	0.776	84.314	0.602	0.188
QUESTION 2	-	-	-	-	-
QUESTION 3	1.005	0.407	24.444	1.011	0.26
QUESTION 4	1.471	0.776	15.686	0.602	0.188
QUESTION 5	1	0	0	0	0
QUESTION 6	1.588	0.771	19.608	0.595	0.187
QUESTION 7	4.353	0.836	83.824	0.699	0.203
QUESTION 8	1.294	0.456	9.804	0.208	0.111

Table. 2. Survey analysis values of technical questionnaire after lean implementation

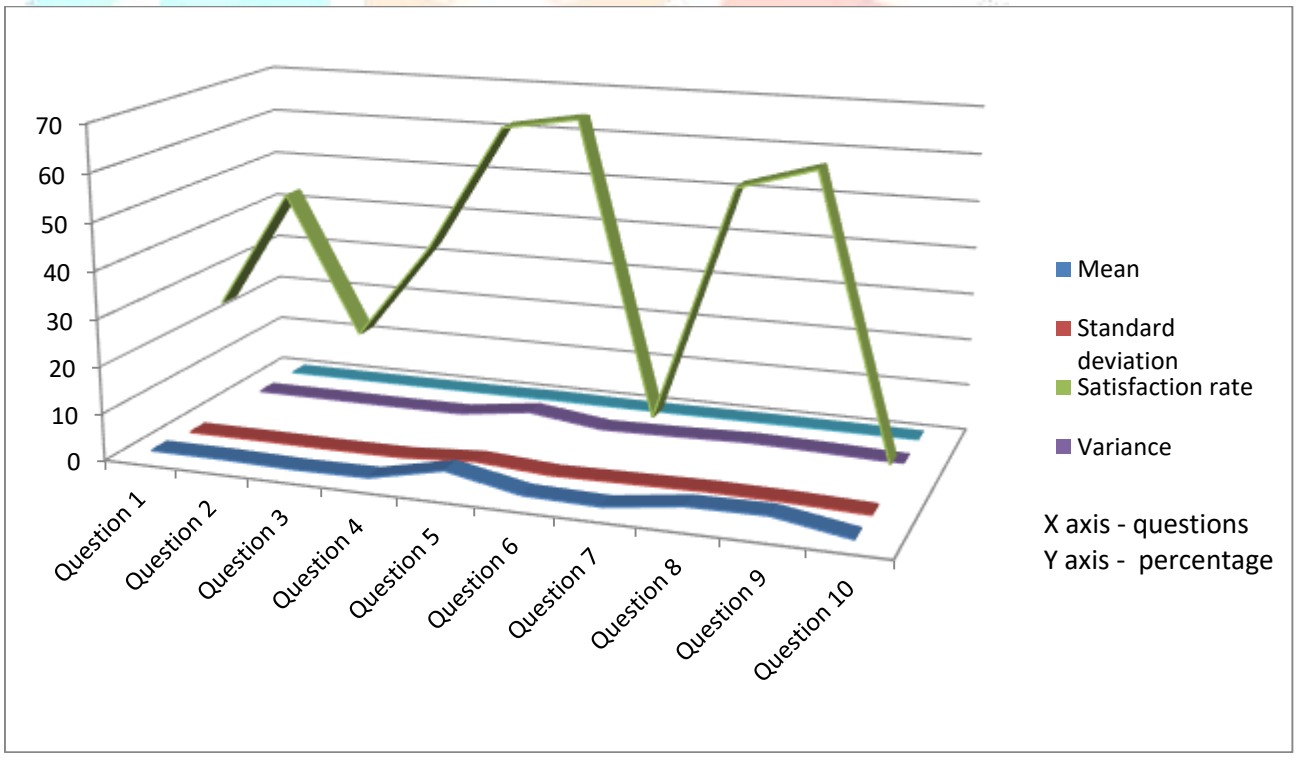


Fig. 10. 3D line representation of survey analysis before lean implementation

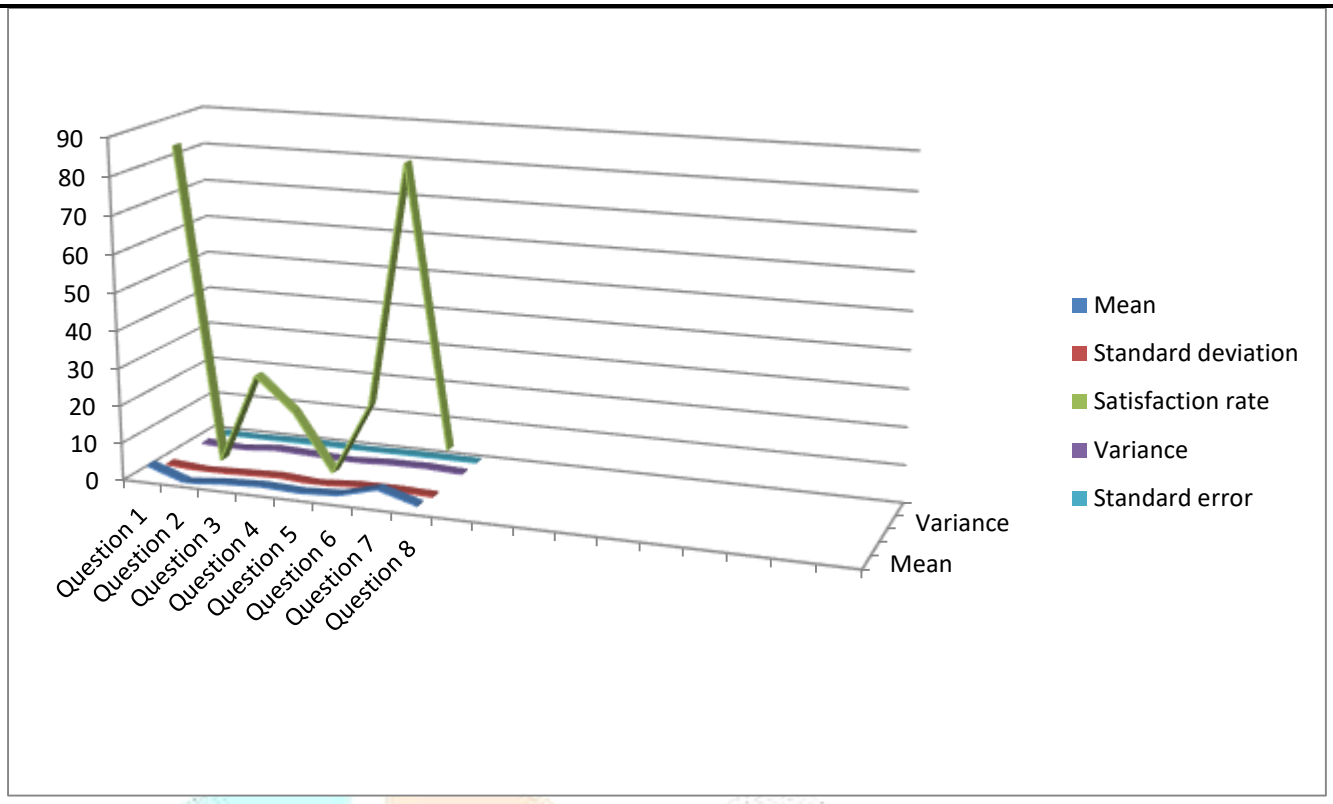


Fig. 11. 3D line representation of survey analysis before lean implementation

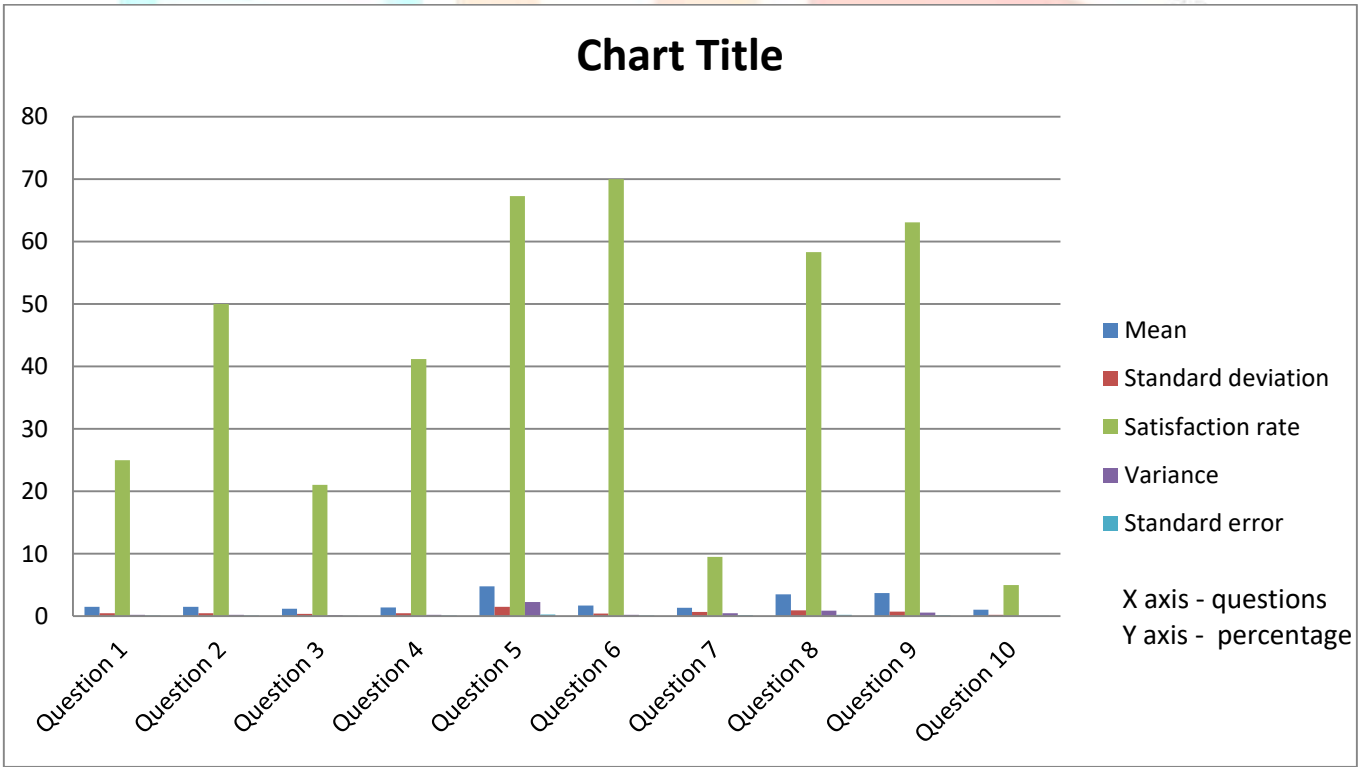


Fig.12. Cluster column representation of survey analysis before lean implementation

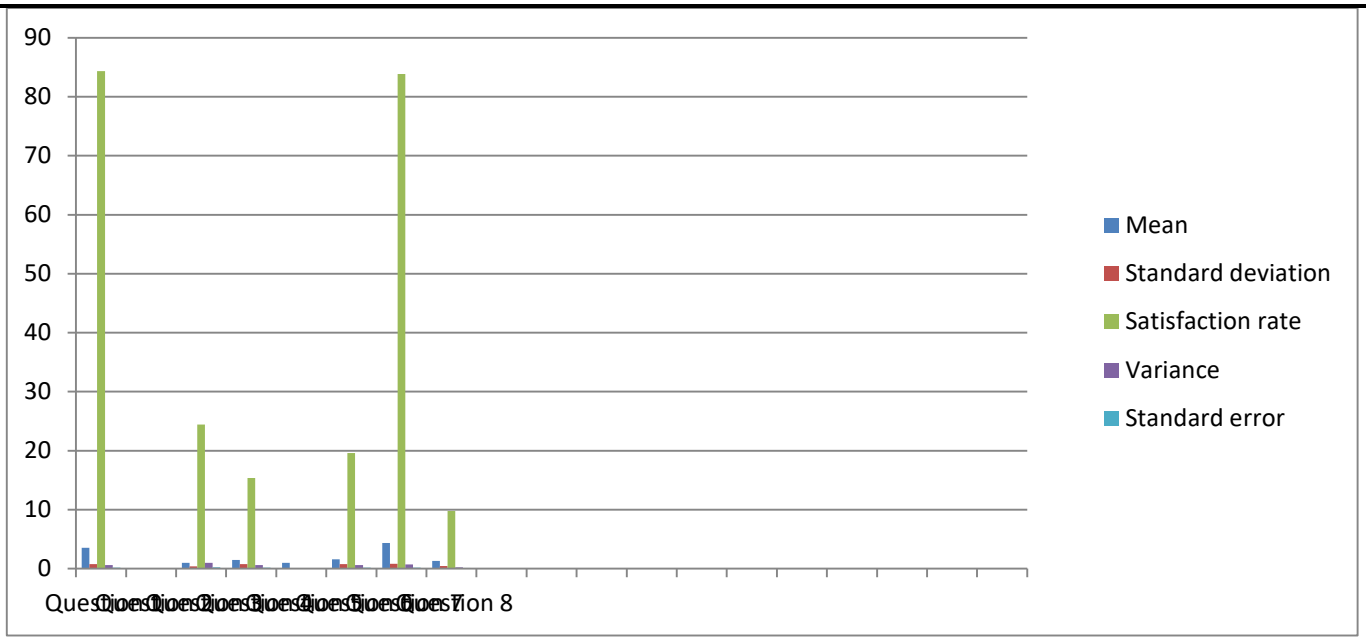


Fig.13. Cluster column representation of survey analysis after lean implementation

VII. CONCLUSION

In this paper a generalized methodology has been developed for the distribution industries after a successful pilot implementation in a selected lubricant distribution industry and survey analysis also done for the industry was pilot implementation is executed. As a next step it will be implemented in all selected distribution industries at a particular zone/location. We hope that the developed generalized methodology will reduce the time for preparing the methodological outline of each implementation at distribution industries in future. As we mentioned before that this improved generalized methodology may not be used as a 100% implementation methodology. By keeping it as a basement the modifications can be done according to the implementation and the industry scenario and working environment.

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