International Journal of Advance Research in Science and Engineering
Volume No.07, Issue No.05, May 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Productivity Improvement in Manufacturing Industry Using Six Sigma

Harish[1], Sandeep Malik[2]

M.Tech. Research Scholar[1], Assistant Professor[2],

Mechanical Engineering Department, U.I.E.T., M.D. University, Rohtak

ABSTRACT: Six Sigma methodology is a set of tools and techniques which is used for process improvements for achieving the desired goals of an organisation. It was introduced by Mr. Bill Smith when he was working at Motorola in 1986. In this we understand the needs and requirements of the consumers. This study mainly focused on six sigma, quality of process by identifying the cause of defects, removing the cause of defects and minimise the variability in the manufacturing process. In this study mainly focused on that philosophy which is used to identify the rejections problem in small and medium scale manufacturing industries. It uses a set of quality techniques, empirical methods, statistical methods, and creates a special infrastructure of people within the organization who are specialists in these methods. Six Sigma in an organization provides sequence of steps, specific value targets, and checks the process for change. Reduce the rejection rate which increase the production rate and productivity of manufacturing industry.

For example: decrease process cycle time, reduce costs of production, maximum customer satisfaction, and increase profits, increase productivity.

Keywords: six sigma, productivity, DMAIC, process capability etc.

I.INTRODUCTION

Six sigma approach is a gathering of methods and instruments which is utilized for development in the process. Six sigma was right off the bat presented in 1986 by Mr. Bill Smith and Mikel J Harry when they were working with Motorola Company. In the time of 1995 Jack Welch utilize six sigma for his business program .It is utilized for quality change of the procedure and process yield is distinguish and expel the reasons for abandons and limit changeability in assembling and business program.

Six sigma going for the decrease of imperfection rate to 3.4 deformities for each million open doors. Six sigma as a task based technique for taking care of particular execution issues perceived by an association. Getting things done in most ideal way and keeping it right way by six sigma. Kaushik gives a definition for six sigma" technique that offers unwavering quality and offering way to deal with take care of the issue by group and an administration framework that aides in making initiative and give specialist for critical thinking in industry." Six sigma helps in drawing in the assembling area for enhancing the nature of definite item.

Six sigma projects methodology:

Six sigma ventures take after two strategies. These procedures are DMAIC and DMADV.

DMAIC: - Aim of this procedure is enhancing a current business forms.

DMADV: - Creating new item or process outlines by this procedure.

In this paper we will examine about DMAIC system.

In this approach has five stages:

#**Define:** In this stage consider, voice of the client and about their prerequisites, and characterize objectives of an undertakings.

#**Measure:** In this stage measure check repeatability and reproducibility of the running procedure and check the procedure ability of an undertaking.

#**Analyze:** Data is gathered and build up a stream of procedure to dissect and confirm circumstances and end results of a procedure and what is the underlying driver of this deformity.

#**Improve:** Improve the running procedure in view of information examination utilizing strategies, for example, DOE, FMEA, Pareto outline is utilized for development.

#**Control:** Standardize and reported the change of the procedure control outline is an instrument which is utilized as a part of this stage to check the procedure issue is move or not.

II.LITERATURE REVIEW

Presently days six sigma has been broadly utilized by various enterprises. Six Sigma is an approach that can help an industry to accomplish expected objectives through consistent task change. Six sigma is an approach which limit the mix-ups and boost the quality estimation of the procedure. Six sigma has been best business change methodology created amid the most recent 50 years. Administration specialists like Walter Shewhart, Joseph Juran gives the thought regarding constant process change. The case of Process change system is the Deming cycle of plan-do-registration. The requirement for nonstop change inside the association is important to manage in the worldwide market [. For this reason, various nonstop change techniques were created in light of generation framework, process change, squander minimization and quality change.

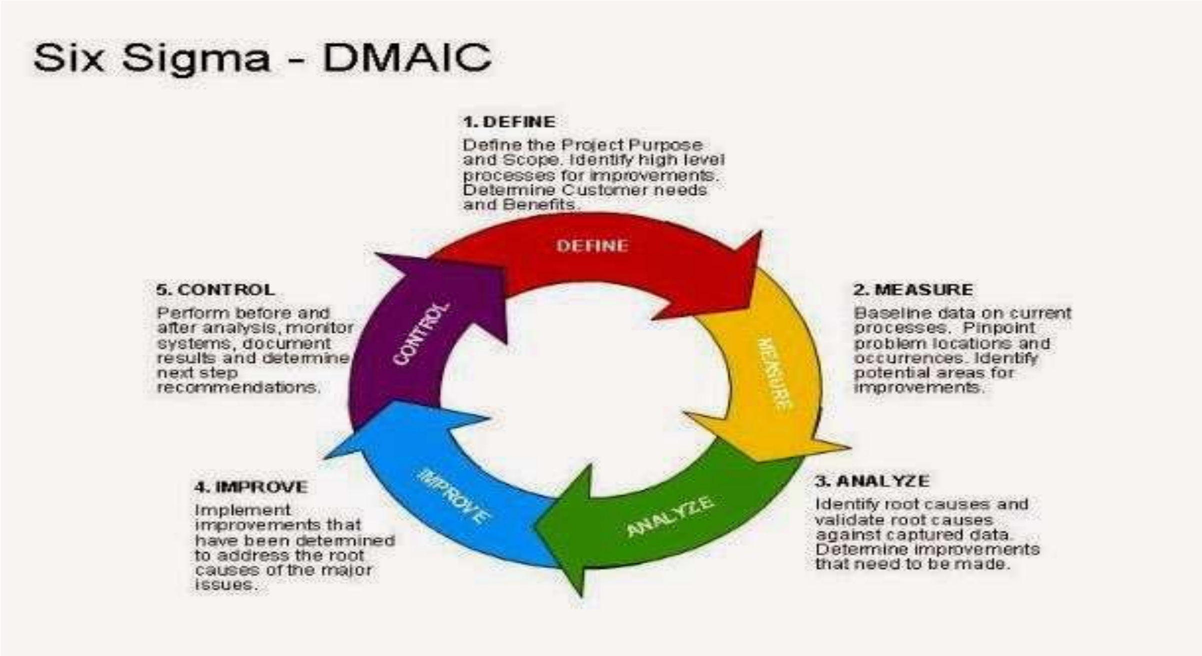

Fig:-1(six sigma methodology)

As indicated by six sigma is best quality change system. Six sigma approach is utilized for enhance efficiency in assembling industry. DMAIC is the model good to nourish the advantages of six sigma in assembling, benefit and other capricious areas.

III.CASE STUDY

Problem formulation:

The investigation was totally about fasteners(nut screws) fabricating industry situated in ROHTAK (HARYANA).Project distinguished is Major Diameter dismissal of Self tap screw (4.8×16) is contributing 83% of the issue. The screw real distance across U/S and O/S restrict is 4.70-4.90. beginning of the task with Initial perception which indicates high dismissal due to" Major measurement issue ".The DMAIC philosophy was receive for tackling the task Initial perception of undertaking indicated terrible outcomes and the staff part and administration was needs to diminish the dismissal rate and executing these progressions.

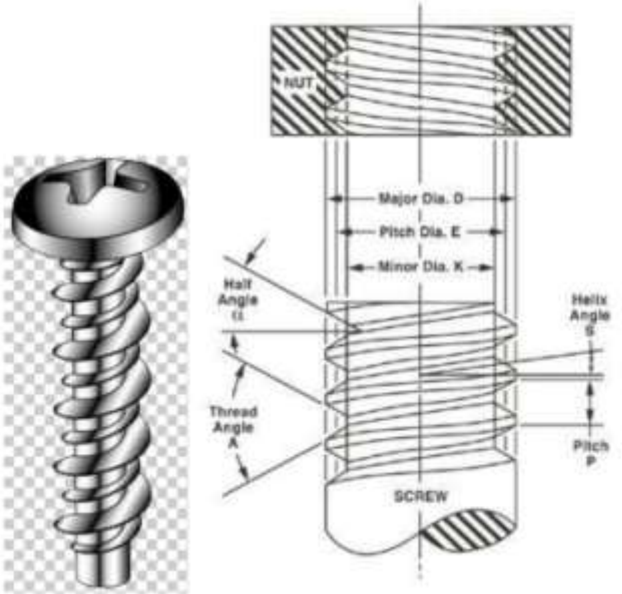

Fig:-2(Self tap screw)

About Organization:

Lakshmi Precision Screws is an ISO-9002, QS-9000, ISO-14001 ensured organization. Lakshmi Precision screws (LPS) ltd. is a fasteners(nut, screw) producing industry which was set up in 1972. The organization which is giving attaching innovation globally. The organization is situated in ROHTAK(Haryana).The organization is one of the worldwide pioneers for manufacturing fasteners and cold forged components.

Study and Analysis of the (4.8×16) Self Tap Screw dismissal because of Major Diameter Problem using six sigma DMAIC Methodology: DMAIC is critical thinking philosophy is utilized for issue investigation. (M. Shanmugaraja and M. Nataraj) (2011)

The Rejection rate of Self tap screw was 1052 PPM (Parts per million) because of the Major Diameter issue. That is the reason diminished dismissal of screw was essential. The dismissal rate of (4.8×16) Self tap screw lessening by utilizing six sigma. In Six sigma DMAIC procedure was utilized to take care of screw dismissal issue and to accomplish the quality level of 3.4 PPM from the present level which is 1052PPM.

International Journal of Advance Research in Science and Engineering
Volume No.07, Issue No.05, May 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

The enrollment of a task was the primary action, which demonstrated endorsement from the administration to begin the venture. Without their assistance and bolster it was never conceivable to include individuals and actualize proposals. The dismissal issue of Self tap screw was considered and the five periods of six sigma(DMAIC) system i.e.(Define, Measure, Analyze, Improve and Control) have been effectively actualized to accomplish the quality level of 5.79σ from 1.12σ (as clarified underneath in fig 7 and 10).

Define

In Define stage, where characterize the voice of client and objectives of a venture. Apparatus utilized for characterizing venture was utilized process stream graph and a SIPOC chart were drawn for Self tap screw (as shows in fig 3 and 4). Process stream chart demonstrates the different phases of the inalienable activities and the stream of material inside the shop. The SIPOC chart demonstrates the data stream inside the business and in addition the part of client and producers.

PROCESS FLOW DIAGRAM

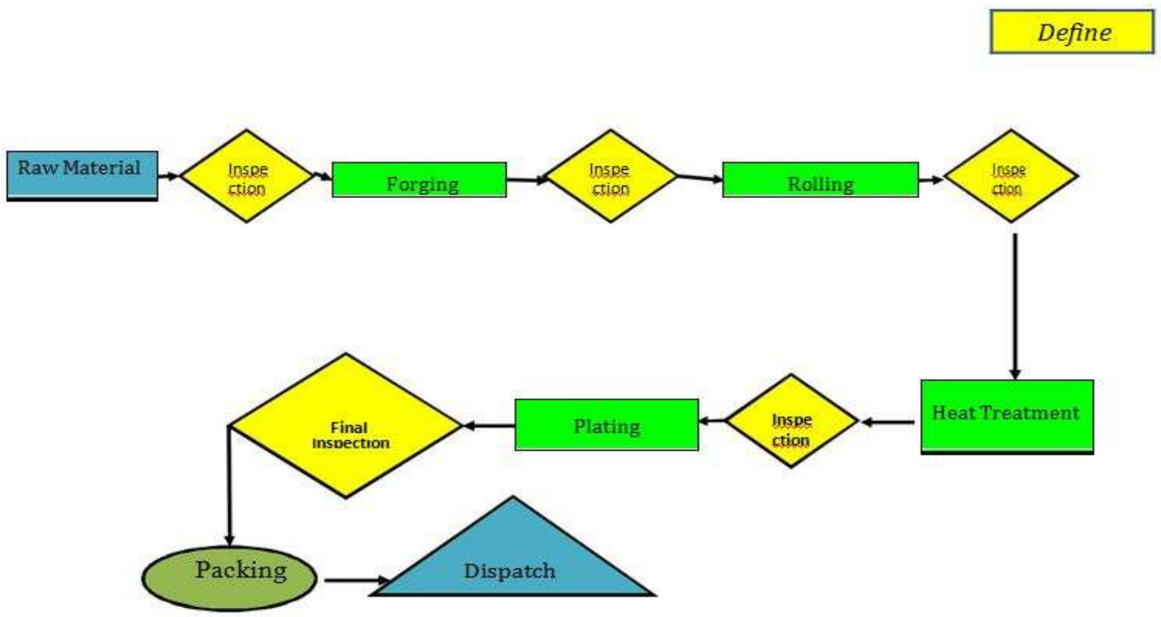

Fig:-3(Process Flow Diagram for Screw)

Measure:

In measure stage, an estimation framework examination (MSA) is utilized by its exactness, accuracy and dependability (limit of the estimation framework). In MSA incorporates a factual instrument which is Gauge R&R (Gauge repeatability and reproducibility) considers. Gauge R&R study where the measure of variety emerging from the estimation gadget measure. In this analysis Two people are required for play out this examination, which for this situation were the examiner and the agent. The example estimate was five and two readings were gone up against each example, along these lines an aggregate no. of readings is 50. The measure which is utilized for this investigation was a micrometer.

In this test Gauge R&R ponder, which offers result to be 26.03 percent and 0.00 percent of repeatability and reproducibility and put the rate think about variety to be 26.03 percent, which is < 30 percent, implies that micrometer was right.

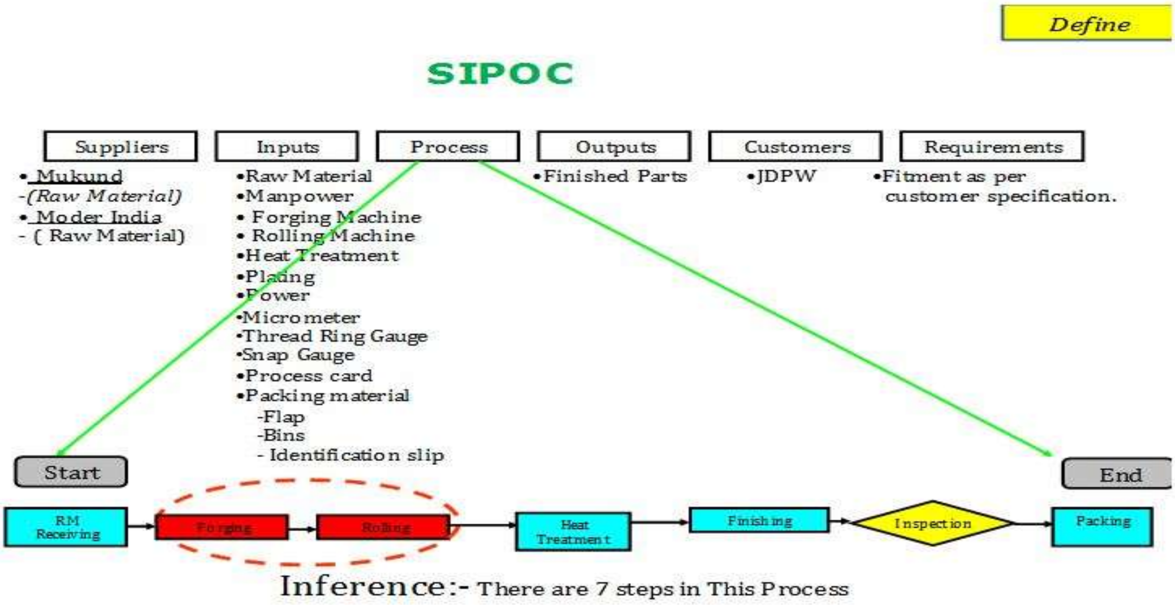

Fig:-4(SIPOC diagram for screw)

Analysis:

The dissect stage where examination of the information gathered. In this stage Process capacity examination was performed to locate the genuine condition of the procedure. Sub-gathering of test was done and ten examples were attracted a gathering of five. Minitab programming was utilized to check the procedure capacity investigation (which is appeared in fig 7&10).

In investigation stage where dissecting 4 factors:

1. TRD (Thread rolling diameter).
2. Total length.
3. Gap b/w die.
4. Machine speed.

Quick wins in FMEA (which enhance item quality and reduce rejection rate of screw)

1. Training to operators.
2. Die life to be set.
3. Pusher life to be set.
4. Preventive support of machine.
5. Profile projector to be utilized for setting endorsement.

IJARSE
ISSN: 2319-8354

6. MSA to be done after like clockwork.
7. Work instructions for setting of machine.

Analyze

FMEA

Process or Product Name:	Rolling,D4.8X16 self tapping screw	Prepared by: Anil K. Verma,Amit Sharma	Page ___ of ___
Responsible:	Sachin Dharane/Amit Sharma	FMEA Date (Orig) ___________ (Rev) ___________	

Process Function	Characteristic of Input (KPIV / X)	Potential Failure Mode (How the X fails?)	Potential Effects of Failure (Y or Mini-Y)	SEV	Potential Cause(s)/ Mechanism(s) of Failure (Sub X's)	OCC	Current Process Controls	DET	RPN	Recommended Action(s)	Responsibility	Completion Date	Action Results: Actions Taken	SEV	OCC	DET	RPN
The highest value process steps from the C&E matrix.	The shortlisted X's from the C-E Matrix	In what ways might the process potentially fail to meet the process requirements and/or design intent?	What is the effect of each failure mode on the outputs and/or customer requirements? The customer could be the next operation, subsequent operations, another division or the end user.	How Severe is the effect to the cusotmer?	How can the failure occur? Describe in terms of something that can be corrected or controlled. Be specific. Try identify the causes that directly impacts the failure mode, i.e., root causes.	How often does the cause or failure mode occur?	What are the existing controls and procedures (inspection and test) that either prevent failure mode from occurring or detect the failure should it occur? **Should include an SOP number.**	How well can you detect cause or FM?	SEV x OCC x DET	What are the actions for reducing the occurrence, or improving detection, or for identifying the root cause if it is unknown? **Should have actions only on high RPN's or easy fixes.**	Who is responsible for the recommended action?	What is the completion date for the recommended action?	List the completed actions that are included in the recalculated RPN. Include the implementation date for any changes.	What is the new severity?	What is the new process capability?	Are the detection limits improved?	Recomkpute RPN after actions are complete
Rolling	Operator	Untarined Operator	Major dia O/S	7	Eneffective Training	5	Training to operator	6	210	Effective monitoring of training	Process Owner	28/10/12	Training has been monitored with taking exam	7	4	3	84
		Setting not proper	Major dia O/S	7	Untarined Operator	5	Training to operator	4	140	Training to operator	Process Owner	28/10/13		7	3	3	63
Rolling	Die life	Die life has not set	Major dia O/S	7	New set of die used	2	No control	10	140	Die life to be set	Tool room	5/11/2013	Die life set	7	4	2	56
		Die fial before set life	Major dia O/S	7	Die life has not set	3	No control	10	210	Die life to be set	Tool room	5/11/2013	Die life set	7	3	3	63
Rolling	Pusher	Pusher worn out	Major dia U/S	7	Pusher life not set	2	No control	10	140	Pusher life to be set	Production	3/11/2013	Pusher life set	7	3	3	63
Rolling	Speed	Speed high/ low	Major dia O/S	7	Speed not optimized	7	Check sheet	7	343	DOE planned				7	7	7	343
Rolling	Maintenance	Preventive maintenance not done	Major dia O/S	7	Frequency of maintaince	4	Check sheet	5	140	Preventive maintenance planned	Maintnenace	26/10/13	Done	7	3	2	42
			Major dia U/S	7	Frequency of maintaince	4	Check sheet	3	84								
Rolling	Die	Die worn out	Major dia O/S	7	Die Life not set	4	No control	10	280	Die life to be set	Tool room	5/11/2013	Die life set	7	3	3	63
			Major dia U/S	7	Die Life not set	4	No control	10	280	Die life to be set	Tool room	5/11/2013	Die life set	7	3	3	63
Rolling	Rolling die pressure	Rolling die pressure more	Major dia U/S	7	No control to set the pressure	7	No control	10	490	DOE planned				7	7	10	490
		Rolling die pressure less	Major dia O/S	7	No control to set the pressure	7	No control	10	490	DOE planned				7	7	10	490
Rolling	Tightening bolts	Tightening bolt threads worn out	Major dia O/S	7	Excessive use	4	No control	10	280					7			7
Rolling	Pickling time	Pickling time maximum during plating	Major dia O/S	7	Manual input of parameter	4	Check sheet	3	84					7			7
Rolling	Initial setting	Initial setting not proper	Major dia O/S	7	Eneffective Training	5	Training to operator	4	140	Effective monitoring of training	Process Owner	28/10/12		7			7
Rolling	TRD	Established TRD not adequate	Major dia O/S	7	Drawing specifiaction not up mark	7	Forging drawing	7	343	DOE planned				7	7	7	343

Supplier Focus Six Sigma Program 21

Fig:-5 (FMEA diagram for identifying possible failure of screw design process)

IJARSE
ISSN: 2319-8354

Analyze

FMEA

Process Function	Characteristic of Input (KPIV / X)	Potential Failure Mode (How the X fails?)	Potential Effects of Failure (Y or Mini-Y)	SEV	Potential Cause(s)/ Mechanism(s) of Failure (Sub X's)	OCC	Current Process Controls	DET	RPN	Recommended Action(s)	Responsibility	Completion Date	Action Results				
													Actions Taken	SEV	OCC	DET	RPN
The highest value process steps from the C&E matrix.	The shortlisted X's from the C-E Matrix	In what ways might the process potentially fail to meet the process requirements and/or design intent?	What is the effect of each failure mode on the outputs and/or customer requirements? The customer could be the next operation, subsequent operations, another division or the end user.	How Severe is the effect to the cusotmer?	How can the failure occur? Describe in terms of something that can be corrected or controlled. Be specific. Try identify the causes that directly impacts the failure mode, i.e., root causes.	How often does the cause or failure mode occur?	What are the existing controls and procedures (inspection and test) that either prevent failure mode from occurring or detect the failure should it occur? **Should include an SOP number.**	How well can you detect cause or FM?	SEV x OCC x DET	What are the actions for reducing the occurrence, or improving detection, or for identifying the root cause if it is unknown? **Should have actions only on high RPN's or easy fixes.**	Who is responsible for the recommended action?	What is the completion date for the recommended action?	List the completed actions that are included in the recalculated RPN. Include the implementation date for any changes.	What is the new severity?	What is the new process capability?	Are the detection limits improved?	Recomkpute RPN after actions are complete.
Rolling	WIP	WIP more	Major dia O/S	7	Eneffective production planning	4		3	84					7	4	3	84
Rolling	Forging die	Ovality in forging die	Major dia O/S	7					0					7			7
Rolling	Cleaning	Before setting cleaning not done	Major dia O/S	7					0					7			7
Rolling	Total length	Total length US	Major dia U/S	7	Forging in put parameter changed	8	Control plan	7	392	DOE planned				7	8	7	392
		Total length OS	Major dia O/S	7	Forging in put parameter changed	8	control plan	7	392	DOE planned				7	8	7	392
Rolling	Mixings of high and low TRD	Mixings of high and low TRD	Major dia O/S	7	Forging in put parameter changed	7		7	343	DOE planned				7	7	7	343
			Major dia U/S	7	Forging in put parameter changed	7		7	343	DOE planned				7	7	7	343
Rolling	Materail	Burring of material during Heat treatment	Major dia O/S	7	Due to sharp edges on threads	4		3	84					7	4	3	84
Rolling	Die make	Supplier A fail to supply	Major dia O/S	7		4		2	58					7	4	2	54
		Supplier B fail to supply	Major dia O/S	7		4		2	54					7	4	2	57
Rolling	Hardness of die	High Hardness of die	Major dia O/S	7		2		2	28					7	2	2	28
		Low hardness of die		7		2		2	28					7	2	2	28
Rolling	Instrument	Error in the instrument	Major dia O/S	7	Calibration frequency not effective	4		3	84					7	4	3	84
Rolling	Checking aid	Checking aid not adequate	Major dia O/S	7	Micrometer used	4		5	140	Profile projector to be used	QA		Cobmination of microemter with profile projector used	7	4	2	56
Rolling	Ring gauge	Ring gauge worn out	Major dia O/S	7	Excessive use	4	Calibration frequency not effective	2	56					7	4	2	56
Rolling	MSA	MSA has not done	Major dia O/S	7	Frequency of MSA	4	No control	10	280	MSA to be done after every six months	QA		MSA done	7	2	3	42
			Major dia U/S	7	Frequency of MSA	4	No control	10	280	MSA to be done after every six months	QA		MSA done	7	3	3	63

Supplier Focus Six Sigma Program 22

Fig:-6(FMEA diagram)

Process capability analysis:

It is essential strategies which is utilized to decides how well a procedure meets with detail limits. Process ability investigation check the genuine condition of the procedure. Sub-gathering of test was done and ten examples were drawn,in a gathering of five. Minitab programming was utilized for draw a procedure capacity examination bend(which is appeared in fig.)

Z-Bench sigma:

Z-Bench sigma esteem was observed in this examination to be 1.12 and existing DPMO level of the procedure which is 132044.64. So open door for development in the process is higher.

Examination of screw major diameter rejection information before executing DMAIC strategy.

IJARSE
ISSN: 2319-8354

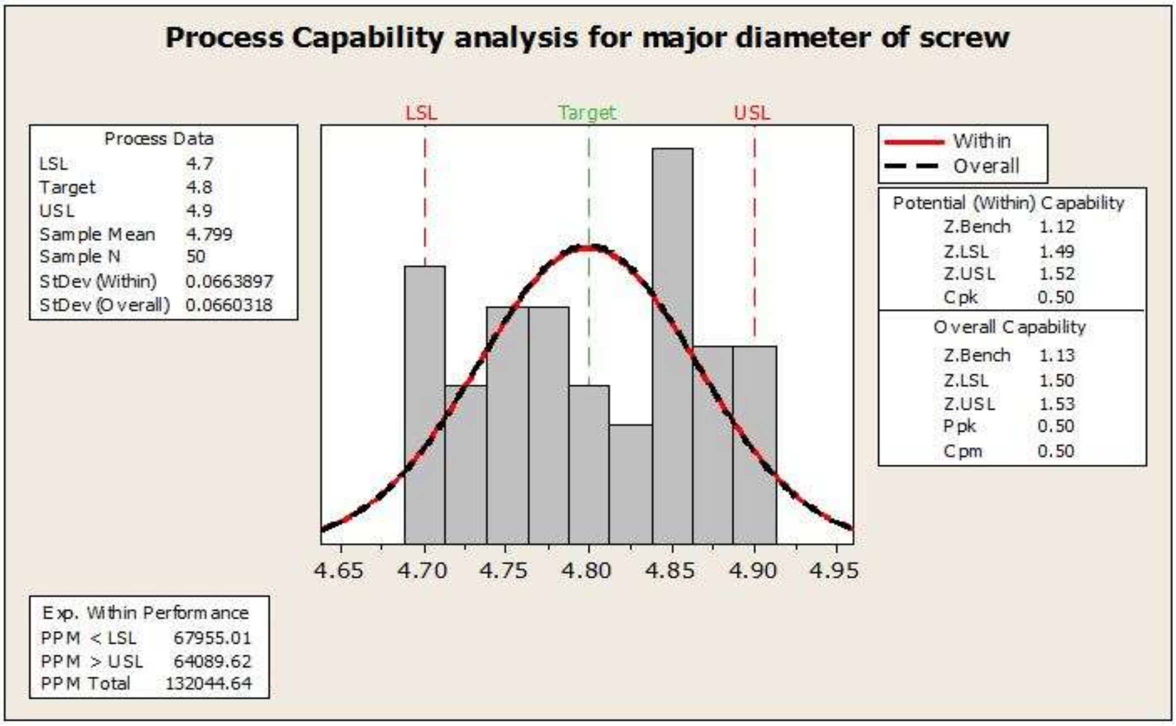

Fig:-7(Process capability analysis)

Fishbone outline:

DPMO level and Z-Bench of significant width dismissal of screw was known by process capability examination. Presently it was an ideal opportunity to discover the more reasons for dismissal of real breadth of screw .A Fishbone chart (as appeared in fig. 8) was attracted to discover more reasons for screw rejections.

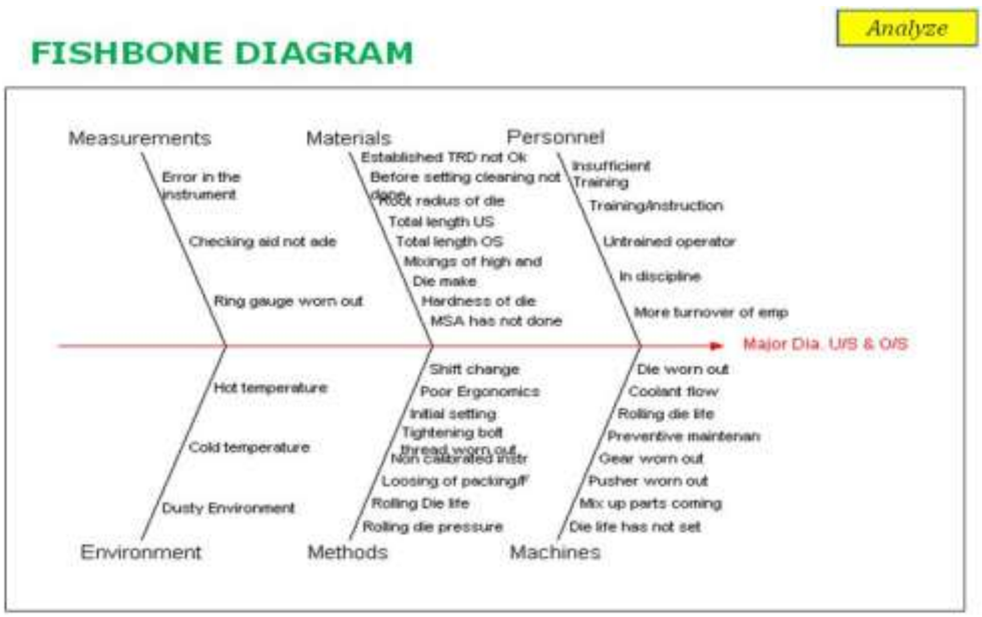

Fig:-8(Fishbone diagram)

Improvement Results:

Enhance the procedure to evacuate reason for defects. This is where the root causes of the problem is removed and the arrangement is institutionalized.

In enhance stage, The two factors that turns out to be the key explanations behind the high dismissal of Self tap screw dismissal are TRD and speed of machine.

Table:-1(which demonstrating two variables and about activity for development and their advantages)

S.NO	INPUT VARIABLE	ACTION	BENEFIT
1.	Thread rolling diameter	TRD has been revised from 3.44-3.48 to 3.46 -3.50	Major diameter found within specification
2.	Speed	Speed of AF-6 machine kept 185 RPM from 200 RPM	Major diameter found Within specification

CONTROL:

In control stage, X bar/R control graph was drawn. to check the conceivable reason for Variation subsequent to executing the progressions in TRD and Machine speed and guaranteeing that the procedure keeps on being in another way of enhancement. Size of 50 test was taken for drawing X bar/R outline (as appeared in fig 9).

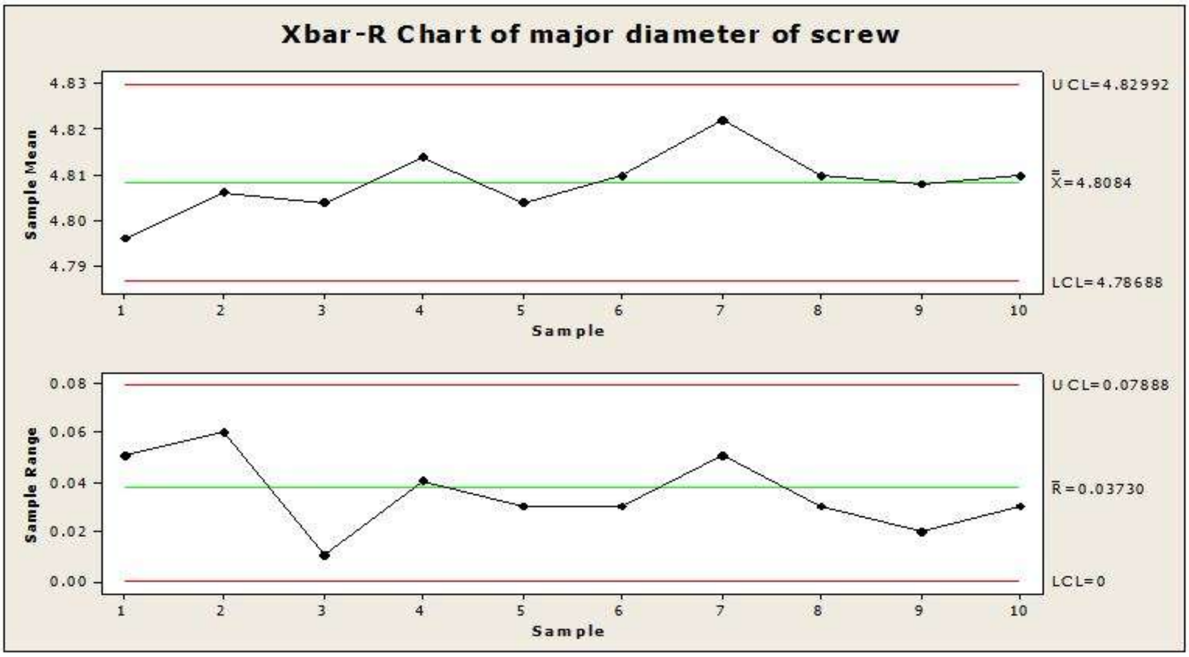

Fig:-9(X/R chart after improvement for screw major diameter)

IV.RESULTS:

Sigma level which enhance up to 5.79 from 1.12 (as appeared in fig 10).Application of six sigma is effectively actualized for this case study which unquestionably energize the other assembling industry to utilize six sigma to decrease the misfortunes in their procedures.

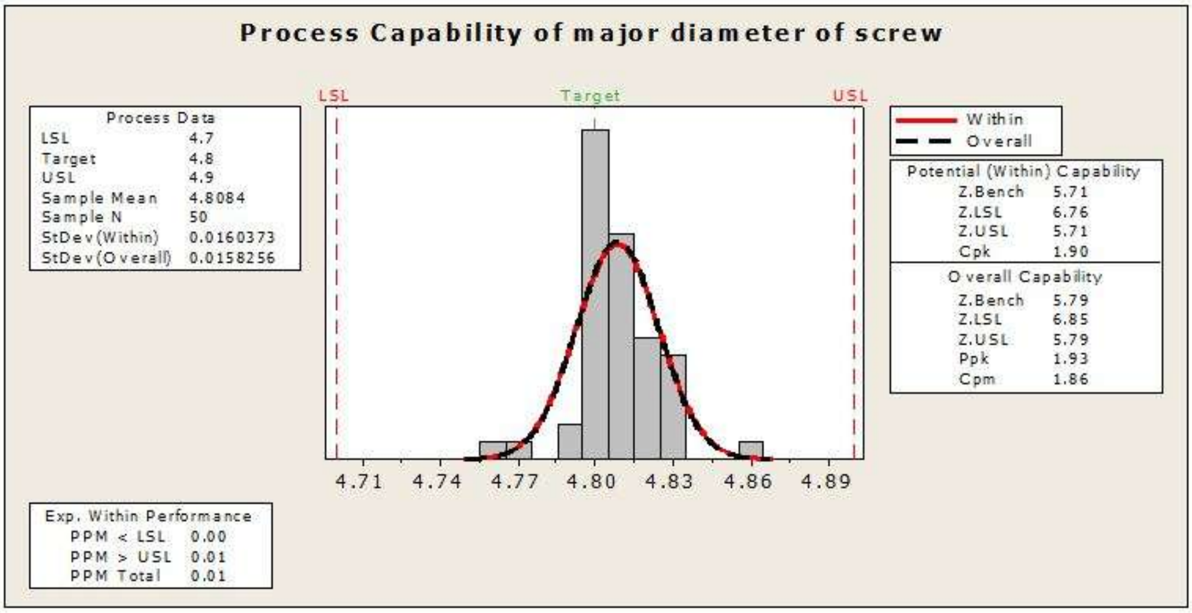

Fig:-10(Process capability graph of screw major diameter rejection information after executing DMAIC technique)

V.CONCLUSIONS:

Different contextual investigations have been accounted for by various industrialists and scientist that demonstrate the ability and the momentous consequences of applying six-sigma philosophy. The above contextual analysis was additionally one of them however unique in some specific circumstance. As the examination utilized a blended approach in use of the instruments i.e. apparatuses utilized are of blend classification. There is the utilization of Minitab programming which requires a high expertise level and a few devices as fishbone graph process stream, FMEA and so forth which is relatively low ability level. The point of the examination was to diminish the dismissal PPM of the business which satisfied by enhancing the sigma level of the procedure.

REFERENCES:

1. Edgeman, R. L., and Dugan, J. P. (2008). Six Sigma from items to contamination to individuals. Add up to Quality Management, 19(1-2), 1-9.

2. Kaushik, P., Grewal, C. S., Bilga, P. S., and Khanduja, D. (2008). Using Six Sigma for vitality preservation: a procedure industry contextual analysis. Global Journal of Six Sigma and Competitive Advantage, 4(1), 18-34.

3. Mittal, K., Khanduja, D., and Kaushik, P. (2010). ABQP: Ladder to Success. SCMS Journal of Indian Management, 7(4).

4. Kwon, Y., Park, Y., Hong, J., and Park, S. C. (2010). Sensor-based remote quality control application in car segments get together. Simultaneous Engineering, 18(2), 141-155.

5. Mittal, P., Kumar, B., Negi, Y. S., Kaushik, B. K., and Singh, R. K. (2011, June). Natural thin film transistor engineering, parameters and their applications. In Communication Systems and System Technologies (CSNT), 2011 International Conference on (pp. 436-440). IEEE.

6. Mittal, K., Dinesh, K., and Kaushik, P. (2011). Utilizing APQP technique to drive
Improvement in SME:A case think about. Universal Journal of Contemporary Practices, 1(1), 38-51.

7. Rivas, M. A., Beaudoin, M., Gardet, A., Stevens, C., Sharma, Y., Zhang, C. K., ... and Fennell, T. (2011). Profound resequencing of GWAS loci distinguishes autonomous uncommon variations related with provocative entrail infection. Nature hereditary qualities, 43(11), 1066-1073.

8. Kaushik, P. (2011). Pertinence of Six Sigma Line of Attack in SMEs: A contextual investigation of a pass on throwing producing unit. Diary of Engineering and Technology, 1(2), 107-112.

9. Mittal, K., Kaushik, P., and Khanduja, D. (2012). Proof of APQP in quality change: A SME contextual analysis. Universal Journal of Management Science and Engineering
Administration, 7(1), 20-28.

10. Sharma, C. (2012). Six sigma appearance toward libraries: An association viewpoint. Worldwide Journal of Management, IT and Engineering, 2(12), 521.

11. Kaushik, P., Khanduja, D., Mittal, K., and Jaglan, P. (2012). A contextual investigation: Application of Six Sigma philosophy in a little and medium-sized assembling endeavor. The TQM Journal, 24(1), 4-16.

12. Falcón, R. G., Alonso, D. V., Fernández, L. G., and Pérez-Lombard, L. (2012). Enhancing vitality productivity in a naphtha improving plant utilizing Six Sigma strategy. Fuel preparing innovation, 103, 110-116.

13. Sharma, C. (2013). Start of Diverse Quality Management Methodologies in Libraries: An Outline. Global Journal of Management, IT and Engineering, 3(8), 617.

14. Mittal, K., and Prajapati, R. K. (2014). Quality gatherings: a review.Worldwide Journal of Management, IT and Engineering, 4(12), 200.

15. Mittal, K., Tewari, P. C., and Khanduja, D. (2016). Restoring Business Processes: An Insight. Diary of Industrial Engineering and Advances, 1(1).

16. Mittal, K., Tewari, P. C., Khanduja, D., and Kaushik, P. (2016). Utilization of Fuzzy TOPSIS MADM approach in positioning and underlining the issues of plywood industry in India. Relevant Engineering, 3(1), 1155839.

17. Sreedharan, V. R., and Raju, R. (2016). An efficient writing survey of Lean Six Sigma in various businesses. Worldwide Journal of Lean Six Sigma.

18. Uluskan, M., and Uluskan, M. (2016). A thorough understanding into the Six Sigma DMAIC tool kit. Universal Journal of Lean Six Sigma, 7(4), 406-429.

19. Srinivasan, K., Muthu, S., Devadasan, S. R., and Sugumaran, C. (2016). Six Sigma through DMAIC phases: a literature survey. Universal Journal of Productivity and Quality Management, 17(2), 236-257.

20. Kaushik, P., Mittal, K., and Rana, P. (2016). Vitality paybacks of six-sigma: A contextual investigation of assembling industry in India. Administration Science Letters, 6(11), 691-700.

21. Biswas, S., and Chowdhury, B. (2016). Mechanical Applications and Practices of Six Sigma– A Literature Review. Sigma, 3(3), 176-79.

22. Chadalavada, H., Raj, D. S., and Balasubramanian, M. (2016). Six Sigma execution in an assembling unit-a contextual analysis. Global Journal of Productivity and Quality Management, 19(4), 409-422.

23. Mittal, K., Tewari, P. C., and Khanduja, D. (2017). Profitability change under assembling condition utilizing Shainin framework and fluffy systematic pecking order process: a contextual investigation. The International Journal of Advanced Manufacturing Technology, 1-15.

24. TEWARI, P. C., MITTAL, K., and Khanduja, D. (2017). On the correct way to deal with choosing a quality change venture in assembling enterprises. Operations Research and Choices, 27(1), 105-124.

25. Mittal, K., and Kaushik, P. (2017). A general model for critical thinking in assembling or administration associations.

26. Kaushik, P., Dahiya, V., and Mittal, K. (2017). Measurements for ventures: An advanced approach. Administration Science Letters, 7(8), 397-406.