Improve the productivity of spot weld components by implementing six sigma in manufacturing Industry

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ABSTRACT: Abstract explanation should be Times New Roman font, 10 Size, Single line spacing, Italic, text alignment should This paper presents a Six Sigma project conducted at a in the MCCB manufacturing company, located in Vadodara. An objective of the study is to reduce the spot weld brazing components production lead time and improve the value added time with safety.Brazing is a "Metal joining process." In which two or more metal items are joined together by melting and flowing a filler metal into the joint, the filler metal having a lower melting point than the adjoining metal. There are many parameters which decide the perfectly brazed joint. This report presents a literature survey on the different parameters as well as how to eliminate the waste, with quality and safety from the process. This is affect the successful brazing of components and the different tests used to analyze the parameters. As the brazing technique has numerous applications even in the current industrial scenario, many researches are being carried out on the same. This report gives a general view of the research work carried out on brazing. The main objective of this study is to increase the productivity against the demand Levels.

***Keywords**: Six sigma, DMAIC Methodology, productivity improvement, Safety*

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1. INTRODUCTION

Competitive scenario, the markets are becoming global & economic conditions are changing fast. Customers are very quality conscious & demand for high quality product at competitive prices with product different variety and reduced lead-time. Companies are facing tough challenge to respond to the needs of customer while keeping manufacturing & other related costs down. Companies can cut down their costs by reducing the production of defective parts. Six Sigma is a quality management program to achieve Six Sigma‟ levels of quality.

Six Sigma implementation uses five step DMAIC (Define, Measure, Analyze, Improve and Control) methodology & DMADV (Define, Measure, Analyze, Design and Verify) methodology is adopted for new product developments Write your paper content here (size 10,Times New Roman font). Write your paper content here(size 10,Times New Roman font).

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2. DMAIC Methodology

The DMAIC means Define, Measure, Analyses, Improve and Control. These all work together to create the DMAIC process. The tools of Six Sigma are most often applied within a simple performance improvement model known as Define, Measure, Analyze, Improve, Control or DMAIC. DMAIC is summarized in Figure 1. DMAIC is used when a project's goal can be accomplished by improving an existing product, process, or service

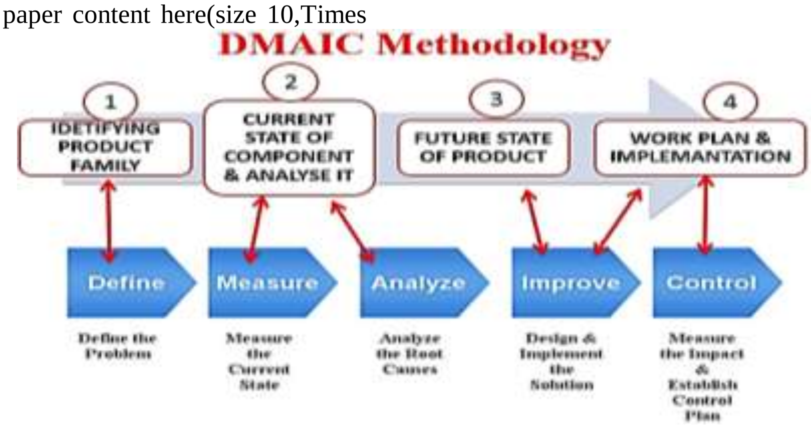

Figure 1 – DMAIC Six sigma methodology

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Steps	Key processes
Define	-Define the requirements and expectation of the customers. -Define the project boundaries. -Define the processes by mapping the business flow.
Measure	-Measure the process to satisfy customer’s nee variation. -Develop a data collection plan. Collect and compare data to determine issues and shortfalls.
Analyze	-Analyze the causes of defect and sources of variation. -Determine the variation in the process. Prioritize opportunities for future improvement.
Improve	-Improve the process to eliminate the variation. Develop innovative alternatives and implement enhanced plan.
Control	-Control process variations to meet customer requirements. -Develop a strategy to monitor and control the improved process. -Implement the improvements of systems and structures.

Table 1-Key steps of six sigma DMAIC Process [14]

3. Literature review

1. Forming Process Integrated Induction Brazing J. Avemanna, R. Willya, G. Zhaoa, P. Grochea ,2010 In this paper, the possibility to integrate brazing into forming process chains is investigated. For demonstration part, a tool that allows brazing inside a servo press is developed. Achievable part qualities and cycle times are evaluated.

2. FEASIBILITY OF BRAZING AS “JOINING PROCESS” Rahul pahwa, Taranjeet Singh, Dheeraj Sagar Gyanendra Singh This paper gives a general view of work carried out on brazing as:

    - Introduction to allied welding processes, Welding brazing comparative study, Different methods of brazing and machine tool, Defects and applications brazing.

3. Calculating Joint Clearance at Brazing Temperature D. G. STROPPA, T. HERMENEGILDO, J. UNFRIED S., N. OLIVEIRA, AND A. J. RAMIREZ This article highlights a simple analytical model to evaluate joint clearances at brazing temperatures and a simple procedure for evaluating and troubleshooting joint clearance incompatibility on brazing processes for dissimilar materials.

4. A review on brazing parameters and the experiments used to analyze the parameters. Mathew K.J. Brazing is a highly efficient method for joining and finds an important place in the current industrial scenario especially in aerospace and automotive applications.

5. Developing and Easing the Brazing Method Vishesh Garg , Ankit Gupta Brazing generally require proper apparatus be it induction, vacuum or torch brazing. In torch brazing, metals are joined by using the oxyacetylene cylinder. It thus becomes difficult to carry out brazing at the places where it is not possible to take heavy gas cylinders and brazing apparatuses.

4. Six sigma case study:

Phase 1: Define

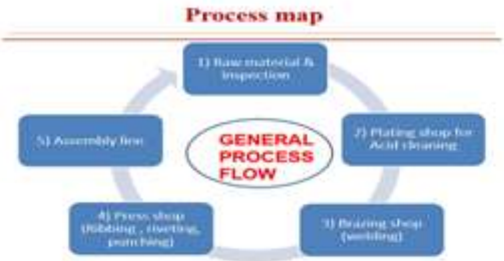

Fig 2. Process map

We wants to achieve higher production from less material consumption. So, for that it is required to increase the productivity through the brazing shop. Therefore, a perceived Total operation time reduce between the Existing operation time and a desired operation time through the Work measurement, design the fixtures and value engineering. So, from the last few month’s data we are taking four components which is having higher rejection.

- First observe the whole process of component as given in the process map
- Now segregate them in some types / some same type of intervals.
- Then collect the past few months’ data about that components rejection or regular problems.

The top management shall identify the problem according to customer feedback, strategy and mission of company, define customer requirements, and set goal. In this phase all the research papers are define the project with the help of some tools like brainstorming, Pareto chart etc. In this phase they identify the problem as well as its product family.

Phase 2: Measure

Measurement is a key transitional step on Six Sigma road; one that helps the project team to redefined the problem and being the search for root causes which will be the objective of Analyze step in DMAIC. In this phase we collect the appropriate data for that problem and show it with the help of trend charts. Like Gap observed, Dimensions not achieved, component bend, button damage, button shift. In this phase I'm taking three components which are having more rejection and less six sigma level.

Month	OK Qty.	Rejection	%	Total	sigma level
FEB	20300	1000	4.93	21300	3.65
MAR	31300	1600	5.11	32900	3.64
APR	16000	800	5.00	16800	3.65
MAY	4249	151	3.55	4400	3.78
JUN	18706	794	4.24	19500	3.71
JUL	12106	594	4.91	12700	3.66
AUG	5983	267	4.46	6250	3.69
SEP	6143	257	4.18	6400	3.72
OCT	7530	270	3.59	7800	3.77
total	122317	5733	4.69	128050	

Table 2 collected data For Product A

MONTH	Ok Qty.	Total	Rejection	%	Sigma Level
FEB	1650	1750	100	5.71	3.57
MAR	2525	2700	175	6.48	3.52
APR	661	700	39	5.57	3.58
MAY	973	1050	77	7.33	3.47
JUN	1070	1150	80	6.96	3.49
JUL	973	1050	77	7.33	3.47
AUG	1400	1500	100	6.67	3.51
SEP	762	820	58	7.07	3.49
OCT	980	1050	70	6.67	3.51
Total	10994	11770	776	6.59	

Table 3 collected data For Product B

Product A

Product A	Problems Faced
	Small hylem blocks wearing off very frequently
	Electrode travel restricted unto a certain limit into the fixture
	Fixture not safe

Product B

Product B	Problems Faced
	hylem Slot wearing off very frequently
	Spark & Foreign material being accumulated at the groove
	Component not Fit properly
	Fixture not safe

Now, from this collected data segregate them in some similar types of defects. This is as shown in Table with the Graphical representation.

Phase 3: Analyze

In analyze stage, we are using different analysis tools and process analysis techniques to identify and verify root causes of the problem. For the reason, we needs to develop causal hypotheses, identify vital few root causes, and validate hypothesis. We are using different analyzing techniques like brain storming, Cause and effect diagram and cause and validation.

We required 4Brainstorming sessions.

Product A output from this session is as below:

Understood the current process and also understand that machine condition, what is machine parameter & process parameter. Then find some most probable cause behind it like,

- Component not having proper space to fit &
- Operator doesn't aware about it.
- Fixture not appropriate.

For product B,

Understood the current process and also understand that machine condition, what is machine parameter & process parameter. Then find some most probable cause behind it like,

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- Electrode travel restricted up to a certain limit into the fixture
- Spark & Foreign material being accumulated at the groove
- Silver button damaged due to misalignment of component

- Electrode travel restricted up to the certain limit into the fixture
- Gap between arc runner & button is greater than 0.7mm
- Operator doesn't aware about it.
- Hylem plate is wear out in some period of time

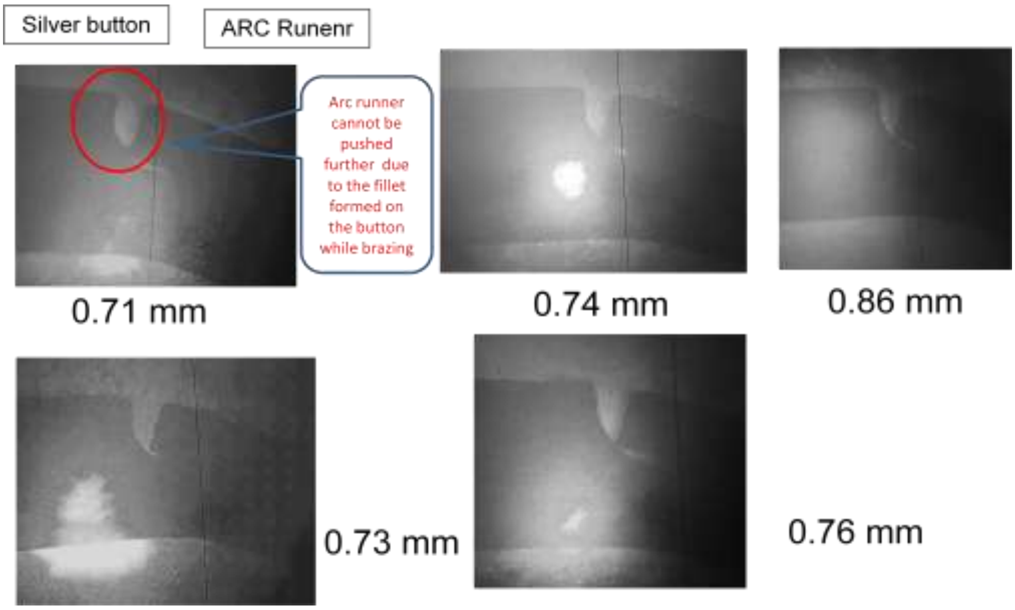

Figure 4 Profile projector images for Arc runner

Cause and Effect Diagram

For Product A

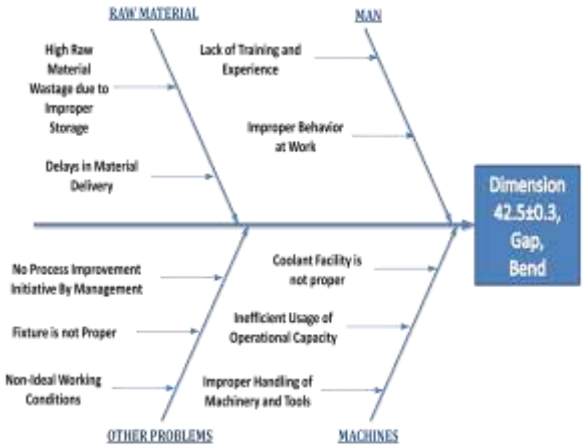

Figure 5 Product A cause & effect daigram

For Product B

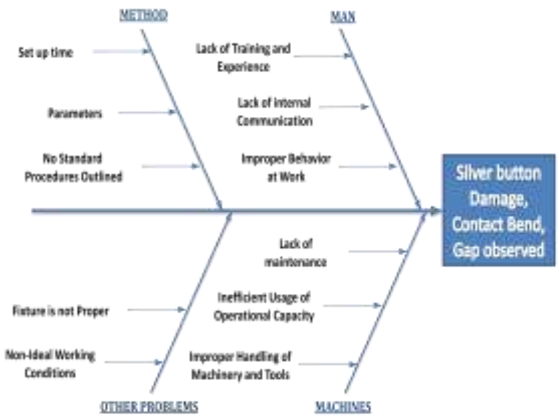

Figure 6 Product B Cause & effect diagram

Multi voting &Cause and validation

Sr. no	Cause	OPT. 1	OPT. 2	QC Head	QC Engg.	Prod. Head	Supervisor	Total
1	Fixture	7	8	6	7	6	7	41
2	Riveting	4	5	7	8	6	8	38
3	Dependability	5	6	5	5	6	7	34
4	Unskilled workers	4	5	3	4	3	3	22
5	Clamping device not clamping properly	5	4	6	6	7	6	34
6	Variation in current &pressure	3	4	3	6	6	5	27
7	Bimetal weak section	4	3	3	3	3	3	19
8	Heater angle variation	3	3	4	3	3	3	19
9	Electrode alignment	4	4	6	3	5	3	25

Table 4 Product A Multi Voting

Sr. no	Cause	OPT. 1	OPT. 2	QC Head	QC Engg.	Pro. Head	Supervisor	Total
1	Fixture	6	4	9	8	9	8	44
2	Unskilled	5	6	6	8	7	8	40
3	Dependability	4	5	7	8	6	8	38
4	Improper parameter	2	2	3	4	3	4	18
5	No SOP	4	4	7	6	7	7	35
6	Electrode alignment	5	5	7	6	7	6	36

Table 5 Product B

Cause Validation:

Sr. No.	Cause	Validation Method	Validation Remark	Valid(V)/Not Valid(N)
1	Fixture	GEMBA	New Fixture Required	V
2	Riveting	GEMBA	Make SOP, Routing	V
3	Dependability	Interaction with operator, GEMBA	Trained workers	V
4	Unskilled workers	GEMBA	Trained workers	V
5	Clamping device not clamping properly	Interaction with operator, GEMBA	Make SOP, Routing	V
6	Variation in current & pressure	GEMBA	Process sheet	V
7	Bimetal weak section	Interaction with operator		N
8	Heater angle variation	GEMBA		N
9	Electrode alignment	GEMBA	Make OPL, Carbon paper Test	V

Table 6 Product A

Sr. No.	Cause	Validation Method	Validation Remark	Valid(V)/ Not Valid(N)
1	Fixture	GEMBA	New Fixture Required	V
2	Unskilled	GEMBA	Trained workers	V
3	Dependability	Interaction with operator, GEMBA	Trained workers	V
4	Improper parameter	GEMBA		N
5	No SOP	Interaction with operator, GEMBA	Make SOP	V
6	Electrode alignment	GEMBA	Make OPL, Carbon paper Test	V

Table 7 Product B

Phase 4: Improve

The goal of the improve phase is to find and implement solutions that will remove/eliminate the causes of problems, reduce the variation in a process, or prevent a problem from recurring. So we needs to develop creative ideas to remove the root causes, test solutions, and standardize solution/measure result. For this we are design the fixture in which we are incorporated the full proof feature. Through this fixtures we improve the process and reduce defects and get improvement in production lead time and after this phase they have to maintain the consistency.

For Product A

For Product B

Improvement Phase

Product A

Month	Manufactured Qty.	Defective Qty.	% Defect
MAY	2000	100	5.00
JUN	7400	381	5.15
JUL	15000	801	5.34
AUG	13200	687	5.20
SEP	13700	675	4.93
OCT	5400	265	4.91
NOV	8700	463	5.32
DEC	15500	840	5.42
JAN	16000	574	3.59
FEB	17800	512	2.88
MARCH	16500	438	2.65
APRIL	11270	188	1.70

	BEFORE	AFTER
Manufacturing lead Time	25-30 sec	15-20 sec

Product B

Month	Manufactured Qty.	Defective Qty.	% Defect
MAY	1050	161	15.33
JUN	1150	200	17.39
JUL	1050	172	16.38
AUG	1500	220	14.67
SEP	820	144	17.56
OCT	1050	171	16.29
NOV	900	98	10.89
DEC	1150	94	8.17
JAN	1750	85	4.86
FEB	1900	91	4.79
MARCH	1750	83	4.74
APRIL	1550	56	3.61

	BEFORE	AFTER
Manufacturing lead Time	25-30 sec	15-20 sec

Phase 4: Control

In the control phase the gains been achieved by the personnel through refined process that yield maximum remunerations. For the consistency of improvement we take some actions: Making Sop at the operator level in both English & Gujarati from which then can easily understand the whole process.

- Making OPL (One Point lesson)
- Daily check list
- Modification in Routing.

6. Conclusion

From the study done on the manufacturing industries in 21st century we conclude that Six Sigma is indeed a business strategy that can provide a breakthrough improvement in the competitive era. By applying Statistical Thinking and DMAIC Six Sigma methodology to the spot weld brazing process the following conclusions were drawn down: brazing fixture is improved with poka-yoke concept implementing. From this fixtures we got the improvement in quality as well as in productivity. As shown in improve phase defects are reduce and sigma level increased. The key strategy for successful implementation of Six Sigma is that the industry applying it should follow a correct methodology and use of tools and techniques is done in such a manner that it gives effective solution to respective problem. Thus a use of proper combination of tools and techniques can lead to great benefits. It was decided to continue the improvement process by tackling the next nonconformities from Pareto chart and also eliminate possible human errors. From all this improvement we get 10lac rupees saving per year.

Giving the current situation, enterprises are under the increasing pressure from global competition to increase their competitiveness, reduce their costs, increase their productivity and most importantly, should take advantage of the event from the six sigma approach to improve in a sustainable manner.

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