Reduction of Cycle Time in Branson Ultrasonic Welding Operation

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Abstract

"With less, it can be accomplished more". In occasions, everybody wants more but do not want to invest. The company needs higher productivity and capacity, which leads to a higher profit and at a lower cost of labor. A good way to achieve those goals is by optimizing the process and taking advantage and use of all the space, machine and persons working in the area. Taking into consideration that the schedule order for a week, are not being finished at the schedule time as proposed. The majorities of the orders are not being finished on time as proposed. In order to finished, a overtime shift on the weekend must keep producing to finished the orders of the week. If the orders are not finished in the extra shift, order must be rollover to the next week, affecting cycle time, productivity of the operation, sterilization process and estimated arrival time (ETA) for the client. During the investigation, it will be evaluated, applying the methodology of DMAIC what is happening in the manufacturing process that the orders are being manufacture on a extra shift or reschedule with a roll over for the next week. It must be optimize the process in order to comply with production schedule and have a solid delivery reliability towards the client.

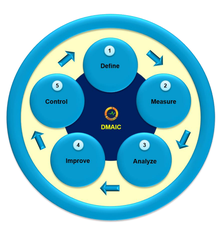
***Key Terms* — — DMAIC method, Voice of customer , 7 wastes: motion, and improvement.**

Problem Statement

The project aims to identify and address the root cause of the machine alarm using the DMAIC methodology, with the increase of efficiency the ultrasonic welding process by 20%. This optimization is expected to increase manufacturing capacity, improve delivery reliability, and enhance productivity and efficiency, while maintaining a low investment cost. The research will involve analyzing the physical properties, dimensions, and parameters of the machine, understanding its limitations, and creating protocols for process improvement. By identifying the possible root cause(s) and corrected, the project will contribute to the overall improvement of the manufacturing process and the local site as a company.

Methodology

"Let the data speak on its own", that is a good saying. An appropriate way to support a project is through data and having facts, acquiring a more quantitative style of project. However, this will be confirmed with the steps of DMAIC. The first objective is to understand and analyze the physical properties and difference of the raw material of products.



Project Start Date 3/24/2025
Project Leader: Ruben Cruz Orengo Sponsor Depart BT
Project Name: *Reduction of cycle time in Branson Ultrasonic Welding Operation*

#	Activity	Assigned to	Start	End	Days	Status	%Done
Week 1	Send proposal to professor and feedback	Ruben Cruz Orengo	24-Mar-25	30-Mar-25	5	Completed	100%
Week 2	Define	Ruben Cruz Orengo	31-Mar-25	6-Apr-25	5	Completed	100%
Week 3	Measure	Ruben Cruz Orengo	7-Apr-25	13-Apr-25	5	Completed	100%
Week 4	Measure/Analyze	Ruben Cruz Orengo	14-Apr-25	20-Apr-25	5	Completed	100%
Week 5	Analyze	Ruben Cruz Orengo	21-Apr-25	27-Apr-25	5	Completed	100%
Week 6	Improve	Ruben Cruz Orengo	28-Apr-25	4-May-25	5	Completed	100%
Week 7	Control	Ruben Cruz Orengo	5-May-25	11-May-25	5	Completed	100%
Week 8	Practice	Ruben Cruz Orengo	12-May-25	18-May-25	5	In Progress	50%

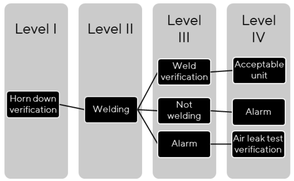
2025 — Mar — Apr — May; Week Starting: 17-Mar, 24-Mar, 31-Mar, 7-Apr, 14-Apr, 21-Apr, 28-Apr, 5-May, 12-May

Figure 1: Project Plan Timetable

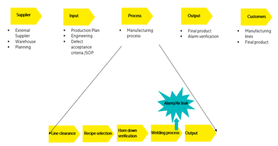
DMAIC

DEFINE PHASE

Critical to Quality



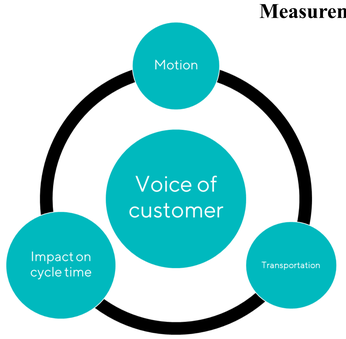
SIPOC



Critical to Quality was developed to understand the key attributes and the measure helps us understand what steps in our process are value-added.

SIPOC was developed to improve and understand processes that impact productivity.

Measurement

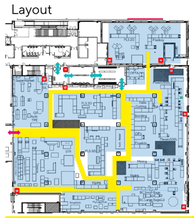


•Operator Feedback: Manufacturing operators report excessive walking required to perform the air leak testing operation.

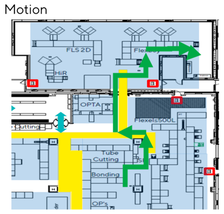
•Impact on Cycle Time: The operation's cycle time is increasing due to the additional motion involved.

•Material Transportation: Inefficient transportation of materials contributes to the extended cycle time.

Layout

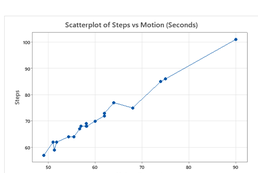


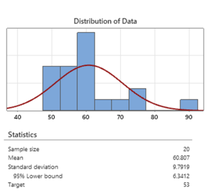
Motion



Clean room 3 consist of a approximately 24 manufacturing stations. It goes from preparation station to manufacturing lines.

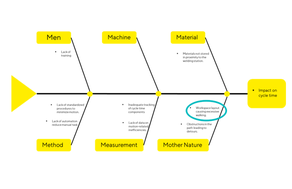
The current cycle time for the ultrasonic welding operation is measured at average minute of 1:00 min, with a significant portion attributed to walking and motion. Data will be collected on the specific tasks and movements involved.



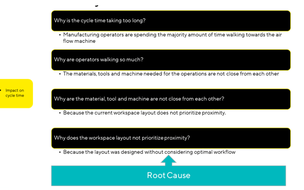


- Data was gathered through time studies, motion analysis, and observation of the welding operation to quantify the impact of walking on cycle time.

ANALYZE PHASE

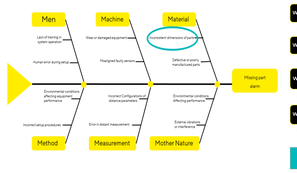


Fishbone Diagram

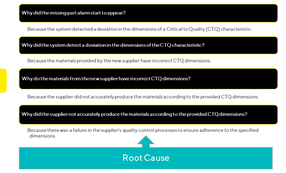


5 Why's

Solution By addressing the layout of the clean room and considering the workflow of the air flow station, could lead to improvements on cycle time, efficiency, elimination 7 lean wastes: motion.



Fishbone Diagram



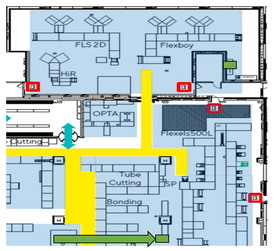
5 Why's

Solution By addressing this possible root cause, it is possible that the alarm can be eliminated.

IMPROVE PHASE

Classification	Root Cause	Action	Status
Mother nature	Workplace layout causing excessive walk	Change layout to approximate air leak tester near the machine through a work order	Completed

Action Plan

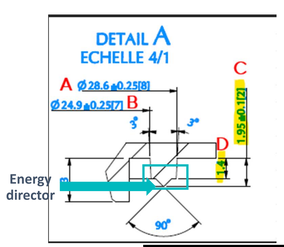


Classification	Root Cause	Action	Status
Material	Inconsistent dimension part	Work order to adjust height of horn down	Completed
Material	Inconsistent dimension part	Perform Engineering study with N=460 welding cycles.	Completed
Material	Inconsistent dimension part	Send material TC112128 and TC112231 to measure CTQ's	Completed
Material	Inconsistent dimension part	Report of air leak tester a test on seal	Completed

Action Plan

Measurement report

- With N=460, we have a 99% of confidence level and 99% reliability. Also, It can be confirm that the level defective rate won't be more than 1%.



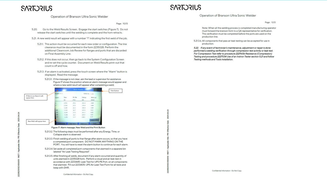
Measurements for TC112128 and TC112131			
Part part number	Cavities	C	D
TC112128	7.1.A	1.89727	1.28448
TC112128	7.2.B	1.75408	1.23188
TC112128	7.3.C	1.77138	1.22048
TC112128	8.1.A	1.89727	1.27828
TC112128	8.2.B	1.76838	1.23208
TC112128	8.3.C	1.76078	1.24938
TC112131	3.1	1.58738	1.02979
TC112131	3.2	1.67758	1.09498
TC112131	3.3	1.62418	1.06659
TC112131	4.1	1.70808	1.18358
TC112131	4.2	1.78427	1.7318
TC112131	4.3	1.74458	1.15378
TC112131	5.1	1.62258	1.03609
TC112131	5.2	1.61878	1.06819
TC112131	5.3	1.64958	1.09168
TC112131	6.1	1.65728	1.11618
TC112131	6.2	1.67658	1.10608
TC112131	6.3	1.69858	1.2788

Measurement report

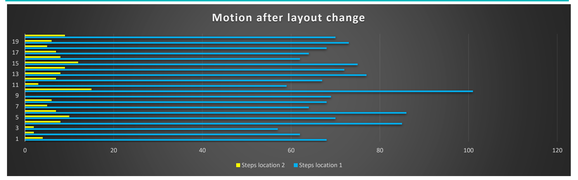
CONTROL PHASE

Daily Management

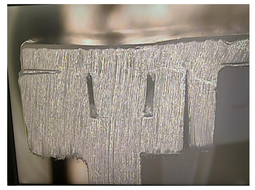
Standard Operation procedure



Current control



Benefits



Reduction of motion 90%,
Increased efficiency, goal exceeded
Cost reduction, goal exceeded by 100%
Improved safety
Higer employee satisfaction

Conclusions

The investigation performed took into consideration several possibles root causes. Through the actions performed, thanks to the tools of DMAIC, it gave us the opportunity to verify the the following:

- The investigation addressed a critical to quality (CTQ) of the ports, the length of the energy director, as the root cause of the machine alarm. By doing By perform the engineering study, it was confirm the correct height of the horn and achieving a quality weld of components. Therefore, the 20% increase was exceeded.
- By applying DMAIC methodology it reduces overtime, improved cycle times, ensured a timely delivery, impacting the delivery reliability.
- Lean manufacturing principles helped reduce waste and improve process, by reducing one of the lean manufacturing waste, motion, the manufacturing personnel are satisfied. The personnel can see correction in the process that they identified.

Acknowledgements

I would like extent a big gratitude to thank my mentor, Dr. Rafael Nieves accepting the challenge of being my mentor and all the guidance during the process. I also wish to express my appreciation to those colleagues that worked side by side with me. Those who dedicated hard work, offering their time, effort and resource without hesitation. This collaboration lead to an accomplishment and achievement.

References

1. [2] Connaughton, S.A. , "Lean Manufacturing." Master, Salem Press Encyclopedia, 2024.
2. Online Source
3. [3] "Fishbone Diagram." ASQ. ASQ, January 1, 2024. https://doi.org/N/A.
4. For other formats, please refer to the Formatting and style guides for IEEE manual available at the PUPR Library's blog (https://bibliopoli.wordpress.com/). For guidance on grammar and usage not included in this manual, lease consult The Chicago Manual of Style, published by the University of Chicago Press.