MODEL G & H SOFTWARE MALFUNCTION RESHIP REDUCTION

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ABSTRACT

This project aimed to reduce the overall defective reship by reducing Software malfunction defects. From October 2022 to January 2023, I-Family reship software malfunction has an average of 0.06% defect rate contribution, with 0.23% defect rate from Model G and Model H. Using the Fishbone Diagram technique, true causes contributed by Man, Machine, Method, and Material were determined. The software malfunction defect rate was reduced by 86% after implementing countermeasures. The software malfunctioning defective rate was reduced from 0.23% to 0.03%.

1.0 INTRODUCTION

1.1 Company Profile

Asurion is a global tech care company that provides protection, repair and support services for a range of tech devices and applicances.

Fig. 1. Techlog Center Philippines

In March 2009, Asurion expanded to the Philippines with Techlog Center Philippines (TCP), located in Carmelray Industrial Park II, Calamba City, Laguna.

TCP is a 100%-owned subsidiary of Asurion and is the fastest-growing mobile phone remanufacturing facility in the Philippines. The facility houses parts recovery and repair, cellphone repair, and inspection lines for remanufactured mobile handsets of various models. It acquired its ISO 9001:2008 Certification from LRQA on December 5, 2011.

1.2 The Team

The team was formed last March 2023 and composed of individuals from Enclosure Operation, Handset Quality, and Engineering. The group was named "Software Savants United" and was inspired by the company's 2023 Key Objectives. Using the DMAIC approach, the team identified an opportunity to contribute to Cost Reduction through kaizen and Continuous improvement.

TEAM COMPOSITION:

Leader:	Renie Boy B. Acasio (QA Engineer)
Sponsor:	Edgardo Carillo (Director, QA)
Champion:	Roberto Visto (Parts QA Manager)
Facilitator:	Alvin Sorima (CI Engineer II)
Members:	Mary Joy Cacho (Senior QA Technician)
	Stephanie Ilagan (QA Technician)
	Jessica Adante (QA Engineer II)
	Richard Elma (Engineering Technician)
	Leona Navarro (Enclosure Operation Team Leader)

1.4 Project Timeline

This project is guided by an activity timeline to ensure completion is within the set time frame. The project started in the second week of March 2023 and the target ended in the last week of May 2023. A total of 11 weeks of activities. The team's meeting period is 1-2 hours, the frequency is twice a week and the meeting schedule is 2 PM to 3 PM.

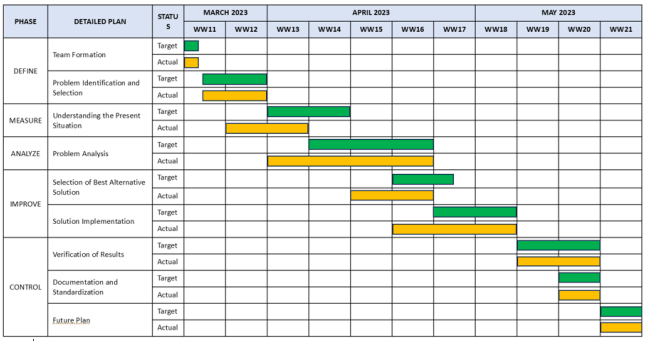

Table 1. Project Table

2. 0 REVIEW OF RELATED WORK

"Not Applicable.".

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3.0 METHODOLOGY

3.1 Define Phase

3.1.1 Problem Alignment to Company Objectives

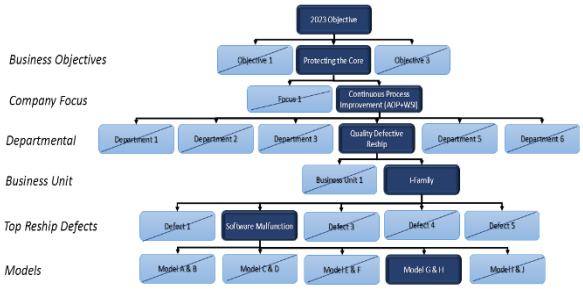
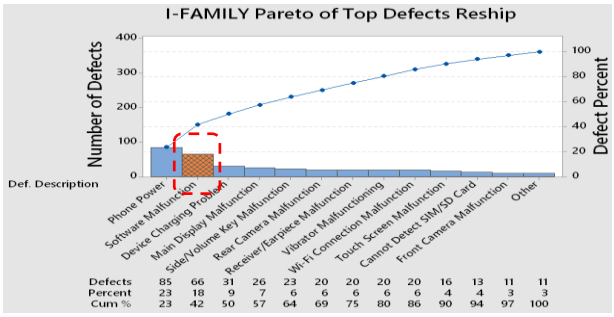


Fig. 2. Tree Diagram

3.1.2 Project Identification / Selection

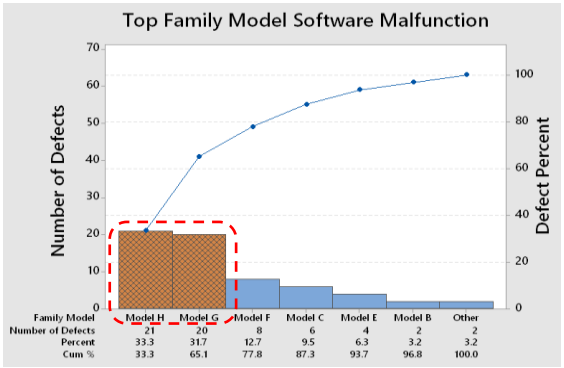
3.1.2.1 Stratification 1: Identification of Top Defects in Reship



Graph 1. Pareto of Defects

The team chose a software malfunction defect, one of the top Contributor of defective reship. This is within team's control.

3.1.2.2 SW Malfunction Top Model Contributions



Graph 2. Pareto of Top Models

The team identified that Model H & G has the highest software malfunction contribution from October 2022 to January 2023 and this will be team's pilot model.

3.1.3 Operational Definition

Reship	Customers return units that are within a 28-day warranty period.
Model G & H	A type of Model designed and marketed by a well-known company.
I-Family	is a line of smartphones designed and marketed by a well-known company.
Cores	Damaged phones (handset) from customer
RMA	Return Material Authorization
DFU	Device Firmware Update
TCP	Techlog Center Philippines
PID	Process Induce Defect
CRA	Costumer Return Authorization
RCA	Root Cause Analysis
SW Mal	Software Malfunction is a state when the Device Firmware Update (DFU) mode automatically appears when the handset is connected to USB.

What is a Software Malfunction Defect

This is a functional defect that the phone automatically puts into Device Firmware Update (DFU) mode every time connected to a USB/PC. DFU mode normally happens if the smartphone is connected to a USB/PC while pressing the power button for several seconds.

Picture 1

Defect Rate – the number of defective product observed over the numbber of units tested.

Formula= Defect Quantity
No of Units Input

3.1.4 Problem Statement

Asurion subscribers encountered a Software Malfunction in Model H&G during a normal phone operation, and this happened from October 2022 to January 2023 with a reship rate of 0.227% or 16.18% overall impact to reship.

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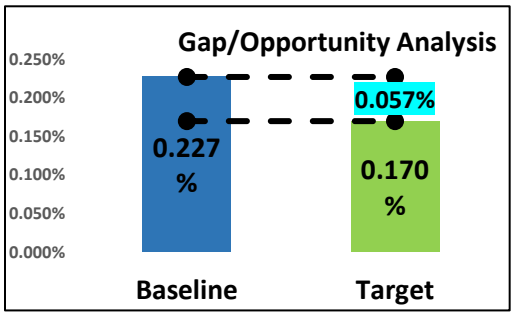
3.1.5 Goal Statement

The project team aimed to reduce the Software Malfunction of Model G & H from 0.227% to 0.170% by the end of May 2023. The calculated target was defined using the Target/Entitlement Formula.

Entitlement Target = Baseline (Ave.) – {[Baseline (Ave.) – Best Achieved] x 70%}



Graph 3. Gap/Opportunity Analysis

3.2 Measure Phase

3.2.1 Macro Process Mapping

TCP receives damaged phones from the US. The phones for repair start at the Phone Dis Assembly Process, wherein they diagnose phones for defects and disassemble them into three main parts: display module, enclosure module, and Main Logic Board (MLB). Each module will be processed separately until it transforms into finished goods and will then assemble to handset assembly process as remanufactured units as the product. The remanufactured handset will be shipped back to Asurion US for issuance to the Customer. TCP receives reship handsets from subscribers through Asurion US. The TCP process will start by receiving the phones at the Warehouse, defect validation by the Quality Assurance Inspection CRA Team, and Product Analysis performed by the Failure Analysis Team and back to the Warehouse for issuance to the production line for remanufacturing.

Suppliers	Inputs	Process	Outputs	Customers
➢ Raw Materials ➢ Internal source	➢ Direct & Indirect Materials	➢ Handset ➢ Enclosure Process Refer to detailed flow chart	➢ Handset FG ➢ Handset delivery ➢ Quality product	➢ US/TLC ➢ Subscribers

Table 2. SIPOC

3.2.2 Micro Process Mapping

Shows the end-to-end process of enclosure to handset assembly to customer. Processes with red lines are the affected process with potential PID and escapee while the process in red box is the customer wherein the failure is being detected.

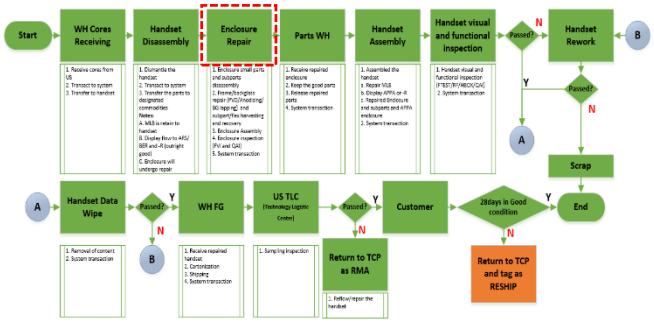
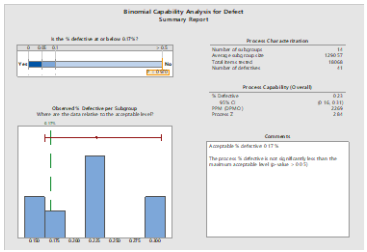


Figure 2. End-to-end process of enclosure to handset assembly

3.2.3 Process Capability Analysis



Graph 4. Capability Analysis

The process Z is 2.84 which means the process is not capable. The process % defective is 0.23% which is not significantly less than the allowable defective of 0.17% target with an equivalent 2,269 DPMO.

3.4 Analyze Phase

3.4.1 Problem Analysis (Graphical Tools/ Hypothesis

The team performed brainstorming to determine the potential process checking, and product analysis. To summarize, we causes and used the "Fish Bone Diagram" technique to deep dive into possible root causes of model G & H with software Malfunction defects. These items will be verified through simulation, actual have a total of 9 controllable, 3 non-controllable, and 1 item subjects for validation.

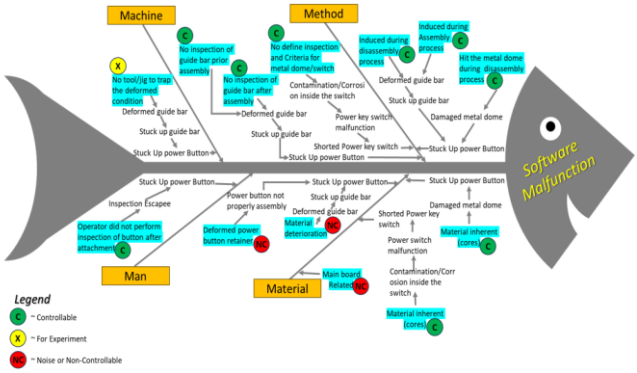


Figure 3. Fishbone Diagram

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3.4.2 Summary of Potential Causes and Validation Result

There are 13 potential root causes identified wherein 8 are true root causes within the team's control, and 5 are not true causes.

RC No.	Root Cause	4M Category	Validation	Validation Result	Team Decision
1	No inspection of the guide bar before assembly	Method	1. Check the current documented procedure 2. Perform simulation of 5 good and 5 with the deformed condition of guide bar and conduct normal assembly.	1. Not identified in the document to perform the inspection and did not perform in the actual process. 2. All samples with deformed guide bar condition manifest stuck up and all without evidence of deformed or good did not manifest stuck up. 	True Cause & Within Team's Control
2	No inspection of the guide bar after assembly	Method			True Cause & Within Team's Control
3	No defined inspection and Criteria for metal dome/switch	Method	1. Check the current documented procedure 2. Conduct 100 units sampling inspection of a metal dome switch	1. The condition of the power side key button/metal switch is part of the check item of the ACA process. No specified criteria for power sidekey button/metal dome assembly based on JA-011-EN-14 job aid and SPEC-011-2040 product specification. 2. 3/100 units with evidence of damaged metal dome 	True Cause & Within Team's Control
4	Deformed guide bar induced at disassembly process	Method	1. Check the current documented procedure and observe no standard way to disassemble the side key guide bar based on 2 operators that we monitored 2. Conduct 100 units sampling inspection of the guide bar after the disassembly process	1. No proper sequence on how to disassemble the side & power key flex in disassembly procedures. 2. 11 out of 100 with evidence of deformed guide bar 	True Cause & Within Team's Control
5	Deformed guide bar Induced during the Assembly process	Method	1. Check the current documented procedure 2. Observed the actual assembled parts if there's a mechanical difference	1. No proper sequence on how to attach the side & power key flex in assembly procedures. 2. Observed that 2 operators have different ways of attaching the side & power key flex during the assembly process.	True Cause & Within Team's Control
6	Damaged metal dome during the disassembly process	Method	Conduct 100 units of sampling inspection of the metal dome switch after the disassembly process	100 units have no evidence of damage on the metal dome switch	Not True Cause
7	No tool/jig to trap the deformed condition	Machine	Check the actual process requirement of the disassembly and assembly process if there's a tool to be used for the detection of the deformed guide bar	No tool to check the condition of the power key guide bar based on document and actual processing	True Cause & Within Team's Control
8	The operator did not perform an inspection of a button after the attachment	Man	Check the current documented procedure and actual element of the assembly process	3 operators followed the documented procedure	Not True Cause
9	Main Board related	Material	Checking of historical data of product RCA from the Failure Analysis team	No found root cause related to the main board as all product causes are related to damaged and contaminated metal dome and deformed power key guide bar as result in FA ASC-FA-CR-2301-0001 and ASC-FA-CR-2211-0003. 	Not True Cause
10	Contamination Material Inherent in Cores	Material	Conduct 100 units sampling inspection of metal dome switch in the ACA process	Found 2/100 with evidence of contamination of metal dome switch. 	True Cause & Within Team's Control
11	Damaged Metal dome is material inherent in cores	Material	1. Check the current documented procedure 2. Conduct 100 units of sampling inspection of the metal dome switch in the ACA process	1. The condition of the power side key button/metal switch is part of the check item of the ACA process. No specified criteria for power sidekey button/metal dome assembly based on JA-011-EN-14 job aid and SPEC-011-2040 product specification. 2. 3/100 units with evidence of damaged metal dome 	True Cause & Within Team's Control
12	Deformed Power button retainer	Material	Conduct 150 units sampling inspection of power button retainer and run up to handset level validation	No found no abnormalities on the power button retainer and all assembled were good until handset level validation	Not True Cause
13	Deformed guide bar (material deterioration)	Material	Conduct product simulation by powering On & Off the handset continuously pressing the power button then checking the condition of the guide bar afterward.	No manifestation of a stuck-up power key and no evidence of deformity on the guide bar during the validation	Not True Cause

3.4.3 Final Objective Statement

To reduce the Reship Software Malfunction in model G&H by providing countermeasures on the following identified true causes; deformed power key guide bar, contaminated and damaged metal dome switch. From a defect rate of 0.227% to 0.17% by the end of May 2023.

3.5 Improve Phase

3.5.1 Selection of Potential Solutions / Pay-off Matrix

The team brainstorms and selects the possible solution for each root cause. We use the Pay Off Matrix to conclude what actions we need to implement and what actions need not be implemented.

The Pay-Off Matrix				Team Decision	
Criteria	Pay-Off Matrix Score			Score	
	5	3	1		
Quality (Q)	3% to 5% Impact on Quality	1% to 2% Impact on Quality	0% impact on Quality	0 ~17	No Go
Delivery (D)	High Impact (10%)	Medium impact (5% on output)	No impact on Delivery (0%impact on output	18 ~ 25	Go
Cost (C)	Zero Cost in investment	Max P5000 investment	P5000 & above investment		
Safety (S)	No Impact on safety	With Minor Safety Concerns (First Aid Cases)	With Major Safety Concerns (Fatality and disability from work. Property damage and revocation of license)	**Formula:** Total = Q+D+C+S+E	
Effort (E)	Easy to implement	Medium Effort	High Effort/Need Assistance		

Table 3. Pay-off Matrix

The below table shows all the identified countermeasures and corrective actions that are GO based on the pay-off matrix and the team's decision.

Problem	Root Cause	Countermeasures	Y	D	C	S	E	Total	Team's Decision
Software Malfunction	Deformed side key guide bar and stuck-up button	Define the proper disassembly procedure of the power key guide bar	5	3	5	5	5	23	GO
		Implementation of Go-No-Go jig to check and detect the deformed power key guide bar for both disassembly and assembly process	5	3	4	5	5	22	GO
		Define the proper attachment of the power key guide bar in the assembly process.	5	3	5	5	5	23	GO
		Include the inspection of the power key guide bar after attachment in the Assembly station	5	3	5	5	5	23	GO
	Damaged and contaminated metal dome/switch (Inherent)	Inclusion of criteria in ACA process (SPEC-011-2040)	5	3	5	5	5	23	GO

Table 4. Decision Matrix

3.5.2 Potential Problem Analysis

To assess and mitigate all the potential risks, a potential problem analysis table was created as shown below.

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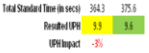
Countermeasures	Potential Problem	Preventive Actions and Contingency Plan	In-charge	Date	Status
Create proper disassembly procedure of power key guide bar Added element for attachment of power guide bar in the assembly process. Include the inspection of the power key guide bar after attachment in the Assembly station	Decrease UPH due to additional elements and activities	Perform TMS: **Result:** With 3% UPH impact but no significant impact in terms of Capacity and HC allocation 	Angelo Torres	4/28/23	Done
Implementation of universal Go-No-Go jig in disassembly & Assembly process	Ineffective go-no-go jig	Conduct measurement of the guide bar and comparison per model	Renz Acasio/ Richard Elma/ Mary Joy Cacho	4/17/23	Done
		Run 300pcs for a feasibility study to validate the effectiveness Result: 300/300 passed until handset level test			
	No available guide bar jig and not sustainable	Assessment of guidebar jig needed for assembly and disassembly process. Request additional or new guidebar jig if necessary.			
		Create a request and coordinate with the fabrication shop		4/28/23	Done
Inclusion damaged and contaminated metal dome/switch in current criteria (SPEC-011-2040)	Not updated parts yield Guidebar and power key flex and WCA parts	Close monitoring of yield performance and communication with Demand planning any change encountered	Richard Elma	5/20/23	Done
	Over and under Rejection judgment	Conduct Attribute Agreement Analysis (AAA) to gauge the inspection judgment of operators. **Results:** 100% Passed **Note:** Failed condition is obvious	Mary Joy Cacho	4/20/23	Done

Table 5. Potential Problem Analysis

3.5.3 Solution Implementation

The team identified eight corrective actions that will help solve and reduce the defective reship for model G&H.

RC No.	Validated Root Cause	Best Solution	Evidence	Date	Results	Error Proof Level
1	No inspection of the guide bar before assembly	a. Define the method of inspection of the guide bar using a go-no-go jig. b. Add mechanical testing after attachment of the power key		3/13/23	For 300 units run no stuck up of buttons was encountered and all passed until handset level validation. 300/300 passed on evaluation	3
2	No inspection of the guide bar after assembly					
3	No defined inspection and Criteria for metal dome/switch	Define the criteria for metal dome switch and update and revise the documented procedures		3/13/23	A damaged and contaminated metal dome switch will already be detected in the ACA process and	4
4	Contamination Material Inherent in Cores				no power key malfunction was encountered in the Enclosure Functional inspection. **Note:** Validated in three months data evaluation run	
5	Damaged Metal dome is material inherent in cores					
6	Deformed guide bar induced at disassembly process	Define the step-by-step process of dismantling the power key guide bar		3/13/23	For 300 units run no stuck up of buttons was encountered and all passed until handset level validation. 300/300 passed on evaluation	3
7	Deformed guide bar Induced during the Assembly process	Define the step-by-step process for attachment of the guide bar during the assembly process		3/13/23	For 300 units run no stuck up of buttons was encountered and all passed until handset level validation. 300/300 passed on evaluation	4
8	No tool/jig to trap the deformed condition of the power key guide bar	Creation of universal go-no-go jig for power key guide bar applicable		3/23/23	a. Go-no-go jig capable of trapping the deformed guide bar and applicable across models. b. Run 10 deformed and 10 of good condition of power key guide bar, Result: all deform conditions failed by the go-no-go tool as the good considered passed.	3

Table 6. Solution Implementation

3.6 Control Phase

3.6.1 Documentation

Action has been documented and disseminated to the affected business unit.

No.	Document Title	Control #	Type	PIC	Date	Status
1	Model G Enclosure Repair Disassembly	JA-011-EN-72	Job Aid	Richard Elma	08/04/2023	Done
2	Model G-2 Enclosure Repair Disassembly	JA-011-EN-73	Job Aid	Renz Acasio	08/04/2023	Done
3	Model G- 3 Enclosure Repair Disassembly	JA-011-EN-74	Job Aid	Richard Elma	08/04/2023	Done
4	Model G-3 Enclosure Repair Assembly 1-4	JA-011-EN-76	Job Aid	Renz Acasio	08/04/2023	Done
5	Model G-2 Enclosure Repair Assembly 1-4	JA-011-EN-77	Job Aid	Richard Elma	08/04/2023	Done
6	Model G Enclosure Repair Assembly 1-4	JA-011-EN-78	Job Aid	Richard Elma	08/04/2023	Done
7	Model H-3 Enclosure Repair Procedure	JA-011-EN-99	Job Aid	Renz Acasio	08/04/2023	Done
8	Model H-2 Enclosure Repair Process	JA-011-EN-100	Job Aid	Renz Acasio	08/04/2023	Done
9	Model H Enclosure Repair Procedure	JA-011-EN-101	Job Aid	Richard Elma	08/04/2023	Done
10	Model H-3 Enclosure Repair Procedure	JA-011-EN-99	Job Aid	Richard Elma	08/04/2023	Done
11	Model H-4 Enclosure Repair Procedure	JA-011-EN-102	Job Aid	Richard Elma	08/04/2023	Done
12	Model H-3 Enclosure Repair Assembly	JA-011-EN-102	Job Aid	Richard Elma	08/04/2023	Done
13	Model H-2 Enclosure Repair Assembly	JA-011-EN-104	Job Aid	Renz Acasio	08/04/2023	Done
14	Model H Enclosure Repair Assembly	JA-011-EN-105	Job Aid	Renz Acasio	08/04/2023	Done
15	Model H-4 Enclosure Repair Assembly	JA-011-EN-106	Job Aid	Richard Elma	08/04/2023	Done
16	Enclosure Inspection Criteria	SPEC-011-2040	SPEC	Mary Joy Cacho	6/27/2023	Done
17	Enclosure Assembly & Disassembly FMEA	FMEA-011-15	ER	Richard Elma	08/31/2023	Done
18	Enclosure Assembly & Disassembly PMP	PMP-011-06	Form	Richard Elma	08/31/2023	Done
19	Stuck Up and Side key Malfunction	OCAP-EN- E1-0005	ER	Mary Joy Cacho	08/18/2023	Done

Table 7. Document Updates

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4.0 RESULTS AND DISCUSSION

4.1. Tangible Benefits – Cost Savings Benefits

The tangible benefits in terms of cost reduction as the team dealt with reship reduction improvement has total cost savings equivalent to 2 brand new Ford Mustangs. A great impact on overall reships and to company's overall cost savings. This was validated by our Finance Team

4.2 Intangible Benefits

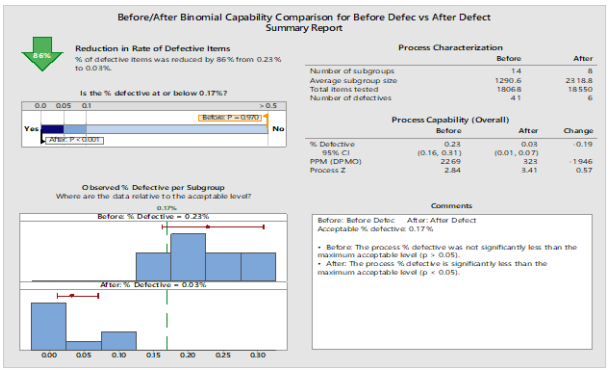
We made a significant contribution to a better reputation of our company's brand. Also, developed team commitment and ownership in every task that we take in our daily activities. We were excited and enjoyed each phase of our project as we discovered the DMAIC tools.

4.3 Team Evaluation

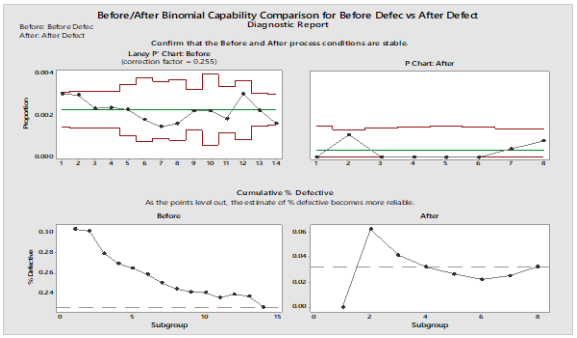
a. What Went Well?
b. Gained knowledge of the DMAIC concept through training and applied in improvement.
c. Enhances stakeholder relationships (Operation, Quality, Engineering, and Support Team)
d. Improved strategy, decision-making, and problem-solving skills.
e. Developed capabilities of the team with training, knowledge tools, and knowledge resources.

5.0 CONCLUSION

As seen from the Model G &H SW Malfunction reship trend, after implementation of all actions it was reduced by 86% from 0.227% to 0.03% in September 2023. Process capability Z score has improved from 2.84 to 3.41 and DPMO reduced from 2,269 to 323. The P-chart shows a decrease in defects before and after improvement.



Graph 5. Summary Report



Graph 6. Binomial Capability Comparison

6.0 RECOMMENDATIONS

6.1 Fan-out

After further evaluation, the team reviewed all the actions implemented assessed the applicability and fanned out to other sustaining and incoming new models. See below table.

Model	Actions	Responsible	Target Date	Status
Model F	Define the method of inspection of the guide bar using a go-no-go jig.	Richard Elma	October 2023	Done
Model E		Mary Joy Cacho	October 2023	Done
Model C		Rhenz Acasio	October 2023	Done
Incoming New Models		New Product Eng'g Team	November 2023	Done

Table 7. Fan-out

6.2 Next Phase of the project

The next DMAIC Project will cover the evaluation of Device Charging malfunction for Model H and G handsets as the 3rd highest defect contributor based on the Reship Pareto Diagram. Also, evaluation and identification process that will improve the Reship performance, create, and implement efficient and effective action to improve the reship performance for model H and G.

Model	Action	Responsible	Target Date	Status
Model-H & G	Device Charging malfunction	Team	January 2024	Ongoing

Table 8. Next Project

7.0 ACKNOWLEDGMENT

The team would like to acknowledge the following persons for their contribution to the realization of the project:
Edgardo Carillo (QA Director)
Roberto Visto (Parts Quality Manager)
Sharon Castillo (CI Manager)
Andrew Medina (QA Manager)
Princess Loveria (Finance Manager)
Jennilyn Natoza (Quality Supervisor)
Alvin SORIMA (CI Facilitator)
Ma. Allana Batalla (Finance Analyst)
Angelo Torres (Industrial Engineer)

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