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Defect Reduction in an Automobile Lock Industry by applying 7 Quality Control Tools

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Abstract

The main role of 7 Quality Control tools is to investigate & collect or gather the data to analyses the manufacturing defects by using the simple tools of quality. By applying with this simple 7 quality control tools we simply want to eliminate the defects and evaluate these defects by root cause analysis and after identification of those root cause take corrective action and preventive action according to the need in the assembly lines. Electric vehicle ignition lock lines were selected to gather the data for continual improvement & defect reduction. By eliminating the defects in an automobile locks company we simply added value to the product by these small changes we saw a big differences that's the stage of continual improvement we have to follow the standard to reduce PPM percentage by to stay in the market. We have to follow the companies' policies such as zero defects, zero breakdowns and zero accidents. By applying the CAPA, Kaizen, POKA- YOKE, PDCA, Brainstorming &Why Why Analysis we reduce the customer complaint to zero and the final product is quality controlled.

Keywords: Defects, 7 Quality Control Tools, Continual Improvement, Root cause analysis.

1. Introduction

In this modern era companies facing the competition in the market by these cut & throat competition there is a big reason to sustain the quality of products. In today's world cost of the product decided by the customer so customer want product with standard quality & affordable prices. The major aim of the Seven Quality Control tools is either data collection, analysis, and root cause analysis and outcome measurement. A group of experts and the corporate management must busily employ quality instruments for their decision-making and continual improvement processes as part of the continuous quality improvement process. There are already many quality assurance and quality management solutions available, so choosing the best one is not always an easy process. Tools are fundamental tools for the completion of a form easily and essential components of a process. Many businesses have chosen tools without giving them enough attention, which has led to advancement obstacles. Although quality tools are a way of problem solving, they cannot solve every quality issue. Therefore, it is important to underline because although tools may be extremely useful they may be highly dangerous in the wrong hands, as well as the right ones. Knowing which tools to use, when, and how, in problem-solving or improvement procedures is essential. [1]. Evaluation of product flaws obtained using quality control station measurement data.[12] The team of field specialists and business leadership are expected to employ quality tools in improvement activities and decision-making processes as part of the continuous quality improvement process. The choice of the best appropriate tool is not always simple because there are currently there are several quality control and management solutions available to quality professionals and executives. In the performed research, it is examined if 7QC techniques could be successfully applied in a number of businesses in the power generation and process industries as well as in the administration, travel, and health services. [2]. In an automobile lock industry these tools are commonly used in analyzing the problems for finding the concrete solution. An automobile lock industry is basically a lock manufacturing unit of different types of locks for 2 wheeler, 3 wheeler and 4 wheelers such as ignition lock, fuel tank cap, steering lock, door locks & lid lockset. By simply using simply we eliminate the defects and going towards the stage of continual improvement. After identification of root cause wesimply take action through PDCA (Plan Do Check Act). Tool improvement and sensory control of the tool are required in order to reduce dependency on as an essential activity, metrological inspection and machining

operator expertise are both required. As a result, automation and tool transformation are crucial, and machining productivity is rising. Finally, automate the use of computer tools to manipulate measurement results, and record the measurement data to the system's database to make it easier to access the data quickly and without needing to keep paper measurement results in a warehouse. [3] So that improvements must be made in order to reduce issues with process variances. [13] The literature review includes a several publications that describe the adaptability of various Quality tools & techniques and their possibilities. I will discuss many quality tools applied in small-scale manufacturing units under this survey. In this review, various authors define the function of QC tools. These approaches may help in many different production areas, such as inventory control at various pieces of machinery in the mechanical workshop to identify procedure variants and define optimum principles of limitations, in addition to helping to reduce the rejection rate. [7] It was designed to be used in Japanese QC reading groups, foremen-led staff training, or for self-study. [11]

Various mistakes are found after reviewing all study papers using 7 QC techniques, and each problem is addressed with a possible underlying reason. The specific challenges of each research paper are assessed, and solutions are then provided in line with the requirements. As a result, the impact of the challenges on production is changed, resulting in an increase in productivity or a drop in rejection rates. [7] The investigation was done to look into the potential uses for quality control tools.[14] Through direct production line monitoring and statistical techniques, the modes of failures are explored. [15]

3. Objectives

Administration of the PAVNA INDUSTRIES LIMITED emphasis the system to achieve the good quality products by using the QC tools. The aim of the company to fulfill customer demand with quality. This concern was that to make this company as a reputative O.E.M in the market, so that continual improvement by using statical process control methodology. Following targets were developed in this context in order to bring about change and meet the objectives connected with the PAVNA INDUSTRIES LIMITED:

1. One aim is to assess how well production as well as quality is going on in company.
2. Defects are the focus of this study and diagnosis.
3. Brainstorming & Quality circle activities done to discuss about the quality issues.
4. Solution implementation to increase Quality & Productivity through better use of resources, less waste, and shorter activity cycles.
5. Results and Proposals for increasing overall efficiency of the industry.

4. Problem Formation

As the company runs there are lots of quality issue occurs while running the line of EV steering ignition switch such defects are as, flash on stator, flash on slider, dent on ss cap & lock moment hard which were catch at CTQ (Critical to Quality) stage but some of the defects passed to customer end & this rise to customer complaint and due to these issue company facing customer dissatisfaction. By the customer dissatisfaction there is chances to customer break business relationship with company. So there are chances of loose company brand value/reputation in the market.

5.Research Methodology

Here in this research methodology we use seven quality control tools to collect data & information and analyses that data. The seven quality control tools are as, histogram, Pareto diagram, fish bone diagram, control chart, check sheets, flow chart & Scatter diagram. From above seven qc tools in this case study we are using only two qc tools for analysis of defects.
5.1 Pareto chart
5.2 Fish bone Diagram

5.1 Pareto chart

A Pareto analysis is a representation that groups things according to how much they contribute, highlighting the few things that have the most impact. Such tools are used in Statical Process Control & quality improvement to priorities improvement projects, create corrective action teams to address issues, identify the items that receive the most complaints, ascertain the most typical sorts of complaints, ascertain the most typical grounds for rejections, and other parallel tasks. The idea for the tool came from Vilfredo Pareto, an Italian economist, observed that a large portion of wealth was concentrated in the hands of a small number of people. He noticed that most fields used a similar distribution pattern. In the area of materials management, ABC analysis makes use of the Pareto principle, sometimes referred to as the 80/20 rule. An organization spends 80% of its budget on 20% of its buys. These make up the A items, which receive the most focus. Dr. Juran recommended use this concept for quality assurance to differentiate between the "trivial many," now known as the "useful many," and the "vital few" problems.. [5]

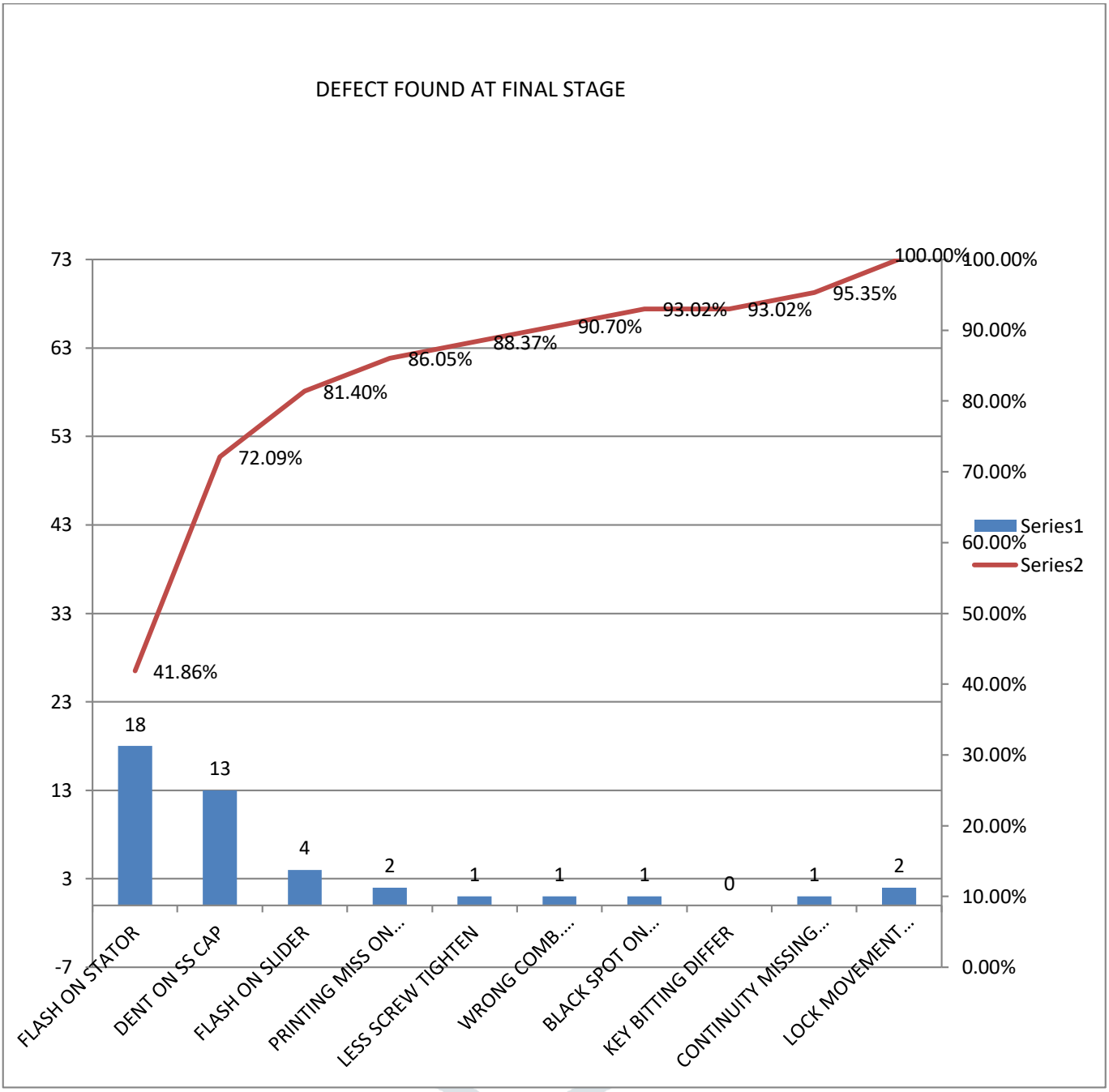


Fig.1 Pareto chart [16]

5.2 Fish bone diagram

The fish bone diagram is a method for organizing probable factors that might have an adverse effect on the stability, center, spread, and form of a vital to quality (CTQ) characteristics metric.. Typically, a team would utilize a fish bone diagram to pinpoint & separate an issues root causes. The approach was created by the late Dr. Kauro Ishikawa, a famous quality specialist of japan; hence, this diagram is also known an Ishikawa diagram. Because of how it appears, it is also known as a fishbone diagram. [7]

The Cause-and-Effect (C&E) diagram aids in guiding us to the problem's fundamental cause if the Pareto diagram assists in prioritizing our efforts and focusing attention on the most urgent issue or symptom. [7]

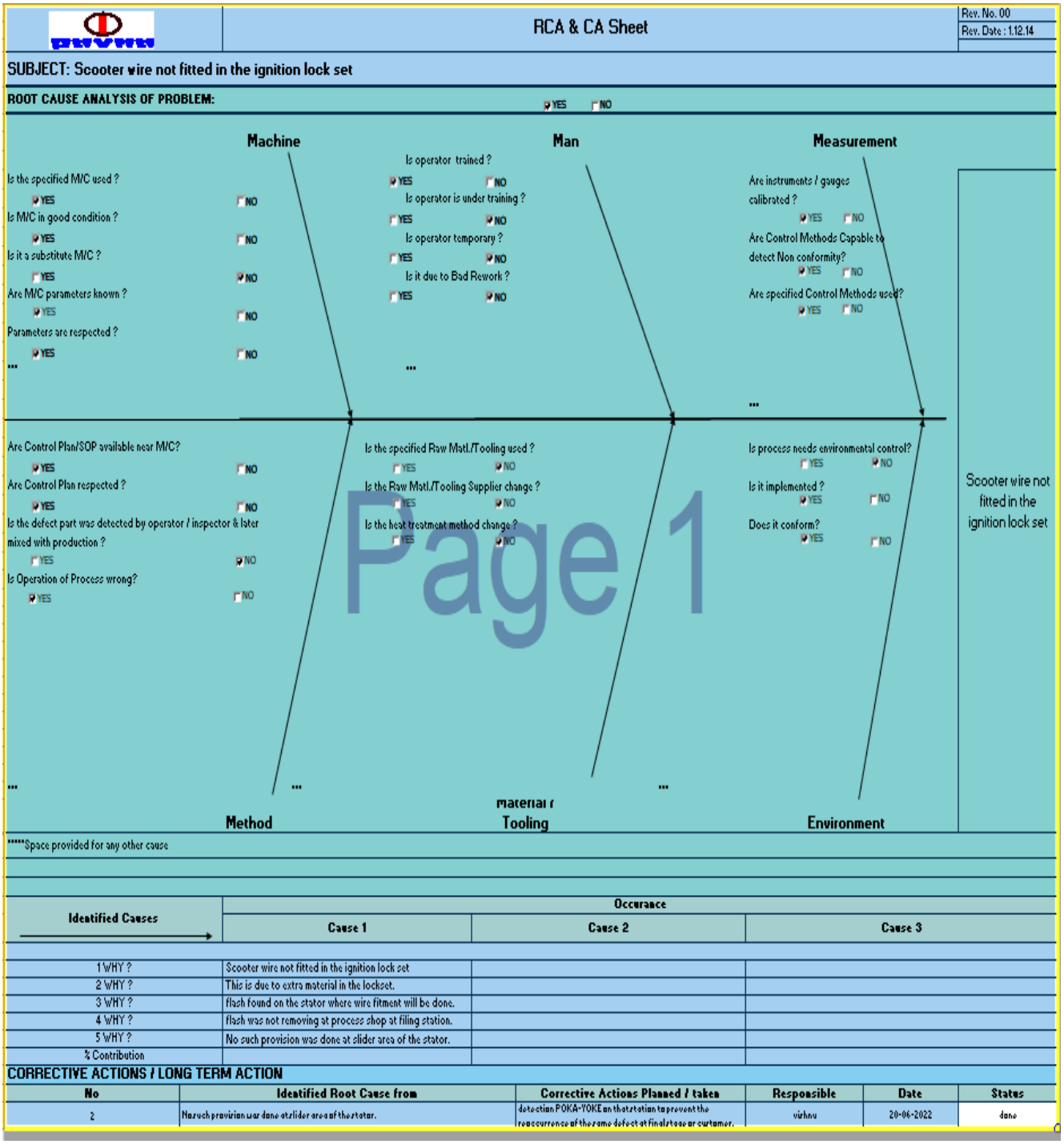


Fig 2. Fish bone diagram [16]

From the above data analysis we are known to the current defects to eliminate these we have to use lean techniques to reduce these customers' complaints. The methodology are used to eliminate the defects are as;

a. Corrective Action Preventive Action
b. Kaizen
c. Poka Yoke
   Brainstorming
d. On Job Training
e. PDCA

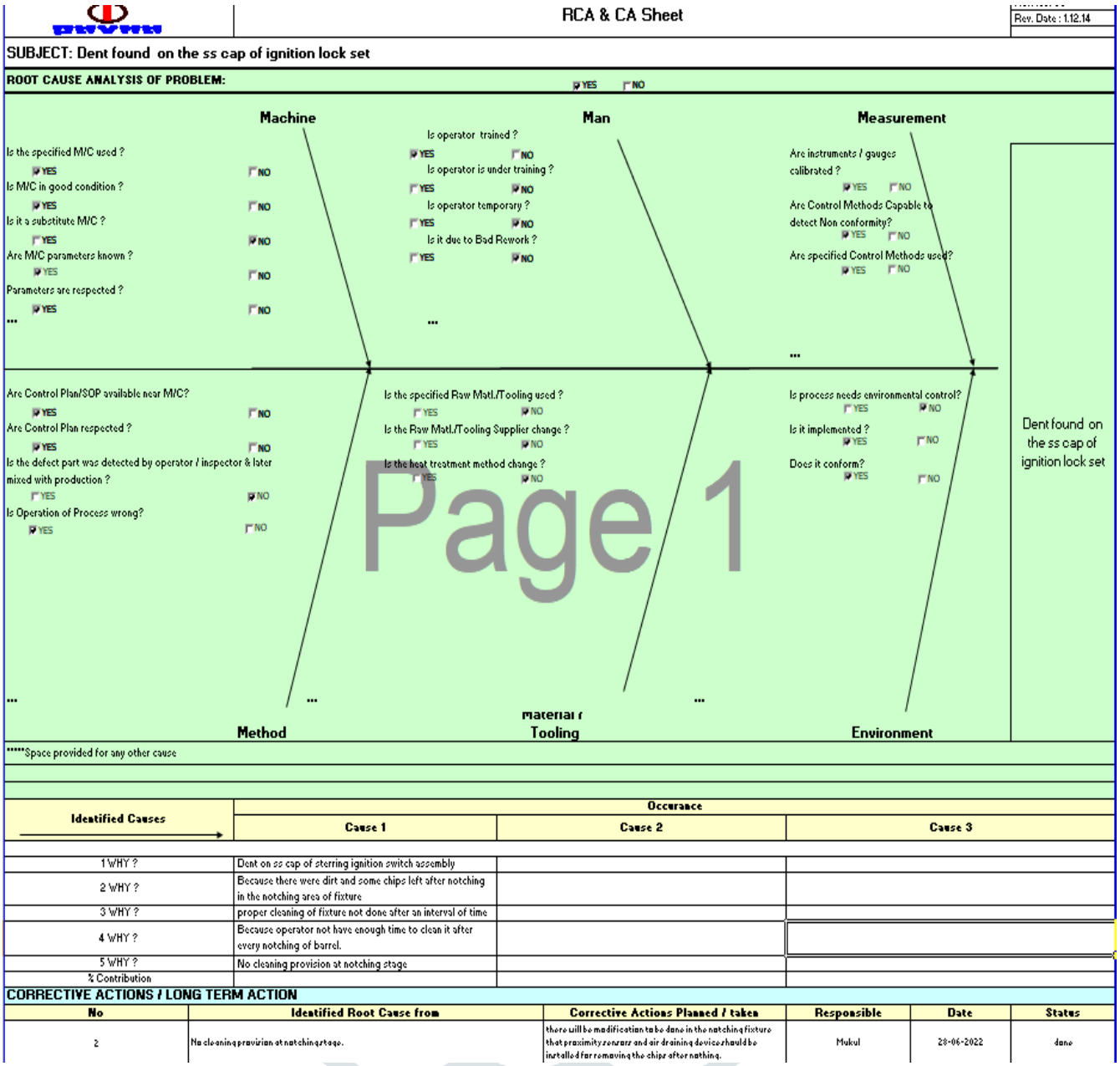


Fig3.fish bone diagram [16]

From the above technique we are used corrective action preventive action, poka yoke, brainstorming & on job training. Here the brief introduction of these techniques are as:

(A) Brainstorming

Using a team's combined strength, the process of brainstorming is utilized to elicit a lot of ideas. It often occurs during an organized session with minimum three participants to maximum twelve participants, with approx. 6 participants presence is enough for an optimum size of any group. The team manager supports every team person's attention, averts disturbances, encourages creativity, and documents the results (or ensures that each member of the team registers their own outcomes.). To avoid interruptions, the brainstorming meeting need to be held behind locked doors. To encourage the exchange of ideas among group members and seats should be arranged in a circular or U configuration. [9]

(B) On Job Training

On job training is a training which is held on the regular basis to aware the operators regarding the defects and awareness training to the operators. To avoid the repeateability of the customer complaint

(C) Poka Yoke

Mistake proofing may involve many checks, contact-type or non-contact devices to look for missing components, or a clever design that will only accept the component one way. People are likely to make mistakes, and if these errors go undiscovered during the production process, they eventually show up as defects. It would be a step toward a product with no defects and high value if we could identify these faults in advance using certain tools or mechanisms at crucial phases. Any concept, tool, technique, or fix for error prevention is known as a poka yoke. [10]

There are basically two kinds of poka yoke are as-

1. Prevention Poka Yoke- A prevention poka yoke is working on prevention as we know prevention is better than cure on that fact this poka yoke works it simply prevents the defects to occurs. This is 100% mistake proofing or we say that fool proofing.

2. Detection Poka Yoke- A detection poka yoke is working on detection it just detect the defect and signal the operator that the part is defective that should be corrected at that source or next workstation.

Corrective Action & Preventive Action

Eliminating the root of a discovered non-conformity or other unpleasant circumstance is the goal of a corrective action. Non-conformity may have more than one source. In order to avoid repetition, corrective action is taken. This method contains: 1). analysis & explanation of the issue or nonconformity. 2). identifying the real problems base. 3). Create a strategy to address the issue and stop it from happening again. 4). carrying out the strategy. 5). determining if the adjustment is working.

An effort to remove the root of a future non-conformity or other unwanted circumstance is known as a preventative action. A possible nonconformity may be caused by several different factors. To avoid occurrence, preventive measures are performed. Preventive action may result from the rising of in-process data, analytical data, audit results, the trending of the causes of non-conformities or complaints, yearly product assessments, quality risk analyses, etc. The method contains: 1). Determine the potential issue. 2). Identify the root of the potential issue.. 3). Create a strategy to prevent this from occurring .4). Follow out the strategy.5). Examine the steps taken and their success in avoiding the issue.

6. Experimental work

The main analysis in these experiments to analyses the data of assembly line EV ignition lock line. By daily visit on the line after a regular interval of time to confirm defect analysis on the line at final inspection. On EV ignition line there is assembly of the whole lock with different sub assembly & child parts. Here, in the EV lock assembly mechanical as well as electrical components are also used and there is rotary motion converted in reciprocating motion when key rotate from off position to lock position. The main of this experiment is zero customer complaint and the lock is manufactured is fully quality controlled.

7. Improvement Approach

The process of defect reduction and continual improvement should be done through first collect data, analysis of data and after the brainstorming on the high quality issues such as (flash on stator, flash on slider, dent on ss cap & lock moment hard) are mainly found on EV ignition switch these defects or customer complaint will be closed by using techniques such as brainstorming, CAPA, Poka Yoke and On Job Training.

7.1 Introduction to EV Ignition switch line

As we know that the Electric Vehicle comes in trend now days because EV is safe for environment as well as cheap for the customer & reliable as well efficient.so the pavna industries limited is an automobile lock company which are adding value to automobile worldwide here in this company an ignition lock manufactured for EV.EV lockset are dispatched to different different EV manufacturer there are around 11 stations on the EV ignition line are as : 1. Barrel Notching 2.barrel filling 3.tumbler projection checking 4.contact carrier sub assembly 5.lead assembly 6.barrel fitment in stator 7.sub assembly 8.screw tighting 9. Eol testing 10. Final checking 11.final packing. And its some of the main parts are as stator, lead assembly, barrel, tumblers, key, compression springs, extension, plunger bracket, slider & end pin.

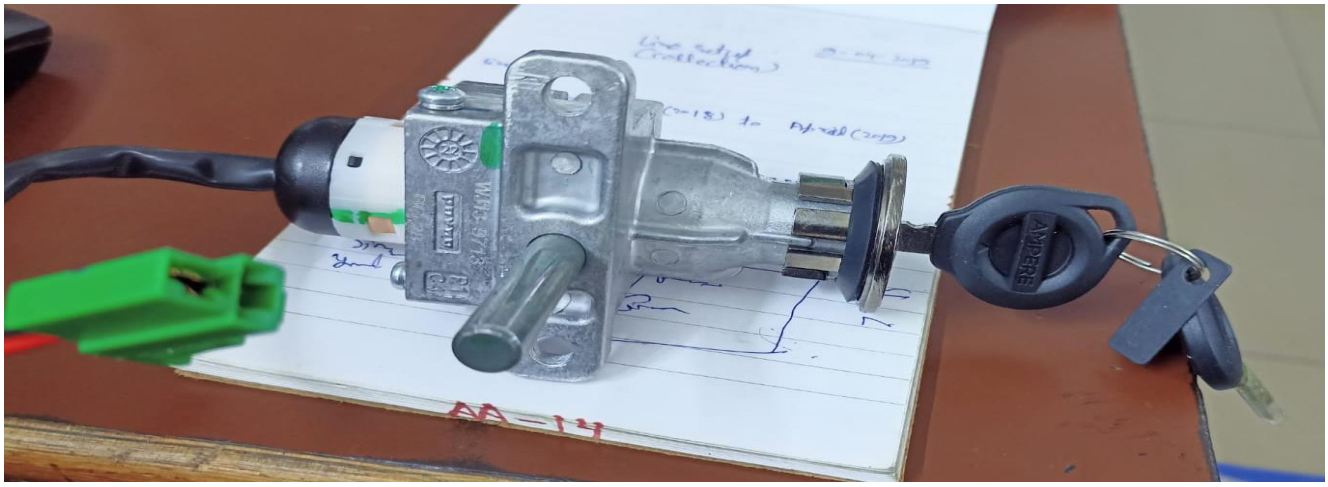


Fig.4 Steering Ignition lock [16]

Barrel Notching

Tumbler filling

Barrel fitment into stator

Stator Sub assly

Screw tigtinnig

EOL Testing

Laser Marking

Final Inspection

Final Packing

Fig.5 Process Flow Diagram of EV Ignition Switch [16]

7.2 Problem formulation

The two major issues we are resolving through analysis of seven QC tools are as flash on stator and dent on ss cap.The QC tools we are using are pareto chart and fish bone diagram these are the customer complaint which has to be closed by taken action plan. Management gave strict orders in pavna industries limited minimize the customer or it becomes zero by applying lean tools we have to achieve the goal of zero rejection or zero customer complaint and by utilising these tools we maintain quality as well as productivity.

7.3 Analysis Defect 1 : Objective 1 (seat catch wire fitment not done in Steering ignition switch)

In the present scenario on daily basis around 18 pcs found rejected part forward to final stage to customer end in may month and 8 pcs in the month of june and this issue is customer concern that the seat catch wire not inserted in the slider of lock assembly. By following some steps we resolve this as soon as possible.

Step 1- Take containment action that all the lockset in dispatched or in transit will be hold for 200% inspection with 100% identification marking on lock & one point lesson provided on line and On Job Training given to all workers.
Step2- For taking corrective action preventive action first we have to do 5 why analysis to find the root cause the problem.
Step3- After root cause identification, we have to give action plan to the customer.
Step4-After that the sustenance of that corrective action preventive action.

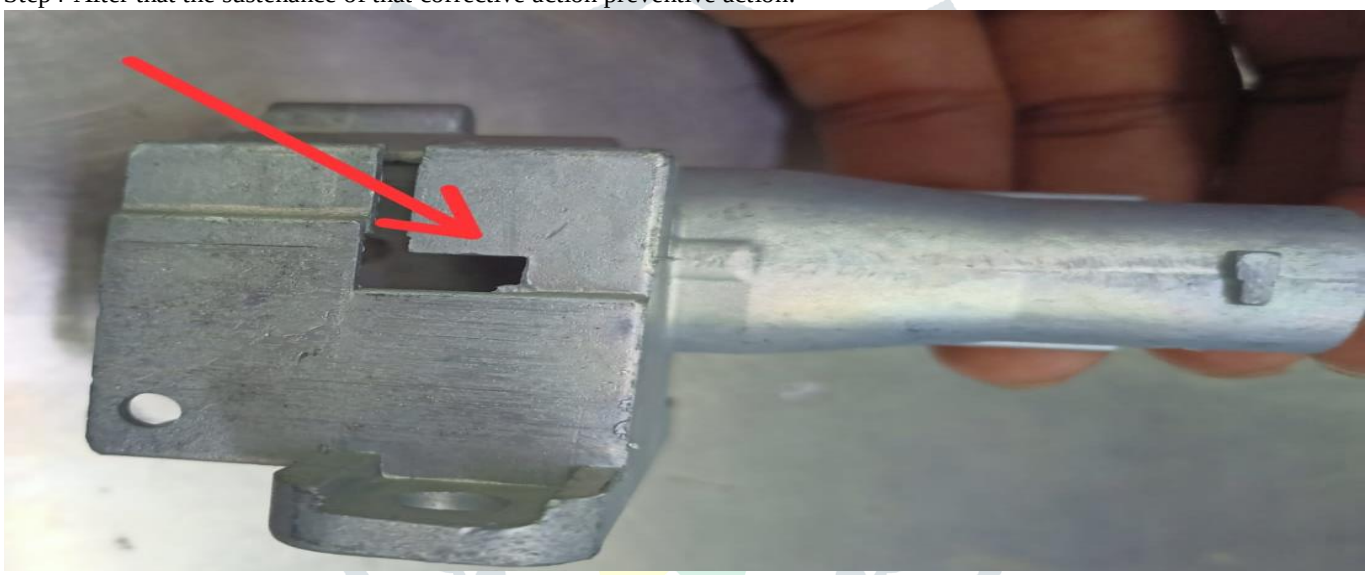


Fig. 6 flash on stator [16]

7.3a Root Cause Analysis

Why Why Analysis to be done for finding the root cause of any problem.

W1- Scooter wire not fitted in the ignition lock set.
W2- This is due to extra material in the lockset.
W3- flash found on the stator where wire fitment will be done.
W4- flash was not removing at process shop at filing station.
W5- No such provision was done at slider area of the stator.

After the whole analysis we are finding the actual root cause of the problem. Now it's time to take countermeasure of the above problem.

7.3b Counter Measure

Proper filing should be done at process shop to remove the extra material from the stator and to ensure that filing will be done with 100% we provide a detection POKA-YOKE on that station to prevent the reoccurrence of the same defect at final stage or customer. Brainstorming should be done by the group of different person from different departments regarding this problem for solving the issue & decision making. After implementation of poka yoke there is proper sustenance should be done through Jishu Hosen one of the pillar of Total productive maintenance. JH sheet implemented on that station. Poka Yoke samples OK and NOT OK samples should be provided on that station for daily checking and these points should be added in POKA YOKE sheet.

7.3c Description of POKA YOKE

For the above customer complaint there is a permanent solution we provided through poka yoke implementation. We provide a fixture for checking the L slot of the stator here we used a pneumatic cylinder to check the overall L slot

through type sleeve gauge. After complete filing on the stator operator just pick the stator and put it the on the fixture after that by pressing green button cylinder reciprocating movement start when the L slot sleeve gauge passed through the stator the green light illuminate and then auto dot punch marking on that stator for the identification of ok material if the L slot sleeve gauge not qualify the L slot of the stator then red light will be illuminate with buzzer after put that stator in the rejection box than the buzzer and red light will be stop.

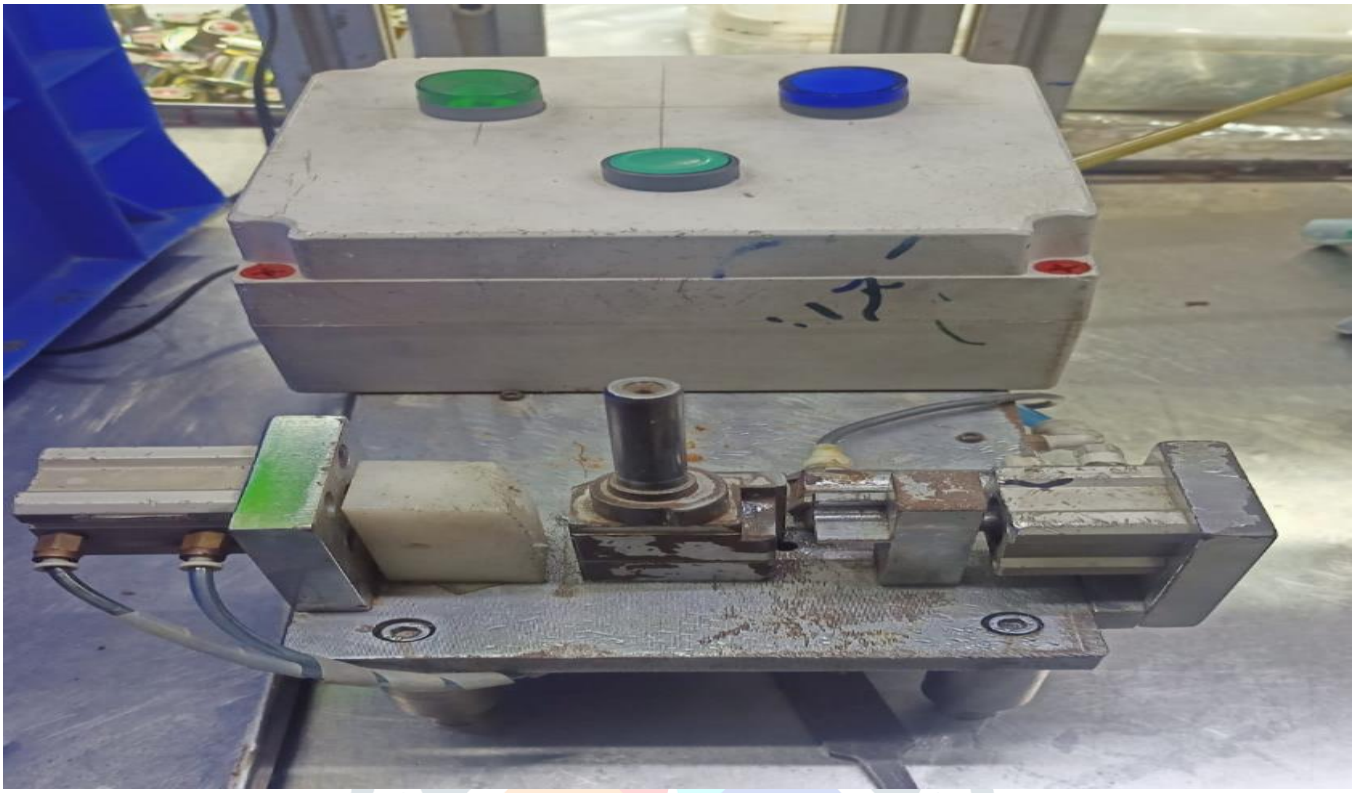


Fig. 7 Poka Yoke fixture for L slot checking [16]

7.4 Analysis Defect 2: Objective 1 (Dent on ss cap of steering ignition switch)

In this issue there is dent found on the ss cap of steering ignition switch at customer end and around 12 pcs found in the month of May and around 6 pcs found in the month of June lot of this is most critical issue.
Step 1- Take containment action that all the lockset in dispatched or in transit will be hold for 200% inspection with 100% identification marking on lock & one point lesson provided on line and On Job Training given to all workers.
Step2- for taking corrective action preventive action first we have to do why- why analysis to determine the root cause.
Step3- After root cause identification and gave an action plan to the customer.
Step4- After that the sustenance of that corrective action preventive action will be done.

NOT OK

OK

Fig. 8 Dent on ss cap [16]

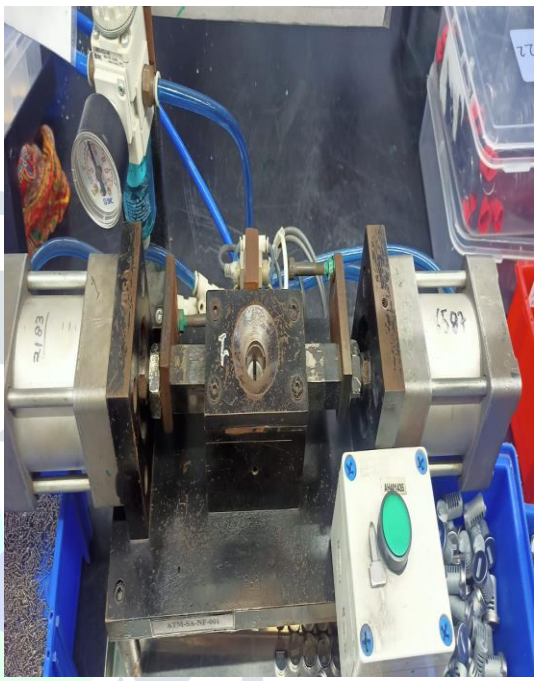
7.4a Root Cause Analysis
W1- Dent on ss cap of sterring ignition switches assembly.
W2- Because there were dirt and some chips left after notching in the notching area of fixture.
W3- proper cleaning of fixture not done after an interval of time.
W4- Because operator not have enough time to clean it after every notching of barrel.
W5- No cleaning provision at notching stage.

The root cause of above problem is no cleaning provision at notching stage so for the above issue we have to take counter measure to resolve this issue as earlier as.

7.4b Counter Measure

First we have to counter the main root cause of this problem chips/foreign particle found in the notching fixture.so first we have to call a meeting for the above quality problem. Different different departments' involvment is necessary in this problem such as production, quality, maintenance & automation to give their suggestions to eliminate the customer complaint. And after this meeting decision making done. Then there will be modification to be done in the notching fixture that proximity sensors and air draining device should be installed for removing the chips after nothing. As the fixture modified according after every notching fixture drain out high pressure air on the notching area. So after every stroke of notching the fixture automatically cleans.

Before



After

Fig.8 notching fixture [16]

8. 7 QC Tools through PDCA.

Coordinating efforts for continuous improvement are done using the PDCA cycle. It highlights and exemplifies the necessity of careful preparation at the beginning of improvement projects, followed by effective action, and then careful planning once more in a continuous cycle—the Deming quality cycle is never-ending. It is a tactic utilized to create significant advancements in safety, quality, morale, delivery costs, and other important corporate goals. [1]

The PDCA cycle consist of four major steps are as:-

a. **Plan: -** organising any improvement.
b. **Do: -** The planned improvements should be put into practise.
c. **Check: -** Control and measurement of procedures and outputs in accordance with changes made in earlier stages as well as with policy, targets, and expected outputs. Report the outcomes**.**
d. **Act: -** The changes should be adopted to run the cycle again for the continual improvement.

9. Defect Reduction after implementation

After using the 7 QC tools on both lines, there has been a noticeable improvement. Illustrate the flaws in the EV ignition switch assembly before and after the use of the 7 quality tools, respectively.

10. Result and Discussion

At PAVNA INDUSTRIES. LTD., the manufacturing process was not operating normally before to the introduction of quality tools. The management and engineers realised the cost of rejecting a work item once the procedures had been included into the process. As can be observed from this research, statistical quality control are crucial success elements for maintaining a firm, achieving customer happiness, and achieving business excellence. These really help to analyse the defects and take action on it and hence there is overall efficiency of the company increases. In this case study below two quality tools really helpful.

1. Pareto analysis states that rejection is due to

a) Flash on stator
b) Dent on s.s cap
2. Cause & Effect diagram determine and uncover the root causes of issues.

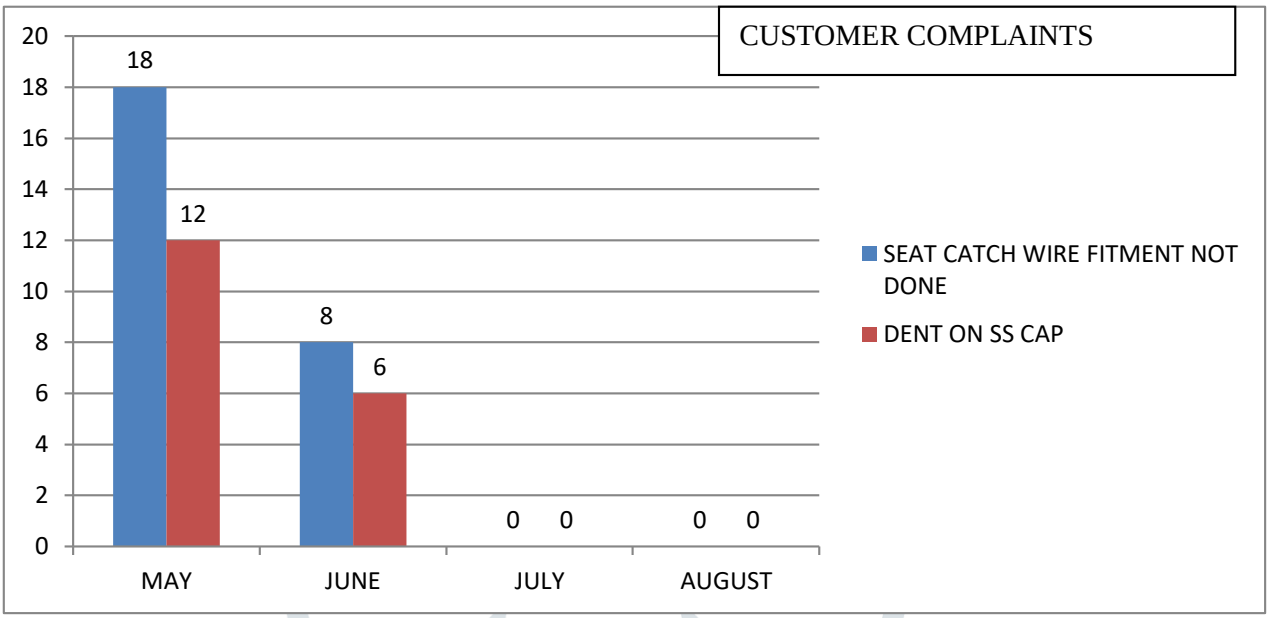


Fig. 9 Customer Complaints

11. Conclusion

This study examined how to reduce defects on an assembly line in the manufacturing division of an automobile lock firm. The EV steering lock found to have the highest frequency of faults. (Flash on stator & dent on s.s cap) was 26 defective part found at customer end in May 2022 (prior to the use of the quality tools) and the minimum number of defects (14) was found in June of 2022 after implementation of poka yoke and kaizen we achieve our aim of zero customer complaint in the month of July and August.

References

[1] Mirko Soković, Jelena Jovanović, Krivokapić , and Aleksandar Vujović, "Basic Quality Tools in Continuous Improvement Process," Journal of Mechanical Engineering, vol. 55, pp. 8-9, 2009.

[2] Chiragkumar S. Chauhan, Sanjay C. Shah, and Shrikant P. Bhatagalikar, "Quality Improvement By Apply Seven Quality Control (7 QC) Tool in Process Industry," IJSRD - International Journal for Scientific Research & Development, vol. 1, no. 10, 2013.

[3] Minh Ly Duc and Minh Nguyen Thu, "Application of Lean Six Sigma for Improve Productivity at The Mechanical," MANUFACTURING TECHNOLOGY improvement ENGINEERING SCIENCE AND RESEARCH JOURNAL, vol. 22, 2022.

[4] Imdad Ali Memon et al., "Defect Reduction with the Use of Seven Quality Control Tools for Productivity Improvement at an Automobile Company," Engineering, Technology & Applied Science Research, vol. 9, 2019.

[5] Varsha M. Magar and Vilas B. Shinde, "Application of 7 Quality Control (7 QC) Tools for Continuous Improvement of Manufacturing Processes," International Journal of Engineering Research and General Science, vol. 2, no. 4, p. 8, june-july 2014.

[6] DALE H. BESTERFIELD and CAROL BESTERFIELD-MICHNA, Total Quality Management: pearson, 2012.

[7] Gitlow, D. L , and Davis S. B, "Quality Management: Introduction to Total Quality Management for Production, Processes, and Services," Pearson Education, vol. 5, 2006.

[8] Mohamed Abdel-Hamid and Hanaa Mohamed Abdelhaleem, "Improving the Construction Industry Quality Using the Seven Basic Quality Control Tools," Journal of Minerals and Materials Characterization and Engineering, vol. 7, p. 9, June 2019.

[9] Gitlow, H. S , Levine , and D. M. , "Six sigma for green belts and champions," FT Press International Standard, vol. 7, 2009.

[10] Palange A, Dhatrak P. Lean manufacturing a vital tool to enhance productivity in manufacturing. Materials Today: Proceedings. 2021 Jan 1;46:729-36.

[11] Neyestani B. "Seven Basic Tools of Quality Control: Appropriate Tools for Solving Quality Problems in the Organizations.".(2017, March)

[12] R Ginting and M G Fattah, "Production quality control with new seven tools for defect minimization on PT. Dirgantara Indonesia" IOP Conf. Series: Earth and Environmental Science 452 (2020) 012082

[13] Amalia Utami Dewi et al (2021). "Analysis of the Application of Total Quality Management in Lens Products in PT. XYZ". 06 March 2021 Sch Bull, 7(3): 14-20

[14] Jatinder Pal, "Implementation of Quality Control Tools in an Automobile Organization to Reduce the Rejection of Casting Components" S. S. Khangura et al. (eds.), Proceedings of the International Conference on Research and Innovations in Mechanical Engineering, Lecture Notes in Mechanical Engineering, DOI: 10.1007/978-81-322-1859-3_57, Springer India 2014

[15] Nikunjkumar A. Parmar and Shubham Awasthi, "Review on Quality Management using 7 QC Tools ", International Journal of Trend in Research and Development, Volume 5(2)14 November 2018

[16] PAVNA INDUSTRIES LIMITED www.pavnagroup.com