P-D-C-A Cycle As TQM Tool-Continuous Improvement of Warranty

Mr. Madan M. Jagtap[1], Prof. S.N. Teli[2]
[1]Assistant Professor, Department of Mechanical Engineering, SCOE, Kharghar
[2]Associate Professor and Head, Department of Mechanical Engineering, SCOE, Kharghar
[1]*Jagtap.aero@gmail.com*,[2]*shivanandteli@yahoo.com*

Abstract— process that will assure quality to product that you plan, test and get feedback before you commit to materialized production. Plan-Do-Check-Act Cycle is one of fundamental technique that can be processed to achieve quality product. This is also known as Deming Cycle or the Deming Wheel after, W Edwards Deming. It is sometimes called the Shewhart Cycle. Deming is first to propagate PDCA Cycle, and pioneered quality management approach with the introduction of statistical process control techniques for manufacturing to the Japanese, who used them with great success. Source of production quality lay in having clearly defined, repeatable processes. And so the PDCA Cycle as an approach to change and problem solving is basic feature of Deming's quality-driven philosophy. Life of a break plat of an Automobile can be improved using PDCA cycle, In this work effective implementation of PDCA cycle increases duration of life for Breaks.

Keywords—PDCA;Warranty;TQM;

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I. Introduction

The implementation of the PDCA cycle has been found more effective than adopting "the right first time" strategy. Execution of the PDCA cycle means continuously looking for better effects on improvement [9]. The PDCA cycle is observed more effective in both doing a job and managing a programme. The PDCA cycle ensures two types of corrective action – temporary and permanent [1]. The temporary action is aimed at practically tackling and fixing the problem. The permanent corrective action, consists of investigation and eliminating the root causes and thus targets the sustainability of the improved process [4]. PDCA cycle were applied to internal quality-assurance procedures:

What are we trying to do?
How will we know that a change is always improvement?
What changes can we desire to improve?

PDCA approach mentioned in this paper used to remove problem permanently, improve life of brake plate in one of the automobile industry.

II. Stages in PDCA Cycle

A. *Step 1: Plan:*

First, identify exactly what is your problem. You may find it in use tools like Drill Down, Cause and Effect Diagrams, and the Why so help you really get to the root of it. Once you've done this, it may be appropriate for you to measure the process. Next, draw together any other information you need that will help you start sketching out solutions.

B. *Step 2: Do:*

This phase involves several activities [3]:

- Generate possible solutions of process.
- Select the best of these solutions, using techniques like Impact Analysis to scrutinize
- Implement a pilot project on a small scale basis, with a small batch, or in a particular geographical area, or using some other trial design appropriate to your problem, product or initiative.

C. *Step 3: Check:*

In this phase, you observe how effective the pilot solution has been, and gather any learnings from it that could make it even better [13]. Depending on observation of the pilot, the number of areas you have identified, and the scope of the whole initiative, you may take decision whether to repeat the "Do" and "Check" phases, incorporating your additional improvements [3]. Once you are satisfied that the costs would outweigh the benefits of repeating the Do-Check sub-cycle any more, you can implement the final phase.

D. *Step 4: Act:*

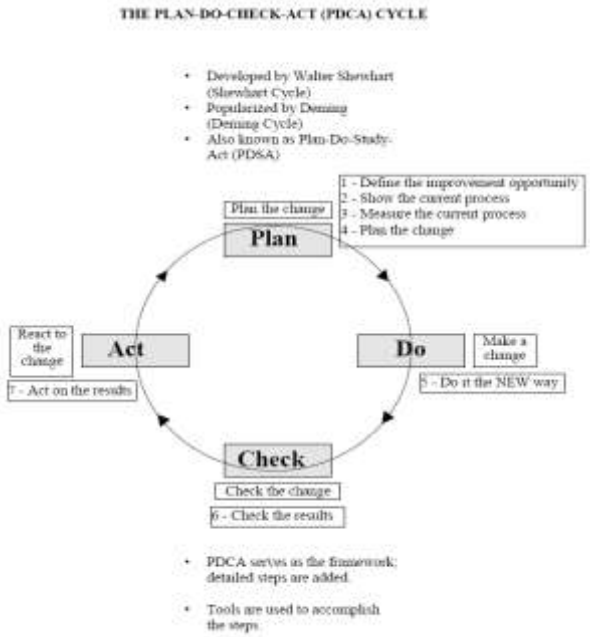
Now you implement your solution. However, your use of the PDCA Cycle doesn't necessarily stop there. You are using the PDCA or Deming Wheel as part of a continuous improvement initiative, you need to loop back to the Plan Phase (Step 1), and find out further areas for improvement [15].

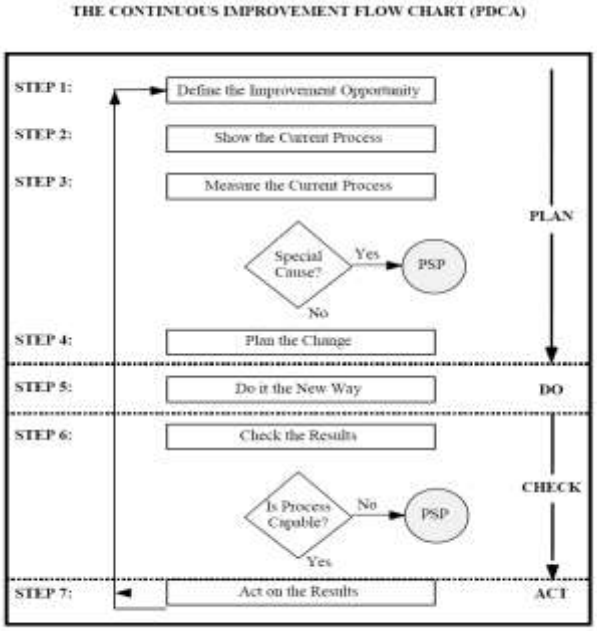
III. Application of PDCA Cycle

The Deming Cycle provides a useful, problem solving process. It is particularly effective for:

- Helping implement Kaizen Continuous Improvement, when the cycle is repeated again as new areas for improvement are sought and solved.
- New solutions and improvement to processes that are repeated frequently. In this situation, you will benefit from extra improvements built in to the process many times over once it is implemented.
- Range of possible new solutions to problems, and trying them out and improving them in a controlled way before selecting one for full implementation.
- Avoiding the large scale wastage of resources that comes with full scale implementation of a mediocre or poor solution.

Clearly, use of a Deming Cycle approach is slower and more measured implementation [6]. In true emergency situations,





this means that it may not be appropriate (however, it's easy for people to think that situations are more of an emergency than, in reality)

PDCA is a never ending cycle in an organization devoted to Quality [10]. Sometimes an investigation cycles between steps several times before implementing a change [8]. At other times, the data collection methods may need several rounds of Trial and error before they are effective [11]. The first application of the seven steps to a process lays the groundwork for future breakthroughs. In subsequent cycles, decisions made in the first round will be reexamined.

IV. Case Study of Automobile Industry

As brakes were the major concern regarding the quality and the warranty analysis of the of the brakes were carried out. A complete study on the brake was carried out .The brakes mainly used in one of the Automobile Industry was of B1 7126 M

1 Identification of Problem (Plan) :

In the early production of the X1 single cut / groove brakes were introduced in the vehicle These brakes were manufactured by B1 and were the suppliers for the Automobile Industry X1 department As a study result and the analytical result we came to know that this brakes weren't satisfactory in terms of long lasting

Figure 1 Single Cut Brake

As these were not up to the mark Automobile Industry took an initiative to upgrade these braking patterns Then they implemented a new braking design in the 2nd production batch of X1 The new version of the brakes were effective but wasn't as effective as they expected The 2nd type of the brakes which they introduced were of angular groove These brakes achieved an impression of reducing the issue's in the customers But even after a certain period of use these brakes were wear in out easily Even these was effected during the warranty period of the vehicle

Figure 2 angular cut brakes

2 Do (Try) :

As per the P-D-C-A cycle, it was time to implement the solution for the problem. Instead of using B1 brake pads we suggested for G1 brakes which where specially designs for suv vehicles in Indian road There was a change in the design parameter in the G1 brakes The G1 brakes were available with no cuts in it. This was not possible to install in an suv vehicle which runs continuously in Indian roads Hence some modifications were required in the G1 brakes The normal schematic image of the G1 brakes is displayed below,

Fig 3 Front view of G1 Brakes

This is the normal G1 brake which has no grooves on the liner Using such type of brakes will lead to heavy wear and tear of the brake liners So to avoid that necessity modifications are carried out in the design parameters,

Design:

Changes were during the design of the G1 brakes Instead of implementing the normal brakes Grooved were generated on the liner pads These grooves were generated by the means of CNC cutters Operated by a cnc specialist After giving the grooves to the brakes, the modified version is displayed in Figure 4,Instead of plain surface it was generated with two different grooves on the surface which will attached to the disk plate directly One groove was vertical where as the other one was bit inclined to the angel of 7 degree

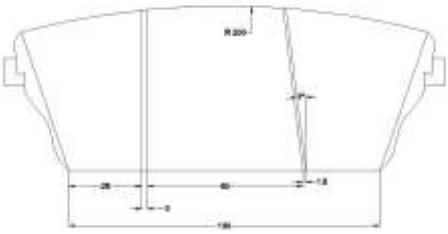


Figure 4 Design Diagram of G1 Brakes

The grooves were created by the means of the cnc operation carried out by an cnc specialist The need of the groove is such that When the liner gets contact with the disk during the braking operation Large amount of heat is realised due to which the some amount of the materials are removed in the form of fine powered particals If these powder are not escaped they will make more wear and tear to the brakes Hence to allow the the powder to escape grooves are created

3 Check :

As the brakes were ready by know it was time to check the brakes Several testing methods were decided to be conducted on the brakes by the help of Automobile Industry team, it was hence possible to test the braking pads the test was completely carried on the test drive vehicle which was allotted by Dealer of Automobile Industry

Fig 5 Brake installed for Testing

The brakes were installed by the expertise The B1 angular brakes were hence replaced by the new G1 dual groove brakes And the G1 brakes were installed know the vehicle and the brakes both were ready for the testing,

Testing Method:

The vehicle was tested for complete one weeks The vehicle was taken for the usual test drive by the expertise On the idle ride the braking was tested by applying approx. to 1000 times The brakes were tested at various speeds at various road conditions There were different brakes at both the front wheels to get an proper comparison between the plain surface brakes and the grooved brakes

4 Act :

The result was satisfactory, The wear and tear of the brakes were less, More braking action was achieved, Less powder deposited to the disk approx. to negligible, The cost of the brake was less as compare to the B1 Was less noisy at the time of wet interference, The G1 dual groove brakes were more efficient as compare to the other two brakes, Liners withstood longer

Fig 6 Implementing Test

V. Results after P-D-C-A Implementation

June-Octomber data for brakes in different Zones

	Issues	Cost	No. of Issuses	Total cost analysis
1	(EZ)Brakes	Rs. 5,800	12	Rs. 69,600
2	(NZ)Brakes	Rs. 5,800	22	Rs. 1,27,600
3	(SZ)Brakes	Rs. 5,800	7	Rs. 40,600
4	(WZ)Brakes	Rs. 5,800	9	Rs. 52,200

November-March data for brakes in different Zones

SR.NO	Issues	Cost	No. of Issuses	Total cost analysis
1	(EZ)Brakes	Rs. 5,800	16	Rs. 92,800
2	(NZ)Brakes	Rs. 5,800	20	Rs. 1,16,000
3	(SZ)Brakes	Rs. 5,800	9	Rs. 52,200
4	(WZ)Brakes	Rs. 5,800	13	Rs. 75,400

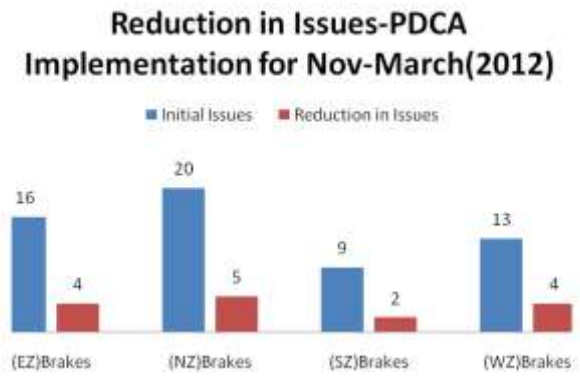


Fig 7 Reduction in Issues Nov-March

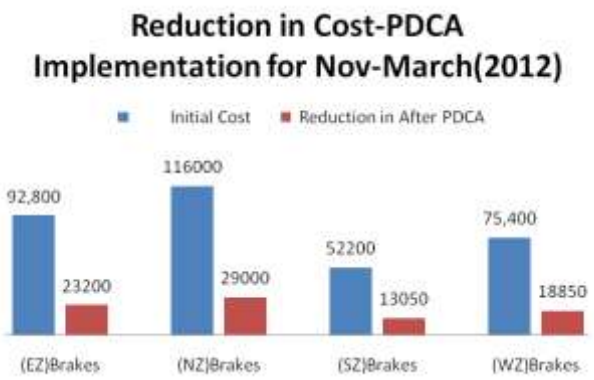


Fig 8 Reduction in Cost Nov-March

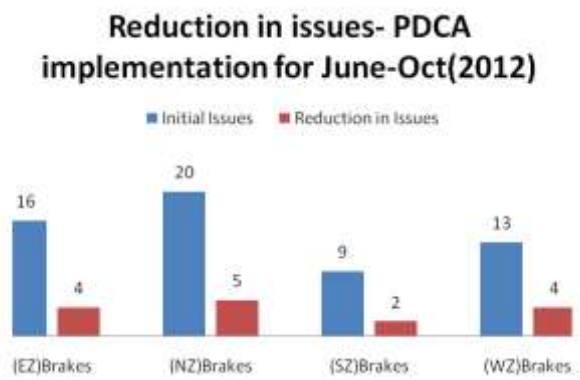


Fig 10 Reduction in Issue June Oct

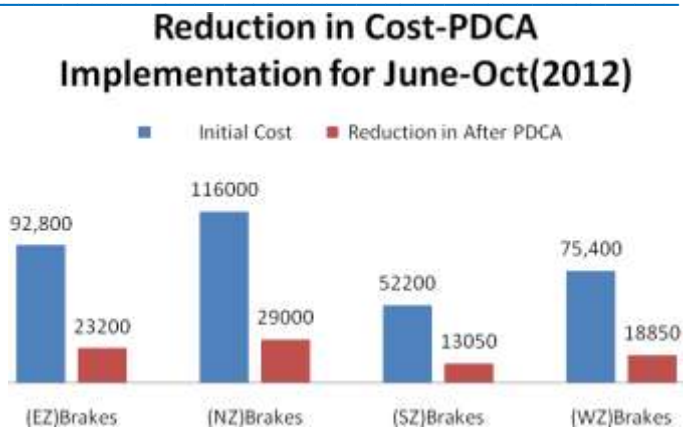


Fig 9 Reduction in Cost June-Oct

VI. Conclusion

- After testing it was seen that the brakes withstood longer
- Reducing 75% of concerns regarding the braking
- reduced the warranty cost for the company
- customers are satisfied
- companies reputation is achieved
- warranty regarding concerns are reduced in brakes
- company is in no more high scale loss regarding the warranty issue in brakes

The study case result were satisfactory, as it was further forwarded to respective Automobile Industry for an R&D process, also were appreciated for the good result achievement from the X1 team.

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