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Application Of Plan-Do-Check-Act Cycle For Quality And Productivity Improvement - A Review

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Abstract: ***The PDCA Cycle is a systematic series of steps for gaining valuable learning and knowledge for the continual improvement of a product or process. PDCA is an iterative four-step quality improvement and productivity improvement process typically used for the better of the business strategy. PDCA is a successive cycle which starts off small to test potential effects on processes, but then gradually leads to larger and more targeted change. Though the method is applicable to process, business and organization as generally utilized by the industry, but this is an attempt to try and adopt the same at an individual level to bring productivity improvement in individuals which will trigger an improvement in process and quality for the organization at a bigger level. How this method would help an individual to become more accountable which will ultimately enable a group, a product line and an organization to be able to make a difference in improving the overall quality. The method tries to bring in changes to the traditional ways how an individual does an activity and with few improvements, the overall productivity can be increased that will ultimately benefit the organization.***

Keywords: PDCA, Quality improvement, productivity improvement

I. INTRODUCTION

The cycle starts with the Plan step. This involves identifying a goal or purpose or a problem, formulating a theory, defining success metrics and putting a plan into action. These activities are included in the Do step, in which the components of the plan are implemented, such as making a product. Second, comes the check (Study) step, where outcome are monitored to check the validity of the plan for progress and success, or problems and areas for improvement. The Act step closes the cycle, integrating the learning generated by the entire process, which can be used to achieve the goal, change methods or even reformulate a theory altogether. These all four steps are repeated over and over as part of a never-ending cycle of continual improvement.



Plan	What is needed
Do	It
Check	That it works
Act	To correct any problems or improve performance

Figure 1[10]

The PDSA cycle (or PDCA) is also known as the Deming Cycle or shewhart cycle, the Deming wheel of continuous improvement spiral. The implementation of the PDCA cycle has been found more effective than others techniques and any small scale industry, school, a hospital can implement PDCA methodology.Execution of the PDCA cycle means continuously looking for better effects on improvement. The PDCA cycle ensures two types of corrective action – temporary and permanent. 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. [1]

II. PROBLEM IDENTIFICATION

Company is manufacturer of different types of products name plates, fascia label, speaker grills, extruded heat sinks, decals, signage, stickers, forged diamond cut logos, etc. They are facing rejection problem at different stages of processes.The reason behind the waste is problems in processes like stamping, brushing, baking, combining screen, offset printing, powder coating, buffing, over printing/painting, scratches, dent marks, in process rejection etc.

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III. LITERATURE REVIEW

Table 1

Sr. No	Title	Author	Journal/conference	My Learning
1	An Examination Of The Application Of Plan-do-Check- Act Cycle In Product Development	Eirin Lodgaard, Knut Einar Aasland	International Conference On Engineering Design, Iced11-15 - 18 August 2011	PDCA will be most suitable when there are no time constraints and enough resources to spend on the problem. Without Systematically integration of the PDCA method improvement is expected to be limited.
2	Productivity Improvement in Milk Industry through PDCA Approach- A Case Study	Mamta Patel, Dr. Raj Kumar	International Journal for Research in Technological Studies| Vol. 2, Issue 6, May 2015	Implementing the TQM with help of PDCA approach. All the causes discussed by the members and categorized those all in three categories and gave the solutions with the help of PDCA.
3	Productivity Upswing Through Two-Phase Continuous Process Improvement Model: The Case Of Apparel Manufacturer	SLOVIĆ, Dragoslav; STOJANOVIĆ2, Dragana; TOMAŠEVIĆ, Ivan	Journal of Textile & Apparel / Tekstil ve Konfeksiyon. Apr-Jun2015, Vol. 25 Issue 2	Processes can be improved with changes in workplace layout, material handling system, workplace arrangement and Standardization of operations.
4	Reducing Rejection Rate in Small Scale Machining Unit Using 7 Quality Control Tools - A Review	Shyam H. Bambharoliya, Hemant R. Thakkar	International Journal Of Engineering Development And Research, Volume 3, Issue 4, December 2015	Reduction in rejection and Rework is indirectly improving productivity and quality with the help of 7QC Tools.
5	Improvement of Productivity by application of Basic seven Quality control Tools in manufacturing industry	Chiragkumar S. Chauhan, Sanjay C. Shah, Shrikant P. Bhatagalikar	International Journal of Advance Research in Engineering, Science & Technology. 2014	7QC used to Improve the production of manufacturing by reducing the percentage of Rejection & Rework.
6	A Review on Practical Application of Quality Tools	Upender, Mr. Lalit Kumar	International Journal of Enhanced Research in Science, Technology & Engineering, Vol. 5 Issue 6, June-2016	Rework can be minimized by the effective implementation of quality tools resulting in less labor cost and more profit.
7	Implementation of Quality Improvement Tools in Brassware Manufacturing Unit to Improve Quality & Enhance Productivity	Kapil Deo Prasad, Dr. Sanjay Kumar Jha, Dr. Ritesh Kumar Singh	International Journal of Applied Engineering Research ISSN 0973-4562 Volume 11, Number 5 (2016)	identify appropriate causes of high rejection & wastage, and to eliminate or minimize these causes to improve quality and hence productivity
8	Application of Quality Control Tools in Taper Shank Drills Manufacturing Industry: A Case Study	Pratik J. Patel, Sanjay C. Shah, Sanjay Makwana	International Journal of Engineering Research and Applications, Vol. 4, Issue 2	7QC tools applied on Company data and analyzed this data and find the Root-causes.

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9	Investigation And Analysis Of Cold Shut Casting Defect And Defect Reduction By Using 7 Quality Control Tools	Prof B.R. Jadhav, Santosh J Jadhav	International Journal of Advanced Engineering Research and Studies, E-ISSN2249–8974	We can Find the root cause of one of the major defect (Cold shut) in an automobile casting produced in a medium scale foundry with the help of 7QC tools.
10	Reduction of rejected components in an automobile assembly line using quality tools	Mayank Jha, R.K Tyagi, Gaurav Gupta	European Journal of Applied Engineering and Scientific Research, 2013	To control the rejection of automotive part assembly in order to increase the productivity with reducing the scrap.

IV. METHODOLOGY

PDCA is a methodology. Rejection and Rework can be reduced with the help of lean tools. Using PDCA methodology because it is a model for continuous improvement process. It consists of a logical sequence of four repetitive steps for continuous improvement and learning: PLAN, DO,STUDY (CHECK) and ACT. so we can use it until we get the best quality of the product. With the help of PDCA methodology reducing rejection problems we will be improve the quality of the product as well as productivity.

V. STAGES IN PDCA CYCLE

A. Plan

This phase incorporates the definition of the problem. A thorough analysis of the current state issues is conducted in order to identify the root causes. Appropriate solutions are then formulated and evaluated to identify the most profitable solutions available.
Identify the problem quality improvement opportunities:

Usually, a team will find that there are several problems, or quality improvement opportunities arise when programs or processes are investigated. A prioritization matrix will help in determining which one to select. Once the quality improvement opportunity has been decided, articulate a problem statement. Revisit and, as appropriate, revise the problem statement as you move through the planning process.
Describe the process Surrounding the problem to understand the process and identify areas for improvements. Flow charts and value stream mapping are two examples of methods to accomplish this. Collect data for the current process
Baseline data that describe the current state are critical to further understanding the process and establishing a foundation for measuring improvements. The data may address, for example, time, people, movements, space, cost, a number of steps, adverse events, and customer satisfaction. Many tools are available to collect and interpret data on the process, such as Pareto charts, histograms, run charts, scatter plots and control charts. The data collected must be aligned with the measures listed in the aim statement. Identify all possible causes

Identify all possible causes of the problem and determine the root cause. While a number of causes will emerge when examining the quality improvement opportunity, it is critical to delve in and carefully identify the underlying, or root, the cause of the problem, in order to ensure that an improvement or intervention with the greatest chance of success is selected. Brainstorming is a useful way to identify possible causes and a cause and effect/fishbone diagram and the 5 Whys are useful for determining the actual root cause.

1) *Identify probable improvements:* To address the root cause, and agree on which one to test. Once the improvement has been determined, carefully consider any unintended outcomes that may emerge as a result of the implementing improvement. This step provides an opportunity to divert the improvement and/or develop countermeasures as needed to address any potential unintended consequences. Revisiting the aim statement and revising the measurable improvement objectives are important steps at this point.

2) *Develop an improvement theory:* An improvement theory is a declaration that articulates the effect that you expect the improvement to have on the problem. Writing an improvement theory crystallizes what you expect to achieve as a result of your intervention, and documents the connection between the improvement you plan to check and the measurable improvement

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objective.

3) Develop an action plan: Indicating what needs to be done, who is responsible, and when it should be completed. The details of this plan should include all aspects of the method to test the improvements – what data will be collected, how frequently data are collected, who collects the data, how they are documented, the timeline, and how results will be analyzed.

B. Do

Once the current situation is fully understood and a plan for improvement has been established, the "Do" phase is where that plan is implemented for the first time. Don't think of this phase as a simply a "test run" or a trial. With the comprehensive learning that has taken place in the "Plan" phase, the "Do" phase can truly be an implementation of what the team believes is a substantial improvement over the current situation; with the opportunity to learn even more, make adjustments, and then implement even greater improvements in the "Check" and "Act" phases. The decided solutions are implemented one by one. At this phase, the people implementing the solutions will have to support the concerned people to make sure that the solutions are fully understood and followed.

Implement the improvement. Collect and document the data..

Document problems, unexpected observations, lessons learned and knowledge gained.

C. Check/Study

Significant learning can take place in this phase by observing the newly implemented processes. By partnering with associates to understand what worked well, what new learning has taken place, and what adjustments need to be made, an improved plan beyond what could have previously been imagined can be developed to include new learning and further elevate the process. This enables the "Check" phase to be an opportunity to develop comprehensive plans to elevate the process to new heights, rather than simply fixing what went wrong in the "Do" phase.

The achieved state after the implementation of the improvements is then analyzed in order to verify the solutions. If the results are negative, the improvement work will have to start over again at the planning phase. If not, the tested solutions will continue to the act phase. Compare the new data to the baseline data to determine whether an improvement was achieved, and whether the measures in the aim statement were met. Pareto charts, histograms, run charts, scatter plots, control charts and radar charts are all tools that can assist with this analysis.

Reflect on the analysis, and consider any additional information that emerged as well. Compare the results of your test against the measurable objective.

Document lessons learned, knowledge gained, and any surprising results that emerged.

D. Act

Once the improvement cycle has reached this step, the solutions are prepared for final implementation by standardization and possibly spread to other parts within the organization. To maintain the continuous improvement work, the key to success is to repeat the cycle in infinity to reach an even higher level.

Options include:

Adopt:Standardize the improvement if the measurable objective in the aim statement has been met. This involves establishing a mechanism for those performing the new process to measure and monitor benchmarks on a regular basis to ensure that improvements are maintained. Run charts or control charts are two examples of tools to monitor performance.

The team may decide to repeat the test, gather different data, revise the intervention, or otherwise adjust the test methodology. This might occur, for example, if sufficient data weren't gathered, circumstances have changed (e.g., staffing, resources, policy, environment, etc.), or if the test results fell somewhat short of the measurable improvement goal. In this case, adapt the action plan as needed and repeat the "Do" phase.

Abandon:If the changes made to the process did not result in an improvement, consider lessons learned from the initial test, and return to the "Plan" phase as shown in figure 6. At this point, the team might revisit potential solutions that were not initially selected, or delve back into a root cause analysis to see if additional underlying causes can be uncovered, or even reconsider the aim statement to see if it's realistic. Whatever the starting point, the team will then need to engage in the Plan cycle to develop a new action plan, and move through the remaining phases.

PDCA offers a data-based framework based on the scientific method. This simple yet powerful format drives continuous and

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ongoing efforts to achieve measurable improvements in the efficiency, effectiveness, performance, accountability, outcomes, and other indicators of quality in services or processes which achieve equity and improve the productivity.[9]

V. KEY POINTS OF PDCA

The Plan-Do-Check-Act (PDCA) Cycle provides a simple but effective approach for problem solving and managing change, ensuring that ideas are appropriately tested before committing to full implementation. It can be used in all sorts of environments from new product development through to marketing, or in any organization. It begins with a Planning phase in which the problem is clearly identified and understood. Potential solutions are then generated and tested on a small scale in the "Do" phase, and the outcome of this testing is evaluated during the Check phase. "Do" and "Check" phases can be iterated as many times as is necessary before the full, polished solution is implemented in the "Act" phase.

VI. CONCLUSIONS

The PDCA cycle (Deming's circle) is more than just a quality tool. The PDCA cycle is a fundamental concept of continuous-improvement processes embedded in the organization's culture. It is simple to understand and should be used by a large number of people in the company. The most important aspect of PDCA lies in the "act" stage after the completion of a project when the cycle starts again for the further improvement. These findings provide useful information for practitioners seeking ways to improve their organizational performance by suggesting a starting point for deploying lean and/or quality improvement methods. Furthermore, the methods identified as not successfully implemented or not perceived as effective suggest areas that employee training and/or academic programs might focus to increase the use of these techniques. In addition, by examining survey results by the type of operation, this work provides others working in similar environments with suggestions about what tools might work well for them; yet, further research is needed to develop a better understanding of how additional techniques can be applied effectively to various types of operations. Finally, the common themes that emerged from the investigation regarding the challenges/reasons for failure associated with continuous improvement techniques provide support

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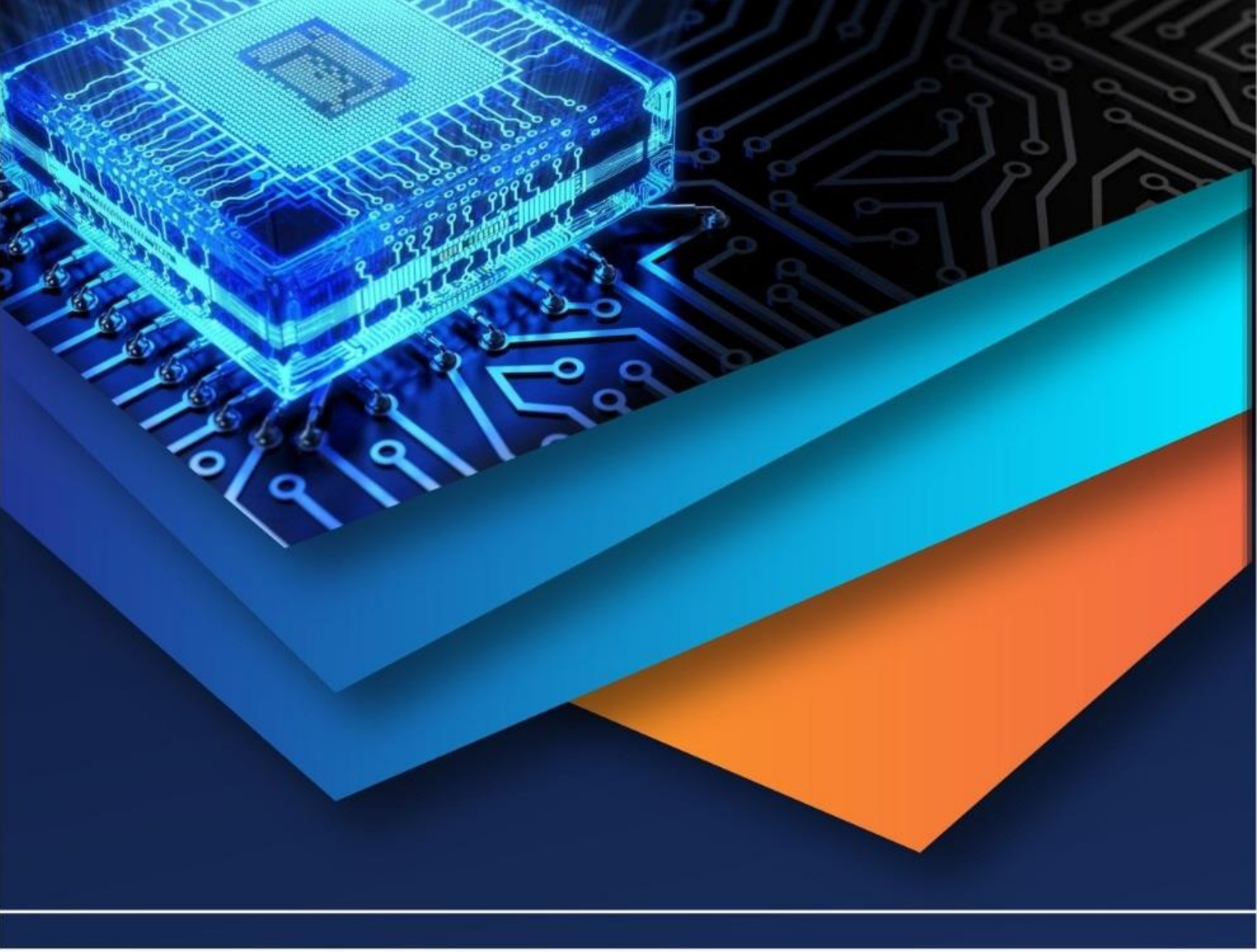

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