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Improvement in the Production of Powder Coating Process of Fan Blades through PDCA Review

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Abstract: Plan-Do-Check-Act (PDCA) cycle is a spiral iterative scientific approach for achieving continuous improvement of quality whether in the process, product or service in any organization. This is paper review on the PDCA approach which throw some light on this topic which help us to understand how PDCA cycle can be implement and what kind of benefits can be achieved by adopting it. PDCA is problem solving technique which helps to improve the reliability and quality of the production. This method is followed by most of the Indian companies in order to maintain and improve their stake in the market and within the company processes for their success.
Keywords: - PDCA cycle, Continuous Quality improvement, lean.

I. INTRODUCTION

In this challenging environment there is a challenge to deliver improved process, product or service in each and every aspects of the quality. Improved process and AQL acceptable quality level is required for maintaining the performance of any organization. This can be achieved through various methods like PDCA, DMAIC, 5S, KAIZEN, JIT, Agile management, TQM etc. for improving the system in the organization. PDCA cycle is also known by two other names, the Shewhart cycle and Deming cycle PDCA is the one of the best practicing and a sure short systematic approach which would help to achieve the goal and target of the organization. It is a four step iterative problem solving approach which improves the reliability and the quality of the production. This makes the organization to grow economically stronger and grew bigger. The PDCA Cycle can be used to affect both major performance breakthroughs as well as small incremental improvements in projects and processes. It is a successive cycle which is initiative with the small test changes with potential effect on the processes, then bit by bit prompts to bigger and more focused on change. This cycle is the effective approach for problem solving and management changing with ensuring that the ideas are appropriately tested before completely implementing. It can be implemented anywhere in any sort of the environment either for the new product development or for the existing process.

The process can be documented and standardize which state the business policy and strategy with its objectives. On application of this PDCA cycle leads to generate the numerous opportunities for the further improvement with in the process. Systematic spiral iterative methodology for investigating how to improve things, that are necessary for the successful application of the production improvement with quality as the working conditions are not appropriate as they might be in any business. So, the strategy is applied for making them more profitable and productive, we should then apply the same to whole process or the product or service, product line and organization to imitate to the example of overcoming adversity for a constructive development and advancement.

II. HISTORY

PGCA means Plan-Do-Chek-Act which is now known as Plan-Do-Study-Act. It is a four step cycle which is used for improving the process, product or service. This cycle is known with other names such as Shewart cycle or Deming's cycle. This is a scientific test fact based process with experiments which initiated with the philosophy of science and work done by the various people in this filed like Galileo Galilei, Francis Bacon and John Dewey from 1610 – 1933. From their appreciated work Shewhart developed a three step hypothesis was developed first line and then later into circle in 1939. Shewhart gave a new version in the form of a cycle known as 'Shewart Cycle' for improving the process. According to him, cycle had three steps-Specification, Production and Inspection which should be repeated again and again for getting the desired result.

In the book "Statistical Method from the Viewpoint of Quality Control" 1939 Walter A. Shewhart explains the PDCA. An organization could be achieved its goals and targets by adopting this PDCA cycle and shows interests in implementing it. Shewhart done a tremendous job in the field of statistics, therefore he also known as father of statistical quality control. Shewhart explains that this cycle configured from the perception that the continual assessment of the management practices and the enthusiasm of the top management hierarchy by implementing and contempt unverified notions will surely help the organization to grow and achieve their

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goals with succession.

Further W. Edward Deming was first who names this cycle as “Shewhart cycle” for PDCA on behalf of its mentor at Bell laboratories in New York. This method is prime process at that time for continual improving process. Later Deming renamed the cycle with PDSA plan-do-study-act was referred PDCA plan-do-check-act. In 1950 Shewart cycle was changed to design-Produce-sell-redesign or plan–make-put it available-test through its statistical modeling. Deming teach this new cycle to Japanese and they termed it as Deming wheel or Deming cycle which plays a crucial role in QC, TQC and QC circle exercises in their in the field of the production as applied on the process for continuous improvement. By adopting and practicing the PDCA approach the Japanese grow significantly in the field of improved quality. So far this technique is used for the system improvement and development which could boost the improvement of the processes.

III. Flow Chart of PDCA Cycle

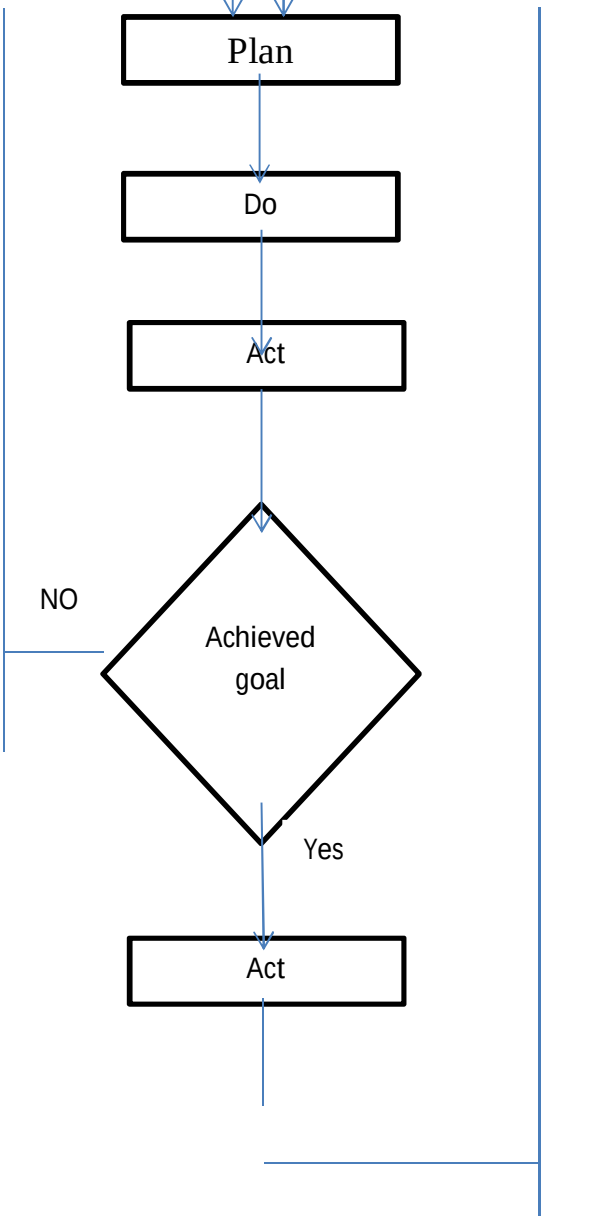

Figure - Flow chart for the PDCA cycle

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A. Plan

This phase is first phase of the PDCA cycle, which consists of Defining, planning, identifying and analyzing of the problem within the process. Under this phase performance and methods should be established, so the goals & targets should be achieved. In this continuous improvement, an inter-disciplinary team is developed by the production and the quality team which is able to solve specific problem. As once the team established responsibilities are assigned to the competent member of the team. Firstly, the process and system must be studied thoroughly in which problem is arising. This would help to know the root cause & clarification of the problem and reason behind that problem. As once the problem is clarified, mapped and analyze then the performance measurement need to be defined to know what are the targets for the improvement of the process. These targets are used in measuring results of the problem-solving effort, to check how much improvement is gain against the performance target. It is quite difficulty find out precise metrics to attain desired improvement.

Root cause analysis can be opted for investigating the true cause for a problem and necessary action should be developed accordingly to eliminate the problem. The challenges is to correctly identify the root causes, as there may be multiple root causes, moreover the identification of one of a root cause is not sufficient to bring about the desired results, action have to be implemented. Hence in order to prevent recurrence of problem, causes have to be eliminated. Otherwise the problem will occur again. For the defined problem, hypothesize possible causes with solution should be developed. Developing and evaluating a number of possible improvement alternatives and creating an effective improvement plan are important in this context. Improvement plan describes who will do what by when. These improvements should be reviewed by the management and implemented with their support.

During this phase following process step has to be taken:

1) Select improvement opportunity
2) Identify the problem to be examined
3) Analyze current situation or process
4) Set measurable and attainable goals
5) Collect and analyze data
6) Verify or revise the original problem statement

B. Do

This “do” phase is the second phase PDCA which involve several activities. As once the improvement plan is prepared, it should be formulated and executed in this phase as per schedule. Trial based implementation of the proposed result is applied to know the behavior of the change in the process. In this phase all the propose solutions are implemented as per improvement plan for all the defined problems. It may be the several potential causes and observed causes, the implemented plan of action against these problems which may results end with not affecting the problem. In this phase we are just trying our proposed solution and measuring their results with the performance target which is set in the initiating or the planning phase. It should be continuously checked for mapping the efficiency of the process. It is important to understand what is working and what not is working. On observed data, the working hypothesize solution would become the best possible result which is scrutinize against testing or analyzing.

For the best solution a pilot batch is produced in order to again check the results against the performance target which set in the plan phase. Once the pilot batch is successful passed, then permanent implementation of the solution and its performance is measured. This is trail phase and it doesn’t mean the proper implementation. It changes the designed to solve the problems on small and experimental scale first. This minimizes to routine activity while testing while testing the changes will work or not.

Do phase develop and implementation of the solution which as follows:

1) Establish experimental success criteria
2) Design experiment to test hypothesis and map the process
3) Generate possible solution
4) Select the best solution after analyzing
5) Gain stakeholder approval and support for the chosen solution
6) Implement the pilot batch on trial basis

C. Check

This is vital step in the PDCA cycle, in which the data gathered in the Do phase is studied and analyzed to measure the result and effect of the implementation. Measurement of the new processes and compared against the target set. Performance targets are

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summarized and evaluated and a review is made of actual and expected results. The difference between the expected and the observed data should be determined, documented and analyzed. Record the data and check the trends of the data. This collected data is become information which is outcome of the experimental results. This phase emphasizes the success of the planned actions in addressing the core problem and whether the root causes have been eliminated.

If the problem is completely solved you can move on to the next phase, if the action items was only partially successful it is necessary to revisit previous phases. After improvement the reports should be submit to the decision makers

Following steps are taken in this check phase:

1) Gather/analyze data on the solution of the trial run
2) Analyze the result of the trial run
3) Draw conclusion
4) Validate hypothesis

D. Act

The efficacy of the improvement of the issues applied is confirmed in the previous phase and further work is to use the valuable work in a proper way both, inside the continuous team, and other relevant persons. On the successful experimental results the proper implementation of the results in the process has to be adopted. Process should be standardize for the improving the process. Learning outcomes from this act phase ensure us to maintain the progress of the process. The performance level is improved and maintained from learning from the each steps of the PDCA cycle

Return to the plan step if the results are unsatisfactory, or standardize the solution if the results are satisfactory. The PDCA cycle doesn't necessarily stop there. If you are using this PDCA or Deming wheel as part of continuous improvement initiative, you need to loop back to the plan phase, and find out the further areas for improvement.

During this final phase of the PDCA cycle following points should be considered:

1) Identify systemic changes and training needs for full implementation
2) Fully adopt the solution for the improvement in the process
3) Standardize the process
4) Monitoring of the solution
5) Continuous improvement
6) Look other improvement opportunities

E. Eight steps in the PDCA Strategy

PDCA cycle is strategy which helps us to address the systematically any quality issues and rectify the problem easily & effectively to prevent them from becoming the recurring problems. These eight steps are the practical problem solving which include the Plan–Do-act-Check (PDCA) cycle. First five are the planning process steps and doing is sixth step. Checking is the seventh one & step eight is involving in the results with the new standard. This is a practical problem solving technique is a vital tool to issues arise in the processes of the organization. Eight step problem solving process are:

1) Clarify the problem: problem can be defined in 3 ways. First is process is deviating from the standard. Second is the difference between the actual and the required conditions. Third is about mismatching the customer needs. For best clarification of the problem, one must look and study the problem thoroughly by itself. This would give a hand-on experience and learning to look forward within the process
2) Break the problem: As on the knowing about the problem properly one should make the work should be breakdown into more detailed and specifics problem. On breaking the problem there is need to check the smaller problems & individual problems under their own supervision. It is easy to study the smaller view rather the whole broader view. This would help to study & analyze the different constraints of the process effectively and priority is given to the problem which is to be tackle immediately. It is easy to manage & solve the micro problem efficiently rather than working on the whole big problem.
3) Set the targets: it is about the focus and the commitment. Consideration is more towards focusing on the need to complete the project and how much effort & time is required to finish it. The targets and the objective are set as per challenge and the problems but according the available resources.
4) Analyze the root cause: While solving the problem this is the major and vital step as it would help to discover the actual causes and the factor that affecting process which create the problem. There are many root causes which have to be analyzed but only

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the potential root causes is to be considered and addressed properly.

5) Develop counter measures: As the root causes discovered, the counter measures are developed for the particular root cause according to the data collected by studying the process and their root causes. Once the counter measure are developed, it should be narrow down the, most practical & effective based off the set target
6) Implement counter measures: As the counter measures are developed and narrow down, it should be implemented and monitor the effectiveness and behavior of the process. Communication is extremely important in this step as to seek the ideas from the team and continue to work back through the PDCA cycle to ensure nothing is missed in the process.
7) Monitor results & process: If the counter measure doesn't work out, a system is required to alter and review in the process to get the desired and planned results. If the intended outcome was result of the action of the counter measure or it is just by chance. After per implementing the counter measures. There is always room for the improvement in the problem solving process, but there is need to be recognizing it when it comes to attention.
8) Standardize & share success: On getting the success on problem solving strategy, it's time to set the new processes as the new standard within the organization and share it throughout the organization. There are lesson learned on successful solving the problem. This working strategy becomes the standard on solving the problem. Now there is time to tackle the new problem and star the problem solving process.

F. Benefits of PDCA cycle

There are numerous benefits could be obtained by using PDCA cycle. This is recognized model for the continual improvement process. This PDCA process is very simple but it is iterative process which is work-out step by step and ensures the improved process. This PDCA cycle helps to make action plan against some kind of problem or change, then see its effect how the process behave on alteration and further make changes as per requirement or according to the action plan if the changes conform according to the target set. This process will ensure the forward improvement by iterative process of the planning, doing, checking and acting against the identified goal and objectives. Constantly, evaluating measuring the performance and re-evaluating growth in the improvements either small incremental or by leap step. Basic benefits of the Deming cycle or PDCA cycle are:

1) To implement standardizes methods in order to achieve continuous improvement that can used to implement in any of the department for resolving the new or present problems in the process.
2) Implementing the solution ineffective or inferior prevents wasted time.
3) Through brain storming and problem solving helps to promote team work.
4) Overcoming the problems internally economically.

IV. CONCLUSION

The PDCA cycle is a continuous improvement through iteration of the process. It is quite valuable and wide applicable process which is used various sectors. This process is often choosing as it for improving the process by the team. Using the PDCA method must lies in the culture and is daily used as a problem solving method used in the company for improving the process. This cycle helps to ensure fact based solution and to avoid solutions which only remove symptoms. Following are the key points of the PDCA Cycle:

A. The PDCA cycle can be an effective and rapid method for implementing continuous improvement.
B. Each step: Plan, Do, Check, and Act are critical for consistent implementation of successful process improvements.
C. Avoid the common disconnects as seen by one professional in industry, such as over/under-planning and not validating the hypothesis, even on successful results.
D. PDCA is used uniquely, electively and effectively by different industries and companies.
E. PDCA adopted under following situation:
1) When there is need for the implementing continuous improvement process.
2) When defining a repetitive work process.
3) Identifying the solution for the improvement in the existing processes.
4) Implementing problem solving methodology.
5) For starting new improvement process.
6) When designing new or improved design of the processes, product or service.

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7) When planning data collection and analysis in order to verify and prioritize problems or root causes.

F. During changed implementation.

This process is agile process typically used for the betterment of the business strategies and by opting this cycle, business process can be examined by the organization. This helps the process to be documented and standardize which state the business policy and strategy with its objectives. On application of this PDCA cycle leads to generate the numerous opportunities for the further improvement with in the process. Managements can never satisfied with the status of the reports or becoming complacent may give a chance to the rivals to move ahead, but by adopting this PDCA principle management can protect their working status against the inappropriate processes and problems arising in the processes.

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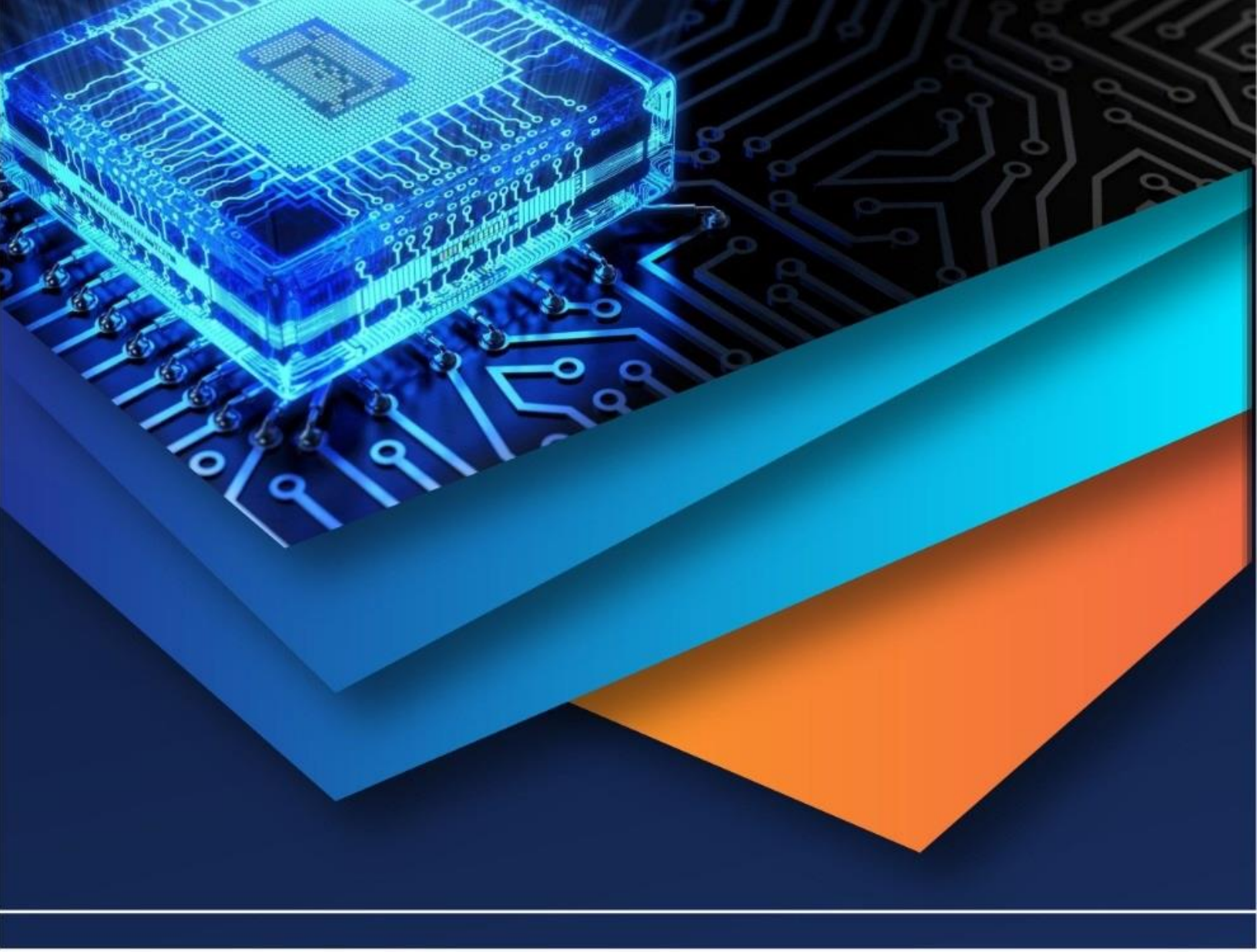

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