PDCA Cycle Application in Management of Industrial Processes in a Manaus Industrial Pole Factory

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Abstract

This study aimed to study and monitor the implementation of the PDCA method. (Plan, Do, Check, Action) Through action research. It was found that achieving the best results required the use of Quality Tools (Ishikawa Diagram, 5W and 2H, Brainstorning, 5S) providing more accurate data for better decision making. The study had bibliographic research and data comparison, providing references to diagnose the root of the problem presented in the production process related to the aesthetic quality of the finished product (Lithium Ion battery for mobile). Using the 5S program to implement and guide employees in new work habits, ensuring product and process quality, avoiding waste and enabling continuous improvement.

Keywords: PDCA; Portable Battery; 5S.

1. Introduction

In today's industrial market competitiveness is increasingly fierce, finding a differential to stand out in the midst of so much technological innovation is to ensure business survival. Seeking strategies for continuous improvement without losing quality is the most appropriate option, however, to ensure better use of quality resources and without raising costs, planning is required, and a simple and easy-to-apply option is the PDCA cycle. Do, Check and Act) which is an effective option, created to ensure that there is organization in the company, applying basic management and administration concepts, with a simple and easily used

structure. The easy applicability of this method is the reason for its great use in companies where it is performing a detailed analysis of the production process to identify and solve problems with low cost with the help of quality tools for generally satisfactory results and may seek continuous improvement.

Second [1] continuous improvement can be defined as a process involving the entire organization around a broad process of incremental innovation. It is a simple concept and low investment, but with great difficulty of implementation and maintenance. It is an essential tool for business survival as it is a vehicle for positive change to be maintained and taken as a reference.

Second [2] process is a combination of the elements, equipment, inputs, methods or procedures, environmental conditions, people, and process information or measures, for the purpose of manufacturing a good or providing a service.

Thus, this article seeks to insert the PDCA method, demonstrating the steps of each activity and the results achieved for problem solving, from its origin to the options and possible outcomes, creating possibilities with emphasis on the low cost of application.

2. Theoretical Foundation

In this article through theoretical framework some concepts will be presented for a better understanding of the project under study, supporting the analysis of the results of this research.

2.1 PDCA Cycle

According to [3] continuous improvement is an endless process, questioning and requesting, and this nature is revealed in the PDCA Cycle, where the method is traversed in a circular manner. A fundamental principle for the PDCA is interaction, once the hypothesis is confirmed (or denied), running the cycle again will imply a greater and more concrete knowledge of nonconformity.

Second [4] The path that leads to success in achieving continuous process improvements is one that combines the two types of management, maintenance and improvements, using the PDCA cycle.

Sengundo [5] The PDCA cycle provides a systematic means to envision continuous improvement and consists of 4 steps, identified as follows: Plan (P), Do (D), Check (C) and Act (A).

According to [6] the PDCA cycle prevails from a sequence of fact-based, data-driven logical procedures that aims to locate the root causes of a problem and then eliminate it. In this cycle, quality tools will act as tools for collecting, processing and disposing of information, enabling reliable decision making.

Second [7] Describes the steps of the PDCA cycle as follows:

PLAN: Identify objectives and actions that are required to deliver expected results as per the customer's wishes and organizational policies;

DO: Make actions that have been planned be implemented;

CHECK: Monitor and measure processes and products with respect to policies, objectives and requirements and report results;

ACT: Implement actions that continually promote process performance improvement.

Figure 1- PDCA cycle.
Source: adapted from [8].

2.2 Ishikawa Cause and Effect Diagram

Second [9] The Ishikawa Diagram is also known as Fishbone Diagram and Cause and Effect Diagram. It is a tool that helps in identifying the causes of a problem and analyzes the factors surrounding the process. For this method every problem has causes that must be analyzed and eliminated in order to remedy the problem. The diagram is made in the form of a graph, which has the purpose of organizing the problems in various processes. It is used for quality control management and its structure considers possible causes of problems.

Method - Identifies all causes involving the method being used at work. It is used to design the product or service;

Material - Identifies the causes involving the material that is used in the work. It is the materials that make up the products;

Labor - Identifies the causes that involve the attitudes of employees. Refers to the people who participate in the process;

Machine - Identifies the causes involving the machine being operated. It is the equipment used in the manufacture of products, especially those that may be causing the problems;

Measurement - Identifies the causes involving the measuring instruments, verifies if the monitoring is being performed. These are the measures taken during the manufacture of the products;

Environment - Identifies the causes that involve the environment and the work environment.

2.3 5W2H (What, When, Why, Where, Who, How, How Much).

According [10] 5W2H is a management tool that we can use in the collection acquisition application, allowing the elaboration of a good action plan and this tool allows the structuring of thought in a well organized and materialized way before we implement any solution in business.

Table 1 - 5W2H Methods Description

	5W2H Method
What	What action will be performed
Who	Who will perform; join the action
Where	Where will the action be performed
When	When will the action be performed
Why	By whom the action will be performed
How	How the action will be performed
How Much	How much does it cost to perform the action

Source: Adapted from: Behr (2008)

2.4 Brainstorming

Second [11] Brainstorming is used to facilitate the generation of ideas. Second [12] Participants are encouraged to express any ideas they can think of during a brainstorming session. Second [13] By giving due attention to group ideation processes, they can provide a basis for organizational innovation. In addition, some of the important factors for creativity such as autonomy at work, a risk tolerant environment and open communication are also important to support innovation.

2.5 Paret Graph

Second [3] Pareto Chart In any breeding process, it is worth distinguishing between what is important and what is least important. Distinguishing the few vital questions from the very trivial ones. Sorting information items into the types or causes of problems in order of importance.

Second [14] says that The Pareto Diagram is conceptually related to the Pareto Law which gave an interpretation for the area of quality, which was also known as the "rule 80-20". According to this rule, 80% of defects are related to 20% of potential causes. This diagram is a representation of the occurrence frequencies in descending order, showing how many results were generated by type of defect. (...) Therefore, the Pareto diagram allows organizing the data, establishing priorities and guiding the corrective actions of the improvement team.

2.6 Check Sheet

[15] Verification sheets can be used for process interpretation as well as control instrument. Data collection plays a major role, as it needs to be performed with extreme rigor, protection and dedication.

2.7 5S Program

According to [16] the program was created by Kaoro Ishikawa in 1950 in Japan, probably inspired by the need to organize the nation's war against the Allied forces. Due to its great efficiency in reorganizing companies and the Japanese economy itself, the 5S is still considered the main tool for quality and productivity management in this country.

Second [17] The 5S denomination is due to five words beginning with the letter "S" in Japanese, which describe the program steps: Seiri (organization and disposal), Seiton (tidiness), Seiso (cleaning) , Seiketsu

(standardization) and Shitsuki (discipline). Adapted to the west the five words were understood as five senses.

2.7.1 Seiri

It is about keeping in place only what is necessary and appropriate for the activities that will be performed. Discarding what doesn't fit and reallocating what can be used in another sector, making it more visible what will be useful in the process [16].

2.7.2 Seiton

Seeks to leave everything in its place to make it easier to find and make it faster and more efficient to use. Facilitating rapid identification and preparation for systemic use of objects [17].

2.7.3 Seiso

Aims to provide an ideal environment for full quality. The work environment and the things in it should be kept clean, and the destination for the trash should be found, each responsible for its space [18].

2.7.4 Seiketsu

Aims to keep the first three steps of the 5S program on a continuous basis. With the principle that a mind free of foreign elements makes work better. [17]

2.7.5 Shitsuki

Represents the need to re-educate and improve our positive attitudes. One must keep the order acquired and always seek to improve the organization, gaining the ability to do things the right way even if not noticed by anyone. [18]

Second [19] At each stage of the 5S one must first act curatively and then preventively, because it is necessary to reverse the status of the organization and prevent it from returning to the previous status.

3. Application of Study

The research was carried out in a factory located in the Manaus-Am Industrial Complex. In which the process of assembling portable batteries and energy storage solutions is performed. The study will look at a portable mobile battery assembly line, where there is excess rework, resulting in higher costs for the company. An internal study was carried out, which proved the seriousness of the problem, thus, defined in a meeting with the management and the team responsible for the line under analysis, the importance of a solution to this problem. The implementation of the PDCA cycle (Plan, Do, Check and Act) was defined.

3.1 The first phase of the PDCA cycle (P) is the problem identification.

To perform this step a detailed analysis of the material taken to be reworked was processed, after the collection of this material was performed a brainstorming. It was found that the critical factor in the rework was the excess of cosmetic defects, where an investigation was made in each step. from the production line,

from various points of view, collecting data for analysis and setting a goal. After collecting data in all sectors and defining the problem to be solved, the Pareto diagram was used to classify the degree of importance of each problem and for an easier visualization of the problems encountered and together with the use of the Ishikawa diagram. potential causes of a particular problem and opportunities for improvement. As the activities progressed, it was defined the use of the 5W2H tool and the 5S implementation to establish a planning, execution and monitoring schedule of the project steps. Thus, defined the action plan with the team.

3.2 Second Phase (DO) Following the preparation of the Weekly Action Plan by the Team.

The first action was initiated, to set the date for the beginning of the training and study of the 5S method to the employees of the sector. At this stage, the importance of the 5S Program, the current situation of the process, was presented, presenting the problem to the employees of the sector. of photos and graphics for easy viewing.

After setting the training method and the dates. Where emphasis was given to each stage and divided the training weekly.

3.3 Third Phase (Check) In order to maintain the 5S Program

Measures were established to maintain and analyze the process continuously, bringing the team closer together and maintaining the means for a cycle of improvements. Defining a person to be responsible for monitoring development and providing technical support when needed. This stage also uses weekly brainstorming to provide data exchange and suggestions with industry employees.

3.4 Fourth Phase (Action) After the implementation of the 5S program

which was defined as the tool to solve the problem encountered in the case analysis, there was a meeting with the 5S Implementation and Training Team, technical responsible for monitoring the analyzed line and the management of the company where the results were discussed and also decided the time that audits would be held, where it was proposed to be performed once a month to improve and monitor the program and to adapt employees to the new reality.

In order to verify the process standardization, the established improvements were applied by the 5W2H method, which classified the verified items and the employees' development in order to check the results and correct any process failures.

4. Analysis of Results

The main difficulties found in the study are related to the services provided by employees without training and process care. The negligence of some of the employees regarding the handling of the product during the assembly process directly interferes with the aesthetic quality presented to the finished product, generating an increase in the rework volume.

To solve the problems found, the PDCA cycle was implemented. Which counted on the aid of quality techniques. That with the action plan established the implementation of the 5S program. And with proper

monitoring and monitoring of each phase in the search for improvements and problem detection, conducting monthly audits focusing on the standardization of the process and the improvements applied.

Table 2 - PDCA cycle

P	**Problem identification: Cosmetic defect.**
	Goal: Eliminate cosmetic rework.
	Process Analysis: Disorganized work environment.
	Method: Brainstorming, Verification Sheet.
D	**Empower:** qualified employees with the 5S methods course. Continuous Updates. Meetings with technical staff and auditors. 5S team training
	Execution: Action plan and presentation of 5S steps to employees Monitoring by the technical team.
	Measure: Through check sheet.
C	**Compare:** Monitor through graphs with the indicators and results obtained.
A	**Act:** Conduct periodic audits and meetings to monitor the process and analyze possible improvements.

Source: Own Author

5. Final Considerations

The need for improvements and quality in finished products led to the search for solutions. And to meet these needs was implemented the PDCA method, identifying and monitoring each step, after the implementation and standardization of the process and its activities was essential to set goals and plan to keep continuous improvement and seek more and more satisfied customers, ensuring a product with customer quality and financial return to the employer.

Through this research, we presented some of the challenges of the industrial sector, detailing existing methods and tools that can help in solving problems in the industrial sector. And especially to guarantee opportunities and means for continuous improvement and maintenance of the results obtained during its implementation.

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