




REDUCING NON-CONFORMITIES WITH THE APPLICATION OF THE PDCA METHODOLOGY IN A PACKAGING INDUSTRY

REDUÇÃO DE INCONFORMIDADES COM A APLICAÇÃO DA METODOLOGIA PDCA EM UMA INDÚSTRIA DE EMBALAGENS

REDUCCIÓN DE NO CONFORMIDADES CON LA APLICACIÓN DE LA METODOLOGÍA PDCA EN UNA INDUSTRIA DE EMBALAJE

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ABSTRACT

The country is undergoing changes due to the speed of information and the dissemination of knowledge, forcing organizations to renew their management to efficiently and effectively meet market demands. This process of meeting these new requirements is linked to the pursuit of quality, which is a priority for every company. The quality management system is no longer a competitive differentiator but a system necessary for the survival of organizations, striving for efficiency and customer satisfaction. This paper addresses the application of the PDCA Cycle continuous improvement method in the quality department of a packaging company, identifying losses due to production defects. This study seeks to analyze the reduction of nonconformities generated by poor production in a container machine. Throughout the study, productivity and quality improvement tools will be discussed according to the analyzed stage used by the case study company. Based on the PDCA roadmap, guidelines for reducing nonconformities will be sought. This paper aims to analyze improvement opportunities to reduce nonconformities identified throughout the process to ensure quality delivery and customer satisfaction.

Keywords: Product Development. Quality Management. Production Improvement. Production Process.

RESUMO

O país passa por mudanças, devido a velocidade da informação e a disseminação de conhecimento, obrigando as organizações a renovarem sua gestão para atender com eficiência e eficácia às exigências do mercado. Este processo de atendimento destas novas exigências está atrelado a busca pela qualidade, sendo prioridade de toda empresa. O sistema de gestão de qualidade deixa de ser um diferencial competitivo e passa a ser um sistema necessário a sobrevivências das organizações, buscando eficiência e satisfação de seus clientes. O trabalho aborda a aplicação do método de melhoria contínua Ciclo PDCA no setor de qualidade de uma indústria de embalagens, verificando as perdas devido a defeitos na produção. Com isso, busca-se analisar a diminuição de não conformidades gerados pela má produção em uma máquina de recipientes. Ao longo do trabalho serão abordadas ferramentas de melhoria da

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produtividade e qualidade de acordo com a etapa analisada utilizada pela empresa do estudo de caso e, baseado no roteiro PDCA, busca-se a diretriz para a redução de inconformidades. Este trabalho tem por objetivo analisar oportunidades de melhoria com a finalidade de reduzir não conformidades identificadas ao longo do processo para garantir a qualidade na entrega e satisfação dos clientes.

Palavras-chave: Desenvolvimento de Produto. Gestão de Qualidade. Melhoria da Produção. Processo de Produção.

RESUMEN

El país está experimentando cambios debido a la velocidad de la información y la difusión del conocimiento, lo que obliga a las organizaciones a renovar su gestión para satisfacer eficiente y eficazmente las demandas del mercado. Este proceso de cumplimiento de estos nuevos requisitos está vinculado a la búsqueda de la calidad, que es una prioridad para toda empresa. El sistema de gestión de calidad ya no es un diferenciador competitivo, sino un sistema necesario para la supervivencia de las organizaciones, buscando la eficiencia y la satisfacción del cliente. Este trabajo aborda la aplicación del método de mejora continua del Ciclo PDCA en el departamento de calidad de una empresa de embalaje, identificando pérdidas debido a defectos de producción. Este estudio busca analizar la reducción de no conformidades generadas por una producción deficiente en una máquina de envases. A lo largo del estudio, se discutirán herramientas de mejora de la productividad y la calidad según la etapa analisada utilizada por la empresa del caso de estudio. Con base en la hoja de ruta PDCA, se buscarán pautas para reducir las no conformidades. Este trabajo tiene como objetivo analizar las oportunidades de mejora para reducir las no conformidades identificadas a lo largo del proceso para garantizar la entrega de calidad y la satisfacción del cliente.

Palabras clave: Desarrollo de Producto. Gestión de Calidad. Mejora de la Producción. Proceso de Producción.



1 INTRODUCTION

Continuous improvement in production processes is essential for companies, so that their product is a differential in the market, given the competitiveness present in the market and the demand of consumers. Product development requires planning in the training of professionals and in the structural organization, in order to seek efficiency in stage, not resulting in errors that cause economic losses to the company. For the development of a product to be efficient, a systemic view of all those involved in the production line and monitoring is necessary (Neves, 2007).

Continuous improvement is a philosophy that is only possible if all areas of the company are analyzed in a structured way in order to increase production performance, integrating employees. In addition, it does not require large investments, as it is characterized by actions, identified through tools such as Ishikawa Diagram, 5W1H, PDCA cycle, among others (Furukita, 2017).

For a product to be launched on the market, a well-designed process is needed so that the idea is realized and generates a result, both economic and social, always seeking customer satisfaction. These steps are controlled by quality management.

Quality management is a process of continuous improvement, in which it analyzes the planning of activities, puts planning into practice, verifies the results generated and adjusts if there are deviations in the production line.

The objective of the research was to demonstrate the production process of plastic packaging and the quality by the PDCA methodology applied within this process, through a case study in the fictitious company EIRT9, in order to present improvements in the quality sector and reduce the number of non-conformities, consequently reducing the probability of customer complaints.

2 GOAL

2.1 GENERAL OBJECTIVE

The main objective of this work is to analyze the reduction of non-conformities in a packaging industry through the PDCA methodology. One of the premises considered was customer satisfaction.

2.2 SPECIFIC OBJECTIVES

The following specific objectives can be mentioned:



- Literature review based on the PDCA methodology;
- Verify the production process and prepare a flowchart;
- Evaluate defects and possible causes;
- Analyze possible problems and opportunities;
- Check the number of non-conformities;
- Present improvements in the production process.

3 JUSTIFICATION OF THE PROBLEM

The PDCA method is composed of four steps Plan, Do, Check and Act (Planning, Execution, Verification and Acting), being a set of tools that involve the study of causes of deviation in production in search of an action plan for the standardization of the process. The PDCA improvement method must be disclosed to all stakeholders in the organization and, therefore, it must be simple, didactic and easy to apply. Finally, the choice of this method is due to the fact that a deep analysis of the process is necessary, especially the flowchart and is low cost, as it has a simple structure, thus bringing great potential for results.

Therefore, the present study proposes to evaluate the potential of applying continuous improvements in a packaging company in order to reduce defects in the production of products, increasing efficiency and customer satisfaction.

4 LITERATURE REVIEW

According to Bessant et al. (1994), in continuous improvement a process involves the entire corporation around a broad innovation process, being a simple concept with low investment, but with great cultural difficulties for implementation and maintenance. It is an essential tool for the longevity of companies, with the character of continuous improvements that, if maintained, will give references to companies. (apud Juran, 1995).

Gonzalez and Martins (2007) say that whether structured or not, any continuous improvement must bring rapid changes to companies, so that they can have reactions to the different scenarios of socio-economic changes (apud Kaplan et al, 1996).

According to Alencar (2008), the PDCA Cycle (Plan, Do, Check, Action), also known as the Shewhart Cycle or Deming Cycle, is a simple technique that aims to control the process (Figure 1).

Figure 1

PDCA Cycle



Source: Bezerra (2014).

According to Neves (2007), the PDCA method is usually used as departmental goals or in individual cells to achieve the company's strategic goals, always bringing cost, quality and productivity advantages to the company. (Figure 2).

Figure 2

PDCA Framework

PDCA	FLUXO	ETAPA	OBJETIVO
P	1	Identificação do problema	Definir claramente o problema e reconhecer sua importância.
	2	Observação	Investigar as características específicas do problema com uma visão ampla e sob vários pontos de vistas.
	3	Análise	Descobrir as causas fundamentais.
	4	Plano de ação	Conceber um plano para bloquear as causas fundamentais.
D	5	Ação	Bloquear as causas fundamentais.
C	6	Verificação	Verificar se o bloqueio foi efetivo.
	?	(Bloqueio foi efetivo?)	
A	7	Padronização	Prevenir contra o reaparecimento do problema.
	8	Conclusão	Recapitular todo o processo de solução do problema para trabalho futuro.

Source: (Campos, 1992).



According to Aguiar (2012), PDCA must be directed to three forms of management in order to achieve the company's survival goals, as follows:

- Maintenance of quality, to be able to provision the company's results;
- Quality improvement, so that with the existing methods you can always have a continuous improvement in the company's results;

The tools that will be covered are: brainstorming, cause and effect diagram, 5W1H and flowchart.

4.1 BRAINSTORMING

According to Santos, Ceccato and Michelon (2011), brainstorming can be defined as a storm or rain of ideas. It is a group technique where people can present ideas freely, it is not advisable for there to be criticism and it needs to occur in a way that does not spend too much time.

4.2 CAUSE AND EFFECT DIAGRAM

According to Costa (2003), this diagram was created in 1943 by Ishikawa, which is why it is known as the Ishikawa Diagram or fishbone because of its shape, it was developed to be used by quality circles to study the problems identified as priorities by the Pareto analysis, which represent the relationship between the "effect" and all the possible "causes" that can contribute to this effect.

4.3 5W1H "ACTION PLAN"

According to Maiczuk and Júnior (2013), 5W1H is used in order to inform and certify a cluster of action plans, diagnose a problem and design actions.

According to Campos (1998), 5W1H comes from English and means: What; Why; How; Who (who will be responsible); When (when, establishes the deadline for execution); Where (where it will be held).

4.4 FLOW CHART

Neves (2007) says that the flowchart graphically demonstrates the steps to be followed in the process, in order to know its sequence. In this way, it becomes essential for the standardization and understanding of it. After its completion, it can be analyzed with what is achieved in practice in order to achieve improvements.



5 METHODOLOGY USED

The scientific research developed is of an applied nature, exploratory objective, combined approach, with bibliographic character and the method through a case study, using various bibliographic sources such as books, academic publications, internet, standards, among others.

The methodology used is divided into three stages: The first stage is related to the Bibliographic Review, in which quality management topics are addressed, such as continuous improvement, PDCA methodology, with a theoretical foundation about the project. Then, a packaging company and its quality management system are studied and analyzed, elaborating a Discussion of Results, displaying the values and benefits of the PDCA methodology in the company. In the last phase, the benefits of using continuous improvement in the product production process are presented. In the end, it is concluded that the search for quality is now a concern of all companies, which has become a priority for every organization

6 QUALITY MANAGEMENT: PDCA METHODOLOGY IN A PACKAGING INDUSTRY

The first contact that the consumer has with the product is through the packaging, and the relationship with the consumer is established.

The company's flowchart is divided into three steps. The first step in the packaging production process is printing, where the virgin transparent BOPP reel is inserted into an 8-color flexographic printer, these printers are high-tech equipment, which result in productivity, agility and excellent print quality ranging from the simplest to the most sophisticated packaging.

The second step is the lamination process, which is the process used for packaging of more than one layer, called laminated packaging. The laminator in its lamination process is able to join two different or equal structures in the same film, without the use of solvent and free of odors, which is an important factor for food packaging. The last step is the trimming and cutting of coils in the sizes and patterns desired by customers, where the operator performs the cutting, eliminating product non-conformities.

And finally, the packaging production process is completed by finishing, where the reels are packaged and palletized to be delivered to the customer.



6.1 STRATEGIC MANAGEMENT OF PRODUCTION AND OPERATIONS

MISSION: To provide high-reliability packaging for the food industry.

VISION: To be a reference as a Brazilian packaging supplier.

VALUES: - Efficiency;
-Technology;
-Reliability;

Table 1

SWOT analysis

FORCES - Strategic vision of the business - Technical qualification of the team	WEAKNESSES - Market entrant - High cost of machinery
OPPORTUNITIES - Low number of competitors - Huge market in the country	THREATS - Unstable economy in the country - Competitors with large structures

Source: The author.

The quality process monitors the entire production, so that the appearance of non-conformities in the product is avoided.

Quality control identified through the SAC (customer service), a problem with one of the batches of packaging that the company produces, where the defect found was printing failures and bubbles in the packaging. Upon learning this, the responsible sector opened an RNC (Non-Conformity Report). In view of this, the possible causes of the problems were raised:

- Printer being shut down when the operator is away
- Unskilled labor
- Wear of rubber rollers in the lamination process
- Factory Layout

These causes will be exposed in more detail in the cause and effect diagram where the objective is to identify in the tool the causes and sub-causes of the problem presented.

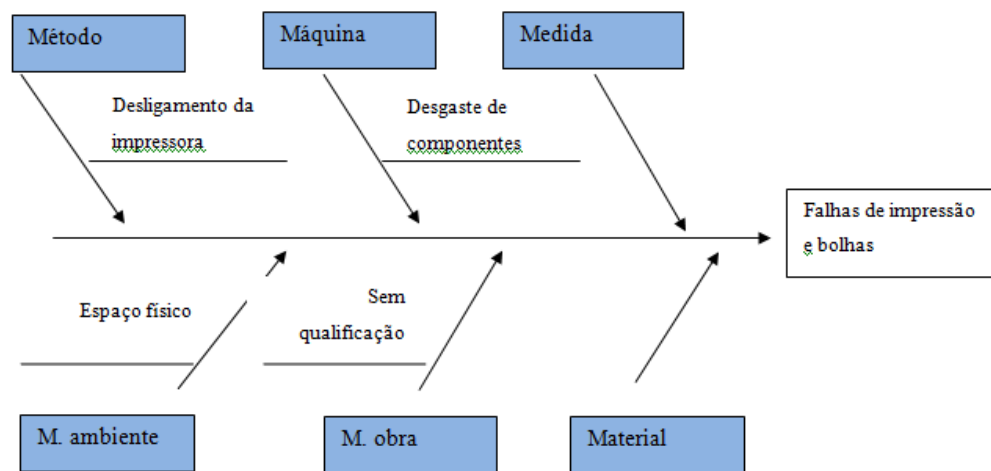
6.2 STUDY AND OPTIMIZATION OF THE PRODUCTION PROCESS

6.2.1 Cause and Effect Diagram

In this tool, the quality sector decided to treat the causes of the problem of printing failures and bubbles in the packages, presenting sub-causes (Figure 4). These suggestions were obtained through a brainstorming session, in which they guided the planning stage.

Figure 4

Cause and Effect Diagram/Print Defect and Bubble Analysis



Source: The author.

The observation carried out by the quality sector identified in the execution method factor a cause related to the central problem, due to the printer operator having to be absent from his workstation during lunch hours and to perform his needs he turns off the printer, thus causing printing failures in the packages.

As far as the machines are concerned, the causes found were the wear and tear of printer components and also the wear of the rubber rollers in the laminator, thus causing printing failures and bubbles in the packaging.

In the environmental factor, a disorganization was noticed in the positioning of equipment and inputs used in the processes, where the inks were far from the printers and the rewinder far from the finishing process, causing unnecessary displacement of operators and loss of time in the production process.

In the labor factor, the lack of training in the operation of printing and laminating equipment and also in the execution of equipment maintenance was noticed.

6.2.2 5W1H Action Plan

After the analysis, the commission concluded that the defects in the product batch occurred due to the lack of corrective and preventive maintenance on the equipment, printing operator having to be absent from the equipment and disorganized layout of the factory.

Therefore, the 5w1h model action plan was created to mitigate the cause of the failures, as shown in the following table (Table 2. Table 5W1H).

Table 2

Table 5W1H

Table 1 - Action plan					
WHAT	WHERE	BECAUSE	HOW	WHO	WHEN
Hire Printing Assistant	Printing industry	Operator support in handling paints	Through resume evaluation	HR Sector	30/05/2020
Perform corrective maintenance	At the factory	Component wear	Replacing Worn Components	Production	15/05/2020
Create preventive maintenance schedule	For all production process equipment	Maintain the smooth operation of the factory	Component Inspection & Replacement	Production	30/05/2020
Schedule training	Training Center	Equipment maintenance	Schedule training	HR	10/06/2020

Source: The author.

6.3 VIABILITY

Cycle analysis for each phase of the process is essential to avoid wasting resources on any project. Basically, this analysis is verified under the strategic aspects of the company and is constantly updated (Araújo et al, 2013).

Because it is carried out at the time of planning, production waste is minimal, since, once the failure is identified, production is immediately improved. The economic viability of this methodology is simple, since there are investments only in the organization of planning and training of employees.



7 RESULTS AND DISCUSSIONS

The results generated for the company were not immediate, as the paradigm shift goes through a period of implementation, so little by little the results came out and knowledge of the learning process of new methodologies was added by the company. Prior to the program, defects that represented an average of 1.6% of production, with the month of December 2019 as a reference and were concentrated in printing failures, representing 31% of discarded products.

After this identification, the printing machines were studied and it was found that of the five printers, only a certain equipment accounted for 55% of the failures.

The quality method implemented for the analysis of batches that presented manufacturing defects made a series of managerial controls that did not exist in the company very simple. These controls are the basis for new continuous improvement efforts.

The fact of adopting a printing assistant, creating a schedule of preventive maintenance of the equipment and training of professionals exceeded the financial return on investment, as the company started to have more reliability of its products before customers. Soon the company started to offer a higher quality product to its customers, with a significant increase in its sales. This difference between the production before the PDCA methodology (December) and after (from January) can be seen in the comparison below, representing a loss decrease of 45%.

8 FINAL CONSIDERATIONS

This work aimed to present possible waste reduction within the packaging production cycle through the PDCA cycle and its tools in search of continuous improvement. Because it is easy to develop and understand, this methodology is widely used by companies in any field.

However, despite being easy to apply, some proposals were not properly executed, since it is difficult to break some of the company's paradigms.

These initial project barriers were overcome throughout the process and after proper training of employees, a significant reduction in packaging waste and, especially, raw material can be perceived.

Non-conforming products were separated for analysis and mapping of defects so that failures could be mitigated, continuously improving the production process.



With this waste reduction, the company can increase its profit margin without having to reduce its quality or increase its sales price, being a great differential in the market.

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