

## **Application of quality tools in the control of non-compliance of a medium-sized furniture industry company.**

**BIANCA AP. M. DE MACEDO**, [biancaammacedo@gmail.com](mailto:biancaammacedo@gmail.com)  
**LUIZ EDUARDO DE SOUZA**, [du-souza1995@hotmail.com](mailto:du-souza1995@hotmail.com)  
**JOÃO PEDRO QUEIROZ JÚLIO**, [joaopedroqj@hotmail.com](mailto:joaopedroqj@hotmail.com)  
**TAINARA FERNANDES PENHA**, [tainarafernandes95@hotmail.com](mailto:tainarafernandes95@hotmail.com)

Unisal, Lorena/SP  
Unisal Lorena/SP  
Unisal, Lorena/SP  
Unisal, Lorena/SP

***Abstract.** The quality is no longer a differentiator and has become a prerequisite for a company to be able to enter the competitive market today. The adoption of methods with a focus on total customer satisfaction is treated as a priority and has been emphasized in ISO 9001: 2015. This paper stresses the importance of quality tools in control and three dealings of internal and external non-conformities of a medium-sized company in the furniture industry. These tools are used to define, measure, analyze and propose solutions for anomalies found in the organizational processes, these solutions help to establish significant improvements in quality control. In this sense, a study of all the available tools was made by analyzing those that best apply to the business' process.*

**Keywords:** Production; ISO: 9001; Tools Quality Control

### **1. INTRODUCTION**

According to WERKEMA 1995, "a quality product or service is one that meets perfectly, reliably, affordably, safely and on time to customer's needs." Thus, quality is not only a product without blemish, but one whose cost is affordable to the consumer. As society gets more demanding by the day, companies seek continuous improvement and invest in quality control programs. This work has as objective the application of quality tools in the control of internal and external non-conformities of a small company in the furniture industry. The six tools that will be used in the process are: Brainstorming, Diagram of Cause and Effect, 5W1H Action Plan, PDCA cycle, Kankan System and Pareto Diagram, aiming to identify the main causes of process inefficiency, actions to be taken and those responsible for compliance of each task. This article has broad relevance because most companies of familiar origin and of medium size do not have a robust system of quality management and also because it is an area directly related to the field of Production Engineering studies.

### **2. LITERATURE REVISION**

#### **2.1. SQC**

The statistical quality control can be defined according to MONTGOMERY and RUNGER (2003) as "statistical methods and engineering" that are used in processes of measurement, monitoring, control and quality improvement.

After TOLEDO, BATTLE and AMARAL (2000), the SQC is related to the development area of statistical control tools, oriented to the control of quality process. Thus, these processes are characterized as preventive approach focused on monitoring and control of variables that can influence the final quality of the product.

#### **2.2. SPC**

The statistical process control enables tools to demonstrate a detailed analysis of the production sector based on statistics. MONTGOMERY cited BERNARDELLI, FERREIRA and GONÇALVES (2009), and aims at <http://www.revista.unisal.br/lo/index.php/reget/>

continuous improvement as quality tools are used (histogram, Pareto chart, cause and effect diagram and check sheet) SPC, which are very efficient to identify causes and prioritize those that have most variation of quality, the goal is to control or eliminate the causes of the defects.

### 2.3. Quality tools

According to JURAN (1992) Quality is the absence of deficiencies", that is, the fewer defects, the better quality of the product or service. After FEIGENBAUM (1994), "Quality is the correction of the problems and their causes throughout the series of factors related to marketing, design, engineering, production and maintenance, that influence user's satisfaction." While CROSBY (1986), says that "Quality is the conformity of the product to its specifications." They should specify the needs, and the quality becomes possible when these specifications are met. DEMING (1993) defines quality as "everything that enhances the product in the customer's point of view," he associates quality to the customer's impression, therefore it is not static. The difficulty of defining quality lies in the renewal of the future user's needs into measurable characteristics, so that the product can be designed and modified to give satisfaction at an affordable price. Another definition is by ISHIKAWA (1993), who says that "Quality is developing, designing, producing and marketing a quality product that is more economical, useful and always satisfying for the consumer."

Regardless of what the definition of quality is, what is expected is that it does not dispute the intuitive notion that is related to it. Note that you cannot define the meaning of quality precisely because it is part of our daily lives.

According to PALADINI (1997), quality tools are intended to organize and structure the production process through data collection and statistical analyzing techniques assisting internal control processes in addressing the quality of the products produced.

As JURAN (1992) states, as simple as they may seem, quality tools, when handled correctly and efficiently, collaborate to the continuous improvement of processes and quality.

#### 2.3.1. Brainstorming

Brainstorming is one of the quality tools and must first be used to make a diagram.

WERKEMA (1995), this tool aims to gather a group of individuals, achieve the largest possible number of ideas on a given subject in a short period, taking into account all the ideas, without ignoring any irrelevant cause. This tool is intended to reveal problems, without omission.

#### 2.3.2. PDCA Cycle

According to CAMPOS (1999), the PDCA cycle consists of the four phases, conforming to Table 1, used to solve problems in the production process: P (plan: Plan), D (from: do), C (check: check) and The (act: act).

**Table 1: Steps and Actions PDCA Cycle**

<b>STAGES</b>	<b>ACTIONS</b>
<b>P (PLAN)</b>	<i>Plan the work to be accomplished through a plan of action, after identification, recognition of characteristics and finding of the main cause (quality assurance of the project).</i>
<b>D (DO)</b>	<i>Carry out the planned work, according to the action plan (implementation of quality assurance, compliance with standards).</i>
<b>C (CHECK)</b>	<i>Measure or evaluate what has been done by identifying the difference between the realized and what was planned in the action plan (verification of compliance with quality standards).</i>
<b>A (ACT)</b>	<i>Act correctively on the identified difference (if any); otherwise there will be standardization and completion of the plan (corrective action on the planning processes, execution and auditioning, definitive elimination of the causes, review of activities and planning).</i>

Source: CAMPOS, Vicente Falconi, 1995.

If the tool was effective and solved the problem it becomes a new standard document within the company. So that everyone starts to follow it as if it were a script of the assignment, seeking operational quality.

After a problem is identified, the PDCA cycle is applied, according to details in the Table 2 below, if the result is positive everyone reaches a new level of quality. If there is no result or the result is not positive, the cycle is done again, but regarding a new method.

**Table 2: Breakdown of the steps of the PDCA**

PDCA	FLOW	STEPS	OBJECTIVES
<b>P</b>	1	Problem identification	Clearly define the problem and recognize its importance.
	2	Observation	Investigate the specific characteristics of the problem with a broad view and from various viewpoints.
	3	Analysis	Discover the root causes.
	4	Action plan	Devise a plan to block the root causes.
<b>D</b>	5	Action	Block the root causes.
<b>C</b>	6	Check	Check that the blockade was effective.
	?	The blockade was effective?	
<b>A</b>	7	Standardization	Prevent against the recurrence of the problem.
	8	Conclusion	Recapitulate the whole solution process of problem for future work.

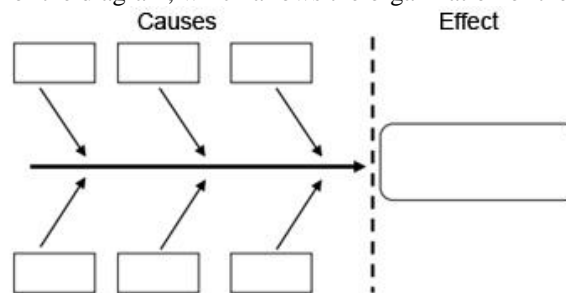
Source: CAMPOS, 1999

### 2.3.3. Cause and Effect Diagram

According to WERKEMA (1995), Cause and effect diagram or Ishikawa diagram is a quality tool which demonstrates the relationship between the result of a process and events that influenced this result

This tool is intended to organize information that enables the identification and visualization of possible causes that may affect a particular problem.

Figure 1 shows the basic model of the diagram, which allows the organization of the possible causes and effects.



**Figure 1 - Diagram of cause and effect.**

Source: WERKEMA (1995)

According to WERKEMA (1995), for the fulfillment of the diagram, the following steps should be followed:

- Define the causes through brainstorming meetings;
- Get the most possible causes for the source of the problem;
- Build the diagram of cause and effect and through the effect, list the causes;
- Record what is necessary and other information such as title, date and responsible.

To solve the problem, it is very important to recognize the flaws so you can find the causes and thus apply corrective action.

### 2.3.4. 5W1H Action Plan

According to PERIARD (2009), 5W1H method is a document that, through questioning, defines how the process will progress and / or the next step of the process. It is used when it is necessary to divide the tasks between those responsible, plan the changes that may occur during the work. It is usually the leader that guides these steps and gives support to those who will do the job.

- **WHAT** - What will be done?
- **WHO** - Who will carry out the tasks?

- **WHEN** – *When should each of the tasks be performed?*
- **WHERE** – *Where will every step be executed?*
- **WHY** - *Why should the task be executed?*
- **How** - *How should each task / stage be performed?*

### 2.3.5. Kanban system

Kanban, according to MARTINS and LAUGENI (2005), is a quality tool designed to indicate, in the form of cards, the progress of the production flow. On the cards is placed information about the task so everyone can easily understand it and continue the process according to the information contained in them. Of Japanese origin, this system was created with the goal of reducing the costs of production processes in series.

### 2.3.6. Pareto Diagram

Pareto Diagram is a quality tool that demonstrates an order of events that must be corrected, and is measured from the highest to the lowest, causing it to prioritize the biggest problems.

According to WERKEMA (2006), the Pareto diagram is made by a vertical bar graph, which is ordered from the highest to the lowest and contains a curve that shows the cumulative percentages of the bars.

## 3. METHODS AND TECHNIQUES

For this article, we used the action-research development method, which according to GIL (2002), consists of the participation of the researcher in the project, to seek practical solutions to problems. After THIOLENT (2008), action research is research designed and carried out in close association with an action or the solving of a collective problem. The representative researchers and participants of the situation or problem are involved in a cooperative and participatory manner.

From what is presented, this method was chosen because the researcher not only observes the situation, but also participates and interferes with the solutions of the raised proposals. With this, the required data were collected and the remaining steps were developed so they are able to identify improvements.

## 4. RESULTS AND DISCUSSIONS

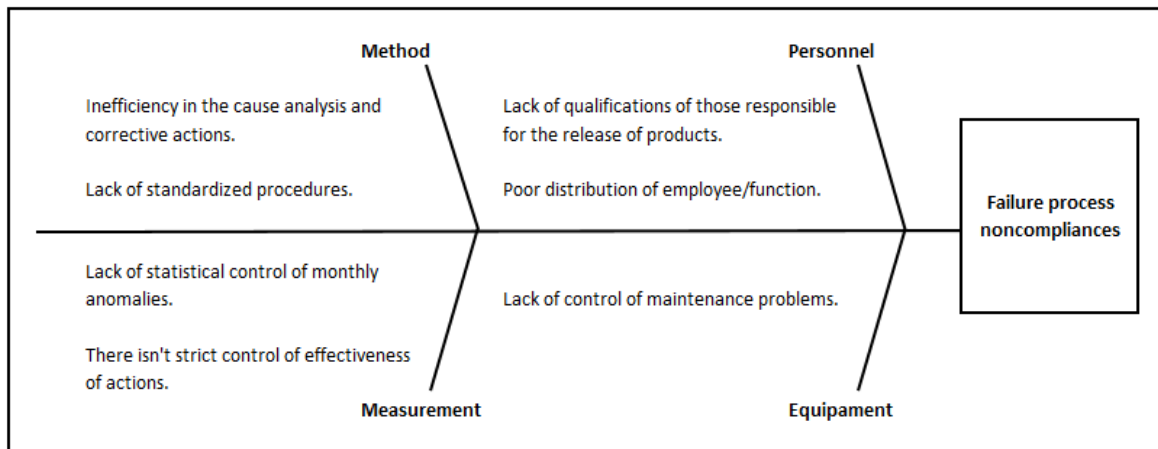
### 4.1. Characterizations Company

This work was carried out with the scenario of a medium-sized company in mind. Located in the state of São Paulo, the company operates in the furniture industry, manufacturing edge tapes and coating papers. Of familiar origin and a pioneer in this industry for over 35 years in the market, the organization is characterized by the high quality of its products, always giving priority to customer satisfaction.

### 4.2. Application Tools

While writing this article, the primary action was to define the problem and the cause of the research. It was determined that the work would be done in the quality sector, because it is an area of contact with all other sectors of the company, and of great importance for the proper functioning of the processes. The company has a quality department, where the control of non-compliance, the implementation of improvements and the research and development laboratory are held.

After defining the problem, a brainstorming section was held with the participation of the company managers and the senior management. With this, we tried to get the largest possible number of the flaws' causes in the process. Then the most relevant points and the improvement ideas were analyzed and then applied using the Cause and Effect Diagram, which can be seen in Figure 2 below.



**Figure 2 - Diagram cause and effect**

Source: Prepared by the authors

Some of the causes observed that impacted directly on the effectiveness of the process are the inefficiency of the cause analysis and the very superficial corrective actions, which lead to the recurrence of the problem. One problem related to the procedure happens due to the lack of standardization of the processes. Another problem related to labor shows lack of qualification of those responsible for the release of goods and poor distribution of employees conforming to the best fulfillment of the function. Another question related to the measurement, demonstrated the lack of statistical control of the effectiveness of corrective actions and the monthly amount of internal and external non-compliances. Finally, another possible cause, related to machinery, shows the non-existence of anomaly control, resulting from the lack of preventive maintenance.

In order to solve this problem and tackle the root cause of process inefficiency, a restructuring was carried out, making it more robust, more critical and thorough, covering the anomalies of all areas of the company, from a technical problem, to process or commercial problem. We defined some actions to be taken to implement the new process. These actions were structured in a 5W1H action plan, as seen in Figure 3.

WHAT?	WHY?	HOW?	WHO?	WHEN?	WHERE?
Procedure update of nonconformities and corrective action.	For all sectors to follow the new process	Update document through the system and distribute to all sectors	Quality Area	Within 6 months	In all departments
Training of all managers and leaders.	For everyone to have understanding of the functioning of the processes	Through of presentation a new process	Quality Area	Within 6 months	In all departments
Implementation of the Kanban system.	Get better view of the anomalies	Purchase of a management framework	Quality Area	Within 6 months	Meeting room
Implementation of the method of analysis and corrective actions.	Ensure greater effectiveness of actions	Through the cause and effect diagram	Manager of each area	Within 6 months	In all departments
Division supervision per turn.	To reduce failures in the productive sector	Distribute the existing supervisors appropriately	Production manager	Within 6 months	Productive sector
Sending monthly report of noncompliances internal and external	So that managers can check the progress of the process and inform their respective teams	By email, with the compiled data and analysis through the Pareto Chart	Quality Area	Within 6 months	Quality Sector

**Figure 3 - 5W1H Action Plan**

Source: Prepared by the authors

### 4.3. Implemented actions

After performing the planning as stipulated by 5W1H tool, the necessary modifications to the old process were made and the new method was implemented using the following actions:

- Review of non-conformities procedure.
- Training of everyone involved in the control of non-conformities.
- Construction and control of the management framework in view.
- Implementation of the Kankan sheet model.
- Validation of the analysis and corrective actions through the Cause and Effect Diagram.
- Application of PDCA cycle for chronic abnormalities.
- Monthly critical analysis of the main problems through Pareto diagram.
- Daily meetings with the top management for the follow up of anomalies.

### 4.4. Results

To measure the benefits of the implementation of new control method, some data of internal and external non-conformities were compiled, by performing a comparison between 2014 and 2015, the year in which the shares were held. Chart 1 below shows the increase of records of internal non-conformities, showing that in 2014 many problems were missed, which, using the new process started to be analyzed.

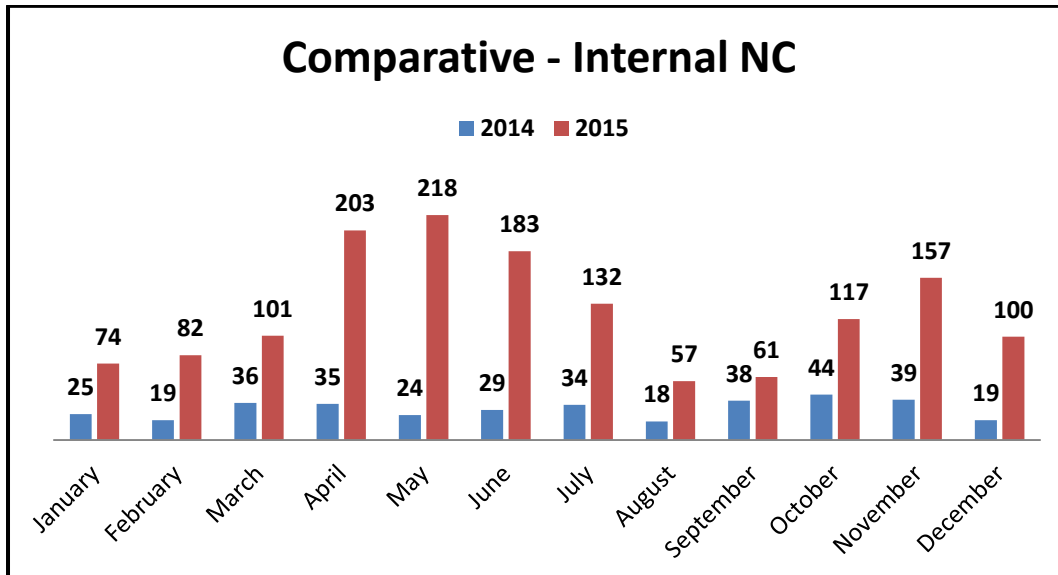
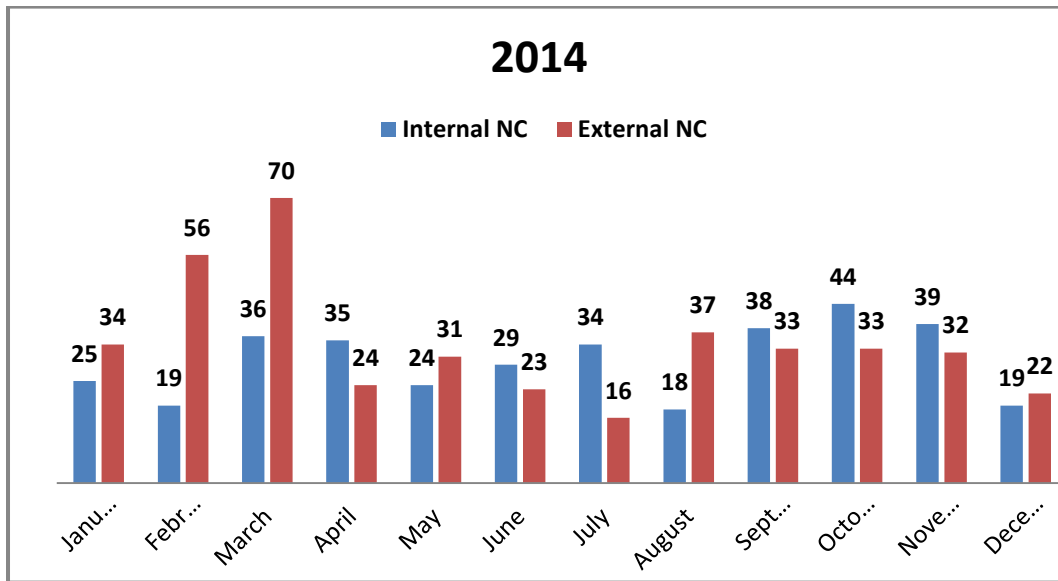


Chart 1 - Comparison of non-conformities between 2014 and 2015

Source: Prepared by the authors

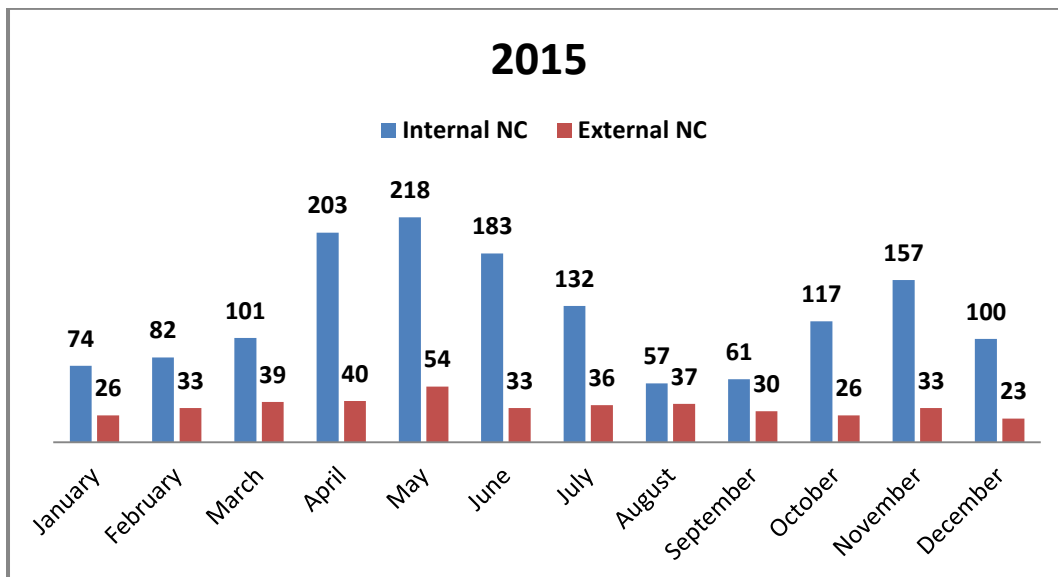
But Chart 2 shows a very serious problem encountered in the process, in most months of the year the number of external non-conformities was higher than the number of internal non-conformities, demonstrating difficulty to solve the problems internally before reaching the client.



**Chart 2 - Non-compliance in 2014**

Source: Prepared by the authors

Finally, Chart 3 represents a significant increase of internal non-conformities in relation to external, a very positive result towards the ISO, which considers this to be one of the characteristics of a balanced management. Almost every month of the year with the new method already implemented had at least twice as much internal non-conformities, demonstrating the ability to contain anomalies internally and take appropriate actions so those do not reoccur.



**Chart 3 - Non-compliance in 2015**

Source: Prepared by the authors

## 5. CONCLUSION

After the application of quality tools in this company was completed, the relevance of the survey and analysis of data was concluded, which resulted in the opportunity to improve the control process of non-conformities. Through brainstorming, different points were raised, looking for ideas that would solve the problem. Application of Cause and Effect Diagram identified the main reasons that resulted in the process inefficiency. After the possible causes of the problems were defined, a 5W1H action plan was prepared with the function of structuring the actions to be taken, showing what should be done, those responsible for the tasks and the deadline for completion. Thus, according to the purpose of this article, the successful accomplishment of the proposed improvement can be highlighted. The application of quality tools enabled the



identification of the causes of the studied problem and the actions to be taken, which resulted in a low rate of recurrence of anomalies and external complaints. The next step to be taken towards excellence in management, would be a plan of action with attack methods for chronic abnormalities that result in large number of internal non-conformities.

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