

## **5S Program: Definition of a methodology and implementation in laboratories at the Federal Institute of Ceará – Campus Sobral**

**Programa 5S: Definição de uma metodologia e implantação em laboratórios do Instituto Federal do Ceará – Campus Sobral**

**Programa 5S: Definición de metodología e implementación en laboratorios del Instituto Federal de Ceará – Campus Sobral**

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### **Abstract**

The 5S Program is a Quality Management program created in Japan and today known and used worldwide, including in Brazil, in order to generate improvements in the work environment. This work had as main objective to evaluate the efficiency of the implementation of the 5S Program in the Laboratory of Sensory Analysis and in the Pilot Plants of Meat and Fish, Bakery and of Dairy of the Federal Institute of Ceará – Campus Sobral. The implantation took place at the same time in the four laboratories and was divided into three phases: Pre – implantation or initial phase, the bases for the implantation were defined; Implementation of the “5S”, the five senses of quality were applied; E Post – implementation or final phase, actions were taken to promote continuous improvement. In the initial diagnosis, pre – implantation phase, using a *checklist*, the laboratories presented the following compliance results: Sensory Analysis 46% (Regular), Meat and Fish 50% (Regular), Bakery 40% (Regular) and Dairy 38% (Insufficient). In the implementation phase of the “5S”, the results obtained were qualitative with regard to the environmental transformation generated. In the Final Evaluation, post – implantation phase, through the application of the same *checklist*, the laboratories presented the following compliance results: Sensory Analysis 90% (Good), Meat and Fish 86% (Good), Bakery 78% (Good) and Dairy 90% (Good). Through the evolution shown in the images and graphics, it is concluded that the 5S is an efficient program capable of generating significant improvements in the work environment.

**Keywords:** Five senses; Quality management; Continuous improvement.

### **Resumo**

O Programa 5S é um programa da Gestão da Qualidade criado no Japão e hoje mundialmente conhecido e utilizado, inclusive no Brasil, com o intuito de gerar melhorias no ambiente de trabalho. Este trabalho teve como principal objetivo avaliar a eficiência da implantação do Programa 5S no Laboratório de Análise Sensorial e nas Plantas Pilotos de Carnes e Pescados, Panificação e de Laticínios do Instituto Federal do Ceará – Campus Sobral. A implantação aconteceu ao mesmo tempo nos quatro laboratórios e foi dividida em três fases: Pré – implantação ou fase inicial,

foram definidas as bases para a implantação; Implantação dos “5S”, foram aplicados os cinco sentidos da qualidade; E Pós – implantação ou fase final, foram realizadas ações para a promoção da melhoria contínua. No diagnóstico inicial, fase de pré - implantação, mediante a aplicação de *checklist*, os laboratórios apresentaram os seguintes resultados de conformidades: Análise Sensorial 46% (Regular), Carnes e Pescados 50% (Regular), Panificação 40% (Regular) e Laticínios 38% (Insuficiente). Na fase de implantação dos “5S”, os resultados obtidos foram qualitativos no que concerne à transformação ambiental gerada. Já na Avaliação Final, fase de pós - implantação, através da aplicação do mesmo *checklist*, os laboratórios apresentaram os seguintes resultados de conformidades: Análise Sensorial 90% (Bom), Carnes e Pescados 86% (Bom), Panificação 78% (Bom) e Laticínios 90% (Bom). Através da evolução demonstrada nas imagens e nos gráficos, conclui-se que o 5S é um programa eficiente capaz de gerar significativas melhorias no ambiente de trabalho.

**Palavras-chave:** Cinco sentidos; Gestão da qualidade; Melhoria contínua.

### Resumen

El Programa 5S es un programa de Gestión de la Calidad creado en Japón y hoy conocido y utilizado en todo el mundo, incluido Brasil, con el objetivo de generar mejoras en el entorno laboral. Este trabajo tuvo como principal objetivo evaluar la eficiencia de la implantación del Programa 5S en el Laboratorio de Análisis Sensorial y en las Plantas Piloto de Carne y Pescado, Panadería y de Lácteos del Instituto Federal de Ceará – Campus Sobral. La implantación se realizó al mismo tiempo en los cuatro laboratorios y se dividió en tres fases: Pre - implantación o fase inicial, se definieron las bases para la implantación; Implementación de las “5S”, se aplicaron los cinco sentidos de la calidad; E Post - implantación o fase final, se realizaron acciones para promover la mejora continua. En el diagnóstico inicial, fase de preimplantación, mediante checklist, los laboratorios presentaron los siguientes resultados de cumplimiento: Análisis Sensorial 46% (Regular), Carne y Pescado 50% (Regular), Panadería 40% (Regular) y Productos Lácteos 38% (Insuficiente). En la fase de implementación de las “5S”, los resultados obtenidos fueron cualitativos en cuanto a la transformación ambiental generada. En la Evaluación Final, fase posimplantación, mediante la aplicación del mismo checklist, los laboratorios presentaron los siguientes resultados de cumplimiento: Análisis Sensorial 90% (Bueno), Carne y Pescado 86% (Bueno), Panadería 78% (Bueno) y Productos Lácteos 90% (Bueno). A través de la evolución mostrada en las imágenes y gráficos, se concluye que El 5S es un programa eficiente capaz de generar mejoras significativas en el ambiente de trabajo.

**Palabras clave:** Cinco sentidos; Gestión de la calidad; Mejora continua.

## 1. Introduction

The Just-in-time (at the right time), *kaizen* (continuous improvement), total quality control, *jidoka* (self-detection), total productive maintenance, and 5S philosophies are used to improve the overall performance of organizations (Rosa, 2007).

The “5S Program” is a work philosophy that seeks to provide discipline in organizations through the awareness and responsibility of everyone in the environment, in order to make it organized for greater safety, productivity, and efficiency (Silva, 2011).

The 5S represents a set of Japanese activities beginning with the letter “S”, which are: *Seiri*, *Seiton*, *Seiso*, *Seiketsu*, and *Shitsuke*. With the intention of maintaining the same denomination “5S”, but without referring to Japanese words, some organizations use the term “Step” for each activity, they are: Sort, Set in order, Shine, Standardize, and Sustain (Silva, 2011). Santos (2019) advises to implement one sense at a time, following the order, to achieve success. That for Reder, Longhini and Brito (2020) will also depend on the collaboration of those involved, who have a fundamental role in this regard.

When we think of the “5S Program”, the word organization comes to mind, it is precisely at its basis. The Program was created so that each organization can create its own model, that is, it has the freedom to adapt it according to its need (Silva, 2011).

A practical example of the application of the 5S can be seen in the Toyota Production System (Monden, 2012 *apud* Jiménez *et al.*, 2015). However, its application is not limited and much less specific. 5S can be applied in food services, food and nutrition units, libraries, offices, companies, city halls, hospitals, industries, laboratories, and even, in home environments.

In Brazil, the five senses were initially adopted in the 90s, by the Cristiano Ottoni Foundation, an institution linked to the Federal University of Minas Gerais, since then they have been disseminated and practiced nationally (Silva, 1996 *apud* Vieira, 2017). Unfortunately, however, the importance is given only to the first three senses. As a consequence, the

demotivation of people is observed, who shortly after implantation return to their previous habits (Abrantes, 1998 *apud* Almeida and Barbosa, 2017).

In food research or analysis laboratories, the absence of management generates uncertainties regarding the performance of activities and results, making it important to implement a quality assurance system (Leite, 2009 *apud* Lazzarotto *et al.*, 2011).

At the Federal Institute of Ceará Sensory Analysis Laboratory, practical classes are carried out, analysis of the attributes or characteristics of food through the senses of sight, smell, taste, hearing, and touch, in addition to research and extensions activities, and internships. In the Pilot Plants of Meat and Fish, Bakery, and Dairy, practical classes, research and extension activities, and internship activities are also held.

The implementation of the 5S Program in these laboratories is justified by the visible deficiency in its organizational management. Therefore, there is a need to make them more organized, aiming to improve the quality of the work environment, the occupational health of outsourced employees, students, and teachers who daily deal with industrial level equipment and end up being exposed to the possible risks offered by them in a disorganized environment, as well as promoting the improvement of the procedures performed in them.

For Oliveira and Moraes (2015), the implementation of 5S is also necessary within a laboratory, considering that the environment will provide students and teachers with a presentation of the tool, thus allowing their preparation for the job market, since it is considered the basis for a quality management system.

The 5S Program brings short- and long-term benefits anywhere, be it public or private, promoting improvements in the: work environment, working conditions, and quality of life for all who submit to this choice (Silva, 2011).

In addition to the countless benefits that 5S can provide to the work environment, there are also implementation difficulties, because when it comes to changes involving people, the appearance of conflicts is natural. Since changes are not always welcome, resistance to new habits is common (Misquiatti, Costa and Polioni, 2013). Even after consolidating the philosophy proposed by 5S, Moura and Lichtenberg (2021) remember that there will always be an opportunity to evaluate and propose changes, for which periodic monitoring is required.

Therefore, this work had as its objective the establishment of a methodology and implementation of the 5S Program in the laboratories of Federal Institute of Ceará –Sobral Campus and evaluation of its efficiency as a form of continuous improvement of the Quality System.

## 2. Methodology

This work characterizes research of an applied nature, that is, it is motivated for practical reasons. According to Gil (2019), applied research encompasses studies designed to solve problems identified in the environment where the researcher is located. Data collection was carried out through the application of questionnaires, *checklist*, through observation, bibliographic and documentary research.

For the development of the proposed project, the following materials were used: **Phase 1** – the “A Bíblia do 5S” book (“The 5S Bible”, if translated to English), evaluation test, notebook, data projector, clipboard, pencil, eraser, A4 white sheet, checklist, disclosure signage, information pamphlet, certificate of participation; **Phase 2** – indicative signages, explanatory text, cardboard boxes, scissors, labels, paper arrows, adhesive tape (colored, transparent, and double-sided), cleaning material, colored clamp; **Phase 3** – checklist, disclosure signage, notebook, data projector, and folder.

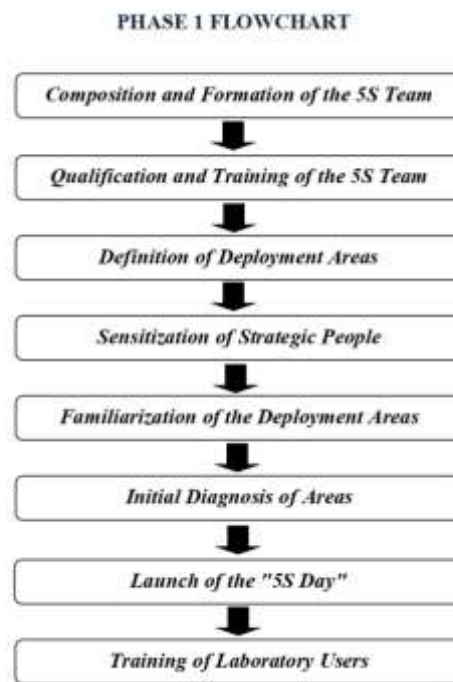
The 5S Program was implemented between May 2018 and May 2019 at the Sensory Analysis Laboratory, Meat and Fish Pilot Plant, Bakery Pilot Plant, and Dairy Pilot Plant of the Technological Axis of Food Production of the Federal Institute

of Education, Science and Technology of Ceará (IFCE) – Sobral Campus. The proposed methodology was inspired by Moura (2014) being divided in three phases:

### Phase 1: Pre – Implementation

In the initial phase, the bases for implementation were defined, which are described in the flowchart shown in Figure 1.

Figure 1 - Phase 1 Flowchart.



Source: Authors.

The team was composed of three students whose selection took place through interviews with students from the Food Technology undergraduate course; The training was given by reading the book indicated “A Bíblia do 5S”, by the author Ribeiro (2006). Subsequently, the knowledge acquired from reading the topic was assessed through the application of a test that ranged from 0 to 10. The introductory training given to the team was based on the implementation methodology created, in order to prepare the team for the implementation, being carried out through slides, lasting 2 hours. The laboratories that had not implemented 5S and the person responsible for each implementation were defined, whose choice was consensual among the team members; The awareness of the coordinators of the laboratories was carried out through an informal conversation, in which the importance and benefits of the implementation were addressed, as well as their support and commitment; Each team member visited their respective area and prepared the layout, in order to explore it and get to know it better. With the same objective, a data survey questionnaire was prepared and applied to each coordinator, which also served as a basis for the elaboration of checklists; A checklist was elaborated and applied by the team in each laboratory, to classify them as to the initial conformity presented in relation to the 5S Program, adapted to that proposed by Moura (2014). The checklist was divided by step and five specific questions were prepared for each one. Each question was assessed through scores from 0 to 2 (0 – did not answer, 1 – partially answered, and 2 – answered). The weight of 20% was established for each step. A score (%) was obtained for each step according to the formula:  $TPO = POS \times WEIGHT / PMS$  (TPO– Total Points Obtained, POS –

Points Obtained in Step, PMS – Maximum Points of Step). The final score (%) was the sum of the total points obtained in each step:  $FS = TPO_{sor} + TPO_{set} + TPO_{shi} + TPO_{sta} + TPO_{sus}$ . The classification of each laboratory was given as follows: **EXCELLENT**– if a final score was obtained between 91% and 100%, **GOOD**– 70% and 90.9%, **REGULAR**– 40% and 69.9%, **INSUFFICIENT**– 0 and 39.9%. At the end, a disclosure signage was attached to the entrance door of each laboratory with the results of the initial classification. Then, an IDR– Initial Diagnostic Report was prepared and sent to each coordinator showing the situation that laboratory was found; During the IX Food Week, the so-called “5S Day” was launched – an event created to publicize the implementation project, which included the following schedule: round table with exchanges of experiences and distribution of information pamphlets about 5S; The monthly training sessions were given to 30 people, with a workload of 2 hours and through slides, for scholarship students, monitors, interns, and other students in the Food Technology undergraduate course and other courses of the Technological Axis, in order to instruct the students to make conscious use of laboratories. Each participant received a Certificate of Participation.

### Phase 2: Implementation of 5 “S”

For the implementation of each step, indicative signs were created to show the user the progress and respective explanatory texts entitled “Did you know?”. The indicative signages were fixed on the entrance door of each laboratory next to the dissemination signages with the results of the initial classification and the explanatory texts fixed on the Technological Axis flannelgraph. The implementation of 5 “S” occurred at the same time in the four laboratories, through the system shown in the flowchart below shown in Figure 2:

Figure 2 - Phase 2 Flowchart.



Source: Authors.

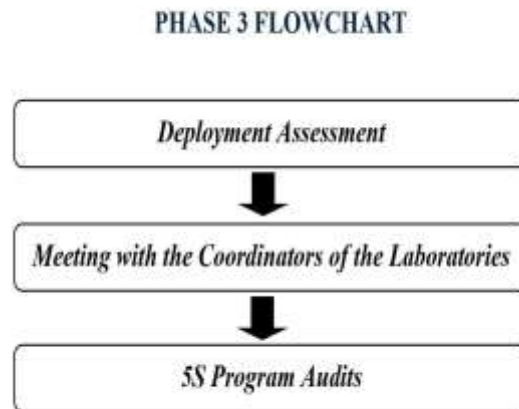
The necessary and unnecessary material for each laboratory was defined. The unnecessary were inspected by each coordinator and taken to a provisional disposal area, from where they were sent to their final destination; The necessary materials were organized through an efficient system that facilitated their access and replacement, described below: initially, 'Identification Labels' (equipment, materials, and storage places), 'Origin Labels' (equipment), and 'Storage Labels' (food products). Each equipment and material were placed in a suitable storage area, the heaviest materials were placed at a height that allowed easy access and those used most frequently were as close as possible to the users. The equipment, on the other

hand, were positioned on the bench, sometimes in ascending order and sometimes in decreasing order of size, according to the available space. All equipment, materials, and storage facilities were identified. For the demarcation and signage of the storage area, green ribbons and indicative arrows were used. And lastly, a critical analysis of the layouts was made with the aim of making them more practical and efficient; Which cleaning would be the responsibility of the users, together with the laboratories Norms of Use, and which would be the responsibility of the employees, through the creation of a Weekly Cleaning Schedule according to each demand, was defined; Favorable working conditions were created aiming at the physical and mental integrity of users, through the following activities: verification of fire extinguishers, risk maps, accessibility and availability of PPE, creation of a 'Defect Label' for the equipment and tying of all wires with clamps; In addition to the Norms of Use, already mentioned, Manuals of Practical Sections (MPS) were also created – with the main objective of describing the practices carried out in the laboratory, as well as serving as reference and guidance material in their applications; Rules and punishments for non-compliance; and Standard Operational Procedures (SOPs) for the use of equipment and Material and Equipment Loan Forms.

### Phase 3: Post – Implementation

In the final phase, after implementation, actions were taken to promote continuous improvement, as shown in the flowchart below shown in Figure 3:

**Figure 3** - Phase 3 Flowchart.



Source: Authors.

In the laboratories, by two professors, the same checklists used in the Initial Diagnosis were applied, to verify their evolution in relation to the 5S Program. A new disclosure signage was attached to the entrance door of each laboratory with the results of the final classification; A meeting was held with the coordinators to disseminate the results, as well as to give instructions for the conduction of the 5S Program. All the material elaborated and used during the implementation was sent to the coordinators; An Audit Frequency Schedule and a Non-Conformity Records Form (NRF) plus the Action Plan for each laboratory were prepared, in order to verify together with the checklists if the 5 “S” will be practiced with the end of the implementation.



### **3. Results and Discussion**

The results obtained in the Pre-Implementation, Implementation of the 5 "S", and Post-Implementation phases are described below:

#### **Phase 1: Pre – Implementation**

##### **Composition and Formation of the 5S Team**

Through the interviews, the three candidates that best fit the profile defined to compose the 5S Team were selected.

The number of participants in a team varies between six and twelve people, with no specific rule for selection. In the case of small organizations, the formation of a team can even be dispensed with (Ribeiro, 2006).

##### **Qualification and Training of the 5S Team**

In the evaluation test, each team member scored satisfactorily. Thus, demonstrating that they can receive training, which, in turn, was an enriching moment that allowed for greater interaction and a mutual exchange of experiences between all those involved.

One of the ways to train a team is through reading specific literature, so it is important to be careful with the literature being too simple or too complex. In addition to being selective with the reading, the reader must also choose the strategy proposed by the author (Ribeiro, 2006).

##### **Definition of Implementation Areas**

The defined laboratories were divided into three areas: the first area corresponded to Sensory Analysis; the second area corresponded to the Meat and Fish Pilot Plant; the third area corresponded to the Pilot Plants for Bakery, Dairy, and the Hot Room for being structurally interconnected. Each member was responsible for the evolution of their area.

Very large areas can be stratified, and very small areas can be grouped, as long as there is one responsible for each. In large organizations, the recommendation is that 5S be implemented in a pilot area, to be later extended to the other areas (Ribeiro, 2006).

##### **Sensitization of Strategic People**

During the conversation with the coordinators, their interest in the proposed project was observed. At no time was there resistance from them, on the contrary, they gave full support and even suggestions, which was considered decisive to start the implementation project.

Raising the awareness of senior management and other strategic people is essential for the successful implementation of 5S in the organization. Usually, it is done by an experienced professional, either through lectures or visits to other organizations that have a consolidated implementation (Ribeiro, 2006).

##### **Familiarization of Implementation Areas**

Through the elaboration of the layouts and the answers obtained with the data collection questionnaires it was possible to explore, to know the routine, the difficulties, and the needs of each area of implementation.

Usually, in large organizations, the team formed is multidisciplinary, that is, composed of familiarized members who work in different areas.

### **Initial Diagnosis of Areas**

The initial results obtained with the application of each checklist were as follows: Sensory Analysis laboratory presented 46% conformity; Meat and Fish, Bakery, and Dairy pilot plants showed 50, 40, and 38% conformity, respectively. All were classified as **'Regular'**, except for Dairy pilot plant which, for having a value of less than 40% conformity, was classified as **'Insufficient'**, attributed to the daily absence of those responsible for the environment.

These classifications, except for Dairy, were similar to that obtained by the Microbiology Laboratory of the same Technological Axis (49.5% –**Regular**), which had the same improvement program implemented by Moura (2014). Reasons that justified, in both cases, the need to implement 5S.

Through the IDR it was possible to give feedback to each coordinator related to the non-compliant points that needed to be improved.

### **Launch of the "5S Day"**

The event "5S Day" was considered productive, given the satisfactory number of students reached with the actions developed to raise awareness/mobilization.

The launch of the 5S can take place in one or more days. Normally, on that day, activities such as lectures, contests, competitions, food, and drinks, among others, are held. If necessary, a team can be formed to plan and coordinate this event (Ribeiro, 2006).

### **Training of Laboratory Users**

With the training given to users, it was possible to visualize them putting into practice what was taught, it was also possible to demand from them on what they had been taught, which was positive to maintain the results already achieved with the implementation. The delivery of the Participation Certificate, on the other hand, was important to be aware of who was prepared to make conscious use of the laboratories.

It is important for the team to define a training system, as well as to develop materials with appropriate content to the profile of each participant to be trained (Ribeiro, 2006). In the case of a university environment, it is advisable that everyone be trained independently of the hierarchical level they occupy, from cleaning employees to the coordinator of the Technological Axis.

### **Phase 2: Implementation of 5 "S"**

#### **1<sup>st</sup>Seiri – Sort**

Materials were removed from each mentioned laboratory: expired food products, useless materials such as (kitchen utensils, old PPE, old parts and equipment, old banners, aquarium, old tables, empty packaging of cleaning products, expired reagents, etc.), and materials from other laboratories such as (utensils, equipment, glassware, etc.) (Figure 4).



**Figure 4** - Unnecessary materials removed from the laboratories.



Source: Authors.

After being inspected by the coordinators, the unnecessary materials were taken to the Fruits and Vegetables Pilot Plant, that served as a provisional disposal area. They were classified and then sent to their final destination: garbage, donation, recycling sector, and sector responsible for the conscious return and disposal of chemical substances. According to Leonel (2011), discarding does not mean throwing unnecessary things away, but rather classifying them and giving them a destination.

With the implementation of this step, lost materials were found, as well as materials that were not known to exist. There was a visible release of physical space and a considerable decrease in material waste. For Campos *et al.* (2005), among the benefits noted with the implementation of this step it can be mentioned: liberation of physical space, reduction of accidents and maintenance costs, reuse of resources, improvement of the environment, among others. However, it is important to acquire only what is necessary and provide it to others.

## **2<sup>nd</sup> Seiton – Set in order**

The use of the 'Identification Tag' was important for familiarization and access to equipment, materials, and storage facilities, especially by novice users who did not know the laboratories. The 'Origin Label' was important so that the equipment borrowed and not returned to the place of origin, were identified, and returned afterwards. As for the 'Storage Label', it was important to know who was responsible for each product stored in refrigerators and/or freezers, as well as to avoid the accumulation of products in them. Since those responsible had the practice of not removing the products, which often spoiled and occupied the spaces unnecessarily. According to Leonel (2011), it is important that the identification of items is standardized and of quick and easy communication, either through codes, labels or the use of colors.

Below, the 'before' and 'after' figures of the 2<sup>nd</sup> "S" implementation of one of the spaces in each laboratory (Figures 5 to 12):

**Figure 5** – SA External Cabin (Before).



Source: Authors.

**Figure 6** – SA External Cabin (After).



Source: Authors.

Sensory Analysis Laboratory (SA) –**Before:** in the Figure5 it is possible to see some booths with no identification and the garbage cans without fixed locations. **After:** the result of the applied organization system is observed: cabins internally and externally identified and garbage cans with fixed locations (Figure 6).

**Figure 7** – M&F bench cabinet (Before).



Source: Authors.

**Figure 8** – M&F bench cabinet (After).



Source: Authors.

Meat and Fish (M&F) –**Before:** in the Figure 7, it is possible to observe the absence of a systematic organization in the location shown, a messy cabinet, without proper identification and demarcation. **After:** the result of the applied systematic is observed: an organized, identified, and demarcated cabinet (Figure 8).

**Figure 9** – BA iron cabinet (Before).



Source: Authors.

**Figure 10** – BA iron cabinet (After).



Source: Authors.

Bakery (BA) –**Before:** in the Figure 9, it is also possible to observe the absence of a systematic organization in the location shown, a messy cupboard, without the proper identification and demarcation. **After:** organization, identifications, and demarcations are observed (Figure 10).

**Figure 11** – DA bench (Before).



Source: Authors.

**Figure 12** – DA bench (After).



Source: Authors.

Dairy (DA) –**Before**: in the Figure 11, it is possible to observe the disorganized bench, without identification and demarcation in the places where equipment and materials are kept. **After**: an organized, identified, and demarcated bench is observed (Figure 12).

With the implementation of this step, there was a considerable reduction in the time spent searching for materials and/or information. And, consequently, an increase in productivity, especially during the preparation of practical sections, it has also become possible to detect failures through a quick visual control. For Campos *et al.* (2005), the benefits from an orderly environment are several: work becomes objective, productivity is increased, reduced costs and work accidents, time is saved, among others. For reasons of space and structure, it was not possible to make significant changes in all layouts, only in Meat and Fish Pilot Plant, which generated significant improvements to the environment and access to the Mini Library created.

### 3<sup>rd</sup>Seiso – Shine

With the implementation of this step, it was possible to show users that cleaning should be part of their daily activities and to the employees, that the cleaning done without inspection is unable to generate improvements in the environment, as well as the importance of combating the places of difficult access for cleaning, which was not part of the routine. According to Leonel (2011), it is essential to create objectives, indicators and targets for the subsequent control of the cleanliness of the environment. For Campos *et al.* (2005), the implementation of this step brings benefits such as: improving the environment, reducing the rate of equipment deterioration generating greater savings, among others.

### 4<sup>th</sup>Seiketsu – Standardize

The non-conformity presented in all fire extinguishers was the absence of signs (Figures 13 and 14). With that, the coordinators were asked to make a Service Order (SO) requesting them.

**Figure 13** – SA extinguisher (Before).

**Figure14** – SA extinguisher (After).



Source: Authors.

Source: Authors.



In all laboratories, the existence of risk maps was verified; The absence of certain PPE and a lower amount of those available for demand was also noticed. Some PPE were inaccessibly locked in cabinets. In view of the importance of PPE for the use of equipment, a request was made to the coordinators, the importance of PPE being accessible to users was also shown; All equipment that had problems were identified with ‘Indicative Defect Labels’ (Figures 15 and 16), in order to avoid possible accidents to the uninformed.

**Figure 15** – M&F Defective equipment (Before).



Source: Authors.

**Figure 16** – M&F defective equipment (After).



Source: Authors.

All loose wires from the equipment were tied (Figures 17 and 18), in order to avoid possible accidents, especially in relation to the floor where the wires were left lying on.

**Figure 17** – DA loose wires (Before).



Source: Authors.

**Figure 18** – DA tied wires (After).



Source: Authors.

With the activities developed in this step, the possible existing risks were minimized, making the environment safer for users. Leonel (2011), states that it is important to assess and record the health and safety risks for all, as well as the development of a preventive action plan. For Campos *et al.* (2005), with the implementation of this step and the maintenance of the others mentioned, the benefits generated are: improved work quality of life, interpersonal relationships, productivity, among others.

### 5<sup>th</sup> Shitsuke – Sustain

With the creation and availability of the Manuals of Practical Sections and SOPs, users now can consult them (Figures 19 and 20). It was significant, mainly for the use of equipment by users, because the equipment did not have identification and instructions, making user's work more difficult and leaving them dependent on third parties. With the changes, they started to have greater independence and freedom.

**Figure 19** – M&F Manual of Practical Sections.

**Figure 20** – SOP visible to M&F users.



Source: Authors.



Source: Authors.

The creation and presentation of the rules and standards served to maintain the order of the laboratories. It was decided that upon the initial non-conformity, the user would be warned. If the non-conformity were recurrent, the user would be prohibited to take the current practical class or to use the laboratory for another purpose, agreeing to what was already happening, according to the coordinators' report. With the loan form, it was possible to have the return of what had been borrowed, which often did not happen.

With the implementation of this step, users noticed a greater compliance with what was established. However, not in such an autonomous and rigorous manner, with the need for surveillance and demand by those responsible. For Campos *et al.* (2005), the benefits that this step brings are innumerable: improvement of interpersonal relationships, personal and professional improvement, predisposition to collective work, improvement of quality due to compliance with norms and standards, among others.

For the consolidation of the 5 "S", the physical change of the environment must also be accompanied by the behavioral and cultural change of the people involved. It is not feasible to implement a quality improvement program if everyone continues with the old habits and the erroneous thinking that the environment must adapt to them and not the other way around. It is important that everyone is engaged and willing to change, especially the coordinators who should be a



reference for others in the 5S practice. According to Leonel (2011), for the maintenance of senses it is important to carry out internal audits, through a checklist.

Moreira, Alves and Queiroz (2017) he stated that it was possible to implement the 5S Program at the Biotechnology Laboratory at IFCE - Campus Sobral and that the results could be observed in all senses, such as space optimization, accident prevention and resource utilization. Araújo and Queiroz (2017) reported that with the implementation of the same Program in the Pilot Plant of Fruits and Vegetables of the referred institution, the place became cleaner, safer and more stimulating. And they guarantee that the changes were not only environmental, but also behavioral. Ribeiro *et al.* (2015), also stated that the implantation in the Chemistry Laboratories of the Federal Goiano Institute, improved the environment, promoted the change of habits, improved the safety and the reduction of the waste of reagents.

These results are similar to those obtained by the Supermarket Beira Lago, in the city of Entre Rios do Oeste (PR), such as self-discipline, improvement of quality and efficiency and greater ease in decision-making (Heidrich, Nicácio and Walte, 2019). Showing that the results are independent of the segment.

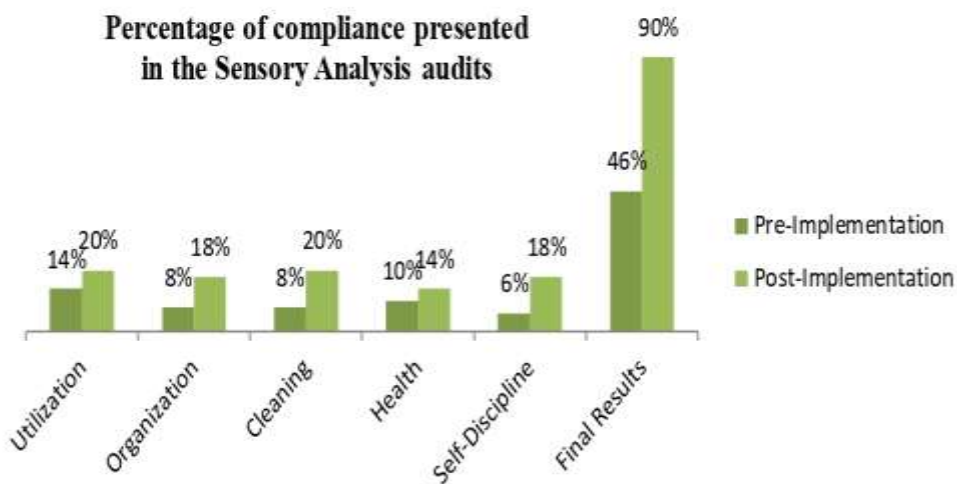
### Phase 3: Post-Implementation

#### Evaluation of Implementation

The results obtained with the implementation of the 5S Program were: Sensory Analysis laboratory presented 90% conformity; Meat and Fish, Bakery, and Dairy pilot plants presented 86, 78, and 90% conformity, respectively. All laboratories were classified as ‘**Good**’.

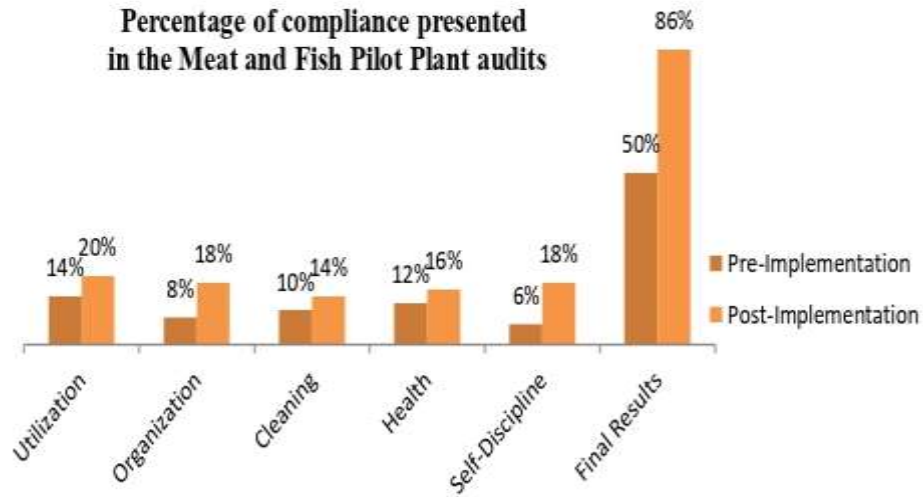
In the following graphs, the evolution of each one will be shown in detail (Figures 21 to 24):

**Figure 21** - Results of the 5S pre- and post-implementation audits (Sensory Analysis).



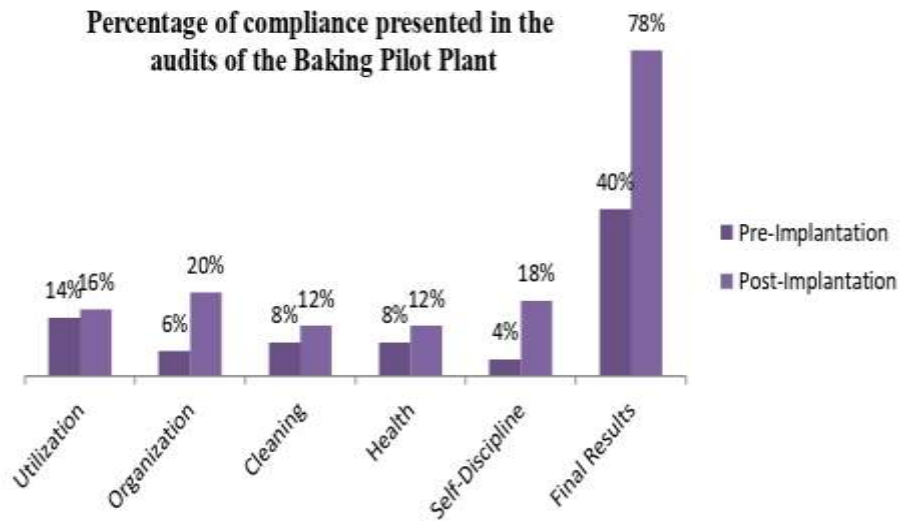
Source: Authors.

**Figure 22** - Results of the 5S pre- and post-implementation audits (Meat and Fish).



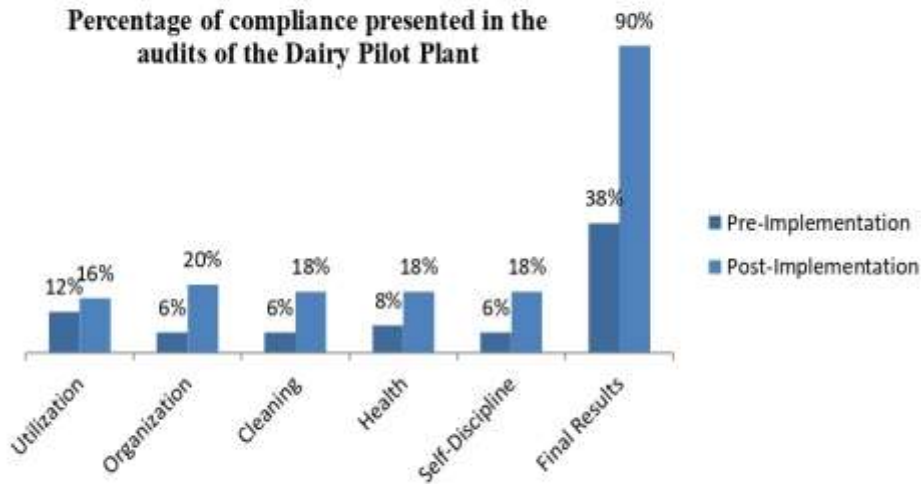
Source: Authors.

**Figure 23** - Results of the 5S pre- and post-implementation audits (Baking).



Source: Authors.

**Figure 24** - Results of the 5S pre- and post-implementation audits (Dairy).



Source: Authors.

Through the graphs it is possible to observe a significant increase in the scores acquired in each step, as well as in the final results (Initial Diagnosis and Final Audit): Sensory Analysis went from 46% to 90% conformity; Meat and Fish 50% – 86% conformity; Baking 40% – 78% conformity, and Dairy from 38% to 90% conformity.

The highlight was the Dairy Pilot Plant, which in view of the precarious situation found initially, obtained a great evolution, in addition to the positive feedbacks received by users and the coordinator. However, for the results to be maintained, there is a need for the daily presence of a person responsible for the environment, whether a scholarship student or an intern. The need is also the same as that of the Sensory Analysis Laboratory.

The new classification obtained in all laboratories was also similar to that obtained by the Microbiology Laboratory (88.5% – **Good**) implemented by Moura (2014). Thus, showing that both works were developed according to the reality and the possibilities offered by the Educational Institution.

### Meeting with Laboratory Coordinators

In the meeting with the coordinators, the graphs with the results of the implementation and the photos of the ‘before’ and ‘after’ of each laboratory were shown. The material used in the implementation was sent and instructions were given, in order to enable the realization of necessary and future maintenances.

It is important during the disclosure of the results, to show only the positive points, the achievements, acquisitions, thus focusing on the areas of greatest evolution. Since the goal of implementing 5S is to generate improvements to the work environment, there is no need to discuss difficulties, problems, or failures.

### 5S Program Audits

The creation of the documentation was important to support the auditors during the audits, as well as to show the coordinators if the frequency was being met (at the end of each semester), and the implementation remained consolidated. The documentation was placed in labeled folders and kept accessible in the 'Documents' drawers for that purpose.

According to Ribeiro (2006) the application of audits is the strategy most used by organizations as a way to guarantee the gradual and progressive evolution of 5S after its implementation. It can be routine, or it can be caused by significant organizational and/or structural changes.

#### 4. Conclusion

According to what was exposed, and through the evolution shown in the figures and graphs, with regard to the qualitative and quantitative results obtained with the implementation, it is concluded that the 5S is a simple, practical, low cost, and efficient management program capable of generating significant improvements to the work environment.

As a recommendation for future works, it is suggested to continue this study by analyzing how the educational institution is maintaining the 5S Program and what results it has obtained. As well as, the application of the proposed methodology in other types of laboratories to verify its effectiveness. For other researchers, this theme is also suggested as a source of research, aiming to value and enrich the available literature.

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