

KAIZEN AS A CONTINUOUS IMPROVEMENT SYSTEM: A CASE STUDY IN AN ANIMAL NUTRITION INDUSTRY

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ABSTRACT

The demand for food destined for animal nutrition has increased over the years, causing industries to increasingly invest in production processes. To improve process efficiency, Kaizen is a viable tool for the implementation of continuous improvements. In this sense, this study aimed to implant Kaizen in an animal nutrition industry to obtain several improvements in the production process of this company. The research method consisted of a case study with application of the steps proposed by the Kaizen tool, which started with the definition of the value flow map and followed with action plans for the proposed improvements. Among the results, ten enhancement measures were implemented in the different sectors of the company, which allowed an improvement in the production of products for animal nutrition. The practical implication is the method of applying Kaizen as a tool for continuous improvement with the help of the value flow map in a food company.

Keywords: Food industry; Lean tools; Value flow map.

1. INTRODUCTION

The demand and supply of food for animal nutrition has increased over the years, causing industries to increasingly invest in production processes to survive in the market (Belik, 1994). The increased consumption of poultry and swine provided a significant increase in animal nutrition (Zen *et al.*, 2015). In addition to investments in research and new technologies, the use of Lean Production tools has helped companies to produce more and better at lower costs, including the Kaizen method (Awad; Shanshal, 2017). Kaizen use can bring to the organization a considerable waste reduction in the flow of materials and information, based on continuous process improvements.

Other Lean tools, such as Just in Time and Kanban can also be used in the application of Kaizen, in order to achieve the desired goals and obtain continuous process improvement, especially when related to the logistics of the production process (Matusova, 2016; Iwao, 2017).

Most animal nutrition industries rely on manual production processes and little automation. Therefore, the implementation of improvements with the use of the Kaizen tool must necessarily count on the participation of the people involved in the production process (García *et al.*, 2014).

However, despite the increased application and benefits of Kaizen programs, there is still a gap in project documentation, implementation and results, as well as what can be more or less effective during implementation. In addition, Kaizen implementation requires a skilled workforce with a mind set on continuous improvement (Glover *et al.*, 2013).

Therefore, this study aimed to implement Kaizen in an animal nutrition industry in Chapecó/SC in order to obtain continuous improvements in the production process of this organization.

2. BIBLIOGRAPHICAL REVIEW

Main tools of the Toyota production system

The new paradigm for restructuring the industry in general from the 1970s onwards was the Toyota or 'Toyotism' system, which also reflected in the food industry. To replace the old model of mass production the new ideas of waste production and elimination have emerged (Ohno, 1997).

Lean can be seen as both a philosophy and a method for planning and controlling operations. Its principles represent a radical change regarding the traditional practice of production (Slack *et al.*, 2009).

Just in Time (JIT) is among the tools used to eliminate waste. Unlike traditional systems that push production, JIT is a tool that pulls production, that is, products are produced from customer demand. Thus, JIT understands that errors are avoidable and can be eliminated. Even if the zero-stock target is not reached, continuous improvement movements can result in very low real defect rates (Corrêa; Gianesi, 2013).

Kanban is one of the main tools used to eliminate waste. It transports collection, transfer and production information vertically and laterally within the company. Kanban defines what, when and how much will be produced, totally preventing overproduction, with no need for extra stock (Ohno, 1997).

Value Stream Mapping (VSM) is also among the tools used to eliminate waste. To create a VSM one must do an analysis in the search for a family of products that can be managed individually. Therefore, a matrix of the product family that grouped the products from the similar sequence of steps and the machines of the final processing is elaborated (Rother; Shook, 2012).

When companies observe their own cells or production lines, they need to improve their vision to check the three fundamental flows:

- a) Does the information flow? Does everyone know the production target per hour? How quickly are problems and normalities perceived? What happens when there are problems or anomalies?
- b) Does the material flow? Do the parts in process move from one stage that adds value directly to another that also adds value?
- c) Do the operators flow? Is the operator's work repetitive and consistent within each cycle? Can the operator go efficiently from one step that adds value to the next? (Rother; Shook, 2012).

In order to understand a VSM, one must first follow the five steps indicated by Womack *et al.* (2004), which are: specify the value, identify the value flow, define the flow, pull and improve.

Another tool is Kaizen, which means change for the better or continuous improvement, and it appeared in Japan after the end of World War II, when the country was practically destroyed. The great theorist of Kaizen enumerates ten principles that must be followed in the companies (Imai, 1992):

- 1) Waste elimination;

- 2) Continuous incremental improvements;
 - 3) Involvement of all employees and managers;
 - 4) Low-cost improvements based on cheap strategy aiming at productivity increases without significant investments;
 - 5) Possibility of use anywhere and not only in Japan;
 - 6) Transparent management, making waste and problems visible;
 - 7) Focus on the factory floor, where gains can be potentiated;
 - 8) Process orientation;
 - 9) Search for training;
 - 10) Search for new mentality through teamwork, quality circles, self-discipline and the cultivation of wisdom.
- Current Value Stream Map (process knowledge)
 - Future Value Stream Map (improvement proposition)
 - Kaizen (implementation of the improvements)
 - It should be noted that the knowledge of the process was already part of the authors' expertise.

Case study

The research was conducted in an animal feed industry that produces nuclei, concentrates and meal feeds, in Santa Catarina. This unit has nearly 100 employees, divided into various sectors, with monthly production of about two thousand tons.

In an animal feed industry, the main steps involved in manufacturing are storage, transportation of inputs, milling, preparation of micronutrients, dosing, mixing and bagging. The process of handling, dosing, adding and mixing the nutrients directly influences the cost, quality and effectiveness of the feed to be produced. The feed manufacturing process starts with the reception of the raw material, from which samples are extracted for analysis. The unloading of the raw material is done in hoppers, which transport the raw material internally. Afterwards, the inputs are dosed, mixed and milled. Simultaneously, another parallel team doses the micronutrients that will be added to the already milled bran. In the ration manufacturing process there are critical points, such as receiving raw materials and equipment, packaging, and manipulators sanitation. Thus, preventive measures should be adopted in order to avoid contamination of the feed.

Implementation process

At first there was the participation and involvement of the unit's supervisor, because the commitment of the top management in the implementation of a new industrial management tool is fundamental. This collaboration was obtained for the survey of primary data, for the elaboration of VSM and definition of the difficulties presented by the unit, as well as data related to the company's production line. Subsequently, multidisciplinary teams composed of the unit's supervisor, employees involved in specific areas, and outsourced personnel in the areas of civil construction, quality control and others were assembled. These teams were assembled with the intention of acting in the various stages of product manufacturing, aiming at the application of Kaizen. To make this possible, first of all, there was a training and awareness of the members regarding Kaizen and the definition of leaders in each team.

Regarding production efficiency using Kaizen methodology, the definitive and continuous implementation of this method, aiming to stimulate several and successive small actions for the change of results, without encumbering the financial revenues, brings positive impacts on the motivation of the workers' teams (Rosa *et al.*, 2010). Furthermore, the Kaizen methodology translates into improved customer service, allowing greater flexibility and speed in responding to market needs (Chahal *et al.*, 2017).

Kaizen methodology is still being applied, especially in developing countries such as Mexico (García *et al.*, 2013), India (Arya; Jain, 2014) and Vietnam (Higuchi *et al.*, 2015).

3. RESEARCH METHOD

Research design

This study employed descriptive qualitative and documental research, aiming at defining the research problem and collecting the data, treating and analyzing them, as well as evaluating the results. The survey is also characterized as a case study.

For a better understanding of the research method used for the implementation of Kaizen in the company under study, the following steps were followed:

- Creation of multidisciplinary teams

Based on the evaluation of the teams and the unit supervisor, the product chosen for the application of Kaizen represented 9% of the total production during the fiscal year, which received the denomination of "Product A", among a total of 480 types of active products. This demonstrates that the company has a great productive variety.

To prepare the VSM, the processes of the "Product A" production line were studied, based on direct observation and use of the Process Study Sheet (PSS), which enabled the registration of important information at each stage of the process. From this analysis it was possible to define the stages of the manufacturing process of the chosen product, the actual number of operators in each function, which operators performed the functions, the time taken for each stage of the process, the machine time, and all possible observations of the production environment.

After the detailed analysis of the current VSM by the multidisciplinary team and the administration, the points that should be improved in the production process were defined. From this, the future VSM, which contains the proposed improvement points highlighted in the map through "balloons", was elaborated.

For each of these ten improvement proposals, Kaizen was applied. The training of the participants of the teams took place next to the meeting and training room of the company. In the training, technical trainings that consisted in the presentation of the Kaizen concepts and the behavioral training, which had the objective of amplifying the perception of the environment, were carried out, encouraging the creativity of those involved.

In the sequence, the Kaizen was applied with the following steps:

Knowledge of the problem: Brainstorming was done to better understand the possible causes of the problem and from that, raise opportunities for improvement. Then the 5W1H action plans were elaborated, and the costs were not disclosed by orientation of the company under study;

Application of the actions: at this stage, the actions described in the action plans were applied, in addition to training the employees to perform the tasks, as planned, and collecting the data after the action;

Verification of the results: at this stage, the before and after actions were compared to verify whether they were effective or not.

4. RESULTS AND DISCUSSION

Current and future value stream map

The current VSM served only for the knowledge of the process, and the focus was on the location of the main points of waste generation in the company. This process mapping is represented by the future VSM in Figure 1, in which the points where Kaizen were employed are highlighted.

As can be seen, ten points have been highlighted for improvement, as follows:

- Improvement in the micro ingredients room;
- Improvement of the flow of RM (raw materials) for superior addition;
- Optimization of the macro ingredient process (salt weighing);
- Improvement in visual management;
- Improvement in the process of adding MP;
- Optimization of palletization;
- Optimization of the bagging sector;
- Reduction of stocks of RM (raw materials) and FP (Finished Products);
- Optimization of shipment loading time;
- Improvement in employee assistance management.

Application of Kaizen 1 and 2

To raise the problems in the micro ingredients room Brainstorming was employed. After that, it was defined as priority of actions the modification of the room layout and optimization of the weighing process, which consists in changing the raw material storage buckets. Figure 2 presents the action plans developed for these priority actions. The action plans were carried out in the time stipulated in the two main actions.

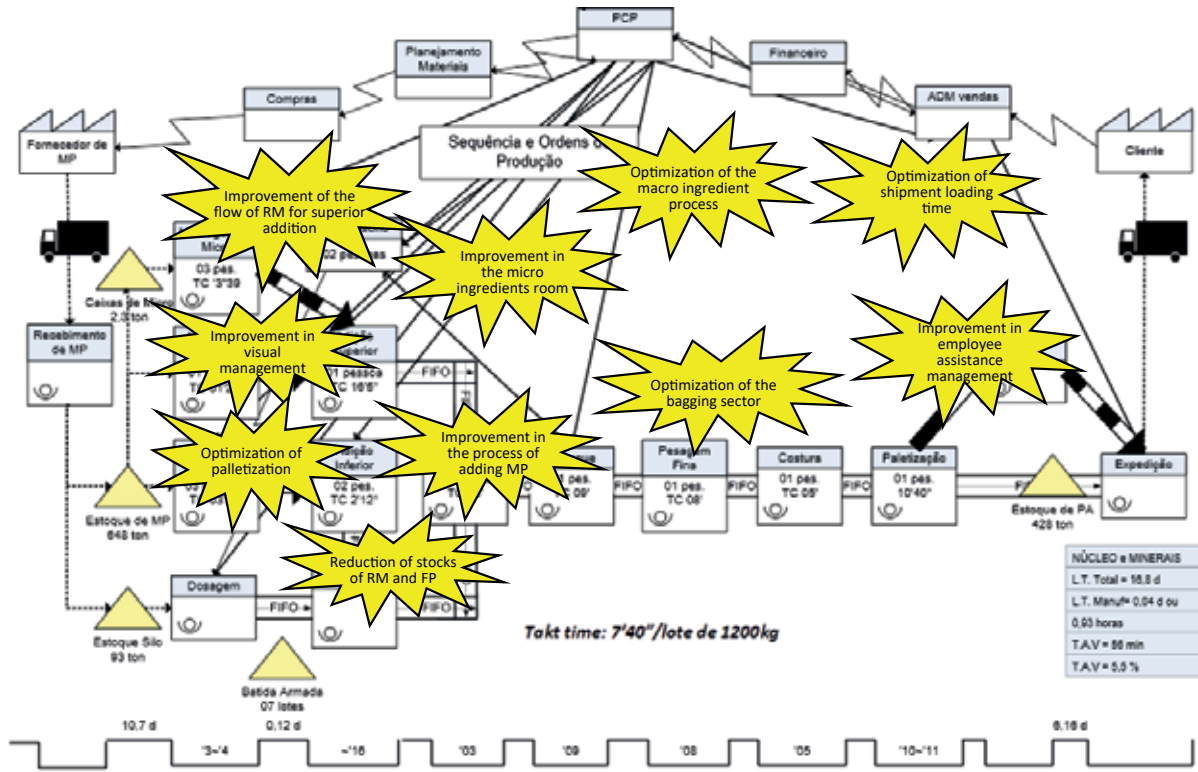


Figure 1. Future Value Stream Map

Source: The authors

What	Who	When	How	Where	Why
Change in layout	Project manager and maintenance team	2 months	Designing a new layout	Micro room	Excess movement of people and materials
Changing the buckets	Production Manager	15 days	Replacing 50 kg buckets with 20 kg boxes	Micro room	Excess weight for employees, resulting in ergonomic problems

Figure 2. Action plans for the micro ingredients room

Source: The authors

In order to verify the results obtained with the changes, a before and after comparison was made. As can be seen in Figure 3a, the room has only one door where the entrance and exit of the ingredients were made, causing a counter flow of raw material, which is not in accordance with the standards of good manufacturing practices. Besides, the flow of the room demanded from the operator many walks until the deposit for the raw material removal.

Thus, by the change in the layout of the micro ingredients room (Figure 3b), it was observed a 35% reduction in the daily walk of the operator. This action together with the change of the buckets reduces the daily fatigue of the operators and also the loss of raw material by tearing of bags and daily movement of products.

Application of Kaizen 3

The second Kaizen applied was in relation to the inadequate flow of raw material for superior addition. From the possible causes raised, it was verified that the main ones were the layout and the inadequate elevator. There were walls and silos blocking the shipment of raw materials allocated in buckets to the freight elevator, because from this, the superior addition of raw materials to the mixing system was performed. The elevator, besides being in an inappropriate place, was old, had only one steel cable, making it an unsafe operation and it could not handle the work volume. Figure 4 presents the action plans for these causes.

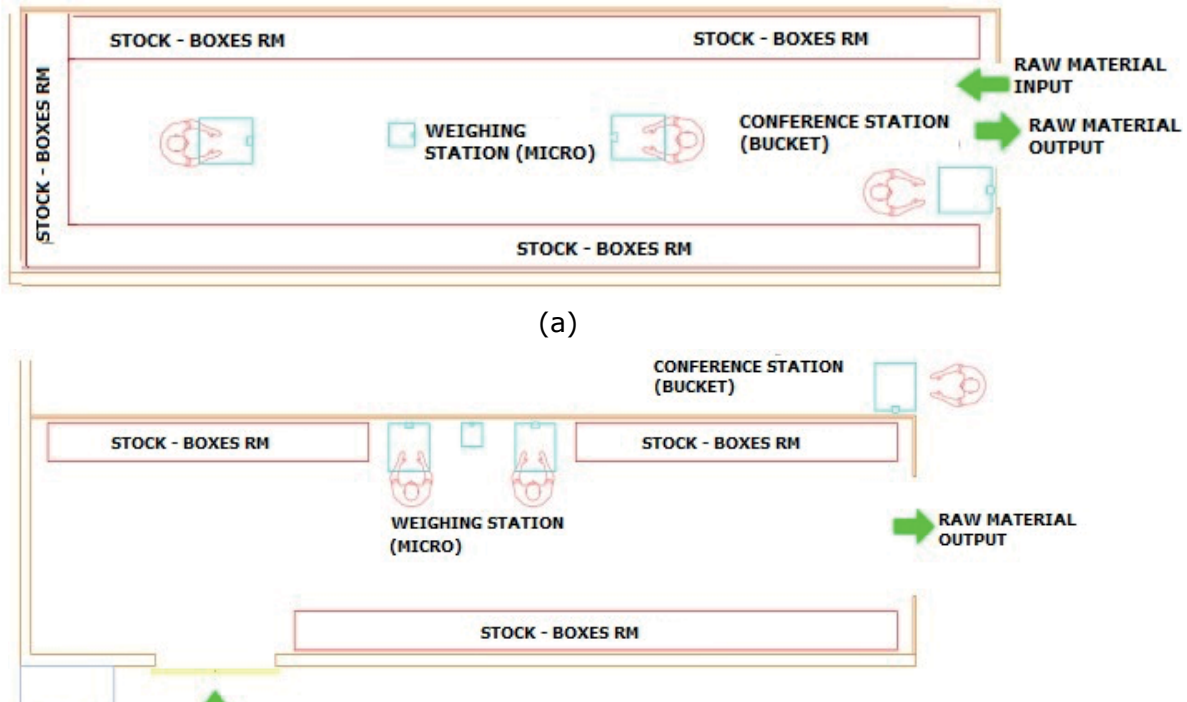


Figure 3. Layout of the micro ingredients room before (a) and after (b) improvements

Source: The authors

What	Who	When	How	Where	Why
Change in layout	Project Manager	3 months	Designing a new layout in a new location	Macro room	Design of old factory with walls and silos blocking access
Installation of a new elevator	Project manager and maintenance team	3 months	Replacing the elevator	Macro room	Old, manually operated and unsafe elevator with only one steel cable

Figure 4. Action plans to improve the flow of MP in the top addition

Source: The authors

After the implementation of the action plans it was possible to verify the results obtained with the modifications made. Figure 5 presents a comparison of before and after in the RM flow for the superior addition. It is possible to notice the great difference in the RM flows to the elevator before and after the new layout. This new layout represented a reduction of approximately 90% in the path covered, as the new elevator was very close to the micro room, making it possible for employees to place the buckets of micro ingre-

dients directly into the elevator, at a distance of 20 m. Before the improvement, the employee traveled around 200 m to reach the elevator. It was also observed that with the installation of the new freight elevator, there was more space for the handling of raw materials, in addition to safety in the execution of tasks.

Application of Kaizen 4

The third Kaizen was in relation to the ineffective process of macro weighing of ingredients, in this case, weighing salt in 50 kg bags. To overcome these problems a Brainstorming was carried out, and the main ideas raised were to improve the worker's ergonomics through Kaizen (Rodriguez; Lopez, 2012), using in this case an automatic salt weighing system. Based on these discussions, an action plan was developed for the realization of the improvements in this stage of the process, demonstrated in Figure 6.

What	Why	Who	Where	When	How
Improve the salt weighing system	Improve the production flow	Unit Supervisor	Production sector	3 months	Buy the big bag scale and train the team.

Figure 6. Action plans to improve the salt weighing process

Source: The authors

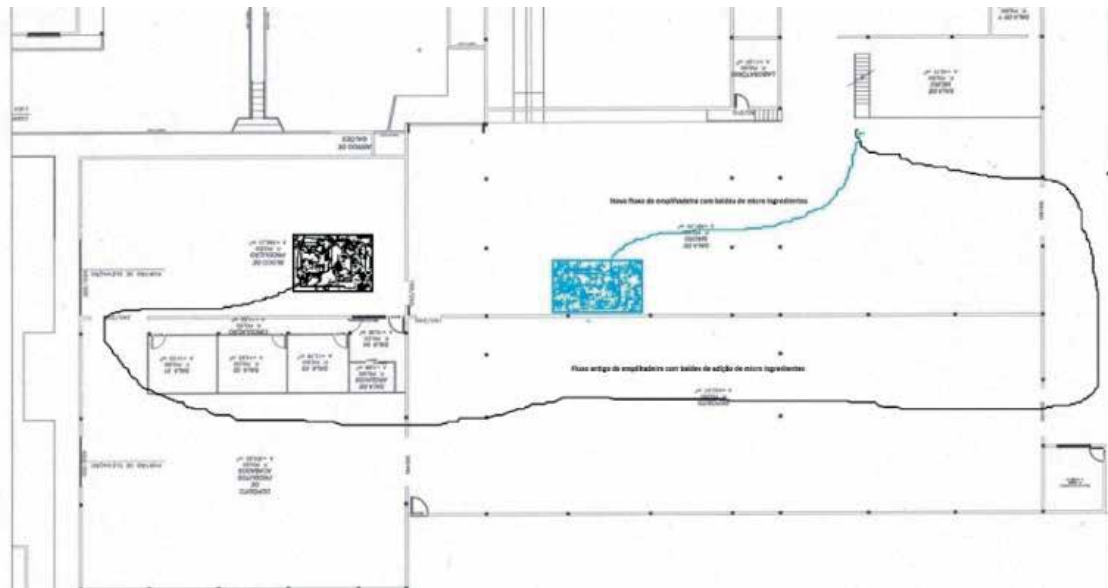


Figure 5. Flow before improvements (black) and after improvements (blue)

Source: The authors

With the installation of the big bag salt weighing system, up to 1,000 kg were weighed at a time, increasing total production, reducing the risks to the employees' health, and optimizing the process time.

Application of Kaizen 5

As defined in the VSM, the need for improvements in the company's infrastructure was noted for process improvement and comfort for stakeholders. Figure 7 presents the new sentry-house, representing a considerable improvement in the company's environment, where the reception room has glass windows, which improves the vision of the guards and the employees who perform the checks of invoices and conference of weight in the road scale. In addition, general repairs, improvements in the bathroom and installation of a television set were made.



Figure 7. Access to the company after implementation of improvements

Source: The authors

Application of Kaizen 6

According to VSM, it was necessary to optimize the bagging sector, and this was one of the tasks that required the most time, due to the delay in purchasing the necessary equipment and training the employees to use it. Figure 8 presents the action plans elaborated from the actions raised.

What	Who	When	How	Where	Why
Reduce the bottleneck in the bagging sector	Project Manager	6 months	With effective equipment	Bagging Sector	Expand bagging speed
Install semi-automatic filling machine	Project Manager	6 months	Acquiring machine	Bagging Sector	Reduce waste

Figure 8. Action plans to optimize bagging

Source: The authors

The new structure contemplated a semi-automatic machine, which operates with five employees (previously it was nine employees); furthermore, the production capacity was 30% higher, which allowed a margin for process and company growth, reducing the bottleneck in this sector.

Application of Kaizen 7, 8 and 9

According to Future VSM (*MFV Futuro*), the company needed improvements in the area of stock and logistics, related to the optimization of palletization, reduction of stocks of RM and FP, in addition to reducing the loading time of the shipment. The Brainstorming technique was used to obtain ideas from the people involved in this activity and the elaboration of the action plan (Figure 9).

The quantity of sacks on the pallet was the maximum possible in relation to the potential of use, going from five b

ags with 30 kg each to seven bags with 30 kg each. This improvement resulted in time gain since more materials were transported per pallet. In addition, greater utilization of labor and more safety in transportation were obtained, as the bags were covered with plastic film.

JIT and Kanban tools were used to reduce RM stock. With the use of JIT there was a reduction in the amount of RM in stock, resulting in 30% more storage space, and a significant percentage is considered for the volume of products produced in the company. The use of Kanban, in turn, resulted in the purchase of much needed RM, reducing the generation of excessive stocks.

In relation to the FP, besides the reduction in stocks, it was observed the need to increase the height of the environment where the products were stored, because many times, the forklift would end up hitting the ceiling of the place. Thus, the old ceiling was removed, and a new higher ceiling was built, so that the forklift could remove the materials on top of the shelves without having contact with the ceiling. The lighting of the place was also improved, and a

more organized arrangement of the finished products was made. With this, there was a decrease in the time to find the desired product for shipment. Figure 10 shows the stock before (10a) and after (10b) the improvements.

What	Who	When	How	Where	Why
Increase safety in pallet handling	Project Manager	2 months	Training the employees	Production Sector	Avoid accidents at work and loss of materials
Reduce underutilization of pallets	Project Manager	2 months	Training the employees	Production Sector	Occupy larger area on the surface of the pallets
Transport more materials on pallets	Project Manager	2 months	Training the employees	Production Sector	Carry a maximum of 30 kg bags instead of 5 bags
Reduce RM and FP Inventory	Project Manager	2 months	Implementing Just in Time and Kanban.	RM and FP Sector	Reduce waste of storage time and space.
Change the structure of the FP stock environment.	Civil construction team	2 months	Increasing the height of the ceiling.	FP Stock	Avoid accidents
Reduce product location time	Project Manager	2 months	Organizing and separating the products	Shipping Sector	Reduce shipping time
Speed up the shipping process	Project Manager	2 months	Shelves in color	Shipping Sector	Reduce waste of time
Optimize the work of operators and forklifts	Project Manager	2 months	Creating a picking area	Shipping Sector	Reduce operator workload and forklift trucks

Figure 9. Action plan for improvements in the area of stock and logistics of the company

Source: The authors



(a)



(b)

Figure 10. FP stock before (a) and after (b) improvements

Source: The authors

Regarding the loading time of the shipment, in this sector, the products were mostly exposed on loose pallets, without the proper organization and separation, causing the loss of time for the correct location of the products and delay in the demand for separation. For this reason, a picking area has been created in the shipping sector, where surplus products from previous shipments are stored and can be used in future shipments.

Application of Kaizen 10

The tenth Kaizen refers to the improvement in employee assistance management. The application of the people management concept is currently more and more required in organizations. Therefore, during the implementation of Kaizen in the company, employees raised the need for a new quality control room, a new occupational health and safety room, as well as the construction of a meeting and training room, which did not yet exist in the company, aiming at improving the infrastructure for employees.

It was identified that a new room should be built for quality control, as the previous room was made of Eucatex partitions, outside the principle of food safety. Moreover, this kind of environment should be in accordance with the norms and requirements of the Ministry of Agriculture, Livestock and Supply (Brazil, 2009). Thus, a new room was built for the quality control of the products in which the

samples were in an environment that complies with MAPA standards, that is, with durable materials that do not propagate humidity, and the room is large, clear and easily accessible to employees.

Regarding the occupational health and safety room, it was found that there was little space for the technicians to exercise their activities and it was located in the maintenance sector, where materials were inadequately stored, which brought discomfort to the technicians' work. Thus, a room for safety and health at work was built next to the production sector, besides the construction of a meeting and training room in the company.

5. CONCLUSION

After the analysis of the data obtained, it was possible to verify that the implementation of the Kaizen tool in an animal nutrition industry, in the city of Chapecó, Santa Catarina, reached the proposed objectives, since it contributed, in a general way, to the improvement of the productive chain of this organization. The process stream mapping proved to be a powerful tool for the knowledge of the manufacturing process of product A, thus allowing, from the information collected, to defining the improvements, which were obtained by applying the Kaizen tool.

All the opportunities for improvement were worked on successfully, as there was a reduction in process times and in material stocks, as well as improvements in the ergonomics of the employees, reduction in material waste, movements, resources, time, among other actions.

Furthermore, it became evident that the people involved in the manufacturing process of the products are essential to apply a new management method, because changes always generate distrust. Therefore, it was necessary to demonstrate the importance of the Kaizen tool, emphasizing the improvements obtained, and encouraging and always counting on the help of the employees. It is also important to highlight that the results obtained in the company are the beginning of the Kaizen tool implementation and that the improvements must be continuous, as recommended by the foundation of this tool.

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