Performance measurement methodology in agrifood industry. The Raporal case

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Abstract

Food waste is a reality nowadays, with a large part of it occurring in the early stages of the Food Supply Chain. It is in this context that the motivation for carrying out this work arises, which was carried out in collaboration with a company in the agrifood sector, Raporal, S.A.

During the meat production process, there is an inherent production of animal by-products, which derive from meat production, but which are not suitable for human consumption. Examples of cleaning processes, which, when poorly executed, may lead to the waste of a potential product.

The fact that there is not a defined set of performance measurement indicators (Key Performance Indicators - KPI) in the operation, that allow controlling and monitoring all processes, makes it difficult to determine all the waste and inefficiencies that may occur when the production processes are carried out. It should be noted that a stopped machine, even for a few moments, constitutes a waste - a waste can be either food or productive.

Based on the relevant literature, considering the themes of waste, by-products and performance indicators, a methodology was proposed to apply to the Raporal case. 8 performance indicators have been proposed to monitor the various wastes that may occur in the operation and validated with the management team. Based on the data collection, an assessment was made of its usefulness in monitoring and reducing waste.

Keywords: Agri-food sector; Key performance indicators; Meat production; Overall Equipment Efficiency; Productivity.

1. Introduction

Currently, about 33% of all food produced is wasted worldwide [4]. This waste occurs along the entire food chain, with losses and wastage from the food production stage during all its phases, up to the level of the consumer.

FAO (2011) [3] states that 54% of food waste occurs in the initial phase of production, composed of the phases of post harvest and storage, and 46% of waste occurs in the phases of processing, distribution and consumption. These figures are worrying since some 815 million people around the world are undernourished, and total food waste has a market value of over 838M [4].

It is in this context that the motivation for this work at Raporal arises. The fact that it is a company belonging to the food industry, and to the meat sector, thus allows us to study the processes that the company carries out in its production, and thus try to optimize them in order to avoid waste and breakage as much as possible. Since, as mentioned, waste starts even at the beginning of the food chain, the fact of being able to work with a company in the sector and analyze it in order to understand the ways to combat this problem is quite motivating. It is also something that interests the company in the sense that, a waste is a loss, something that the company will not be able to profit economically. It is important to efficiently manage all available resources and in-house operations so that, on the one hand, an emerging problem is faced, and on the other hand, to help the company reduce unnecessary expenses. It is recognized the need to develop a consistent performance assessment methodology and its monitoring in the area of food waste in the production phase. Therefore, it is intended that this study develops solutions that can respond to this problem.

The proposed solution is presented in this paper as it follows: in Chapter 2 is presented the theoretical support of the subject to be studied, description of the company in which the study was developed; in Chapter 3 is made a survey of the main articles, books, documents, and theses relevant to the area of search and study for the development of the Dissertation; in Chapter 4 is proposed the

methodology of resolution for the case study, and presented the 8 KPI's to be implemented in this resolution; in Chapter 5 is presented the development of the methodology and results; and in Chapter 6 the main conclusions and future direction to follow.

2. Case Study

The company was founded in 1971, due to the will of a group of pig farmers, who wanted to do more and better at the level of feed production, which led to the creation of Raporal, S.A. In 1980, Raporal, acquires its first livestock, with the purpose of making pig production. In 1986, Raporal, S.A. acquires STEC, a slaughter and meat processing unit, the first of the company, thus having a wider business area. The company is constituted by the following brands: Raporal Agro, Raporal Rações, RapFarms, STEC and Loja da Carne.

Currently the company owns more than 10,000 breeding pigs, produces more than 300,000 pigs per year and processes more than 300,000 pigs per year. It has a total of 340 employees, in all areas of the company, and has an annual turnover in the order of 100 M eur.

The main customers are in modern distribution (such as: Jerónimo Martins, Sonae, Lidl, Auchan, Intermarché, Aldi), which represents about 80% of sales, and the remaining 20% of sales are wholesale meat retailers.

To better understand what will be described throughout the dissertation, it is necessary to define and clarify an important concept, that of by-product. A by-product is a substance or object resulting from a production process whose main objective is not the production of this item. An animal by-product is, therefore, entire bodies or parts of dead animals, products of animal origin and other products that come from animals that are not intended for human consumption (Regulation (EC) No. 1069/2009).

Animal by-products are classified into three categories representing the degree of risk they pose to public and animal health. There are 3 categories of by-products, M1, M2, and M3. Those of category 1, which present the most significant risks, are normally disposed of as waste by incineration. Category 2 by-products, which present intermediate risks, are also normally disposed of by incineration. Those of category 3, that present little significant risk, are normally later integrated in other industrial processes. Having said that, it is important to understand that the by-products of categories 1 and 2 have a cost associated with their treatment (the company pays for their treatment), while the by-products of category 3 have a benefit associated with their treatment (the company sells them).

This chapter also explains the production processes that occur in the company, with the initial phase consisting of three slaughter lines: pigs, cattle and sheep. Each of these processes are described in detail. Mapping of these processes was done, which is presented in a figure. These are the processes that will be studied in Chapter 5, for the case of cattle and pigs. There are 3 categories of by-products, M1, M2, and M3. Those of category 1, which present the most significant risks, are normally disposed of as waste by incineration. Category 2 by-products, which present intermediate risks, are also normally disposed of by incineration. Those of category 3, that present little significant risk, are normally later integrated in other industrial processes. Having said that, it is important to understand that the by-products of categories 1 and 2 have a cost associated with their treatment (the company pays for their treatment), while the by-products of category 3 have a benefit associated with their treatment (the company sells them).

It was proposed to develop a tool that could monitor the operations, which is later presented in Chapter 4 and Chapter 5.

3. Literature review

The agri-food sector in Portugal is the manufacturing industry that contributes the most economically to the country, with a turnover of about 15,000 M eur. The contribution of this sector to the trade balance has been quite positive, with export rates higher than import rates, which gives a positive balance of this balance [8]. The sector also makes a positive contribution to the growth of the economy as over the last few years it has performed satisfactorily, also due to the increase in the export rate, and also because it has an impact, albeit indirect, on other economic sectors, which creates economic sustainability [5]. The growth of the agrifood sector involves implementing a culture of productivity and greater efficiency in companies in the sector through the creation of improved business practices, cost optimization, sustainability of production methods and creation of synergies between companies in the sector.

The meat sector generates large volumes of by-products such as blood, bones, meat trimmings, skin, fat, horns, legs, skull, viscera, among others, and all of them have a cost associated with their treatment and disposal in an ecological manner and respecting food safety rules. These costs can be balanced through innovation with the aim of generating products of added economic value in order to increase their profitability. Meat by-products can be a valuable resource if they are handled properly to produce substances or products with added economic value. There are numerous applications based on new or improved tech-

nologies for processing meat by-products [10].

FAO (2018) [4] defines food loss as all food produced for human consumption that is not ingested by humans, and defines food waste as part of the food loss and is understood as food designated for human consumption that is discarded or allowed to spoil. Food loss is mainly caused by inefficiencies along the food supply chain, such as poor infrastructure, lack of adequate technology, lack of access to markets, insufficient knowledge, and poor management. On the other hand, food waste is mainly rejection, whether by choice or deterioration of food, and is closely related to the behavior of retailers and consumers.

In order to assess the success of supply chains, an adequate performance measurement system is needed to monitor the relevant performance indicators of products, services and processes in a timely manner. Performance indicators are the criteria by which these parameters can be evaluated, and compare the efficiency of a system with a defined standard value [1]. Supply chains lack precise performance indicators for comparison, benchmarking and decision making.

Several companies work with wrong measures, many of which are incorrectly called KPI's. The reason is that few companies have explored what a KPI really is [9]. There are three types of performance measures:

1. The key result indicators (KRI's) - inform the performance in perspective;
2. The performance indicators (PI's - performance indicators) - indicate what should be done;
3. The KPI's - tell what to do to drastically increase performance.

Many performance measures used by companies are therefore an inadequate mix of these three types. We can relate these three measures of performance by making an analogy of an onion, i.e. the outer part describes the general conditions of the onion, but as we peel the layers of the onion we find more information. The peel represents the KRI's, the layers represent the various PI's, and the core represents the KPI's.

KPI's represent a set of measures focused on aspects of organizational performance, these being the most critical to the success of an organization's present and future. These have a significant impact, given that a good KPI will affect most Critical Success Factors, and have a chain effect, i.e. an improvement in one key measure has a positive impact on many other measures. Hope & Fraser [6] suggest a maximum of 10 KPI's. The ultimate success of a change strategy depends very much on how the change is introduced and implemented, and not just on the merits of the strategy itself. The development and successful use of key KPI's is therefore crucial.

Lohman et al. (2004) [7] emphasize that the development of a Performance Measurement System (PMS) should be considered a coordination effort, and suggest the development of a metrics dictionary using the metrics definition model presented in Table 1 as the main element in the development of a PMS.

Table 1: Metrics definition model.

Metric attribute	Explanation
Name	Use of exact names to avoid ambiguity
Goal	Relationship of metrics to organizational objectives must be clear
Scope	Indicates the business area or parts of the organization included
Target	Benchmarks must be determined to monitor the process
Formula	The exact metric calculation must be known
Calculation Units	Which units are used
Frequency	Frequency of registration and reporting
Data source	Exact sources of data involved in calculating the metric
Person in charge	Person responsible for data collection and reporting
Actions	Factors that influence performance
Comments	Indicator issues that need to be mentioned

To be successful in implementing KPI's in an organization, there needs to be all the preparation behind it that makes the implementation of these not in vain. It is essential to establish a solid environment in which KPI's can develop and operate. Once the organization understands all this process, the construction phase of the KPI's can begin.

Only in recent years, the agri-food industry has recognized and started to adopt supply chain management (SCM) as a key concept for its competitiveness. The rapid industrialization of agricultural production, food distribution, the advancement of information and communication technologies in logistics, customer concerns and government regulations on food safety, the establishment of food quality requirements, the growing importance of vertical integration and horizontal alliances, are just some of the real-world challenges that have led to SCM in the agri-food sector (Chen, 2006)[2].

At the operational level, there are a number of key points that need to be addressed so that operations are carried out in the best possible way,

so that they are the least costly and generate the greatest possible revenue. In this literature review, some key points in waste, key performance indicators, and agrifood supply chain management have been identified, which will support the methodology to be adopted in the case of the study to be solved.

4. Methodology

Once the case study has been defined (Chapter 2), and the relevant existing literature has been studied (Chapter 3), the need arises to collect and analyze a series of data before suggesting and implementing a possible resolution methodology. That said, the need to collect a set of data for the year 2019 arises. This preliminary analysis allows the definition of a set of KPI's to be implemented by the company for production analysis in the various lines in order to improve the production efficiency of the company, and reduce all existing waste, whether by-products or of a productive nature.

Over a year, there is a large production of animal by-products in Raporal's facilities. In 2019, 6,551 tons of byproducts were produced, coming from different areas of production and activity - slaughter, Stec 3, cutting, boning, packaging and butcheries. Most of the by-products produced in the company are unequivocally in the slaughter area, where the animals are killed and a series of carcass preparation processes are carried out.

By observing the activities carried out in the production areas, it was possible to see what types of waste were occurring. This waste does not refer exclusively to the final product, but also to the production level. If a machine does not produce due to a stoppage, it is considered a productive waste, because the time that the machine is not in operation is time belonging to the production, so the productive efficiency is not at its maximum value. It was then that the sketches of KPI's definition appeared.

This development of KPI's appears as a request by the company as something to be developed and implemented along the stage that was carried out during the period of preparation of this dissertation. In a first stage, the idea would be only to work on the issue of by-products, however, it was then proposed by the company that a set of KPI's be developed in order to control the most varied levels of production performance related to specific areas of interest. Having said this, the first step that was made for the development of KPI's was observation work. During two weeks, daily visits were made to the production area in order to understand which points of the operation had potential for performance evaluation. At the same time, scientific articles with relevant studies that could serve as a basis for the definition of the KPI to be implemented in Raporal were being sought, and no study was verified that resembled the intended. In a second phase, a set of KPI's were developed to be discussed in a first of two meetings with the KPI's approval committee. The definition of the KPI's was made using relevant articles on this subject, more specifically on industrial KPI's that were suitable and could be applied to the production in question. After undergoing the necessary adaptations, considering the intended study in question, a version was developed with a proposed set of KPI's to be submitted for evaluation. Before presenting the KPI's to the management team, they were first presented to Raporal's Operations Director. After a careful analysis of them, a consensus was reached on suggestions for improvement to be made before the meeting. In a third moment, the first KPI's meeting took place. The meeting was attended by members of the Administration, the Director of Operations, the Director of Quality and Food Safety, the Slaughterhouse Manager, the Slaughter Area Manager and the Cutting Area Manager. The set of KPI's that the first column of Table 2 shows was then presented, which resulted from the initial proposal arising from the operations management literature. Once the suggestion was made, each intervenor had the opportunity to express himself/herself, giving his/her opinion about the suggestion and making comments and suggestions for improvement or alteration. In general, the KPI's were accepted, only slight changes were requested in the definition of the proposed KPI's, and two additional KPI's were defined. In the end, another meeting was scheduled to present the suggested improvements and additions. Afterwards, the work went through the realization of the suggested changes, as well as the definition of the intended KPIs. In the second meeting, which was attended by the same people as the first meeting, the KPI's presented in the second column of Table 2 were then presented. The KPI's were unanimously approved and considered validated. That said, it was necessary to define in a meeting the evaluation parameters for each KPI. The KPI's for which there was a production history and it was possible to calculate an expected average value, or on the other hand, the production was more or less known, the parameters for their evaluation were defined. The others, for which there was not enough data, it was defined that the parameters would be defined at the end of the month of implementation of the KPIs. Since the period for implementation and study of KPI's would be only during July 2020, it was suggested to focus only on the slaughter area (of the two lines - pigs and cattle), since it is the area where most of the by-products are produced, where the largest number and diver-

sity of operations occur, and since it is the only area where the cattle are processed, since there is neither cutting nor boning of this type of animals. Although the analysis of the evolution of these KPI's focuses on the slaughter area, this does not mean that they cannot be used in other production areas, since they are generic and easily replicable to other operations.

Table 2: KPI's proposal e validated

Initial KPI's proposal	Final and validated KPI's proposal
1. Task execution time	1. Task execution time
2. Produced SP's percentage	2. Produced SP's percentage
3. Quantity produced by house	3. Quantity produced by house
4. Inactivity time	4. Inactivity time
5. Working hours in production	5. Working hours in production
6. Indicator of used of installed capacity	6. Average speed of production
	7. Indicator of used of installed capacity
	8. *Overall equipment efectiveness*

Since the period for implementation and study of KPI's would be only during the month of July 2020, it was suggested to focus only on the slaughter zone (of the two lines - pigs and cattle), since it is the zone where most of the by-products are produced, where the largest number and diversity of operations occurs, and since it is the only zone where the cattle are processed. Although the analysis of the evolution of these KPI's focuses on the slaughter area, this does not mean that they cannot be used in other production areas, since they are generic and easily replicable to other operations.

Once the KPI's are defined and approved, the study can be started. The purpose of developing the KPI's in the short term is their implementation in the company, study of their variation in the month defined for the study, and analysis and discussion of results. In the medium and long term, the intention is to apply the KPI's to day-to-day production, that is, to have a set of indicators that constantly evaluate the performance of operations and processes to occur systematically in the company, in various areas of production.

5. Methodology's Implementation

This chapter aims to develop the KPI's that were presented in the previous chapter. In a first part the KPI's are presented, and in a second part the results are discussed, as well as the difficulties felt during their elaboration and implementation. The KPI's elaborated will be presented next:

- KPI 1: TASK EXECUTION TIME: This KPI measures the average time that a unit resulting from a process takes, depending on the workers present on the production line in real conditions, taking into account the expected time to perform this process if there are no interruptions on the line (constant flow), and taking into account the ideal number of workers present on production line;
- KPI 2 - PRODUCED SP'S PERCENTAGE: This KPI measures the percentage of by-products produced per working day given as a function of the total weight of animals that underwent processing on the same day. It evaluates what is the percentage of by-product that the daily transformation of animals into meat (final product);
- KPI 3 - QUANTITY PRODUCED BY HOUSE: This KPI measures the amount of product processed on a given production line, according to the number of workers operating the line and the time spent until the product to be processed that day is completed. It evaluates the amount of final product, given the specifications of the line, in function of the time spent in this operation and the labor force available on the day in question;
- KPI 4 - INACTIVITY TIME: This KPI measures the percentage of time that a production line is interrupted, during one day of operation. This KPI aims to evaluate how much time a certain production line is stopped as a function of the total operation time, in the form of a percentage;
- KPI 5 - WORKING HOURS IN PRODUCTION: It is the inverse of KPI 4;
- KPI 6 - AVERAGE SPEED OF PRODUCTION: This KPI aims to evaluate how fast the products are transformed along a line, for example: in the case of the slaughter line it is interesting to know the average speed in terms of animals per hour, in other lines the numerator can be changed to another unit;
- KPI 7 - INDICATOR OF USE OF INSTALLED CAPACITY: This KPI aims to evaluate what

is the percentage of workers operating on a given line, on a given day, according to the total number of existing jobs. Installed capacity means the set of physical installations, machines and equipment that the company has to produce a certain quantity of products in a time period; KPI 8 - OVERALL EQUIPMENT EFFECTIVENESS (O.E.E.): It is a well known industrial metric that identifies the percentage of planned production time that is actually productive.

Evaluating parameters of swine KPI's: Since many indicators constitute a new tool for evaluating the performance of the company's production activity, many of the KPI's do not have at first intervals of parameters for evaluating the results obtained. In a meeting the parameters to evaluate the KPI's were discussed and it was possible to have a notion of the values that were expected to be obtained, and from there it was possible to define the values of the parameters. On the other hand, the KPI's for which it was not possible to predict the values to obtain, the parameters were only defined after data collection and elaboration of the KPI's for the period under study. The KPI's evaluation parameters of the performance in the swine production line are:

- KPI 1 - "Good" level for values between 90% - 100%, "Moderate" level for values between 75% - 89%, and "Bad" level for values below 74%;
- KPI2 - through the production history of 2019, it was possible to define the following evaluation parameters: the reference value for the analysis of the by-products production is 17.08%, therefore, the "Good" level is for values below 17.5%, the "Moderate" level for values in the range 17.6% - 20%, and the "Bad" level for values above 20%;
- KPI 3 - "Good" level for values above 700kg/hh, "Moderate" level for values between 600 - 700kg/hh, and "Bad" level for values below 600kg/hh;
- KPI 4 - "Good" level for values lower than 6.5% (which corresponds to stops of at most 4 minutes/hour of production), the "Moderate" level for values in the range between 6.5% - 10%, and the "Bad" level for values higher than 10%;
- KPI 5 - "Good" level for values above 93.5%, the "Moderate" level for values in the range between 90% - 93.5%, and the "Bad" level for values below 90%;
- KPI 6 - "Good" level for values above 200, the "Moderate" level for values between 160 - 200, and the "Bad" level for values below 160;
- KPI 7 - "Good" level for values above 90%, the "Moderate" level for values between 80% - 90%, and the "Bad" level for values below 80%;
- KPI 8 - "Good" level is assigned to percentages above 85%, the "Moderate" level for values between 65% - 85%, the "Weak" level for values between 40% - 65%, and the "Bad" level for values below 40%.

The KPI's evaluative parameters of the performance in the production line of the bovines are:

- KPI 1 - "Good" level for values between 90% - 100%, the "Moderate" level for values between 75% - 89%, and the "Bad" level for values below 74%;
- KPI2 - through the production history of 2019, it was possible to define evaluation parameters for the analysis of the by-product production is 31.12%, so the "Good" level can be defined for values below 31.5%, the "Moderate" level for values in the range between 31.6% - 35%, and the "Bad" level for values above 35%;
- KPI 3 - "Good" level for values above 350kg/hh, the "Moderate" level for values in the range between 200 - 350 kg/hh, and the "Bad" level for values below 200kg/hh;
- KPI 4 - "Good" level for values lower than 7.5% (which corresponds to stops of maximum 4:30 minutes/hour of production), the "Moderate" level for values in the range between 7.5% - 15%, and the "Bad" level for values higher than 15%;
- KPI 5 - "Good" level for values above 92.5%, the "Moderate" level for values in the range between 85% - 92.5%, and the "Bad" level for values below 85%;
- KPI 6 - "Good" level for values above 25, the "Moderate" level for values between 10 - 25, and the "Bad" level for values below 10;
- KPI 7 - "Good" level for values above 90%, the "Moderate" level for values between 80% - 90%, and the "Bad" level for values below 80%;
- KPI 8 - "Good" level is assigned to percentages above 85%, the "Moderate" level for values between 65% - 85%, the "Weak" level for

values between 40% - 65%, and the ”Bad” level for values below 40%.

Table 3 and Table 4 show the result aggregate indicators for the month's production, and for each animal species - pigs and cattle, respectively. Throughout the month of July 2020, there were 22 productive days in the processing of swine animals, and 13 productive days in the processing of bovine animals. The tables present, in aggregate form and for each KPI, which number of occurrences (in productive days, since the analysis of KPI has a daily periodicity) for each level of performance.

Table 3: Performance of KPI's for swines.

Swines			
#KPI	Parameters of performance		
	Good	Moderate	Weak
1	2	11	9
2	8	3	11
3	3	11	8
4	2	18	2
5	2	18	2
6	3	14	5
7	7	13	2
8	-	1	21

For pigs, as Table 3 indicates, the results of the indicators, from in general, have a moderate level trend. It is necessary to find out the causes that lead at least a part of the results not to go to the good level. For indicators with worse scores, it is also necessary to evaluate the reasons. In general, but more with regard to the latter case, it is necessary to evaluate the metrics of performance evaluation in order to assign fair results, that is, if a KPI has a tendency to have many negative results over time, perhaps the parameters considered are too optimistic.

Table 4: Performance of KPI's for cattle.

Cattle			
#KPI	Parameters of performance		
	Good	Moderate	Weak
1	1	4	8
2	7	3	3
3	4	6	3
4	2	2	9
5	2	2	9
6	4	8	1
7	4	1	8
8	-	1	12

As far as cattle are concerned, as Table 4 indicates, the results of the indicators, in general, have a tendency of either good or bad level. It is necessary to ascertain the causes that lead at least a part of the results not to pass to the good level. In relation to indicators with worse classifications, it is also necessary to evaluate the reasons for their occurrence. In general, but more with regard to the latter case, it is necessary to evaluate the metrics of performance evaluation in order to assign fair results, that is, if a KPI has a tendency to have many negative results over time, perhaps the parameters considered are too optimistic.

Typically, the aspects required for a better KPI's performance are related to a well defined set of aspects. These are practically all transversal to the totality of the KPI's since these indicators are of use and evaluation for the same line, and on a general level, the requirements for a good performance are the same for the whole line. These aspects are: speed in the execution of the tasks in each operating station, without jeopardizing the final result; not allowing work to be accumulated to perform; correct execution of tasks in each operating station; frequent maintenance of industrial equipment. At the level of difficulties felt, each KPI presents its associated difficulty. It is normal that in a moving line, the observation activities have associated constraints.

Since Table 1 was studied when the relevant bibliography was surveyed, it is essential to present an identical table for the KPI's developed and validated, also as a summary form. Figure 1 shows the eight indicators developed, and the relevant individual metric parameters: name, target, equation, units of measurement, actions and comments. The other attributes defined below are common to all indicators, and depend on the zone to which they will be implemented.

Objective: performance monitoring and waste control.

Scope: can be applied to any productive zone.

Frequency: measurement should be daily and reporting should be monthly (in the initial phase of implementation).

Data sources: observation of production and shared company files.

Person in charge: responsible for the area where the KPI is implemented.

Once KPI's are defined, their use by the company is supposed to be continuous. Their development was thought as a way to increase productivity and reduce waste. In this case, the possible waste would be at the level of misused time, underused capacities, badly executed operations, etc. Therefore, the purpose of these KPI is also to combat these losses due to misuse of resources. To this end, it is necessary to proceed with the implementation of these KPI as well as the successive control of them, in order to ensure that they meet the intended objective. Regarding the KPI's it is nec-

essary to understand that a month of analysis is a very short period to draw big conclusions. However, the definition of the KPI's is made in a correct and considered way, the eventual adjustments to be made are related to evaluation parameters. The analysis made to the result of all indicators, in a general way, and for both types of animals, is that there is a need to work with more demand so that the best results, because in general are weak.

Name	Target	Formula	Calculation units	Actions	Comments
#1 Task execution time	Swines: 95% Cattle: 95%	$\frac{\frac{tempo\ entre\ 1º\ e\ ultimo\ posto\ real}{nº\ trabalhadores}}{\frac{(tempo\ entre\ 1º\ e\ ultimo\ posto\ esperado)}{nº\ trabalhadores\ ideal}} \times 100\%$	-	Stops; number of line operators.	Measures the productivity of the system to be
#2 Produced SP's percentage	Swines: 17% Cattle: 31%	$\frac{peso\ total\ subprodutos\ animais}{peso\ total\ animais} \times 100\%$	-	Performance of functions.	Measures the performance of the functions performed.
#3 Quantity produced by house	Swines: 700 kg/hh Cattle: 350 kg/hh	$\frac{peso\ total\ produto}{número\ trabalhadores \times tempo}$	kg/hh	Stops; number of line operators; performance of functions.	Measures the productivity and performance of the functions performed.
#4 Inactivity time	Swines: 6,5% Cattle: 7,5%	$\frac{tempo\ paragens\ na\ linha}{tempo\ total\ funcionamento\ linha} \times 100\%$	-	Stops; number of line operators.	Measures the productivity of the
#5 Working hours in production	Swines: 93,5% Cattle: 92,5%	$\frac{tempo\ trabalhado\ na\ linha}{tempo\ total\ funcionamento\ linha} \times 100\%$	-	Stops; number of line operators.	Measures the productivity of the system to be
#6 Average speed of production	Swines: 200 animais/h Cattle: 25 animais/h	$\frac{nº\ animais}{tempo\ total\ funcionamento\ linha}$	animais/h	Stops; number of line operators; performance of functions.	Measures the productivity and performance of the functions performed.
#7 Average speed of production	Swines: 90% Cattle: 90%	$\frac{número\ de\ trabalhadores\ na\ linha}{número\ de\ postos\ de\ trabalho\ na\ linha} \times 100\%$	-	Line jobs; line operators.	Measures the utilization of installed capacity.
#8 *Overall Equipment Efficiency*	Swines: 85% Cattle: 85%	$Availability \times Performance \times Quality$	-	Availability; Performance; Quality.	Measures the performance of the operations performed.

Figure 1: KPI's metrics definition.

6. Conclusions

In this work is studied the performance evaluation of a set of indicators that was carefully developed with the company. The main objective of this study was in the development of a robust and consistent evaluation tool, which would cover the entire range of operations that are carried out in the company, and thus could be transversal to all productive areas.

To approach the development of a new evaluation methodology, a methodology was defined in light of the needs of the problem, which consisted of the following steps:

- Considerations of the company's decision maker for the development of indicators;
- Proposal of a set of performance indicators to be implemented and validation by the indicators management committee;
- Implementation of indicators, analysis and discussion of results.

Thus, in a first stage, the indicators that would best suit the company's needs were analyzed. From this analysis came an initial formulation of a set of indicators that would be useful for the evaluation of the company's operations. After validation by the company's managers, the indicators became suitable to be implemented. The methodology of resolution consisted in applying the indicators of performance measurement, and through the control of the values of the indicators and any procedural changes that could be made, suggest changes that could lead the values of the indicators to more desirable orders of magnitude. A set of eight performance indicators was defined in order to evaluate the company's production processes, as well as the parameters necessary to perform the evaluation of results.

It remains to leave some guidelines regarding the future work to be done by the company. Once the performance indicators have been carried out with the people who watch over the best possible performance of the processes carried out, it is expected that the continuity of the use of the tool developed will be something to be used in order to monitor on a daily basis the performance levels of the processes carried out. It is important that evaluation parameters are defined for each area, and thus that the indicators are implemented to all productive areas. A periodic analysis of results should be made, as well as meetings to discuss them. Whenever necessary, changes should be made that are considered, with a view to also improving the operations management tool's evaluative performance.

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