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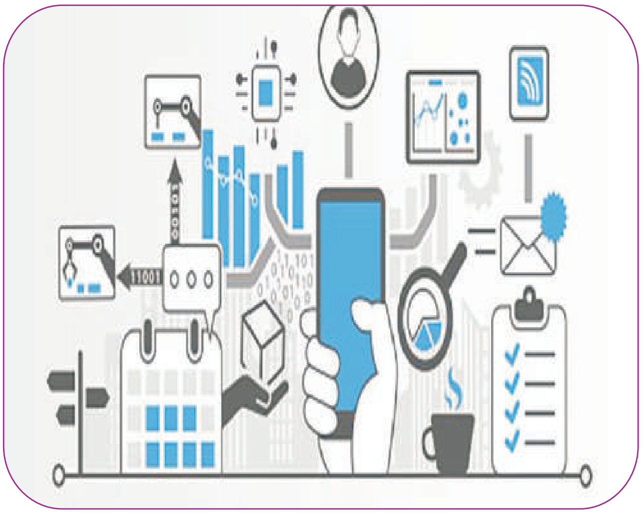
WID SYSTEM REAL TIME MONITORING OF CARDBOARD PACKAGING PRODUCTION IN AN INDUSTRY OF THE INDUSTRIAL POLE OF MANAUS (PIM) - (BRAZIL)



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ABSTRACT

In a manufacturing process it's of fundamental importance that the information of the production process be accurate and reliable. With the technological advance and worldwide globalization of information, it's necessary that industries are well prepared throughout their manufacturing process to produce as many of their products as possible, with low production costs and high quality of the same, because for only in this way, they will be prepared to face the great worldwide rivalry of the highly competitive market. The objective of this work is to describe the Cronos WID real time computer monitoring tool that, after its implementation in the productive process of the industries that have productive processes controlled by cyclical means, help in real time the managers to take the correct decisions as the measures to be adopted for the best continuity of their productions. For this, we used the descriptive methodology that outlines the operation, resources and necessary equipment of infrastructure and software so that the system addressed can contribute positively in the generation of useful and reliable information of the whole productive process of the industry in which said real-time production monitoring system is implemented. As well as, are presented results and discussions on the quality and reliability of the data, the production losses by notes, the efficiency of the production planning, the analysis of the idleness of the machines and, the traceability of the decisions of the managers with the use of the monitoring of the production process in real time with the Cronos WID system in comparison to the same productive control using only controls by means of manual notes. It's concludes that, with the use of the study tool of this work, the results of the products produced show improvements in quality, production efficiency, reduction of costs with waste losses and competitiveness of the same, since it can produce more with lower losses in your process.

KEY-WORDS: *Productive process. Cronos WID. Real Time Monitoring. Quality. Efficiency.*

1. INTRODUÇÃO

With globalization, the great technological advance and the rapid dissemination of the information provided by the communication means, results not only for industry, but also for service sectors, agriculture, among others, have great impacts on the productive or durable goods or services goods. On this way, for companies or industries to remain active in the market if demand productivity, qualities and competitiveness. The information age environment, both for manufacturing organizations and service sector organizations, requires new capabilities to ensure competitive success [1].

In a time of intense business competition, where even simple news can destabilize any competitiveness becomes a preponderant factor in any segment of the productive sector [2]. It's therefore of the utmost importance that develop and apply methods, tools, technologies, means, processes and other means enable them to produce efficiently, quality and cost. In this sense it becomes essential for any organization, whether from the public or private sector, management methods that are effective not only for detailed analysis of all expenditures, but also, in order to obtain efficient performance indicators [3].

In Brazil, the industrial sector represents an index of economic thermometer for the formation of the Gross Domestic Product (GDP). The industrial sector has immense importance in the process of economic growth and development, but it is clear that the participation of other sectors in this process can't be of somehow despised [4]. Therefore, for that industries can develop their activities satisfactory economic conditions, it is necessary that they can carry out with low costs and high productivity of their products.

Industrial production (IP) is considered to be one of the most important of the level of economic activity in Brazil. Although the Gross Domestic Product (GDP) is its main measure, industrial production presents an important differential [5]. While GDP is a quarterly measure, disclosed with a delay of more than two months, the IP is monthly and is disclosed with a delay of slightly more than one month. In addition, the cyclical component of PI is well correlated with the Brazilian economic cycle [5]. This way, PI is a natural alternative for both research that uses monthly data and for analyzes carried out by economic agents, who make decisions in real time and need to obtain recent information on the state of the economy [5].

In abstract terms, productivity is a measure of efficiency in the conversion of economic resources, that is, the relationship between what is produced (goods and / or services) and resources that are used to produce them [6]. The recent literature on real-time data analysis has shown that several measures of economic activity undergo important revisions of data over time, implying limitations relevant to the use of these measures [5].

The main objective of this work will be demonstrate the application of the computational tool of real time monitoring of different productive processes using the Cronos WID software to identify wastes in a production system through the key indicators of the production and to present the efficiency of the tool in the outlet decisions by the factory floor management. As well as, to discuss the importance of the implementation of the supervisory system object of this article for the real-time monitoring of the productive process of an industry of the Industrial Pole of Manaus (PIM) and to show how, where it's applied and what will be necessary for implementation of this system. As well as reporting on the importance of using the information technologies for the monitoring, control and management of the dynamic system of the productive process and to show that the data and information collected from the production process in real time generate the necessary knowledge to implement strategies and management of innovations of products and competitive production processes.

2 LITERATURE REVIEW

We live in the evolving world, where, with the advancement of science and the discovery of new technology, it becomes possible for industries, be they consumer goods or services, to develop their products with quality and competitive costs, thus achieving profit maximization and, conquering new consumer markets. Since the end of the twentieth century, the world has been experiencing a process of profound economic changes, changing patterns of wealth generation, consumer relations and ways of doing business. Facing an increasingly complex scenario, it becomes difficult to remain in the market without seeking excellence in products and services, or wait for the competitor to slow down [2]. [7] Points out that this value that the company needs to generate to stay in the market, refers to what the company can create for its buyers, which exceeds the cost of manufacturing.

With globalization and as a consequence, organizations felt the urgent need for transformation, to seek performance measures, methodologies and practices that would lead to positive results in cost management and also to their organized, planned and managed development and growth [3]. To achieve these goals, the technical knowledge and application of methods are essential for cost management, they are the fundamental basis for a corporation's success and the results are: attitude change, pursuit of excellence, speed in actions and continuous improvement at all levels, in addition to engaging people and awareness of costs [3].

The Achieving better long-term performance is a goal for most companies. Several studies and theories were developed aiming to define the relevant variables and to explain the phenomenon scientifically. Most of these studies define as key variables for their understanding, industry structure, competitive environment, organizational processes and competitive strategies [2].

The increasing competitiveness, the reflexes of the opening of the market for foreign products and the need to optimize results demand procedures of appropriation of indirect costs that make the prices of the various manufactured products more competitive and that explore the tendencies of the consumer market [3].

The social, political and economic environment in which Brazilian companies are inserted, regardless of size, induces challenges by incorporating significant changes that provide greater flexibility and efficiency of the productive processes to maintain the power of competition [8]. The introduction of a methodology for the planning and control of production systems allowed a productive improvement for companies, through the measurement of indicators and results, a search for the reduction of costs and losses within the production chain of the organization [9].

The operation of any business generates costs, which are the monetary value spent by the consumption of resources. For any cost object (industry, product, customer, etc.), the cost can be obtained by adding up the costs of the various resources. In general, these resources are classified in direct materials, labor and indirect resources, that is, manufacturing [10]. Competition among companies is based on the best combination of attributes to be offered to customers. The competitiveness of a company depends on how it combines five attributes: quality, speed and reliability, flexibility, innovation and cost [11].

The organizations lack efficient tools to be used in business management processes. In any circumstance, it is always possible to contain costs, either by the rationality of the tasks, by the relentless combat to the wastes and by the elimination of the superfluous ones. The good management of costs in the companies is dependent and consequent of the decisive courage of the administrators in changing processes and behaviors [3].

As in the Private Sector, the Public Sector needs tools to evaluate its processes, always aiming for continuous improvement in the execution of any day-to-day operation, as well as in the follow-up of administrative processes, and the expenses arising from it [3].

The Public Institution is constructed over time, in this way, is changing as political, economic and cultural changes are happening, they are the fruit of social movements and their political elites [12].

In order to establish in the PIM and to produce with federal tax incentives, every company must obtain approval of an industrial project in SUFRAMA, which must meet, cumulatively, the following basic conditions: contingency to the approved annual import limits, increase in the supply of employment in the region, granting of social benefits to workers, incorporation of technologies and production processes compatible with the state of the art and technology, increasing levels of productivity and competitiveness, reinvestment of profits in the region, investment in training and human resources training for the scientific and technological development, attendance to the Basic Productive Process - PPB and regular fiscal situation.

3 MATERIALS AND METHODS

3.1 WID CRONOS SYSTEM

For the preparation of this work, a study of a case with the implementation of the monitoring system of the a real-time production process of a factory producing cardboard packaging boxes at the Manaus Industrial Pole (PIM), using the Cronos Waste Identification Diagram (WID), a visual tool developed in the Production and Systems Department of the University of Minho in Portugal, whose main purpose is to represent in real time through blocks and arrows units of production of any productive process that has cyclical machines, that is, it has a standard production cycle for a given product.

And, in an intuitive and friendly way, it can obtain the data from the production machines by means of a Human Machine Interface (HMI) and stores such information in a database server so that they are handled, and the excess resources production indicators followed by other indicators and important production data. Thus, with the information collected from productive machines through Programmable Logic Control (PLC), they can describe the main characteristics of current conditions of a given production system, evaluate their performance and identify their wastes such as: Waste with use of labor, in transport, movements, waiting, rework, etc.; Inventories of raw materials, materials in progress and finished product; Losses with quality and inefficacy in the use of equipment; Efficiency losses Overall Equipment Effectiveness (OEE) for unplanned outages due to faults, setups, lack of equipment, etc.

With the factory production process being monitored in real time, it becomes possible to effectively add greater competitiveness to the products produced, adding to the company greater profitability of its products. Competition among companies is based on the best combination of attributes to be offered to customers. The competitiveness of a company depends on how it combines five attributes: quality, speed and reliability, flexibility, innovation and cost [11].

3.2 NETWORK ARCHITECTURE AND SYSTEM DESCRIPTION WID CRONOS

For the WID system be implemented in a production process, it's necessary a physical (data networks) and logical (Database and operating systems) installation. For the part of the physical installations, the HMIs or PLCs are installed, which in turn collect information in real time through an electric pulse obtained from a relay, which represents the operating cycle pulse of the machine. That is, the actual production cycle of the machine.

With the production cycle obtained from the electrical signal of the relay of the machine to be monitored, the information is processed by the PLC and sent to the database server by means of an RS-485 type data transmission network.

The pattern TIA / EIA-485, known as RS-485, describes a communication interface that uses balanced data transmission over one or two pairs of wires to establish communication between 32 "load units". Generally, each network device (Transmitter and Receiver) corresponds to a "unit load", resulting in a network of 32 devices. New devices may be fractional, increasing the number of networked devices allowed. RS-485 networks generally communicate using a twisted pair of wires, where data flows in both directions. Each device connects its line driver only when data, and keeps it off (in high impedance state) for the remaining time to allow other devices to transmit. Only one device can transmit at a time, which is called a half-duplex operation. RS485 networks can also operate using 2 pairs of wires, in full-duplex mode, as described for RS422.

The pattern RS-485 allows the implementation of point-to-point and multipoint systems. Only 2 wires are required for communication, they are used to transmit the signal, where one wire carries the inverted signal from the other. This allows for a stronger electrical signal, consequently greater distance in communication. A wire for the common signal is also available. Each network allows at least 32 devices to communicate without the need for repeaters. The maximum allowable network distance is up to 1000m.

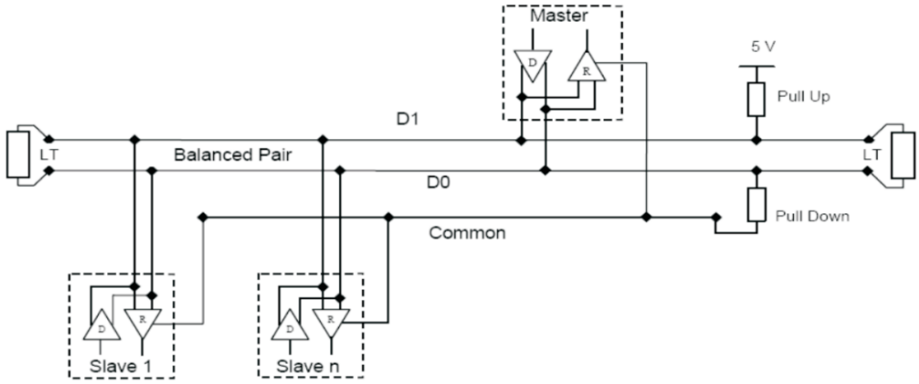

Figure 1: Electrical connection of an RS485 network. Source: [14],(2006).

The Machine data acquisition is based on the use of programmable logic controllers (PLCs) installed on a machine to be monitored by the Cronos WID system, which, in addition to being interfaces for sensors and actuators responsible for automatic machine data collection, also have a keyboard and display that aims to become a Human Machine Interface (HMI) that will assist the employee who operates the company's production machine for manual data collection and information visualization.

After the information, be collected by the CLP, it's sent to a Structured Query Language (SQL) database server, structured query language, so that the information is handled by the Cronos WID system. This database server is based on the client-server architecture, that's, where the processing routines of the analysis of the data collected from the production process are written in store procedures in the database, and allows only the query data, made by the Cronos WID software through the monitoring terminals, to travel in the corporate network, while the processing, which requires more hardware performance, is done in the database server, making possible greater reliability in data integration and better performance for accesses made by monitoring terminals.

The SQL (Structured Query Language) language, used to query the database, provides a series of functions that can be used for calculating statistics, such as SUM for the sum of values and AVG for the average. More complex statistics, such as the standard deviation, are also supported by some DBMS [15].

With the information already stored in the SQL database server, they're treated and provide a lot of information to the managers through the monitoring terminals, which are workstations that can be installed in the most diverse areas involved in the process and productive control from the company.

Only through the monitoring and supervision of production can the performance of a production system be evaluated. For this it is necessary to collect the data of the production and to control them. The greater the degree of information controlled by production management, the greater the capacity of the team to visualize losses that are hidden behind indicators that are not controlled [16].

In a productive environment, the lack of reliable factory floor information creates a perspective that does not portray reality. Monitoring that provides information quickly and reliably can be a great differential in maintaining the competitiveness of manufacturing companies [17].

The Production monitoring systems that are responsible for generating information on the shop floor are becoming unavoidable due to the demand for quality and speed of this information [18]. The use of sensors installed in the production equipment can be integrated to systems that create information in graphic form and in real time for process monitoring [19]. In this way, (Figure 2) demonstrates the physical data network (hardware) and logical topology (software) necessary for the operation of the WID system.

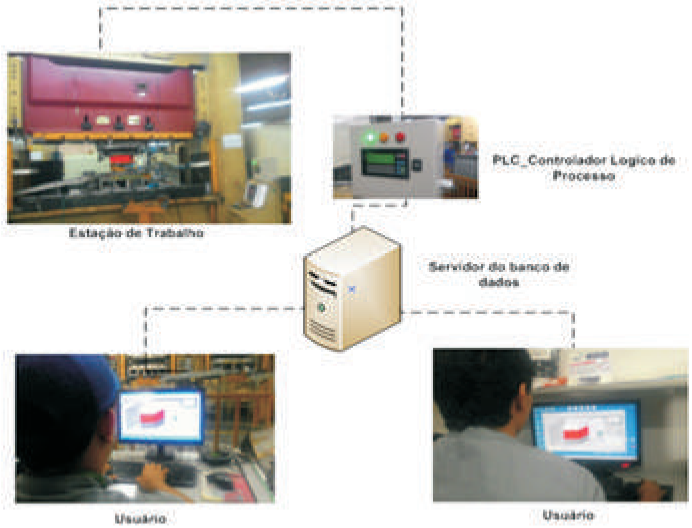

Figure 2: Hardware and Software topology of the Cronos WID system. Source: Authors, (2017).

3.3 GRAPHIC REPRESENTATION OF THE WID CRONOS SYSTEM

With the implementation of the monitoring system of productive process machines through the Cronos WID system, it's possible to have a 3D visualization by the managers involved in the process, all the machines of the productive process of the company. Such machines being represented by means of a block diagram (Figure 3) in which, each block represents a production machine of the plant and the system having the capacity of setting up to 32 machines / blocks for each manufacturing unit. This limitation number is directly associated with the hardware platform RS-485 device drivers, where the limitation of the network device is limited to this number. However, if it's necessary to monitor machines in a factory park with numbers greater than 32 machines, then another RS-482 network controller device must be installed, thus expanding the duplication capacity of another 32 machines as each network controller is added RS-485.

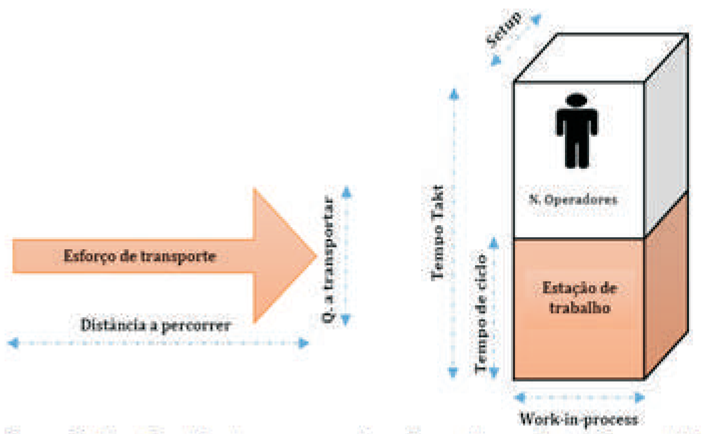

Figure 3: The Graphical representation of machines of the Cronos WID system that reports on an isolated workstation. Source: Authors, (2017).

The main purpose of the Cronos WID system is to represent in real time the production process of the monitored machines by means of a block diagram capable of representing the entire production units (machines), not only by a flow of a particular product family , as well as represent all the production flows in the production unit; display and evaluate all types of waste in a visual and intuitive way; provide effective visual information; provides performance information; be a reference tool for continuous improvement. Thus, adding values to the company's production process. Every process must, necessarily, add value in the perception of process clients. Adding value means that the output of the process has more value than its inputs considered individually, or in its entirety. The process should add something to the inputs, so that the output has a larger value than the inputs. This higher value in the output is the customer's perception regarding value aggregation in the process [20]. The management of the productive process is the coordination of integrated activities that seek the results of the business as a whole [21].

The steps of the Productive Process can be considered industrial sub processes and interact with each other with characteristics of customer and supplier. The interaction of the entire operational sequence depends on the work efficiency of each of these stages and the synchrony that exists in their relations [21].

Then, in the Cronos WID system, the productive process of the company's production machine is made by the physical representation of the block through its three-dimensional dimensions (x, y, z axes) that presents different information regarding the production process of the machine that is being monitored. This physical dimension of the block (Figure 3) comprises 4 distinct data types, namely: The width (x-axis) of the block indicates the amount of parked material to be processed in which units can be assumed: kg, cubic meters, or any another unit of the International System of Units (SI); The total height (y-axis) of the block represents the takt time (TT) and the height of the lower part of the block is considered the station time (TE).

The difference between heights represents the available or idle capacity of the machine; The measure of the depth (z-axis) of the block represents the time between product exchanges (setup) occurred in the workstation itself; The arrow is intended to represent the waste with effort to transport the products on the factory floor and assumes the following units of measurement: kg per meter, liters per meter, products per meter or any other unit of the International System of Units (SI). Note that the thicker the arrow in width and height, the greater the incidence of waste in the process in question. Therefore, in order for a production system to be as efficient as possible, all the dimensions (x, y and z axes) are as small as possible.

3.4 WID CRONOS SYSTEM IN PRODUCTION

Once the deployment of the Cronos WID system with the adjustments and functionalities of all the Software and Hardware requirements necessary for the system to work properly has been completed, it is necessary that after that step, the Cronos WID system is definitively set for production. That's, it's at this stage that the system will effectively work with all the resources it provides so that it can meet the improvements of the productive process of the company's machines.

To do so, it works together with all the areas involved in the company's production process. With the production orders properly planned, they'll be inserted into the Cronos WID system and from that moment the system will be monitoring in real time the productive process of the machine in which it was prepared to work together with Cronos WID. Production planning is based on demand forecasts and customer orders and aims to adjust production capacity to demand-driven needs, establish minimum stock levels consistent with targets, and ensure delivery time of orders [22]. The main objective of planning is to specify the optimal production rate, the required labor force and the stock of materials [23].

Production planning should be done by adjusting production rates, work schedules, inventory levels, overtime, subcontracting, and other controllable variables. In addition, a number of other factors must be taken into account, which pass through a workforce and appropriate equipment. If even minimal production can't be met, overtime, subcontracting or temporary work must be used [24].

The Cronos system was allocated in production in the production machines of a manufacturing unit of the Industrial Pole of Manaus (PIM) that produces cardboard boxes for packaging, according to the reality of the company's production planning, for a certain order of production of cartons (Figure 4).

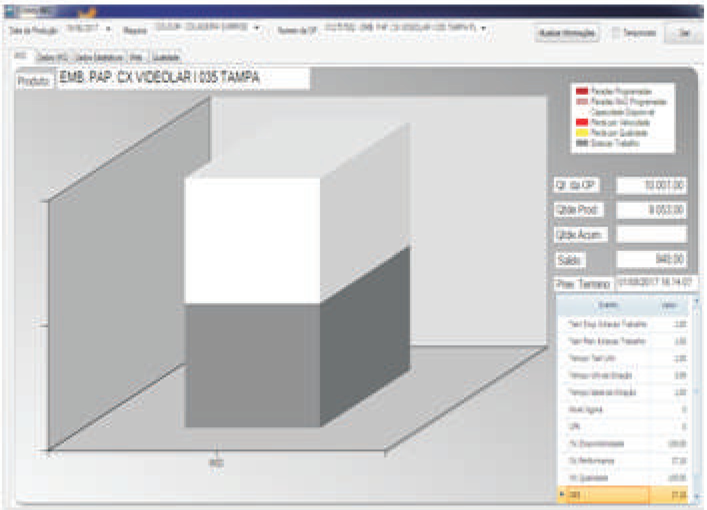

Figure 4: WID Cronos system. Source: Authors, (2017).

It can be observed by the real-time monitoring of the production process of the machine the evolution of the effective productivity that occurs instantly on the factory floor. Where, in the Cronos WID system, there are five separate tabs (WID, WID Data, Statistical Data, Web and Quality) for obtaining production data that the system provides to managers in real time.

3.5 DESCRIPTION OF THE WID GUIDE INFORMATION

For the WID tab, you can obtain various block data represented in color, to know: Scheduled Stops (Brown Color): Describe the time required for stopping the machine for previously planned activities, such as: stop for lunch, stop for setup, stop for preventive maintenance. Maintenance is the term used to address the way in which organizations try to avoid failures while taking care of their physical facilities, being an important part of most production activities, for example, the role in its production process [25].

The maintenance has the objective of to keep facilities operating under the conditions for which they were designed and also to intervene when these conditions cease to be ideal, so that they return to normal operation. Next, the types of corrective, preventive, predictive and total productive maintenance will be specified [27].

In the preventive maintenance, the main objectives are the reduction or even elimination of the probability of the occurrence of maintenance failures that could cause malfunctions in the operation of the equipment following a pre-established and systematic schedule (cleaning, lubrication, checking and, if necessary, replacement of components which present unsatisfactory conditions for the operation of the equipment) [25].

Unplanned Stops (Grey Color): This type of stopping is what most should be avoided in a production process. It occurs for a variety of reasons, such as lack of material, lack of production planning and, when the machine is defective, there is a need to activate the factory maintenance team to perform the purpose of putting the machine to produce again in the shortest period of time, since, with the machine stopped, consequently the results of the production will be negatively affected.

The corrective maintenance is the exercise of equipment operation so that interventions to correct failures occur only after failure [25]. This is a reactive measure, since it acts after the problem occurs [27].

The Cronos WID system detects and makes available to the managers in real time this type of stop, so that they take the correct decisions to eliminate these stops of the productive process of the company, causing the machine to return to produce with effectiveness in the shortest time machine downtime.

Available Capacity (Color Banking): Represents the capacity available for production of the station / machine.

That's to say, with this information, managers can have a broad view of the production capacity of their manufacturing plant and, based on the information, decide whether or not there is a need for investments in new equipment to increase production.

The productive capacity consists, at the maximum level of activities - or quantities of a product - value added, in a certain period of time, that a process can perform under normal operating conditions [25]. In order to increase productive capacity, it is necessary to analyze all the factors capable of restricting it: equipment capacity, hours available for production, installations, product mix, process sequence, human availability and training, financial resources, inputs used, the influence of external factors such as the quality required for the products and the relevant legislation [26]. In the case of the Cronos WID system, it provides information to managers usually used to increase the variable availability of machine and its useful life.

Loss of Speed (Red Color): This type of loss occurs due to the loss of the efficiency of the machine's production cycle, that is, it starts to work with a production cycle much lower than the production cycle defined by the Consequently, such losses will affect the company's productivity and profits as a whole.

The objective of the companies is the total elimination of losses, however, so that this objective can be achieved it is necessary to attack the root cause. They add that the control of root causes is the differential for the company to obtain gains, both in productivity, as well as in quality, cost and safety [28]. Therefore, the Cronos WID system monitors these losses in real time and provides sufficient data to managers to minimize such losses.
Loss by Quality (Yellow Color): As well as the loss by speed, the loss due to quality will also affect the final objectives of the company, which always aim at increasing profits with increased productivity and reducing costs. There are countless tools in the market that can measure such losses, among which we approach the loss tree.

It's an approach based on the search for competitiveness in the industry, in the application of this methodology the main focuses are the productive processes, where there will be the maximization of production by the elimination of losses, this methodology leads companies to obtain competitive advantage, considering that generates increase in productivity, in quality and especially in the reduction of production costs, also obtaining optimization of processes with the elimination of losses [29].

Work Station (Gray Color): This information is the one that informs the managers in which cycle time the machine is actually operating, compared to the cycle time previously determined by the engineers.

Beyond the information previously described, the Cronos Wid system also provides a summary of important information to the managers of the manufacturing process, namely:

The total quantity of the planned production order; the quantity of products produced to date; the balance still to be produced to finalize the production order; forecast with due date and time for the end of production of the planned products; station time; ideal season weather; % availability, performance and quality; OEE and others.

3.6 DESCRIPTION OF THE INFORMATION IN THE WID DATA GUIDE

It allows to extract from the system important information of the productive process such as:

Unscheduled stops: Describes all stops not provided for in the process, and filters can be performed per hour of start and end of the stop, and it allows to view the subtotals of unplanned hours for the production process, as well as the reason that led to these not planned stops.

Scheduled stops: It allows the managers of the manufacturing unit to view all the stops that were previously programmed to be carried out during the production process. Also, it becomes possible to perform the same filters described for not planned stops.

Withdrawals: Allows you to view the quantitative data of the products that were produced with refuse.

Production: It allows to have information available in real time referring to the production actually planned, with date and time of the beginning of production, as well as the date and time expected for the end of production based on the previously defined process cycle time and also, the quantitative of the production until the current moment.

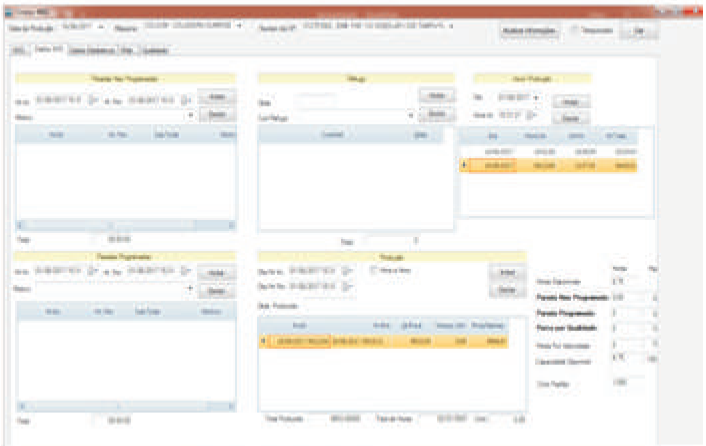

Figure 5: WID Tab. Source: Authors, (2017).

3.7 DESCRIPTION OF THE INFORMATION ON THE STATISTICAL DATA

It allows to have an effective control in real time through the histogram in vertical bar graphing, the frequency distributions of the standard cycle previously defined by the process engineering team. Through the information generated by the system through the graphics, it is possible to effectively evaluate the behavior of the work cycle that the machine in question is working.

Figure 6: Statistical Data Tab. Source: Authors, (2017).

3.8 DESCRIPTION OF THE INFORMATION IN THE STATISTICAL DATA GUIDE

The WID makes it possible to have effective control of the quality process being produced at the factory, using the already established method, 6 sigma 5W2H.

The six sigma programs are raging across corporations around the world, with some companies citing savings in $ billions resulting from the implementation of six sigma. The six sigma has proponents and detractors with some arguing that nothing new is involved and others who identify it as revolutionaries. The view advocated here discusses six sigma as a methodology within the larger structure of total quality management - a mixture of old and new in the sense that six sigma tools are often familiar but are applied with an eye that is more strategically focused on what the historical use of these tools typically indicates [30]. To know:

What: Makes it possible to define the real need of the action to be taken, that is, what should be done as a priority at the exact moment. Defining the activity to be performed so that the process is not negatively affected by an action that, if not performed immediately, will have negative consequences to the process.

Why: Justifies the need to take immediate action to correct and / or improve the process, due to a problem previously identified and that is directly or indirectly affecting the company's production process.

Who: Allows you to define which direct responsible person should perform the previously defined activity that needs to be corrected and / or improved.

When: Once the problem has been identified, the need for correcting the problem is justified and the person responsible for correcting the problem is defined, it is necessary to define the initial and final time for the problem to be remedied and / or improved.

Where: Defines where the action will be taken to correct and / or improve the problem, so that once corrected or improved, the expected objectives are achieved and can bring improvements in the productive process in which it is being implemented corrections and / or improvements.

How: In order for there to be no errors when performing the action to be corrected and / or improved, it is necessary to define means that will allow how the previously identified problem will be corrected or improved.

How Much: It is necessary to quantify the monetary value to be used to correct or improve the problem. For if the required courses are not reserved, the expected objective is not realized because there is no previous planning of financial resources to carry out the task that is impacting the results of the company's production process.

Therefore, in order to achieve the desired results with success, it is of fundamental importance to plan the actions described above.

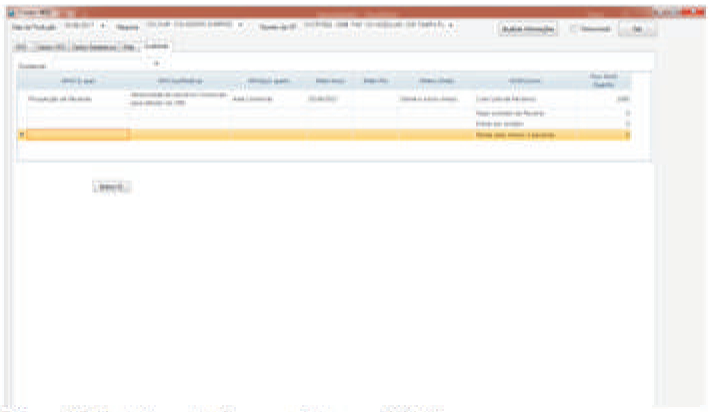

Figure 7: Quality tab. Source: Authors, (2017).

3.9 MANUAL MANUFACTURING POINT AND AUTOMATIC POINTERS

It's evident that, in order for the productive process of a company to succeed, several factors must be observed and addressed. These include planning and production control (PCP).

The PCP is the management function related to planning, directing, and controlling the material supply and process activities in a company [31].

Effectively managing the flow of material, the use of people and equipment, and responding to customer needs using supplier capacity and internal structure is an essential task of the PCP system. The PCP system provides the information from which managers make effective decisions [32].

The main objective of the PCP is to compare what was accomplished to what was planned and to provide means to make feasible the production plans. Based on this check, you can provide feedback to planning, known as feedback. Thus, it becomes possible for deviations and errors to be detected, allowing the elaboration of new plans or the revision of existing ones, and also allows to form a historical basis to be used in future planning [33]. In order to do so, it's necessary to carry out the production notes, in order to ascertain if the actual production results are consistent with the results sought by what was done by the PCP. Then comes the need to perform production notes.

There are several types of data collection and recording of production, namely: manual pointing; with data collectors and; automatic collection [34].

The manual pointing is very functional and recommended for long lead time operating environments where there is little physical evolution of production, low daily production volumes and low collection frequency, but it has several disadvantages, such as: collection and recording of data; The lower the registration frequency, the longer the data will be known; Increase in the cost of labor due to the time required for appointment; Needs of parallel controls due to not making all the information available on the pointing forms [33]. Here in this work, one of the several means of manual pointing is shown, by means of tables (Figure 8).

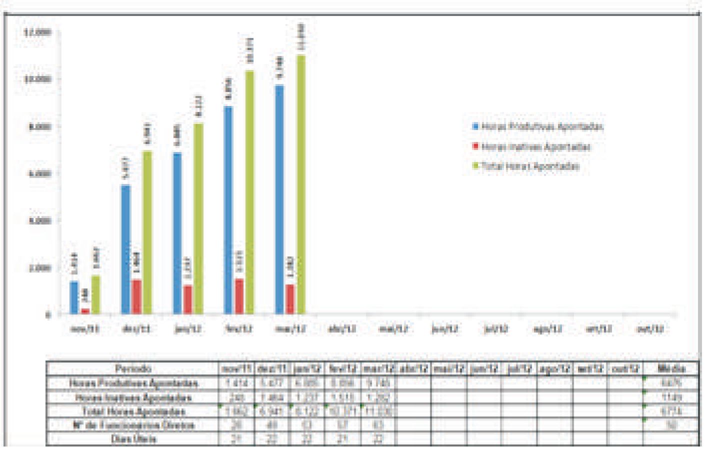

Figure 8: Manual pointer for the evolution of hours indicated. Source: [35] (2012).

However, for the problems of manual pointing to be minimized or even eliminated, it's that the industries committed to the quality and productivity of their products, invest in notes of production through tools that perform the pointing with automatic collectors.

The data collectors are characterized by the use of electronic sensors to capture data, or those operated instead of manually registering information operate data collectors that operate the collection process through bar codes. This type of advice is recommended for environments with a considerable amount of handling and processing of products on the factory floor [33].

In this sense, the Cronos WID system presented in this work is a system aimed at solving the problems presented by the type of production control that uses the manual notes, that is, it's a system that minimizes and, in many cases, eliminates the problems of the production control that uses the manual notes.

4 RESULTS AND DISCUSSIONS

In order to obtain the first incipient results of the performance of the Cronos WID Six Sigma prototype, it was necessary to carry out real experiments with the prototype in a stamping machine in a metal parts manufacturing company for microwave ovens. The information contained in the table below was obtained through the comparison made by managers of the company itself, where the efficiency of the manual pointing method that is currently used with the Cronos WID Six Sigma real time data collection system was compared.

The figure 9 has the objective of to present a qualitative comparison of the results obtained from the notes, followed by the analysis, discursions and conclusions of the application of this new monitoring and information control model as a potential tool to solve waste problems and support floor management of decision making in the day to day that contribute to the continuous improvement of the productive process.

MONITORING WITHOUT CRONOS WID REAL TIME

- The quality of the data doesn't express reliability due to the lack of attention and availability of the operator in keeping records records permanent. There are also errors when these are transferred to spreadsheets and slow response speed.
- The losses pointed out by the operators do not match the reality of the events that occurred. This creates daily discussions between managers.
- The Company Planning Department has difficulty performing the analysis of machine availability losses because it does not have a reliable data source.
- The Information when transferred to spreadsheets is archived and is used only for auditing purposes.
- The model doesn't allow you to analyze the idleness of the machine.
- The model doesn't allow access to the control and measurement of stop losses and traceability for decision making.
- It doesn't provide any visualization of the economic performance of the unitary production of the products in the machine.
- Difficulty in prioritizing efforts for the root cause of time losses with stops.
- The record of occurrences is done in files manually and are not recorded at the time of occurrence. The next day, the files will be transferred to the spreadsheets.
- The quantities produced are manually pointed out by the operator and the values do not correspond to reality.

MONITORING WITH CRONOS WID REAL TIME

- Increased reliability of information and reduced time to response to occurrences of time-consuming Workstation because it is a real-time monitoring model.
- It identifies through a diagram and intuitively the main losses, allowing a quick intervention "blocking" before the impact is much greater.
- It intuitively enables you to evaluate and compare the impact of planned and unplanned outages on the loss of machine and equipment availability.
- Innovative view and in real-time display of available Takt, Takt Planned, and Takt Useful indicators, Allowing the manager to decide what actions to take with stop occurrences to ensure that the production plan in the machine is completed and with the best efficiency.
- Through the diagram it is possible to visualize in real time the idleness of the machine "available time" dedicated to produce the product.
- It presents in an easy and intuitive way the effective time of unit production in the workstation, bringing together a set of key and real-time indicator variables: quantity produced, quality losses, speed losses, cycle time and machine time or equipment for planning purposes.
- It allows to visualize in an "easy" way the comparative of the economic result of the unit cost of production per hour, per shift, per day.
- Reduction of the loss of time with stops of machines, equipment and people.
- The system automatically monitors, records and detects occurrences of producing machine and machine stopped at all times and then stores the history of the data in an electronic medium to enable further actions.
- Automatic counting of quantities produced and control of the production order and easy Integration with management system (ERP).

Figure 9: Comparison of results obtained with the WID. Source: Authors, (2017).

5 CONCLUSIONS

It's a fact that in the globalized market in which the world is inserted, companies seek the best use of the installed machinery in order to reduce investments and production costs, thus seeking to increase productivity with the lowest possible cost of production. This work evidences that with the use of the Cronos WID real-time monitoring system, it's possible to achieve the goals sought by the industry, that is, increase production and reduce costs.

It's of very importance that the management of the production process is continually improved. However, routine methods with handwritten records present a number of problems, in terms of time for operators to note, slow flow of information, involvement of many people in the process, risk of incorrect notes, lack of follow-up production histories, among others. All these problems compromise the immediate and correct decision-making of managers based on reliable information.

The Cronos WID real-time monitoring system overcomes the problems of manual pointing, since the information about the production notes are made available in real time on the screen of the managers' computer, minimized risk of error, then facilitating the rapid dissemination of the information and significantly improving the information management of the company's production process.

The Production managers and all those involved in the production process support team have access to the same production information in real time, through tables, graphs and a wide variety of reports that the system makes available, making it an important tool for the management of the productive process and, aiding with clear and reliable information the decision-making and identification of productive losses by the managers of the company.

With the completion of this work, it was verified that the system (Cronos WID) provides productive gains as well as, it significantly helps the production managers with the information of the data of the production line, thus facilitating the process of decision making and improvement in the dispersion of the information about the production process. Enabling the company to achieve success with the deployment and use of new machine monitoring technology. Providing thus, improvement of the available productive capacity not used in the machines and equipment; accuracy in equipment maintenance planning based on performance presented by OEE indicators; increasing the efficiency of production in manufacturing, reducing waste with the use of labor in transport, movements, waiting, rework, etc; improvements in the inventory of raw materials, materials in progress and finished product; reduction of losses with quality and inefficiency in the use of equipment; improved efficiency losses of OEE due to unplanned outages due to faults, setups, lack of material, among others.

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