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ANALYSIS OF TIMES AND MOVEMENTS IN THE PANEL MANUFACTURING PROCESS

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Abstract: The project was carried out in the board production area of a forestry company, this area receives the sheet metal from the dryers in order to improve it and remove the greatest number of imperfections it presents and thus obtain views of different types, they are processed and They assemble the various boards for both interior and exterior in their different thicknesses that are marketed among their clients. During the execution of this project, the patching area was analyzed, taking ten samples and later changing it to thirty, in order to have a more representative sample during the process. The number of leaves that were patched and the number of patches that were placed on each leaf were determined, obtaining averages of patches per leaf and the time required to patch one leaf. It was possible to increase the production of sheets by approximately 25% per hour, achieving as a result a higher daily production and with fewer movements for the operator. The causes that originated dead times were determined and solutions were presented. In the gumming area, the standard armed time was determined for each type of thickness in each of the gummers. The gumming cycle was analyzed, taking into account the press area to determine the loads per hour and dead times that occurred. Finally, data was collected from the patches that were detached from the already patched sheets, according to their classification, obtaining production indices from each of the operators.
Keywords: Productivity, time study, standard time

INTRODUCTION

The statistical yearbook of forestry production (2020) indicates that, in Mexico in 2017, the farms authorized to produce wood, its derivatives or any non-timber product exceeded 14,000, providing jobs, income and a production that exceeded 10,000. millions of pesos. The forestry industry in Mexico has historically been concentrated in the regions where the coniferous forests are located, the largest amount of forest extraction has occurred mainly in the states of Durango, Chihuahua, Michoacán, Oaxaca, the State of Mexico and Jalisco.

Berrospi and Herrera (2014) indicate that the inefficient use of the raw material that occurs generates social, environmental and economic problems, therefore the need to carry out research that contributes to the correct use of the forest resource. The creation of goods and services require the transformation of certain resources, and the relationship that exists between this input and output is called productivity, as expressed by Heizer and Render (2009), being vital for companies to improve this rate.

For Chase, Jacobs and Aquilano (2009), productivity indicates how well resources are being used in the organization. Measuring productivity is essential, because that way organizations can know the performance of operations. According to Heizer and Render (2009), productivity depends on three factors or variables, such as: labor, capital and administration.

The company that is the subject of the study is dedicated to the manufacture of boards derived from wood, one of the main problems encountered is that there is no standard form of work at the time of making these boards, which causes operators in the same area work in different ways and do not show the most favorable results. A study was carried out to help the company find out the errors caused by these actions, in order to improve and control the time standards in the three main production areas (patching, gumming and pressing).

When analyzing the situation of the company, it was found that there is no system or specific monitoring of the production

process, that is, the processes and methods used are very empirical, this means that each worker performs an operation as best facilitated, Since sometimes the operator loses time or the work method has unnecessary movements, this implies that he does not perform his function correctly.

In recent years, a technological advance has been presented, allowing a rapid and substantial development of the study of times and movements, which has facilitated the work of operators and analysts, providing greater precision, speed of application, as well as more reliable, understandable and accurate results. rapid. Hodson (2001) defines time study as a procedure used to measure the time required by a skilled worker who, working at a normal level of performance, performs a task according to a specified method. García, R (2005) defines work sampling as: "a technique for quantitative analysis in terms of time of the activity of men, machine or any observable condition of operation" (p. 250). These observations are made randomly, and it has advantages over other methods since it is easy and does not require much time.

Niebel (2009) affirms that the use of more sophisticated tools such as time recording machines, video and cinematographic cameras in combination with equipment and computer programs, are successfully used while maintaining some advantages with respect to the stopwatch. For Niebel and Freivalds (2009), standards are the objective of time study or work measurement. This technique makes it possible to establish the standard of time that an operator must be allowed to carry out a certain task or activity, with due consideration of fatigue and unavoidable personnel delays (tolerances). The fundamental purpose of work measurement for Chase, Jacobs and Aquilano (2009) is to establish the times that serve as a basis for the proper management of resources.

The analysis of operations, according to Niebel and Freivalds (2009), is the study of the productive and non-productive elements of an operation, with the aim of improving productivity per unit of time and thus reducing unit costs. This analysis seeks to establish the different components of the process of the current and proposed method.

The analysis of times and movements in the different production lines allows determining work standards in order to optimize time, resources, materials, tools and supplies that are used in said company. Currently, the company does not have a standardized work method in the aforementioned lines, which is why there are large variations in time with respect to the work that is carried out, generating large waste of material, time and tools.

METHODOLOGY

The research developed was applied according to its purpose, since it solved a real and practical problem. The focus of the research carried out was quantitative, since the data was examined numerically, especially in the field of statistics. According to the data source, it is documentary when carried out in an orderly manner, with precise and field objectives (in situ) when it is developed in the place where the object of study is located. The scope of the research is descriptive since it collects, measures and evaluates the data independently of the phenomenon to be studied and explanatory because it details and discloses the results of the investigation. The design was focused solely on the molding process of the company, not being possible to assign or control the elements that participated randomly (human resources, type of machines, processes).

During the project, the patching area was analyzed, taking ten samples and later changing it to thirty, in order to have a more representative sample during the process. The

number of leaves that were patched and the number of patches that were placed on each leaf were determined, obtaining averages of patches per leaf and the time required to patch one leaf. The causes that originated dead times were determined and solutions were presented. When this information was obtained, the gumming area was analyzed, the objective was to obtain a standard armed time for each type of thickness in each of the gumming machines, the gumming cycle was analyzed, taking into account the press area to determine the loads per hour and dead times that occurred. Lastly, data was collected from the patches that were detached from the already patched leaves, according to their classification, to obtain production indices for each of the operators.

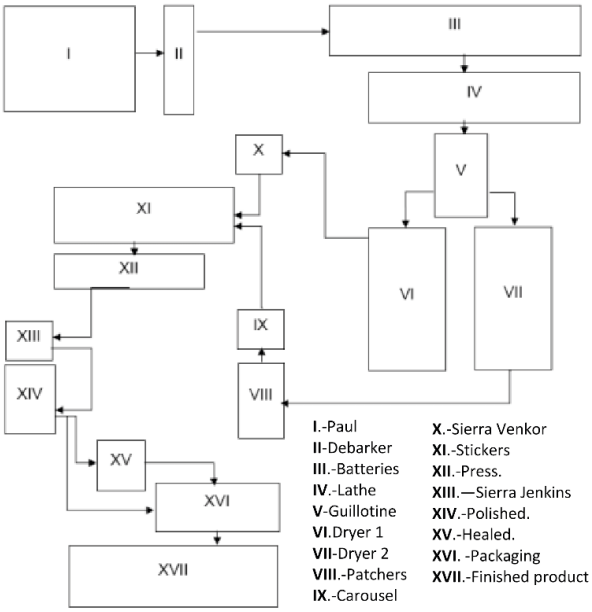

Figure 1. Plant layout

Source: own author

GOALS

The objective of the project was to improve the productivity indicators in the patching, gumming and pressing line, using process reengineering tools, establishing a method and monitoring and controlling the proposed production standards. The causes that originated dead times were determined and solutions were presented.

PROCESS RECOGNITION

In order to start with the analysis of the times and movements, it is necessary to know the process in depth, for this a survey was carried out that shows the Description of the distribution of the current plant of the different departments or areas of activity related to the production process. manufacturing (Figure 1).

An analysis was made through a time study of how the work will be carried out in the plant and its different areas involved in the process used. The study was timed in minutes and seconds, and the data was recorded in previously prepared formats for each of the areas.

The patching area has several patching machines. The study of each one of the patchers was evaluated per hour, the operator was observed and analyzed during a certain hour to know how many sheets are patched and what is the patching method of each one of the operators, the observations will also be placed. Once the observations were taken, the factors that are generating delays or defects in the process were determined, being the basis for the standard work method to be used, allowing to reduce delays or defects and give the respective follow-up until the operators do not make mistakes.

The gluing area has three gluing machines, the study of each one was also evaluated per hour, observing and analyzing the operators during a given hour to find out how many

boards are produced and what delays or dead times occur, determining the factors by which are generating delays or defects in the process and with this the standardization method and its follow-up were carried out to confirm said improvements.

RESULTS

To obtain the times in this area, an hourly study was carried out in patchers 2 and 3, since they are the ones that are constantly working in two crews, in order to indicate unnecessary times, the results are presented in Table 1.

Patcher	Color	Average patches per sheet	Average time per sheet	Time-out	Total sheets
2	Red	7	113	9.16	26
3	Red	7	94	0	24

Table 1. patching area times

Source: own author

PROPOSED METHOD IN PATCHING AREA

Inside the plant, the people in charge proposed a change in the tape. The work method consisted of working with a 3M ¾" x 60 yards masking tape, the data was collected with the implemented method, obtaining the values shown in Table 2.

Patcher	Color	Average patches per sheet	Average time per sheet	Time-out	total sheets
2	Red	6	64	16.93	41
3	Red	6	56	22.46	35
2	Blue	8	151	104.48	14
3	Blue	4	70	63.03	22

Table 2. Patching area times (proposed method)

Source: own author

The sampling for patcher 2 blue color showed that the material is in very poor condition, the leaves are dry and many of them are also broken, this makes handling them more complicated and the operator must be more careful when moving them. At the time of working under equal conditions, that is, with the same material in both work methods, if a significant change could be found, when the proposed work method was used, it resulted in the removal of four to six more views per hour.

A data collection was made in the gumming area with the purpose of determining the assembly times of the boards, and the presence of delays or dead times with the current method, was considered for the thicknesses of 17/32 and 23/32. a load of 10 boards while for thicknesses of 15/32 it was 20 boards presenting the results shown in Table 3.

gluer Thi-ckness	Color	Average time per Board (min)	Time-out	Total boards	Time per charge
1 17/32	Blue	15.88	0.78	10	15.88
2 17/32	Blue	16.96	0.73	10	16.96
3 23/32	Blue	20.32	1.05	20	21.37
1 17/32	Red	54.67	.188	28	19.31
2 17/32	Red	58.93	1.11	32	19.08
3 15/32	Red	19.79	1.55	20	21.34
1 17/32	Blue	58.78	19.98	32	18.8
2 17/32	Blue	48.82	0	27	17.7
3 15/32	Blue	19.69	0	32	19.69

Table 3. Board assembly times, gumming area

Source: own author

At the end of the data collection and the observations that occurred most frequently, an Ishikawa diagram was developed to determine the causes that cause delays and this way try to eliminate the present causes, the results obtained are shown in Figure 2.

Once the causes were determined in the diagram, it was proposed to eliminate the most frequent causes or those that were most important.

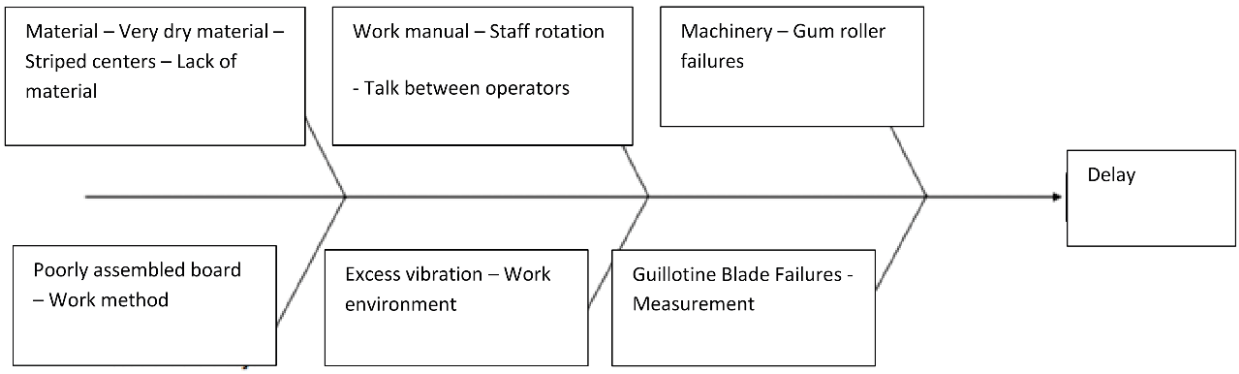

Figure 2- Diagrama Ishikawa causas demora

Source: own author

GUMMING CYCLES

The number of loads that can be produced in the course of an hour was determined, for which the reinforcement of the different thicknesses of each gluer was analyzed, to determine these. The reinforcement time of a board with thickness 23/ was taken. 32" in gluer 3 from the start until it is unloaded and ready to move on to the next area, the results are presented in Table 4.

Description	Time (minutes)
Armed	15:00
Transportation	00:30
Pre-load	06:00
Transportation	00:30
Load in press	03:00
Load	10:00
Download press	02:00
Total	**37:00:00**

Table 4. Time to make a board with a thickness of 23/32".

Source: own author

The time for the cycle of the gumming area for a thickness of 23/32" is made up of armed, Transportations and pre-load and this results in 22:00 minutes. Therefore, the number of loads per hour would be 2.7 loads per hour. In the 3 gluing machine with a thickness of 19/32", the time taken to carry out the assembly of the board, from the beginning until it is unloaded and ready to move on to the next area, the results are presented in Table 5.

Description	Time (minutes)
Armed	20:00
Transportation	00:30
Pre-load	00:00
Transportation	00:30
To load	06:00
load	12:00
Download press	02:30
Total	**41:30**

Table 5. Time to make a board with a thickness of 23/32".

Source: own author

The time for the cycle of the gumming area for a thickness of 19/32" is made up of the armed, Transportations and pre-load, the total of the times results in 21:00 minutes. Therefore, the number of charges per hour that can be performed is 2.8 charges per hour. In gluers 1 and 2 with a thickness of 17/32" the time it takes to assemble a board from the beginning until it is unloaded and ready to move on to the next area, the results are presented in Table 6.

Description	Time (minutes)
Armed	20:00
Transportation	01:30
Pre-load	06:00
Transportation	00:30
Load press	04:30
Load	07:00
Download press	02:30
Total	**42:00**

Table 6. Time to make a board with a thickness of 17/32

Source: own author

The cycle of the gumming area for a thickness of 17/32 is made up of the armed, Transportations and pre-load, the total of the activities gives a result of 28:00 minutes. Therefore, the number of loads per hour would be 2.14 loads per hour. In gluer 3 with a thickness of 15/32, the time taken to carry out the reinforcement of a board from the beginning until it is unloaded and ready to move on to the next area, the results are presented in Table 7.

Description	Time (minutes)
Armed	14:30
Transportation	00:30
Pre-load	06:00
Transportation	00:30
Load press	05:00
Load	06:00
Download load	02:00
Total	**34:30**

Table 7. Time to make a board with a thickness of 15/32

Source: own author

The time for the cycle of the gumming area for a thickness of 15/32" is made up of assembly, transport and pre-press, the sum results in 21:30 minutes. Therefore, the number of loads per hour would be 2.81 loads per hour.

The results of the time it takes to assemble a board with a thickness of 11/32" in gluer 3, from the beginning until it is unloaded in the press and ready to move on to the next area, are presented in Table 8.

Description	Time (minutes)
Armed	12:00
Transportation	00:30
Pre-load	06:00
Transportation	00:30
Load press	02:00
Press	04:30
Download press	01:30
Total	**27:00**

Table 8. Time to make a board with thickness 11/32

Source: own author

The cycle of the gumming area for a thickness of 11/32" is made up of assembly, transport and pre-press, the sum and this results in 19:00 minutes. Therefore, the number of loads per hour would be 3.15 loads per hour. As can be seen, the assembly time of the loads is the important part that sets the production rate and what separates it from carrying out two or three loads per hour, as in this case, since it is material with complete centers and being a thinner thickness, the first three charges were completed and the fourth charge began.

The patched views were followed up, noting that the patches in the views were falling off, so it was decided to count the number of patches that were dropped in the view, from the patcher to the carousel, with a total of of 43 patched views with an average of 4-5 patches per view. According to the complaints expressed by the operators, the main causes for which the patches fell off were due to the conditions of the material, the tape they use and the patching machines.

The results on the patches, once the sufficient data has been collected from the two crews, it can be observed that the differences

are not very significant, as long as the material used is similar, since it must be taken into account that the material It is something that cannot be so controlled. It was concluded that the main problem is the tape that is being used, the patchers are doing their job correctly and the patches that do not reach the next area are minimal, the problem begins when the views are Transportationd and it is in this maneuver when the patches begin to fall due to the deficiency that the tape has when it is glued.

DISCUSSION AND CONCLUSIONS

After having carried out the activities corresponding to the analysis of times and movements in the patching, gumming and pressing processes in the company, it was observed based on the results presented, that there is variability in the assembly time of the boards, due to the fact that the operators who use the equipment do not carry out the correct procedure in the assembly process, this means that each operator makes use of the machine in the best way possible, regardless of whether they make unnecessary movements and the assembly time increases, as well as causing greater wear on the machine, due to the fact that at first they were not given training on the machine and in reality they are ignorant of the correct operation of said equipment.

Another of the failures that were detected in the process was that the tape used did not perform its correct function as it did not hit with enough force, the operators were aware of this problem and even so there was no supervision to follow the process, with the results and With the proposals of this project, it was possible to establish a production of approximately forty sheets per hour, which is why 30 sheets per hour were previously made. Applying this study, it was possible to increase the production of sheets by approximately 25% per hour, achieving as a result a higher daily production and with fewer movements for the operator.

RECOMMENDATIONS

A good follow-up must be given to the proposals and to all the analyzes and studies that have been carried out previously, since by carrying out a good production system, focused on continuous improvement, efficient processes could be reached with greater quality. Also that the operators follow the established process, without the need to be supervising and thus avoid unnecessary movements and without increasing the established time.

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