

Positive impacts of having good maintenance management in the manufacturing industry

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Abstract — *Many companies especially family-owned businesses do not offer the proper maintenance for their machinery. Such sloppiness in any company is responsible for more expenditure on operations as well as a decrease in production capacity, which puts them at risk of not meeting the demands of the market; it also disturbs the quality of the products. This project consisted on the analysis from a management perspective of a company that did not have any type of maintenance program or a hierarchical order that worked directly with the employees in charge of maintenance. Focused in the hierarchical structure of the company, and with the implementations of various tools of Industrial Engineering, the maintenance management system was implemented, which lead to the company increasing 11% of their sales*

Key Terms — *Hierarchical Structure; Preventive Maintenance Management; Product Demand; Quality.*

INTRODUCTION

The author of this paper was contracted by a company that manufactures aluminum products such as doors, security windows, Miami windows, among others, in order to find the reason for the poor performance in several lines of business through the company. The main problems were the high cost of production and that the company's profits had been drastically reduced in recent months. This was attributed by the board of trustees due to a significant increase in the labor force, and to a lack of supervision, where employees were not giving their maximum effort and were not producing the amount required by management. With this scenario the author started studying all the processes in the company to view the current

situation and determine how these can be improved, in order to increase the capacity in the production lines. Within the period of research it was determine that the company lacked a system of maintenance.

Furthermore there was not a hierarchical order in the factory. The employees received different instructions from all the different levels of management. Especially the mechanics received different and sometimes conflicting instructions from different entities, such as the board of trustee, (which is composed of 5 members and a controller), the Manager of the company and the production floor supervisor. This problem was causing mechanics to leave jobs inconclusive to go and solve another problem as requested by any of the superiors. This can cause a mess in the production floor because the mechanic will leave a broken machine, delaying the production, and compromising a purchase order from a client and, even worst, affecting the quality of the product due to the use of a broken machine that is not performing as supposed.

With the lack of a maintenance program, the only maintenance that receives the machinery is when it is broken, which also stop the production. It was only then that a mechanic was assigned to inspect and repair the affected machine. When this kind of problems stops the production, employees are idle waiting for the mechanical to fix the machine, which creates delays in its production plan. For this reason it was decided to create and implement a preventive maintenance plan, and to establish a hierarchical order and to train the management of all levels on how to properly run the company.

BACKGROUND

As a general culture of an Industrial Engineer, the preventive maintenance increases production and operation capacity. Also having a preventive maintenance program will provide an advantage between competitors, because it will help improve the quality of the products and lower the cost of production per product. Moreover a planned maintenance strategy is critical to reducing failure and downtime, extend the useful life of production machinery, meeting industry safety watching for the health of operators in the production floor, and ensuring business continuity and availability in order to maximize productivity and profitability.

Poor maintenance practices will have a negative effect on profit and associated costs. These costs can include, loss or output, idle workers, schedule disruptions, injuries, damage to other equipment, products or facilities, and repairs which may involve maintaining inventories of spares parts, repairing tools equipment and repair specialists.

A hierarchical organization is an organizational structure in which every entity in the organization, except one, is a subordinate to a single entity. This consists of a group of power at the top with subsequent levels of power beneath them. Members of hierarchical organizational structures chiefly communicate with their immediate superior and with their immediate subordinates.

All the managerial levels must understand the main purpose of the hierarchy, where all the members of the hierarchical organizational structure must chiefly communicate with their immediate superior and with their immediate subordinate. This way it can reduce the communication overhead, without limiting the information flow. Also there would not be unfinished jobs and at the same time there would be no misunderstandings among all the managerial levels and within the operators of the company.

PROBLEM

The company analyzed for this project manufactures aluminum products such as security windows, Miami windows, doors among other products. It was looking to restructure the operations of their best selling products in order to reduce the cost of manufacturing and improve their margin of profit. While studying the manufacturing process of these products, it was determined that there was a lack of a maintenance program and it was difficult to ignore the state of the machines that were used in the production area. With the passing of days, the deterioration of the machines was more evident, as was the struggle of employees to work with the machines because these were atrophied.

In addition to this, the lack of mechanics in the company was evident, because they were solving some other issue outside the plant. Sometimes the mechanics were repairing a machine and another problem arise and they had to leave the machine they were fixing unattended to solve the other issue that somebody in the top management wanted fixed in the minimum time possible. When this happened, sometimes the mechanics made a preventive remedy so the machine could work until they could come back and fix it completely. This quick fix could endanger the quality of the products as it affected the termination of the finished goods and at the same time, offering low quality product to customers. This situation was also causing operators to take even more time in their daily tasks to operate the machines. This caused that the operators were required to make excessive effort to put the material into the machine.

In addition to this, the mechanics and operators lacked tools. They had to make homemade tools so they could perform the job of assembling the products due to poor maintenance of the equipment. An example of this is that they were creating screwdrivers from continuous screw thread, and creating hammers from scraps of metal, among others.

In addition none of the managers of the 3 levels of management were following a hierarchical order. The mechanics were receiving instructions from the different management levels. In Figure 1 is

recipients using a correct and appropriate way without jumping hierarchical levels. To assure that these changes were implemented and followed, a controller was designated to be in charge of establishing the control of the board of trustees and impart the instructions to the second level management. Meanwhile, the second level management will impart instructions to third level management. This changes were seeking a reduction in production cost and an increase in production capacity within the company. Figure 4 shows the proposed hierarchy for the company.



Figure 4
Proposed Hierarchy

RESULTS AND DISCUSSIONS

After completing the sampling and compiling the data, it was observed that the machines in general were operating only 55% of the time. Within the 45% that they were detained, 60% of the time was stopped due to lack of maintenance or service. The other 40% of time that a machine was detained was due to lack of material, or waiting for material to be processed, or because the machinery that processes the material was itself stopped for some type of defect that prevents the machine from running. In Figure 5, the data collected can be seen.

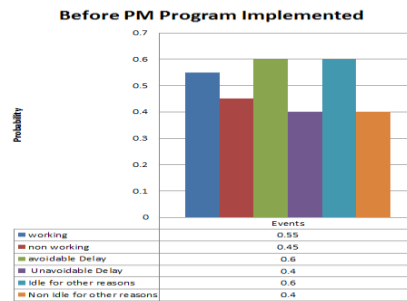


Figure 5
Machine Work Sampling Before PM program implemented

After starting with the sampling, there was a meeting with the entire management team of the company. In that meeting the advantages of having a hierarchical order were explained. At that meeting it was agreed that the controller of the company would be in charge of transmitting guidelines and instructions to the manager of the company, thus avoiding that the manager or production floor supervisors receive phone calls from the owners of the company or from the sellers, asking for an advance on purchase orders or giving some other order. In addition the controller of the company will be in charge of transmitting information of agreements reached by the board of trustees which are relevant to the business. In addition to this, the mechanics were instructed that they would only receive instructions from their immediate supervisor, the production floor supervisor, and plant manager in case that their supervisor is not available at that time.

After this, a sampling was started again to see how machines were behaving after the mechanics were focused on working only on the machines and ensuring that they were working at all times. Also it was verified that the mechanics were giving the proper preventive maintenance.

After making the changes, the information collected and compiled from the sampling was analyzed, it was found that there was an increase in the time that the machines were operating. This time the machines were operating at 70% of the time. The 30% that the machines were not

operating was composed of 40% which could be cataloged as an avoidable delay. The other 60% of the time, it might be due to the lack of an employee to operate machines for doing another task, or that the machines were stopped due to lack of materials. It should be noted that within this 60% there were unavoidable delays. With some tools, the 40% of avoidable delays could be lowered. To lower this 40%, tools like line balancing, product flow can be used. In Figure 6 the new sampling results are presented.

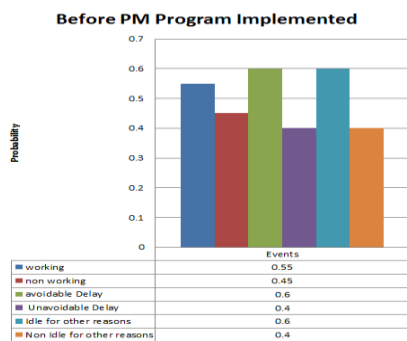


Figure 6

Machine Work Sampling After PM program implemented

This increase in time of machines working produced an increase in capacity of production. The increase represents an 11% of increase in daily capacity throughout the company. This increase is broken down as follows: an increase of 53% in the area of doors, a 19% increase in security windows, a 15% increase in Miami windows and 13% in the area of cleaning and inspection of products. This increase in capacity is shown in the pie chart of Figure 7.

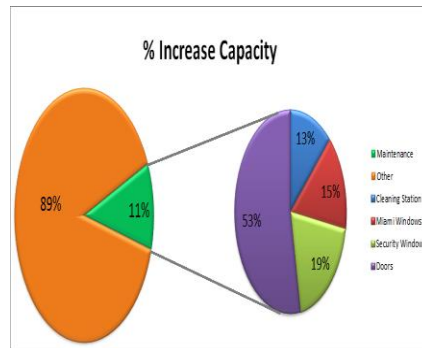


Figure 7

Percent increase capacity per production area

This increase in capacity, in terms of production is reflected in an increase of 38 additional doors per day, 12 additional security windows more per day, 11 additional Miami windows per day, and in the area of quality and cleaning a capacity to work with 17 additional products per day. Figure 8 shows the capacity of the company before the changes (in blue), and the increased in capacity after the proposed changes, in red.

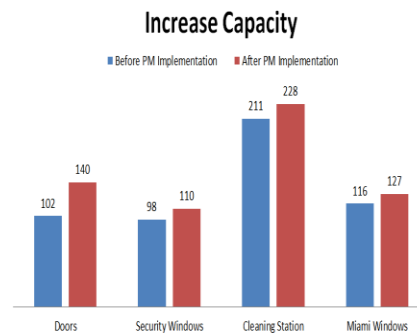


Figure 8

Capacity before changes and capacity after changes

As an additional recommendation, two logs were created. With these logs it was intended to raise awareness for maintenance and create a habit for the mechanics to verify the factory's equipment. These logs are one for when the shift begins and another for when the shift ends. For example, in the log to be filled before starting the shift, what is

sought is that the mechanic checks if the machine’s preventive maintenance is on up to date. For this, a label was placed on the machine where it indicated when was the last preventive maintenance of the machine and when the next one is due. In addition to this, with this log the mechanic will verify that the safety gates on the machines are on, checking them to safeguard the lives of the operators, because the security must go ahead of everything in the workplace. The mechanic responsible to fill up this document will ensure that everything is in order and in the right conditions to operate during the day. The log to be filled before starting the work shift is presented in Figure 9.

Line Start Up Report		
Production Area		
Activity	Description	✓
1	Preventive maintenance on date	
2	Verify air compressor	
3	Verify safety fences are well placed and fastened and in place	
4	Check for wear on crucial parts	
5	Check Machine grease	
6	Check lubrication	
7	Lubricate machine if necessary	
8	Check for machine supply parts(rivets, nails, etc)	
9	Machine is suitable to operate	
10	Drills are good working conditions	
SETUP DATE MM/DD/YY		
OPERATORS		

Figure 9
Line Start Up Report

The end of shift log, targeted to be filled up by the end of the work shift, is to make sure that all machinery of the production floor is turned off. Also to verify and remove the excess lubricant to prevent excessive accumulations of lubricant and grease; at the same time ensuring that all equipment, tools such as screwdrivers and drills, are placed in the appropriate place, leaving the whole production area organized. Figure 10 shows an example of this log.

End of shift report		
Production Area		
Activity	Description	✓
1	Clean machines, remove material waste	
2	Remove excess lubricant	
3	Place drills, screwdrivers, hammers, hex keys, silicone dispenser and other tools in warehouse	
4	Clean waste compartments	
5	Turn off all machines	
6	Turn off air compressor	
7	Turn off lights	
SETUP DATE MM/DD/YY		
OPERATORS		

Figure 10
End of shift report

Also as a recommendation, it was indicated to the manager and the board of trustees to purchase industrial type tools for the company. This because the present tools, such as drills, screwdrivers, wrenches and others, were not designed for an industrial use. Therefore this type of equipment has a lower useful life, which needs to be replaced continuously, representing an economic disadvantage. The manager and board of trustees indicated that they purchased does type of tools because those are cheaper compared to industrial ones. But when making the comparison of the useful life of the tools focused on industrial use and the quality of work that they represent, the company will save more money over time. Also the operators will conduct their work easily and this tools will meet all the requirements needed to carry out their task in a more effectively way.

After all these implementations and changes in both the hierarchical structure and the implementation of a preventive maintenance program, the company had an 11% increase in sales. Figure 11 shows that the company obtained an increase in sales of \$177,873.95 after the changes were implemented. The red line represents the sales after changes implemented vs. the blue line which represents sales before the changes.

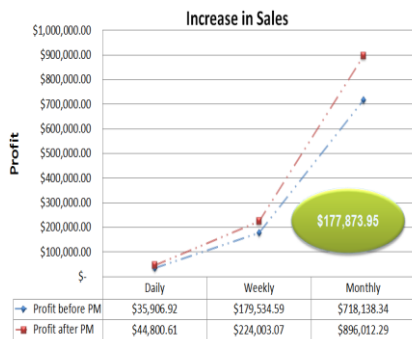


Figure 11
Increase in Sales

CONCLUSIONS

In any process where mechanical equipment is involved, there is a need for a good maintenance program both to increase its useful life, get better performance and not affecting the quality of the products. With this was shown that maintenance is important and it can be view as a cost saving method.

Having the proper hierarchy helps the information to flow more quickly and to reach the levels that the top management wanted to reach. A proper hierarchy leads to certain economics saving since all personnel can focus on a single aspect, the development of the business to another level.

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