MAINTENANCE PROGRAM IMPLEMENTATION AT AISLANTES INDUSTRIALES DE MONTERREY

By

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ABSTRACT

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This study examined the Aislantes Industriales de Monterrey S.A. (AIMSA), in Monterrey, NL Mexico, and provided a possible solution for increasing throughput by the reduction of equipment failure. Using observation techniques to measure the number and frequency of machine failures rates within a determinate time, AIMSA was analyzed. The objective of this study was to examine the “run-to-failure” solution activities of AIMSA, complete recommended maintenance system schedule and document. Decisions and recommendations were made through an analysis of AIMSA and presented to the management.

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I. RESEARCH PROBLEM AND OBJECTIVES

A. Introduction

According with the management of Aislantes Industriales de Monterrey in Monterrey, NL Mexico AIMSA was running well, but failures killed the production plan in manufacturing. Traditional activities used did not include any type of maintenance. Operators were busy with other assignments; moreover, the lack of a maintenance program and the disorganization between personnel and management did not give the chance to run a productive maintenance.

AIMSA molding machines' effectiveness was affected by mainly four critical components within the machines; piston's o'ring, booster, hydraulic valve or motor failure was the critical components. To improve the overall efficiency of the machines maintenance program need to be standardized and documentation of maintenance schedules in AIMSA need to be established, completed and followed. This study used existing documentation from AIMSA and requires the creation of new documentation. The data for this research project was collected through observation along with reviewing existing documentation and implementing the procedures established for documentation at AIMSA.

B. Problem Statement

The objective of this project was to develop maintenance program and reduce AIMSA failure rate on the manufacturing department in Aislantes Industriales de

Monterrey in Monterrey, NL Mexico. This was accomplished by first documenting the machinery requirements on the maintenance program and then optimizing personnel resource by scheduling the maintenances; therefore, eliminating the two major cost components of failure lost production and direct cost of "unplanned/preventable" mechanical/electrical failure.

C. Research Goal and Objectives

The research involved in the study, helped Aislantes Industriales de Monterrey in many ways by achieving the following objectives:

1. Reduced machine's failure rates and improved productivity of the manufacturing department
2. Standardize schedules for an appropriate maintenance system

D. Research Significance

Aislantes Industriales de Monterrey was designed to be a small business but circumstances made it changed into an efficient company. Aislantes Industriales de Monterrey has never had any maintenance studies on the process itself. The process has been as it started that is the actual operations of the machines in the manufacturing line are running as much as they can. The downfall comes on the persistent machines' failures, due to the lack of an adequate maintenance program in the manufacturing department.

Prior to this study, maintenance actions were non-existent. There were established forms for fix the equipment, but just when the problems were there, bringing big problems to production.

Over the past two years, the management at Aislantes Industriales Monterrey has committed itself to efficient production operations due to sales increases. One very large production problem has been the number and the frequency of failures within the manufacturing department. To do a normal "maintenance", the maintenance personnel had to wait the machine to break down.

E. Limitations

The study was limited to AIMSA at Monterrey, NL Mexico.

Not all data necessary to this study was documented for AIMSA.

Estimates were made by AMISA, and its employees on the time spent on previous fixtures.

F. Definition of terms

Responsiveness - ability to satisfy customer requirements in a timely fashion

Maintenance - is the serve, repair or rebuilt according to a predetermined schedule based on actual equipment condition (Kruger, 1998)

Run – to – Failure Maintenance – corrective action that is perform until the equipment performance is unacceptable (Dundics, 2000)

Schedule Maintenance – planned maintenance action based on past experience with the equipment (Weil, 1998)

Preventive Maintenance - restorative maintenance actions that improve equipment before failure, reducing and eliminating unplanned downtime and increasing machine efficiency through advanced maintenance techniques (Weil, 1998)

Predictive Maintenance (PdM) - maintenance strategy monitors equipment performance to recognize the onset of failure, determine degradation rate, and forecast failure based in a condition-based maintenance (Dundics, 2000)

Oil Analysis - one of the most popular techniques to predict current internal condition and impending failures (Levitt, 1995)

Vibration Analysis – method that predict when the shaft would fail. This method tries to anticipate problems prior to failure (Kruger, 1998)

Total Productive Maintenance (TPM) - maintenance operation makes the operator a partner in the maintenance effort, involving he in preliminary maintenance activities by encouraging them to keep machines clean and wee-lubricated, also involving operators to reports indications of incipient distress to the maintenance department (Weil, 1998)

Uptime - percent of time a facility can operate at its maximum demonstrated rate while making first-pass, first-quality product as required by the production plan (Desirey, 2000)

G. Assumptions

The operators observed during the study were representative of the others operators, in respect to knowledge and skill.

Preexisting information documented by AIMSA, however limited, is accurate.

The management was committed to reduce the number and frequency of failures in the manufacturing department by setting a maintenance program.

II. REVIEW OF LITERATURE

A. Introduction

Maintenance is the largest single variable operation cost in most enterprises. Yet maintenance does not receive a proportionate amount of management attention. High-productivity maintenance contributes to better customer service, higher quality, on-time delivery, and satisfied customers (Westerkamp, 1999). For this reason, maintenance is being recognized as a vital investment, not just a cost (Desirey, 2000). Traditionally, the mission of the maintenance has been to support the productive output or activity of the organization (Levitt, 1996). In a world of increasing global competition with increasing customers' requirements, reduction of breakdowns and failures has become the focal point to improve. The increment in the number of orders and the need to respond quickly to them place a premium on a company's ability to respond quickly to customer demands. Responsiveness refers to the ability to satisfy customer requirements in a timely fashion. Marketplace responsiveness results from the application of schedule and lean maintenance programs that lead to reduced breakdowns and failures in the manufacturing equipment.

Aislantes Industriales de Monterrey's managers and supervisors want to reduce critical components problems that are causing a high number of breakdowns and failures in the manufacturing equipment to improve productivity. However, several factors must be considered to achieve significant change. These include the nature of the equipment itself, a schedule needed to plan the schedule programs to be installed.

Once the equipment is full with customers' orders, maintenance becomes harder to achieve due to production demand, but is exactly on this crush time when the equipment needed more maintenance. To do this, supervisors and floor manager must have in-depth understanding of different aspect of the most problematic components in the equipment. Generally, maintenance can be divided into three categories depending on the performance involved in each category. These categories include "run-to-failure" which performs only at the time of failure, "preventive maintenance" which performs according to a fixed schedule and "predictive maintenance" which performs based on actual equipment condition (Kruger, 1998).

Maintenance programs can reduce failures and emergency repairs (Dixon, 1995).

B. History of Maintenance Program

Production efficiency dictates how important it is for a company the use of maintenance on the shop floor. The more breakdowns and failures the equipment runs, the more important it is that they achieve a goal of practicing the optimal maintenance program.

Some people define maintenance as the taken action that responds to broken down machine. This type of maintenance may minimize work, but it also leaves machine tools in state of poor repair much of the time, producing out-of-tolerance parts and scrap (Weil, 1998). This most elementary traditional method is used by AIMSA. However, remember the other things involved in it that are not included in this simplistic definition. Cost of lost production, extra repair time due to adverse conditions, extra cost due to core damage and extra damage of associated parts are among the many things that are not considered in this definition.

A more accurate definition for maintenance is the serve, repair or rebuilt according to a predetermined schedule based on actual equipment condition (Kruger, 1998). While involving more variables with this definition, it offers a much larger target for a cycle maintenance program – and anything that affects the equipment performance has to deal with a production run.

Run-to-failure (RTF) maintenance – embodying the concept: "if it ain't broke, don't fix it" this corrective in nature maintenance strategy is not performed until equipment performance is unacceptable. Also known as reactive maintenance, RTF maintenance has the potential for a great amount of up time. Equipment is never taken offline for maintenance. It allows for a lower skill set, as the failure are usually well defined. And, there is no requirement to purchase extra parts or labor, because there are no maintenance actions between failures. Unfortunately, failures occur at the most inopportune times, and severely disrupt production. Repairs are expensive emergencies because there is no resource planning. Parts require express shipment and overtime costs are high (Dundics, 2000).

Schedule Maintenance (SM) – probably the most broadly practiced technique in large manufacturing operations, SM calls for the development of a preset maintenance schedule for each machine tool. Managers base these maintenance intervals upon past experience with the specific machine. From this experience comes a maintenance and rebuild schedule. The method forces planned maintenance action for all machines. Unfortunately, maintenance becomes arbitrary, because the time to carry out maintenance is an average figure applied to a variable quantity. It may take place too soon, while the machine still operates well. Or, if it comes too late, some machines may fail before the scheduled maintenance time. Others may produce unacceptable parts. Furthermore, the accumulation of information on the useful life until rebuild is limited to large operations with similar machines. Small machine shops with only a few machines cannot gain statistically meaningful insight into this question. Scheduled maintenance occurs too often to be on the conservative side of the potential machine distress (Weil, 1998).

Preventive maintenance – this maintenance strategy consists of restorative maintenance actions that improve equipment before failure, reducing and eliminating unplanned downtime and increasing machine efficiency through advanced maintenance techniques (Weil, 1998). Time-directed (TD), as it is also known, applies experience and failure history to identify a pattern of degradation, then attempts to apply specific maintenance actions to return a desirable level of performance (Dundics, 2000). These actions include lubrication, servicing, overhaul, inspection, adjustment, tightening, scheduled replacement and cleaning. Correctly applied, TD is successful in extending the interval between failures and maintains equipment at high performance. Unfortunately, it also reduces availability by intentionally taking equipment offline to perform the actions. Maintenance increases and more labor and parts are needed. The largest disadvantage is that poor maintenance practice and procedures create more problems than if the maintenance were never performed. Incorrect maintenance may damage the equipment.

Even if the action was done correctly, statistics show that 68% of those actions might cause “infant mortality” on relatively good equipment. This is why so many problems exist immediately after returning equipment into service following maintenance. Maintenance action should be performed only if the benefit of restoration outweighs the risk and consequences of mortality (Dundics, 2000). One point that is commonly missed is that PM is a way station to the ultimate goal of maintainability improvement. PM can be an expensive option because it requires constant inputs of labor, material and downtime. The ultimate goal of maintenance is high reliability without the inputs. Understand what PM is trying to accomplish, and know the critical wear point (Levitt, 1995). PM systems are designed for two purposes: to detect the location of the critical wear point along the wear curve and, by proper lubrication, cleaning, tightening, and adjustment, to defer critical wear. Critical wear will sometimes manifest itself as an inability to hold a measurement or tolerance (Levitt, 1995).

Predictive maintenance (PdM) – this maintenance strategy monitors equipment performance to recognize the onset of failure, determine degradation rate, and forecast failure based in a condition-based maintenance. Due to a correct PdM maintenance actions can be performed at the optimum time before failure (Dundics, 2000). The fundamental aspect of PdM is developing a “true cost” of failure (Kruger, 1998). PdM assumes that equipment operates in a steady state for long period, but eventually begins to wear. For example, in traditional PM, a filter is changed monthly. In condition-based maintenance, the filter is changed when the differential pressure reading exceeds certain readings (Levitt, 1995). If left untreated, equipment eventually fails in service, possibly with catastrophic results. The cost of lost production seriously compounds the expense. Predictive maintenance enables users to avoid the unexpected, and therein lies its greatest value. The process actively trends changes in equipment such as operating temperatures, vibration, bearing noise, and particles suspended in lubricants. Serious problems usually begin as small changes in system parameters. They can be the result of wear, misuse, or age. These small changes are difficult to detect by any one technology (Brook, 1998).

Trend analysis key – According to Ralph Lostracco, president of the maintenance-consulting firm Predict Monitoring Systems (Toronto), trend analysis is the key element in a successful predictive-maintenance program (Morris, 2000). Oil analysis and vibration analysis are the most popular used.

Oil analysis – one of the most popular techniques to predict current internal condition and impending failures is oil analysis (Levitt, 1995).

Oil analysis determines when the oil had deteriorated to the point where it should be changed, but it also determines why the oil is failing (Kruger, 1998).

A oil analysis includes an analysis of the suspended or dissolved non-oil material including Babbitt, chromium, copper, iron, lead, tin, aluminum, cadmium, molybdenum, nickel, silicon, silver, and titanium. In addition to these materials, the analysis will show contamination from acids, dirt/sand, bacteria, fuel, water, plastic, and even leather. The other aspect of oil analysis is a view of the oil itself (Levitt, 1995)

Vibration analysis – this widely used method was begun with the purpose of predicting when the shaft would fail, and it worked. As the shaft-neared failure, the vibration analyst anticipated the problem and the shaft was replaced prior to failure. The “acute” problem was solved. However, there was still significant lost production during shaft replacement (Kruger, 1998). The next step was to determine why the shaft was failing. The vibration analyst diagnosed a structural resonance problem and made specific recommendations for stiffening the structure in the plane of motion. The shafts stopped needing replacement. And now the problem was solved (Kruger, 1998). For this reason repair department rely heavily on vibration analysis because the largest percentage of machine failures are mechanical. And vibration patterns pinpoint changes in the condition of bearings, gears, couplings, and other mechanical components (Brook, 1998).

Equipment repairs cause the trend to drop dramatically and should be documented, which could simplify future troubleshooting (Brook, 1998).

Trends, which change linearly, are easily read. Loading modifications and speed changes on variable frequency drives are some of the parameters that can cause variations in a trend (Brook, 1998).

Temperature measurement, ultrasonic inspection, advanced visual techniques; magnetic particle techniques, penetrating dye testing and automated lubrication equipment are some other useful trend for a better predictive maintenance performance.

Total Productive Maintenance (TMP) – this maintenance operation makes the operator a partner in the maintenance effort, involving he in preliminary maintenance activities by encouraging them to keep machines clean and wee-lubricated, also involving operators to reports indications of incipient distress to the maintenance department (Weil, 1998). In industry, the machine operator is the key player in a TPM environment. Under TPM maintenance department has less reliance due to control and responsibility are passed to the operators (Levitt, 1995). And they are responsible to pursue continuous improvement in small steps. By this, TPM recruits the operators into the maintenance function to handle basic maintenance tasks and to be the champion of the machine's health (Levitt, 1995). TPM returns to the pre-1920 roots by involving the operator in maintenance activities and decisions.

Other discipline that TPM puts special attention is the planned maintenance, or the ability to organize an area so that maintenance of equipment is as natural as any other job in the area. Guesswork is eliminated, and equipment is maintained to schedule (Rogers, 1998). For this TPM uses the operators to perform all of the routine maintenance including cleaning, bolting, routine adjustments, lubrications, taking readings, start-up / shut-down, and other periodic activities. The maintenance department becomes specialist in major maintenance, major problems, and problems that span several work areas, as well as trainers. The operator goes through seven steps to reach full autonomous maintenance:

1. Initial cleaning review of entire machine, tightening.
2. Maintenance prevention.
3. Establish consistent standards
4. Inspection.
5. Autonomous inspection.
6. Organization to support ongoing.

7. Full-functioning.

TPM is one of the most effective methods of improving the delivery of maintenance service while increasing the effectiveness of the equipment. Beyond routine maintenance, the operator carries out only the indicated corrective actions, and thus does no unnecessary work (Weil, 1998).

The dual goal for TPM is zero defects and zero breakdowns. To achieve this goal, TPM has the following four elements:

- Maximize overall equipment effectiveness
- Establish a shared system of PM for the equipment's complete life
- TPM is not really just a maintenance program, but also a partnership of maintenance and production.
- TPM works only because the operators begin to "own" the equipment

C. Maintenance Elements

An examination of the nature of maintenance work reveals its unique characteristics. It is low-volume work. A maintenance technician often does many different jobs in a single day, unlike production personnel, who do high-volume work. The maintenance technician does longer cycle work, while the production worker does shorter cycle work. These significant differences led to major problems in early attempts to measure maintenance work (Westerkamp, 1999).

The combination of many elements, maintenance tasks, and skills resulted in the need to develop, apply, and maintain more than 7,000 standards. One of the most difficult activities the industrial engineer faced was applying the standards to the daily maintenance workload.

A system based on two techniques; ranges-of-time and work-content comparison, was developed to get information technology project management as well as to trouble call management at the tech support desk (Westerkamp, 1999).

The range-of-time technique recognizes the variable nature of maintenance work, while work-content comparison recognizes that even though the parts may be different. Then, the engineers organize the collected data in building-block fashion similar to direct labor standard data. The foundation of this is predetermined basic motions using one of two widely predetermined time systems; methods-time measurement and the Maynard operation sequence technique. These techniques measure work by dividing it into basic motions. Motions, sequences of motions, and time are documented (Westerkamp, 1999).

In most maintenance organizations the need for planners is indispensable. The planner’s role is to maintain a backlog of ready-to-work jobs for each maintenance technician. Close communication with supervision is an important part of the process. The planner field-checks jobs as needed, plans work content, verifies priority, identifies special tools and materials, requisitions non-stock or out-of-stock items, and plans safety requirements, crew size, craft needed, and time to do the work. The planner also develops benchmarks and maintains the data library (Westerkamp, 1999).

Most departments without planners are about 50 percent to 60 percent productive. Productivity is raised to at least 80 percent with a dedicated planner (Westerkamp, 1999).

D. Foundation of Maintenance

The days when effective preventive/predictive maintenance practices were hidden from the daily production highlights are rapidly ending, and maintenance is being recognized as a vital investment, not just as a cost (Desirey, 2000).

But the question remains: How can maintenance be integrated into today's rapidly changing production environment?

In many businesses, bringing maintenance will have a profound effect. But in order to get this impact, an organization alignment has to be implemented so the power of common thinking would succeed.

Once the maintenance strategy is aligned with the internal partners of the business (sales, operations, technical, and finance) the continuous improvement of the business and the natural work of delivering the products and services can proceed in a focused and orderly approach (Desirey, 2000).

First on the list is how maintenance can provide an advantage in routine production. Maintenance has long been a powerful source of know-how and when to best schedule production. Maintenance needs time for key preventive and predictive maintenance work. Production needs to comply with customers' schedules (Desirey, 2000).

Numerous basic elements are necessary to implement maintenance programs that will assist, rather than interferes with the final objectives (Lorick, 2000).

In order to obtain success implementing maintenance programs, numerous key elements have to be followed. The establishment of goals, the commitment of management and supervisors, the involvement of maintenance staff and supervisors, the establishment of a continuous improvement process and the implementation of a program to manage maintenance, upon several others, enhance the maintenance program to reach the objectives (Lorick, 2000).

Many companies are learning that having maintenance engaged as a full participant in the business resource planning process best meets this need. Business resource planning provides the necessary input that allows maintenance to have a voice in improving the operational effectiveness of the plant.

The process works this way. Once the demand from the marketplace is determined, production and maintenance can use the plant’s capacity as a playing field to best fit the resources of people, machine time, ingredient deliveries, and necessary maintenance work in the formal process that will allow meeting the required customer delivery schedules (Desirey, 2000).

The objective is to produce the planned quantity with nothing less than first-pass, first-quality product. Maintenance is a key player in establishing the process capability and consistency that allow continuous improvement in the high confidence of production on-aim, every time (Desirey, 2000).

This work is followed by documentation of the highest capable, demonstrated production throughput allowable that will permit the on-aim requirements. This task must involve the production partners of maintenance, technical and production.

The concept of continuous improvement is to continually raise performance as high as possible. So, the demonstrated throughput level does not become minimal or guaranteed, but it continually pushes the operations team to strive for higher outputs of production capability.

Given that the demonstrated throughput is documented, a measure of "uptime" is used to drive a continuous improvement process. Uptime is defined as the percent of time a facility can operate at its maximum demonstrated rate while making first-pass, first-quality product as required by the production plan.

The question should constantly be asked: "If uptime is not 100%, then why not?" (Desirey, 2000). This questioning will result in a Pareto Analysis that will list all of the reasons that will work as a game plan for the maintenance, production and technical groups to improve asset productivity.

Becoming a competitive advantage to the business is much like bringing the diversity of musical instrument together to make beautiful music. Each instrument brings it's own uniqueness for style and quality. The functional group of maintenance, production, sales, quality, etc., all have critical skills. When maintenance is brought into the business resource planning process, it takes on its rightful role as a competitive advantage (Desirey, 2000).

E. Advantages of Maintenance

The implementation of maintenance program has several advantages. First and the foremost, companies gain uptime – the capacity to produce and provide goods and services. Also, companies expand the process capability, or the ability to produce goods and services to the customer's satisfaction, consistently. Finally, more than ever, companies can predictably provide a safe and controlled work or service environment, with a minimum of risk (Dixon, 1995).

F. General Information Overview

Maintenance program encourages employees to adapt the new culture in the daily work.

III. RESEARCH DESIGN

A. Introduction

This study was based on the needs of Aislantes Industriales de Monterrey. The objective of this study was to reduce breakdowns implementing a maintenance program, increasing productivity and thereby increasing profit of the AIMSA manufacturing department in Monterrey, NL Mexico.

According to management AIMSA in Monterrey, NL Mexico, was running with a high number of breakdowns in its molding equipment, management knew that AIMSA was capable to run at higher productivity. Each operator was continuously busy, as were the repair people with the their repairs, yet several problems that hindered the productivity still needed to be addressed. The traditional method of fixing the equipment did not have an established maintenance program. This was not the fault of the supervisor or operators, but this simply was how it had always been at Aislantes Industriales de Monterrey.

Aislantes Industriales de Monterrey runs at its highest rate possible when the molding machines are up and running. Because much time was lost in the repair process, the overall productivity of the machine was affected. To improve the overall productivity of the manufacturing department a maintenance program needed to be established and documented. This study used observed information from the Aislantes Industriales manufacturing department and required the creation of documentation.

B. Research Design

The main idea of this research project was to develop appropriated maintenance program that fits with all the Aislantes Industriales de Monterrey's manufacturing department needs. This was accomplished by first documenting the most common causes of failure in the molding machines and then selecting the type of maintenance adequate for each type of cause, therefore eliminating the production of unacceptable parts and increasing productivity. The maintenance program documentation was critical to Aislantes Industriales de Monterrey.

The research involved in the study helped Aislantes Industriales de Monterrey in many ways by achieving reduced number of failures and improved manufacturing department productivity, thus avoiding tedious and expensive emergencies and completed documentation required to have control over the manufacturing department's productivity.

Over the past few years, the management at Aislantes Industriales de Monterrey has committed itself to increasing productivity of manufacturing. One very large operating problem has been the numerous failures of the molding machines in the manufacturing department. To do a normal maintenance, the maintenance personnel had to wait until the machine breaks down to react. These breakdowns included booster, hydraulic motor, piston and hydraulic valve. For example, using old management practices only a certain number of not repaired boosters were stored for not particular reason. With this theory firmly in place, boosters would be repaired to be set up and trued for a certain job on a specific machine, then would be cannibalized when it was time to do the next repair.

Remembering that for the repaired booster ready to work, the savings would be extremely significant on production up time. This took in account four to six hours of down time on the machine; four to six hours the operator used on a repaired task, and four to six hours of programming that could be done off line. At first, Aislantes Industriales de Monterrey was only concerned with daily production, not long-term benefits of maintenance programs.

Aislantes Industriales de Monterrey at the process of machining had been struggling such there was plenty full of room for improvement. Therefore, the study focused on the reduction of breakdowns and failures when the machines were running a production.

Aislantes Industriales de Monterrey has not had maintenance studies done on the process itself. The process itself has been unexplored.

The design of the research problem was done in four major stages. The first stage was to learn the way and method Aislantes Industriales de Monterrey used. Second was to create the documentation. Third was to create and define the most efficient and adequate maintenance program. For the final stage of the research project a maintenance program was developed and implemented.

1. Learning the system

The first step involved in learning the system is how maintenance team worked at Aislantes Industriales de Monterrey. Juan Rivera, AIMSA supervisor explained how a normal maintenance took place. This involved receiving the operator order that something is wrong with the machine, deciding what the machine problem and determined whether jump into a corrective maintenance or just a brief adjustment. To do this a list of the most common problems and ways to solution needed to be established. Aislantes Industriales de Monterrey had no list of problems that was used to establish a base of knowledge. With the most common problem's list not available on the manufacturing department, there was a lack of standardized way of doing maintenance. A list of the most common problems within the manufacturing department was created to make maintenance actions more efficient in the Aislantes Industriales de Monterrey's manufacturing department (see Appendix A).

2. Complete and Create Documentation

The documentation to have accurate track of fixtures was nonexistent. Information about when and what fixture was made to each machine was on, either the supervisor's or manufacture management's mind. To make a correct and accurate list of most common problems for each machine, a new one needed to be created.

3. Adequate Maintenance Program

After the documentation was complete, a list of all the required steps was compiled. Lists with a mixture of simple and complex steps were created. An inventory of necessary tools was done to keep the maintenance efficient. During the inventory all tools were labeled by metal stamping with punches. After the list was compiled and inventory of tools were done the information were presented to Juan Rivera and the management at Aislantes Industriales de Monterrey.

4. Design and Implementation of Maintenance Program

After the list of steps and inventory tools was established a way to execute maintenance based on the list of following steps was designed. The design incorporated everyone's ideas. To implement the system the maintenance team was trained during two weeks.

C. Populations and Samples

This study was an internal study. It was done directly with management and staff of Aislantes Industriales de Monterrey. The researcher used machine operators and the maintenance personnel as the sample. The limited existing documentation also served as part of the sample.

D. Instrumentation

Information on maintenances, molding machines and from observation of the Aislantes Industriales de Monterrey manufacturing department was needed for this study. The data for these three categories consisted of qualitative and quantitative data. In addition to this cooperation from the staff and management of Aislantes Industriales de Monterrey was needed.

E. Method of Data

The data presented in this report is the result of observation and research.

F. Research Activities and Schedule

The research activities were organized according to the researcher's schedule taking in to consideration for the researcher's classes and schedule work.

Research Activity	Week
1. Preliminary search for topic selection	2
2. Preliminary search for project and selecting the topic	2
3. Search for data to establish need for research	1
4. Literature Review	4
5. Research design and instrumentation	5
6. Learn the system	12
7. Create and complete documentation	4
8. Adequate maintenance program	3
9. Design and implementation of maintenance program	5
10. One week check-up	1
11. Putting together all the material into appropriate format	1

G. Project Staffing

Federico Gutierrez was the only member in this study. Assistance was given from the workers and management of Aislantes Industriales de Monterrey when needed.

H. Evaluation Plan

Frequent comparison to the research objectives and the research study was done to ensure research was relevant to the objectives of this study. Continual visits to the field study company Aislantes Industriales de Monterrey, was done to insure objectives were being attained.

IV. DATA ANALYSIS AND FINDINGS

This chapter contains the results of the study. The ultimate purpose of this study was to design and recommend a way to implement a maintenance program in the Aislantes Industriales de Monterrey manufacturing department, thereby increasing molding machines' efficiencies and production in general.

A. Presentation and Analysis of Data

Data presented in this study was classified into groups based on when and where the information was found. The groups are classified as follows:

1. Old Documentation
2. New Data Sheets
3. Inventory of Backup Parts
4. Organization and Storage

First data grouping was the old documentation. Out of approximately 5 maintenance sheets needed to document the manufacturing department maintenance program there were only one that had been started and it was not finished and incorrect.

The next grouping of data was the completion of the new data sheets. Here a maintenance sheet needed to be completed for each part to be run in the manufacturing department. There were approximately 8 parts that were involved in the maintenance program. The maintenance sheet can be used for any machine. This means that there is not a designated maintenance sheet for each particular machine in the manufacturing department. All the machines follow the same concept and function equally. This means all the backup parts and maintenance procedures work exactly the same for every machine. For a set of complete maintenance sheets see Appendix A

The third set of data grouping was the inventory of backup parts. Here a list was made from the maintenance sheets. The list include a set of backup parts for every machine, all tooling needed and all the steps for the maintenance procedure. With this list all the backup parts and tooling were gathered up and brought together at the storage room in the manufacturing department. Here it was determined that about fifty percent of the maintenance steps were already made. An inventory that organized the backup parts in one location had never been done before.

The fourth set of data came from the process of organizing and storing the backup parts. Therefore, with keeping in mind that Aislantes Industriales de Monterrey did not want to spend a lot of money on too many backup parts, a storage system was develop and implement to easily identify the backup parts. The system had to be easy to maintain, easy to expend, easy to see what goes where, and easy to see what was missing. In short, the system had to be easy. Aislantes Industriales de Monterrey wanted a system that was easy to use, and could easily make changes on the storing room.

B. Findings

The finding section will provide a summary of data trends found in Aislantes Industriales de Monterrey

1. Old Documentation

As started earlier, the old documentation, that is the documentation prior to this study, was very sparse and incomplete. If the two maintenance people that have worked at Aislantes Industriales de Monterrey for over the past ten years each decided to leave, no one would be able to do the correct maintenance because there is no documentation. This is not saying that Aislantes Industriales de Monterrey wants to replace these two maintenance people, but free them up to do other things. In addition, the maintenance style of both the maintenance persons was a little different. This sometimes caused differences in maintenance and caused inconsistencies in the machines' performance. This was another reason for documentation.

2. New Data Sheets

Since the were not old setup sheets brand new maintenance sheets needed to be created to fit the Aislantes Industriales de Monterrey molding machines. As a part of the daily basis process molding machines in the manufacturing department suffer wear some of the key elements in its mechanism. A column was put on the maintenance sheet so the mechanic can fill the pertinent information. A space was also provided to put the organization name, location, downtime, and others valuable information. Check-off boxes where used as much as possible to reduce writing and to improve completeness.

The bottom of the sheet was made to set the time in and time out and the description of the work done. A space was also provided to list the program number and fixture number. To see a copy of the maintenance sheet Appendix A and Appendix B.

3. Inventory of Backup Parts

After the maintenance sheets were filled out, a listed was made of the backup parts that are required to restore in the storing room. This list contained all the fixtures made during the maintenance in each part in the machine. After the list was finalized and approved by Juan Rivera, the maintenance responsible, all the tools and parts that were lying around the machine just worked were collected and placed in one area. Once the tools and backup and changed parts were collected.

The tools and backup and changed parts then were grouped together, putting all in the storing room. This gave us an idea on how much space we needed to have in the storage and organization of all the stuff. This also showed us which part group needed more space than the others.

4. Organization and Storage

After an idea of how much space was needed for storage and keeping in mind that Aislantes Industriales de Monterrey would like to use the existing storing room. After many discussions and ideas, the final storage plan was decided upon. This plan used the existing storing room with the creation of about shelves to organize the tools and backup parts. Then parts were organized in a manner on the shelves so that most frequently used would be the easiest to get to. The shelving was then labeled so the items on the shelf could easily be identified. The label was a plastic impression that was oil resistant and permanent.

C. Findings Overview

Documentation needed to be created and completed using a new maintenance program customized for Aislantes Industriales de Monterrey. A list of required backup parts and compared to existing to find lack of them. Lack of backup parts were noted and given to the management at Aislantes Industriales de Monterrey. A storing system was designed and implemented next to the manufacturing department.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. Presentation and Analysis of Data

Three elements were identified as the basic steps in helping to perform maintenance program efficiently. These elements are documentation, backup parts inventory and organization. The purpose of this study was to apply these steps in to the context of perform maintenance program within Aislantes Industriales de Monterrey in Monterrey N.L. Mexico.

B. Conclusions

With the support of a company commitment to production increase, the manufacturing department had been marked by Aislantes Industriales de Monterrey management as a targeted area of production maximization, to be achieved by a customize maintenance program. Because the manufacturing department of Aislantes Industriales de Monterrey did not have any maintenance procedure going on the machines, the maintenance program had to be implemented to increase productivity in the manufacturing department. After completion of the maintenance program and organization of the tools and backup parts, increase in production occurred, currently leading to overall profit for Aislantes Industriales de Monterrey. Luis Arenas estimated that a 10% production increase was achieved through this new maintenance program, correctly accomplish with the new paper work and storage. This 10% production increase is achieved because of the decrease in total breakdowns and failures as reported Luis Arenas.

C. Recommendations

1. It is recommended to continue efforts concentrated at reducing the numbers of breakdowns and failures in the manufacturing department through maintenance programs
2. It is suggested that the tools and backup parts be stored and counted in the storing room correctly for easy maintenance performances.
3. It is strongly recommended to continue documentation of new maintenance procedures in the manufacturing department.
4. It is strongly recommended the impacts of this study be continually monitored and evaluated.

VI. Follow Up

There were two follow-ups conducted to this study between the researcher and Aislantes Industriales de Monterrey. One follow-up was at one week after conclusion of the study and one at three months out. The one-week follow up was intended to be a visit to correct any problems or over sights. The only problems that were identified at that time were a couple wrong specification numbers on the maintenance sheet. These were easily corrected; Juan Rivera, maintenance responsible and manufacturing department supervisor said that everything was working well.

The three-month follow up was for two reasons. The first was to check and see if the operators and maintenance personnel were following the maintenance program appropriately. The second reason was to see if there was a reduction in the number of breakdowns. The system implemented for storage and organization was easy enough that the employees use these on a regular basis. Thereby, the usage of the system provides that it was a useful tool to help the employees.

In discussion with Juan Rivera, he said the storing of the tools and backup parts has moved the company forward in production. He also said the maintenance program has been the most noticeable change. The maintenance have gone from having nothing established to have a decent maintenance program that has brought benefits to the manufacturing department.

He also stated that the maintenance procedure have helped in the training of new people. He estimated that this to be a 10% production increase through doing the maintenances correctly. In addition, the efforts of the researcher putting this system together gave Juan Rivera and Aislantes Industriales de Monterrey management time to do other projects that they would not have been done due to time constraints.

Appendix A

#MWU	Location:	Date:	Time Down:
Maintenance Write Up		Downtime? Y N	Time Back In Service
User:	Phone:		Down Hours:
System:			Requested By:
Description Of Work Requested:			
Time In/ /Time Out	Description of Work	Parts & Materials: Description/Part No.	Quantity
|			
|			
|			
|			
|			
|			
|			
|			
What was found: Notes From Mechanic			
Date Completed:	Inspected By:		

Appendix B

Recap of Jobs

Machine Name:				Machine Number:			
Machine Description:				Date From:		To:	
Line Date	Mechanic Name	Work Number	Request Name	Work Requested Work Completed	RSN PTY	Hours	Material Used
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

RSN - Reason for Repair
PTY - Priority

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