Total Productive Maintenance (TPM) to Improve Laboratory Performance

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Abstract

Total Productive Maintenance is a methodology focused in the improvement of equipment performance. TPM is a concept mainly employed in the manufacturing operations in which the equipment performance is constantly monitored to reduce the impact in the yield. This research records the implementation of TPM into the laboratory operation and how the equipment performance improved. The implementation consisted in the identification of equipment losses, performance indicator identification, the assessment of the preventive maintenance program and in the implementation of 5S tools. The focus relied in a reduction of equipment issues and malfunctions increasing the availability of the equipment issues and malfunctions increasing the availability of the equipment and improving the laboratory performance.

Introduction

At industries Total Productive Maintenance (TPM) is a concept mainly employed at the manufacturing operations as an improvement tool focused in equipment performance. Many studies have shown the results of the implementation of TPM concepts in manufacturing operations such as the automobile industry [1] [3]. Results demonstrated improvements in Overall Equipment Efficiency (OEE) and in defects reduction [3][4]. Meaning that the application of TPM tools improved the equipment performance. The question becomes, can be the concept of TPM be applied to other operations such as laboratories?

Background

In previous years, quality control laboratories have implemented improvement concepts in order to pursue and be more efficient and agile. Concepts of lean laboratory was one example of the tools employed in order to improve the laboratory performance. Deployment of standard work, visual management, shift huddles were some the activities related to lean implementation in the laboratory. Nonetheless, TPM was a concept never applied before at laboratories. The approach used in the laboratories was one focused in the improvement of testing methods and human error reduction. However, the equipment performance was not a focus area for laboratories even though the analytical testing requires equipment usage. Equipment issues such as unplanned stops, system suitability failures or malfunctions were only assessed if was related to a laboratory investigation. The inclusion of TPM at the laboratory operation added a new scope into the improvement loop. Equipment is a key element inside the laboratory operation along with the analyst performance and testing methods.

Problem

The main objective of this research is finding how the application of TPM will improve laboratory performance, as well as, determining major offenders of equipment failure in the laboratory. Additional objective includes find out areas of improvement such as access the Preventive Maintenance Program, develop job aids for the analysts and define metrics to measure the equipment performance in the laboratory.

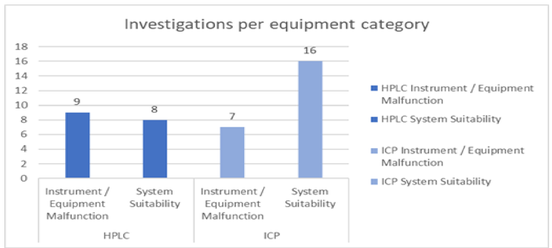
Methodology

The Methodology selected for this project design is a quantitative study. The application of a quantitative approach allows on to measure the equipment performance and consequently quantify the improvement. The study will employ a similar approach used by the case studies presented in the literature review for the auto-parts grinding machine and the die bonding machine in the manufacturing industry. [3] & [4] The methodology will replicate the TPM model into the laboratory operation. The model includes: the data collection of a period of one previous year, the identification of the performance indicator and major offenders. An equipment will be selected as pilot of the implementation. The project scope includes the identification of main losses of the equipment, the application of 5S and the review of the preventive maintenance program. Furthermore, train the analyst is part of the project scope. The team will consist of the laboratory analysts, instrumentation service contractors and leaders. After the TPM implementation, the equipment performance will be monitor according to the performance indicator identified. The results will be analyzed to measure the improvement and impact of the implementation.

Results and Discussion

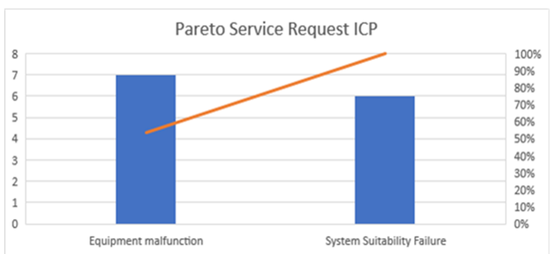
A laboratory investigation query was performed to gather the data from one year (2019-2020). The report of the query contained only the investigations related to instrument malfunction and instrument failures. The investigation report query showed 40 investigations related to equipment: 16 of equipment malfunction and 24 of system suitability failure in one year.

FIGURE 1 LABORATORY INVESTIGATION REPORT



The service request query collected the work requests related to instrument service. A total of 37 work requests were generated addressed to equipment support, 24 for HPLC and 13 for ICP. Of the 24 of the HPLC only 12 were related to equipment malfunction. Figure 2 shown that all request for ICP were related to equipment performance.

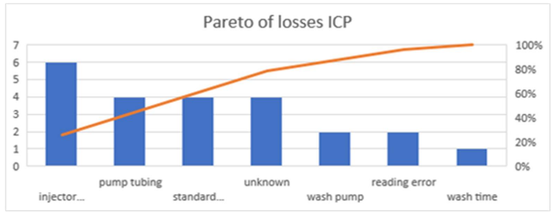
FIGURE 2 ICP SERVICE REQUEST REPORT



Results and Discussion, cont.

The ICP was identified as the pilot for the TPM implementation. Figure 3, showed that the losses were related to malfunction of equipment parts. The major offenders were related to the malfunction of the injector and pump tubing.

FIGURE 3 PARETO OF LOSSES ICP



The analysts assessed of the ICP area applied the 5S tools. The instrumentation contractors performed the Planned Maintenance Program (PM). A preventive program was led to develop visual job aids with training for the analysts. Figure 4, the job aids included visual inspection, execution of critical steps, safety warnings aligned to the standard operating procedures.

FIGURE 4 ICP JOB AIDS

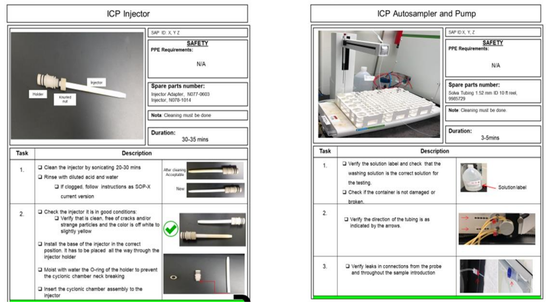
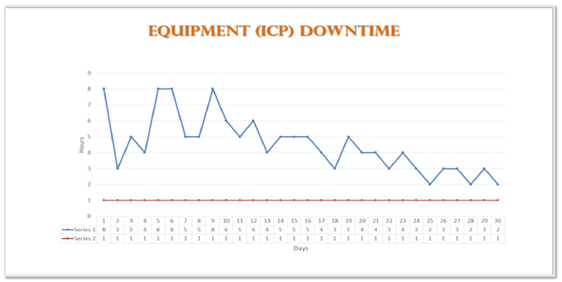


FIGURE 5 DOWNTIME METRIC



Downtime was the performance indicator identified at the beginning of the project. Downtime was the period of time that the equipment was off; unavailable to use. Figure 5 portrays the ICP downtime data of thirty days. The tendency for the first days had higher values of downtime. Value of eight hours of downtime for the ICP. After the implementation, a value of two hours of downtime was achieved. The availability of the equipment increased by six hours, which meant an increase of availability of seventy-five percent in contrast to the initial state. An improvement of seventy-five percent of equipment performance was achieve with the implementation of TPM.

Conclusions

The implementation of Total Productive Maintenance into the laboratory operations improved the equipment performance. This changed the approach used in the past by the laboratories regarding laboratory performance. The inclusion of equipment into the laboratory approach allowed to assess and monitor the equipment performance finding areas of improvement that would impact the performance. Improvement such as five S, downtime reduction and capabilities of the analysts were implemented in the project.

The implementation of the TPM concepts into the laboratory contributed into the organization, demonstrating how Total Productive Maintenance works in the laboratory operation. Developing a Preventive Maintenance Program for the ICP. Training the analyst in the preventive program. Increasing the capabilities and skills of the analysts. Defining a performance indicator to measure equipment performance. Promoting a teamwork environment.

Future Work

Applying the Total Productive Maintenance into organizations such as laboratories and replicate the implementation in other areas. Also, the scope of the TPM could be expanded through all the laboratory operations including other equipment in the TPM program. The application of performance indicators such as Overall Equipment Efficiency would need to be assessed in order to be included into the laboratory performance.

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