Production Performance Increase through Five S Technique on Manufacturing Equipment Tools

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Abstract

Pharma LLC, a company dedicated to solid drug product manufacturing, performed an assessment, and determined they were experiencing overtime cost increases, lower productivity and personnel discomfort with tools and resources available for them to work. To address these issues, the Five S technique was used to minimize equipment downtime, reduce overtime costs, and increase productivity in three manufacturing lines. Several cross functional interviews and feedback sections were held to align on developing and implementing the solution. A shadow board box was implemented on each manufacturing line. This not only allowed to easily find tools within the different areas, but also to identify missing tools and trigger a process to replace if needed. For the process to be maintained, a checklist was added to the daily activities for operations supervisors. The implementation of shadow boards resulted in a reduction of 56.75 hours in equipment downtime over a period of 10 days, overtime cost avoidance of $184K annually and average increase of 15% on productivity.

Introduction

Companies across the world are facing day-to-day challenges due to changes in customer behaviors, competitors, and cost increases. To overcome these obstacles, they need to become more efficient in the way they operate, while maintaining high quality and meeting regulatory requirements.

Pharma LLC, a company dedicated to solid drug product manufacturing with many years of presence in the pharmaceutical industry, has also faced these challenges. As part of their goals and objectives, a series of capacity increases, and cost reduction initiatives were necessary across their different sites.

During the assessment, it was observed that over the years, overtime cost increased, productivity declined, and personnel has expressed discomfort with the tools and resources available for them to successfully execute their activities. Specifically, for the solid drug product manufacturing lines there was a need to increase production performance through Five S technique implementation to manufacturing equipment tools.

The specific facility where these activities were performed has three manufacturing rooms within the scope of the project, which are supported by manufacturing operators and maintenance technicians responsible of running and troubleshooting equipment as needed. As part of the initiative, it was expected to eliminate waste associated to movement, downtime, and poor capacity due to lack of standardization and availability of critical tools to manage equipment utilized for manufacturing activities.

Background

The Five S methodology is widely used around the world and across different businesses [1]. The structure provided focus on the use of the following concepts as a framework in the work area to assess solutions:

Sort	Elimination of unnecessary tools or instructions from unwanted materials.
Set in Order	Organization of anything that remains by arranging parts by ease of use.
Shine	Execution of cleanup activities.
Standardize	Establishing periodic maintenance by conducting the above 3S.
Sustain	Making the changes and the 5S implementation a habit by always following the steps above.

When following this or similar methodologies, it is suggested to use elements of planning, designing and management of the production process in combination with technical information to determine the next steps and approaches to be taken [2]. Learning from other organizations' experiences and leveraging their success is also important to better implement changes and process improvements. Lean, Six Sigma and Change Management should be used in conjunction to achieve processes with zero defects [3].

During application of 5S and Lean Methodologies interviews should be completed throughout the process, as they allow to gather feedback on the changes being implemented and how people would react to them. Performing this exercise post implementation allows one to gain valuable insight on how the results have improved according to the desired outcome [4].

Problem

Significant overtime cost increases, lower productive levels and personnel discomfort and disengagement. To address the findings, the following objectives were established.

Increase	Increase productivity by 20% in solid drug products manufacturing lines by Q2 2022.
Reduce	Reduce overtime costs in solid drug products manufacturing lines by Q2 2022.
Minimize	Minimize solid drug products manufacturing equipment downtime by Q2 2022.

Methodology

- Identification of non-value-added activities (waste).
- Reduction and elimination of non-value-added activities to increase productivity in manufacturing lines.
- Identification of sources of overtime costs associated to drug product manufacturing lines.
- Reduction or elimination of sources of overtime cost.
- Identification of sources of equipment downtime for drug product manufacturing lines.
- Reduction or elimination of sources of equipment downtime through use of 5S to equipment tools.

Results and Discussions

Manufacturing line performance data on equipment downtime, overtime and productivity was collected over a period of ten-days period before and after implementation activities were completed. Table 1 shows a summary on equipment downtime, for which the three manufacturing lines experienced a total of 33.75 hours of downtime prior improvements. Post-implementation a total of 2.0 hours were observed, with a total reduction of 31.75 hours,.

Table 2 shows a summary of overtime with a total reduction of 56.75 hours. They were assessed in terms of cost according to a rate of $125 per hour leading to a projected annual cost of $207K prior implementation and $23K post implementation, representing projected cost avoidance of $184K annually.

Scheduled and worked hours were assessed and summarized on Table 3, showing an average productivity increase of up to 15% for the three lines and up to 20% by line per day. Average productivity prior to changes was 84% increasing up to 99%.

Table 1 Equipment Downtime Summary

Area	Before (Hrs)	After (Hrs)	Difference (Hrs)
Manufacturing Room 1	10.00	0.50	9.50
Manufacturing Room 2	10.75	0.50	10.25
Manufacturing Room 3	13.00	1.50	11.50
Total Hours	33.75	2.00	31.75

Table 2 Overtime Summary

Area	Before (Hrs)	After (Hrs)	Difference (Hrs)
Manufacturing Room 1	20.00	1.50	18.50
Manufacturing Room 2	20.75	1.00	19.75
Manufacturing Room 3	23.00	5.50	17.50
Total Hours	63.75	7.00	56.75

Table 3 Productivity Summary

Area	Before (Hrs)	After (Hrs)	Difference (Hrs)
Manufacturing Room 1	60.00	69.50	9.50
Manufacturing Room 2	59.25	69.50	10.25
Manufacturing Room 3	57.00	68.50	11.50
Scheduled Work Hours	210.00	210.00	N/A
Worked Hours	176.25	207.50	31.25
Productivity*	84%	99%	15%

From assessment with cross functional teams, it was determined that the main cause of equipment downtime was due to the lack of the proper tools to support production activities and equipment maintenance and utilization in the different rooms. Missing and broken tools were the most common cause of downtime. Required tools for each room were identified and procured. For easy access and sustainable solution, a shadow board box, a place to store the tools with specific locations was created for each room as shown in Figure 1 and Figure 2. It uses the tool image, identifying its specific location within the board allowing easy identification of missing tools.

To ensure the tools are always in place, a daily check was added to operations area walks for each shift. This process required each supervisor or lead to confirm that all tools were in place or available in each manufacturing room at the beginning of each shift activities. For missing tools, the process would trigger associates to look for tools and replace in case of being needed.

Figure 1 Shadow Board and Tools Design

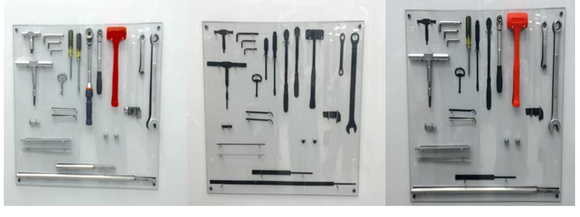

Figure 2 In-Process Shadow Boards Installation

Conclusions

For a successful execution, it was essential to maintain an open communication with all the cross-functional groups impacted by the changes in all stages of the activities.

There was active engagement through several interviews and feedback sections with the associates' responsible for executing, collecting data, and using the tool developed to identify root causes, but also to develop the right solution for their areas.

This active collaboration allowed for the changes to be widely and easily accepted by different functions.

Future Work

Packaging Lines	Shadow board development and implementation for equipment tools utilized in manufacturing packaging lines across the facility.
Maintenance Carts	Shadow board concept for tools used for maintenance technicians in carts that can be transported across the different areas in the facility. Tools shadows will identify specific locations withing the cart drawers.

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References

[1] Sangode P. Impact of 5S Methodology on the Efficiency of the Workplace: Study of Manufacturing Firms. CLEAR International Journal of Research in Commerce & Management. 2018;9(12):14-16.

[2] Geng, Hwaiyu, ed. 2016. Manufacturing Engineering Handbook. 2nd ed. New York: McGraw-Hill Education.

[3] Arthur, Jay. 2016. Lean Six Sigma for Hospitals: Improving Patient Safety, Patient Flow, and the Bottom Line. 2nd ed. New York: McGraw-Hill Education.

[4] Kanamori, S., Sow, S., Castro, M. C., Matsuno, R., Tsuru, A., & Jimba, M. (2015). Implementation of 5S management method for lean healthcare at a health center in Senegal: a qualitative study of staff perception. Global health action, 8, 27256.