



Data Driven Maintenance Efficiency

José A. Quiñones Hernández, EIT

Advisor: Héctor J. Cruzado, PhD, PE

Polytechnic University of Puerto Rico, Graduate School



Abstract

Opportunities for improvement were identified in the maintenance engineering department of a leading biopharmaceutical firm, particularly regarding uneven distribution of preventive maintenance tasks throughout the month. Early in the month, tasks are performed arbitrarily, leading to a rush at month's end and an accumulation of work. This project was aimed to optimize preventive maintenance by improving reliability and balancing the workload among technicians. Historical data from the firm's computerized maintenance management system (Maximo 7) was analyzed to identify correlations that could help distribute tasks more evenly. Graphical aids representing the data were presented to management to identify underperforming teams and measure the outcomes of interventions. Although further improvements are needed, positive progress was achieved, enhancing overall preventive maintenance practices.

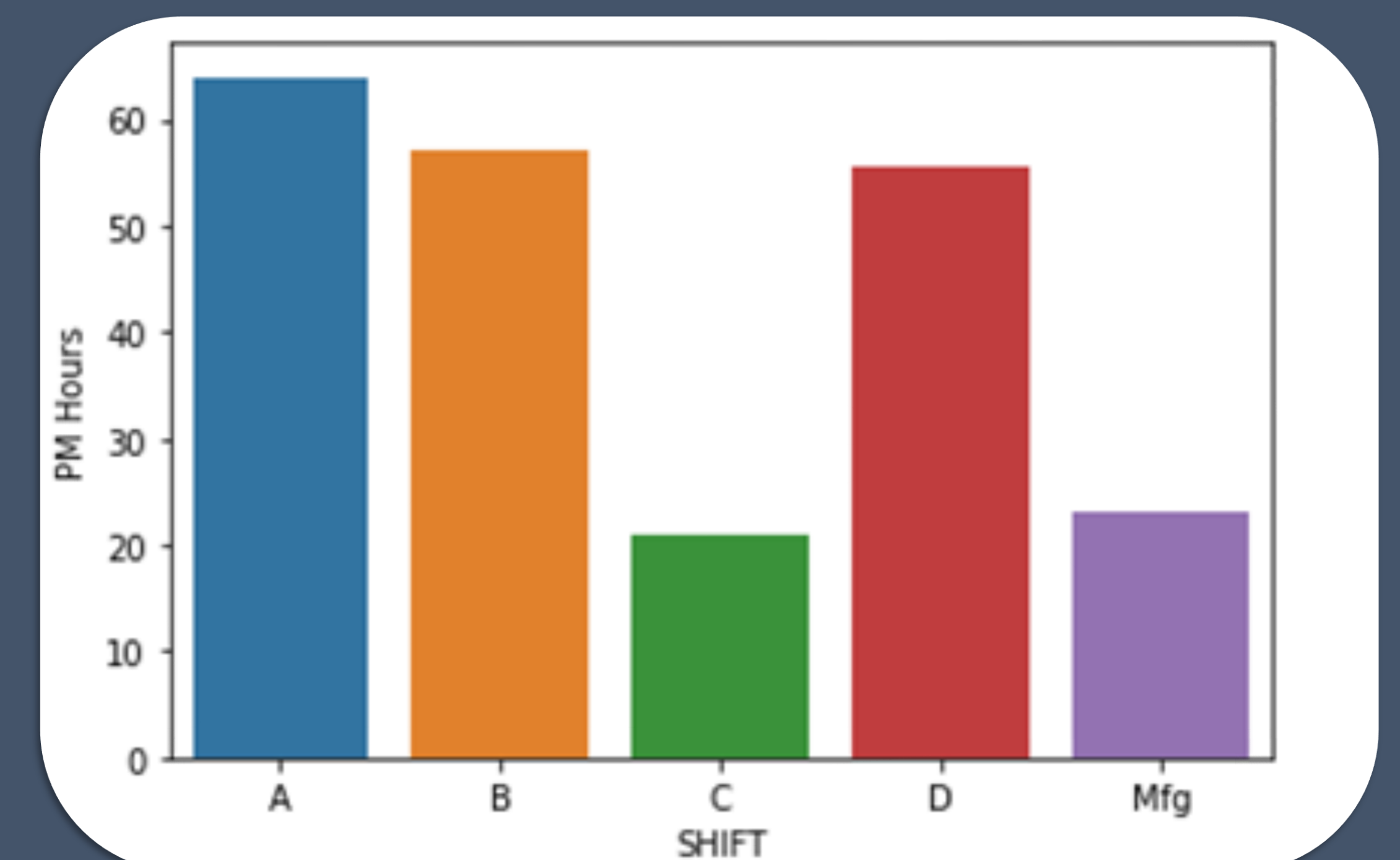
Methodology

Historical preventive maintenance execution is recorded within the company's computerized maintenance management system. This data was retrieved and statistically preprocessed to identify key trends, categorical attributes, and numerical results, revealing how work is executed throughout the month and which shifts are underperforming. Additionally, open preventive maintenance work orders were grouped by the time required to complete each work type and sorted from highest to lowest. This approach allows prioritization of the most labor-intensive tasks at the beginning of the month, leaving the less demanding tasks for the end, thereby optimizing the overall maintenance workflow. To prompt systematic correction, the management team was presented with this data through the month, so each manager had a reference as to when and what work to distribute.

Results

Following regular feedback provided via email to the engineering maintenance shifts, a notable improvement was observed across most shifts. Shifts A, B, and D exhibited more consistent execution of work, with each shift maintaining a standard deviation of 3.58 PM Hours. Conversely, Shift C displayed suboptimal results, suggesting a need for management to investigate and implement necessary corrections to ensure uniform work distribution across all shifts. Before the implementation of this system, preventive maintenance tasks typically consumed the entire month. However, following implementation, overall completion of preventive maintenance tasks was achieved with four days remaining in the month, illustrating a marked improvement in efficiency.

Post-Implementation Completed Work Results Per Shift at Month Close



Traditional vs Quantitative

A key area of opportunity is the recurrent reliance of the management team on traditional experience for work distribution. No formal methodology is employed in deciding the priority and sequence of preventive maintenance work orders. Effective maintenance execution management should include measurable outcomes and inputs aligned with predefined plans to optimize outputs and support the team. Defaulting to traditional methods will continue to result in large workloads nearing deadlines, threatening the plant's regulatory compliance. This compliance is mandated by U.S. Federal Code of Regulations (21 CFR 211.67 and 21 CFR 820.70) and overseen by the Food and Drug Administration.



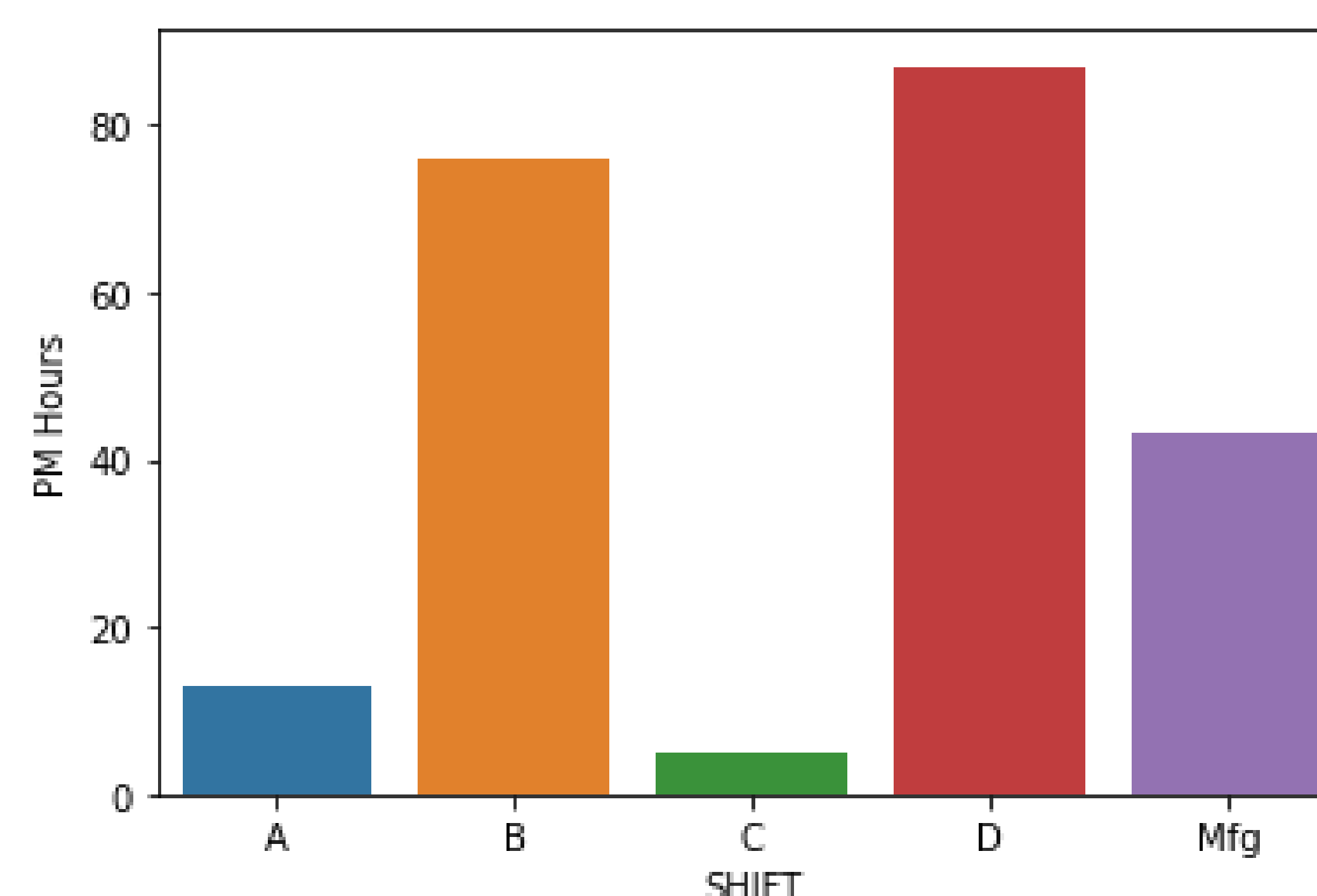
Open Preventive Maintenance Work Orders Grouped and Sorted by Execution Time (PM Hours)

Pending Maintenance Technician PM duration for current Month

	Job Plan Description	Job Plan Number	Job Plan Count	Job Plan Duration	PM Hours
0	SEMI-ANNUAL MAINTENANCE / CERTIFICATION OF MAN...	134549	24	2.5	60.0
1	QUARTERLY MAINTENANCE OF MONOLITHIC SHT (10X16)	123268	45	0.5	22.5
2	ANNUAL MAINTENANCE /CERTIFICATION OF SYNTEGON ...	137061	11	2.0	22.0
3	ANNUAL MECH MAINTENANCE FOR HERMA LABELER AMG ...	136297	1	9.0	9.0
4	ANNUAL MECH MAINTENANCE OF CLOSURE LABELER, AC...	107197	1	8.5	8.5
5	MONTHLY MAINTENANCE OF VIAL INSPECTION GRIPPER...	113229	15	0.5	7.5
6	ANNUAL MECH MAINTENANCE OF MARCHESINI CARTONER...	127580	1	7.0	7.0
7	ANNUAL MAINTENANCE OF GROSS FILL VOLUME MANUAL...	110150	13	0.5	6.5

Pre-Implementation Completed Work Results Per Shift at Month Close

<AxesSubplot:xlabel='SHIFT', ylabel='PM Hours'>



Conclusion

The implementation of a streamlined preventive maintenance management strategy has yielded substantial improvements in task distribution and execution. By leveraging historical data and sophisticated analytical tools, the project has successfully normalized the workload across all engineering maintenance shifts and improved the reliability of task completion by consistently reducing the time required to complete monthly work.