

Problem Description

At Micron Technology, Inc., estimating the Cost per Wafer (CPW) for spare parts—a critical yet manual process—posed significant challenges. The manual calculation was not only time-consuming but also prone to errors, making the task of budget estimation for material procurement each quarter laborious and inefficient. This process, susceptible to human error, hindered quick adaptability to changes, increasing the workload and affecting the accuracy essential for the Material Planning Team's operations.

Recognising the need for a transformative solution, the project aimed to automate the CPW calculation process. This strategic shift was designed to enhance precision, reduce manual effort, and support Micron's commitment to operational excellence and cost-effective manufacturing.

Preventive Maintenance

It involves scheduling routine maintenance for parts before any problems occur. This helps avoid unexpected breakdowns and keeps the manufacturing process smooth and uninterrupted.

Corrective Maintenance

It's the maintenance work done after a part has broken down or shown signs of failure. This is more unpredictable and can vary greatly in cost depending on the issue.

Automated CPW Calculator

Achievements & Impacts

- Current Method: Excel: Manual inputs. Prone to errors. Limited in handling complex data.
- New Automated Approach: SQL for data management Python for analysis and cost calculation

Feedback from the director of Planning department

Addressed a critical need for improved efficiency and accuracy in forecasting CPW

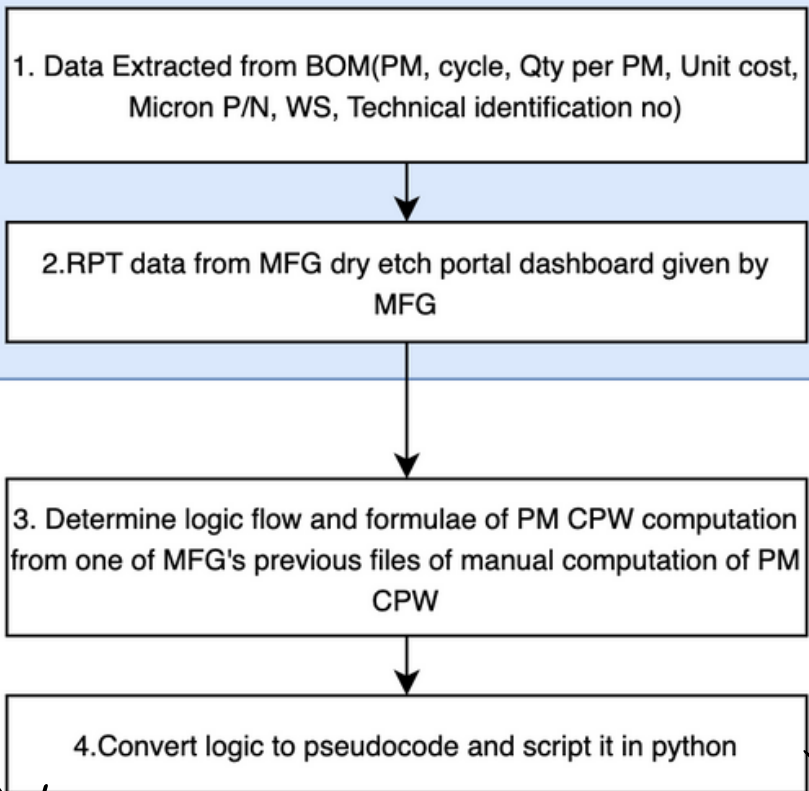
Unveiled new areas for enhancement within their existing systems

Approach

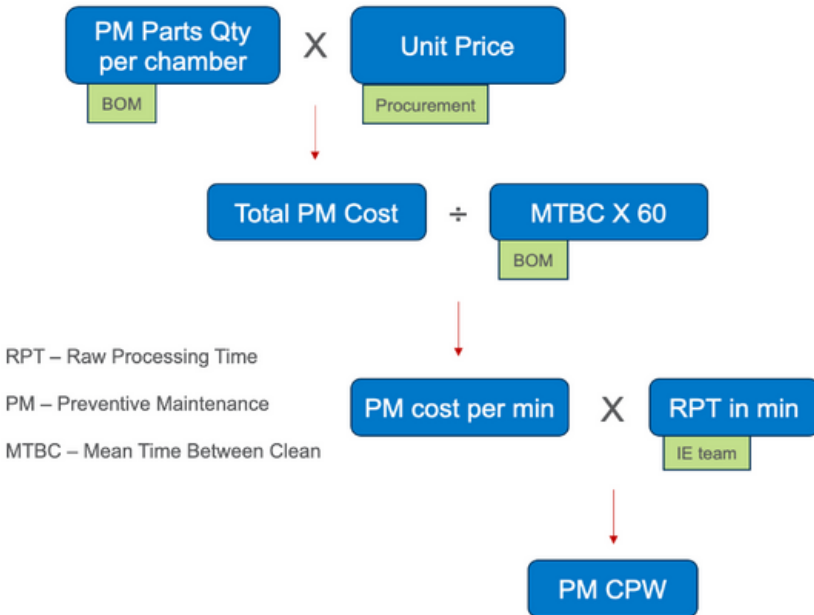
Navigating Through Preventive Maintenance(PM) and Corrective Maintenance(CM) Strategies

PM CPW Calculator

PM Data preparation via SQL



PM Calculator Development via Python



CM Data Preparation

1. Automatically import different Excel files and compiled into a single data frame
2. Data cleaning
3. Data frame is saved into pickled file

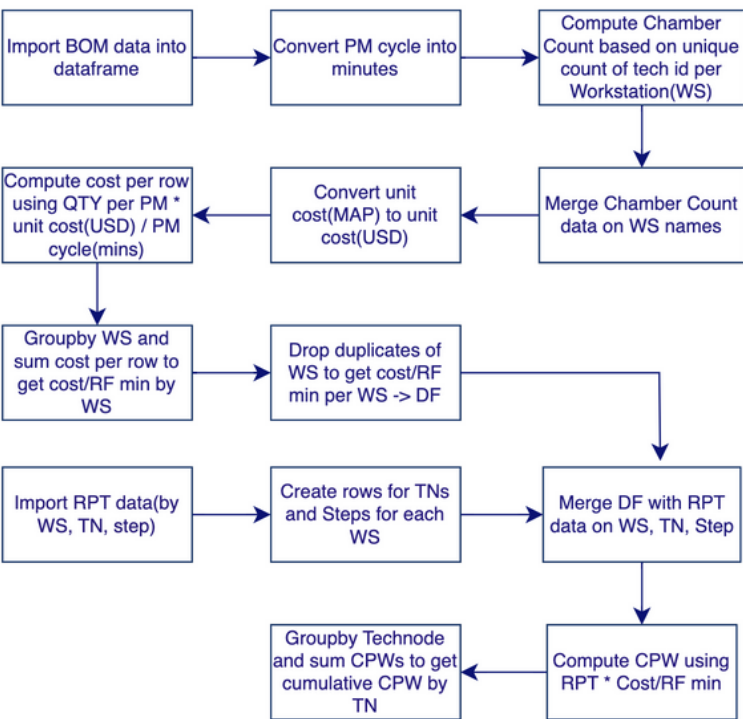
CM Parts Comparison

Purpose: Find list of unique parts that go through corrective maintenance

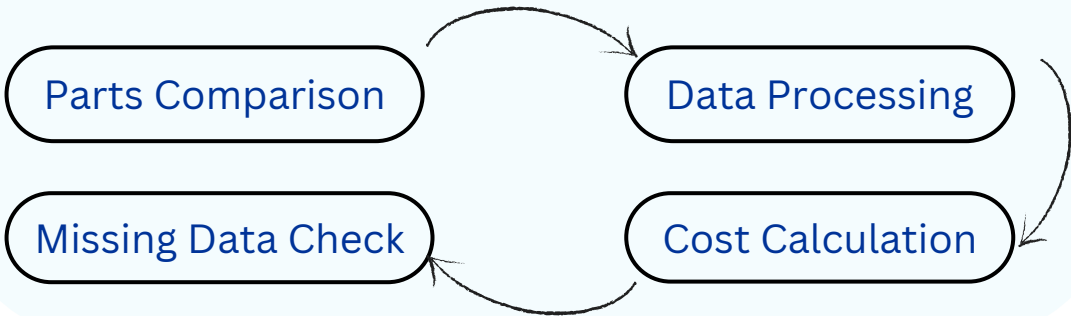
Done by comparing two different files and finding parts that incurred expenses on one of the files but not the other.

CM Data Processing

- Observations with missing data are removed
- Date is converted to a year-month format
- Date converted into Micron's fiscal year and quarter.

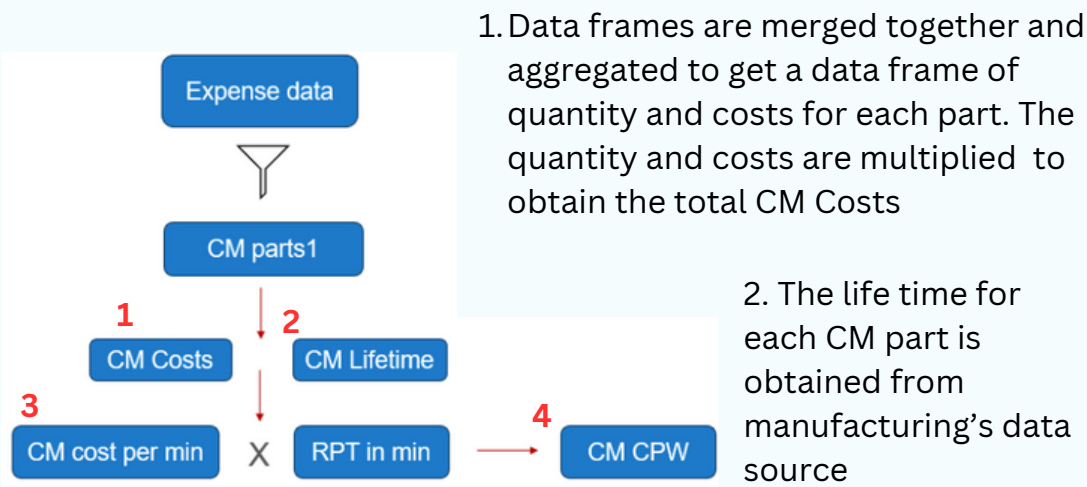


CM CPW Calculator



CM Cost Calculation

Cost is calculated based on the logic flow of CW CPW calculation



3. The CM cost per minute is obtained by dividing the total CM cost with the lifetime for each part
4. Raw Processing Time (RPT) in minutes is obtained from the manufacturing data source and multiplied with the CM cost per minute to get the CM CPW

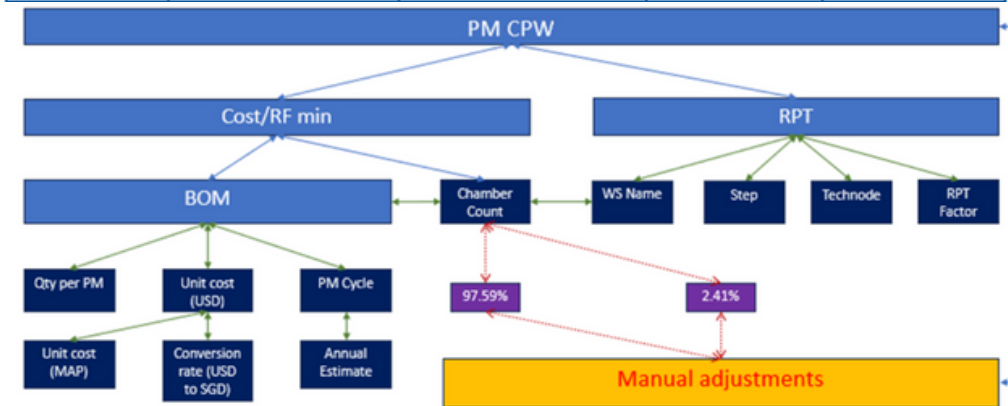
CM Missing Data Checks

Missing data rows and entries are compiled based on the 'Cost per RF Minute', 'Raw Processing Time' and 'Work Station'.

Results Analysis

PM Results Analysis

Technode	Sum of CPW (Automated)	Sum of CPW (Manual)	Delta	% Delta
100s	19.67	22.96	-3.30	-14.36
110s	26.11	31.03	-4.92	-15.87
120s	28.89	29.99	-1.10	-3.67
140s	12.96	12.95	0.01	0.08



Despite the overall success, there were variances in some calculations. 97.59% of these discrepancies were traced back to differences in chamber count values from 3 workstation data. 2.41% was due to manual adjustment on other columns of data.

CM Results Analysis

Technodes	Sum of CPW (Automated)	Sum of CPW (Manual)	Delta	% Delta
100s	24.97	26.20	1.23	4.68%
110s	33.86	30.70	-3.16	-10.29%
120s	40.82	38.70	-2.12	-5.48%
140s	17.76	15.10	-2.66	-17.6%

Technode	Delta	% Delta	Variance Reasoning
100s	-3.30	-14.36	Manually adjusted from actual 15 failures to 10 per year for 10-3TEL_SCCM_OX_04
110s	-4.92	-15.87	Manually adjusted ESC (40-50) & Agile Unit (1->6) for 10-3TEL_VIGSRK4_OX_06MERCN
120s	-1.10	-3.67	
140s	0.01	0.08	

Variances are explained by the manual adjustment of parts used by the Manufacturing Team as they predict the machines' efficiency from the past data.

Future Improvements

- Understanding Manual Adjustments
- Proactive Inclusion of Adjustments in Automation
- Missing data validation check

Past Trend Analysis

1. Quarter to quarter CpW Comparison to look for fluctuation
2. Automated variance commentary

Cost Forecasting

1. Quantify more factors that contribute to the change in CpW
2. Simulation of budget expenses for different loading scenarios

The team proposed to forecast the Cost per Wafer by using different regression models such as linear regression, polynomial regression and ridge regression. However, we were advised that there are more factors affecting future forecasting, some of which are difficult to be quantified.