Wafer Accounting Tracking Change (WATCH)

IE3100R System Design Project AY 2024/25

Department of Industrial & Systems Engineering

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1.Problem Description

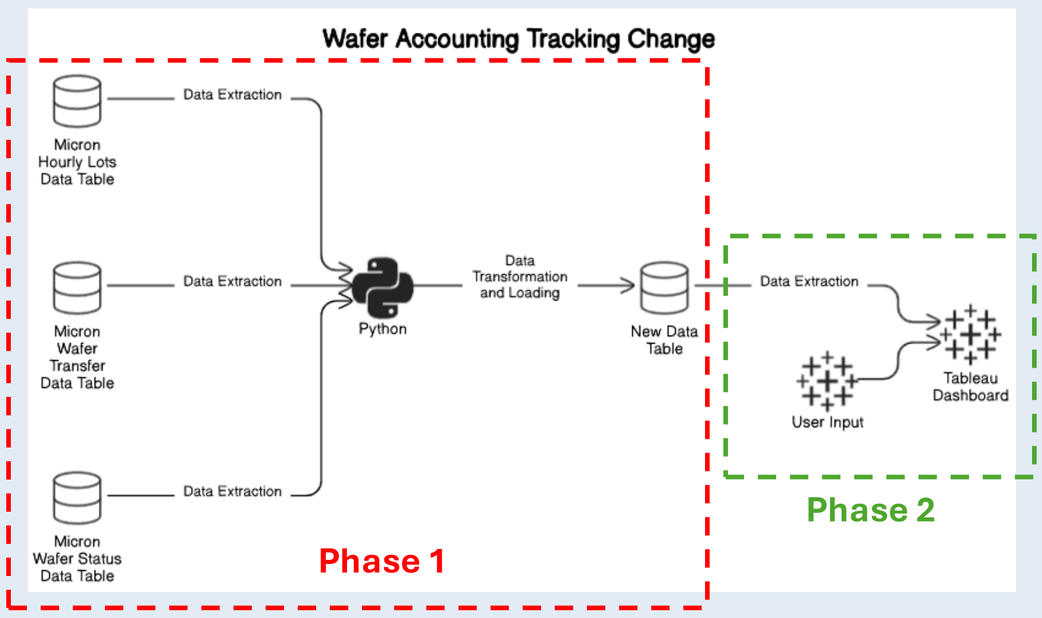
Significant changes in wafer output between two timestamps require users to manually compare large datasets across the timestamps. This process is time-consuming and prone to errors. Without structured guidance, users often rely on manual judgement, leading to inconsistent analysis, reduced productivity, and a higher risk of mistakes.

2. Project Aim

This aim is to develop a system that helps user visualise and analyze the change in wafer counts between two user-defined timestamps. By presenting it as an intuitive dashboard, the system allows users to efficiently trace discrepancies in wafer movement and gain clearer insights into their root causes.

3. Solution Overview

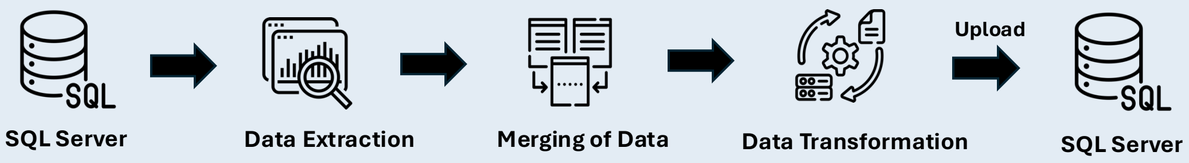
To resolve the issues mentioned above, our team used a two-phase approach.



Phase 1: Implement an automated Extract, Transform, Load (ETL) process using Python to clean and consolidate the wafer data for reliable analysis.

Phase 2: Develop an interactive dashboard to visualise wafer movements, enabling users to perform analysis and provide wafer-level insights

4. Phase 1: Python ETL – Wafer-Level Tracking Table

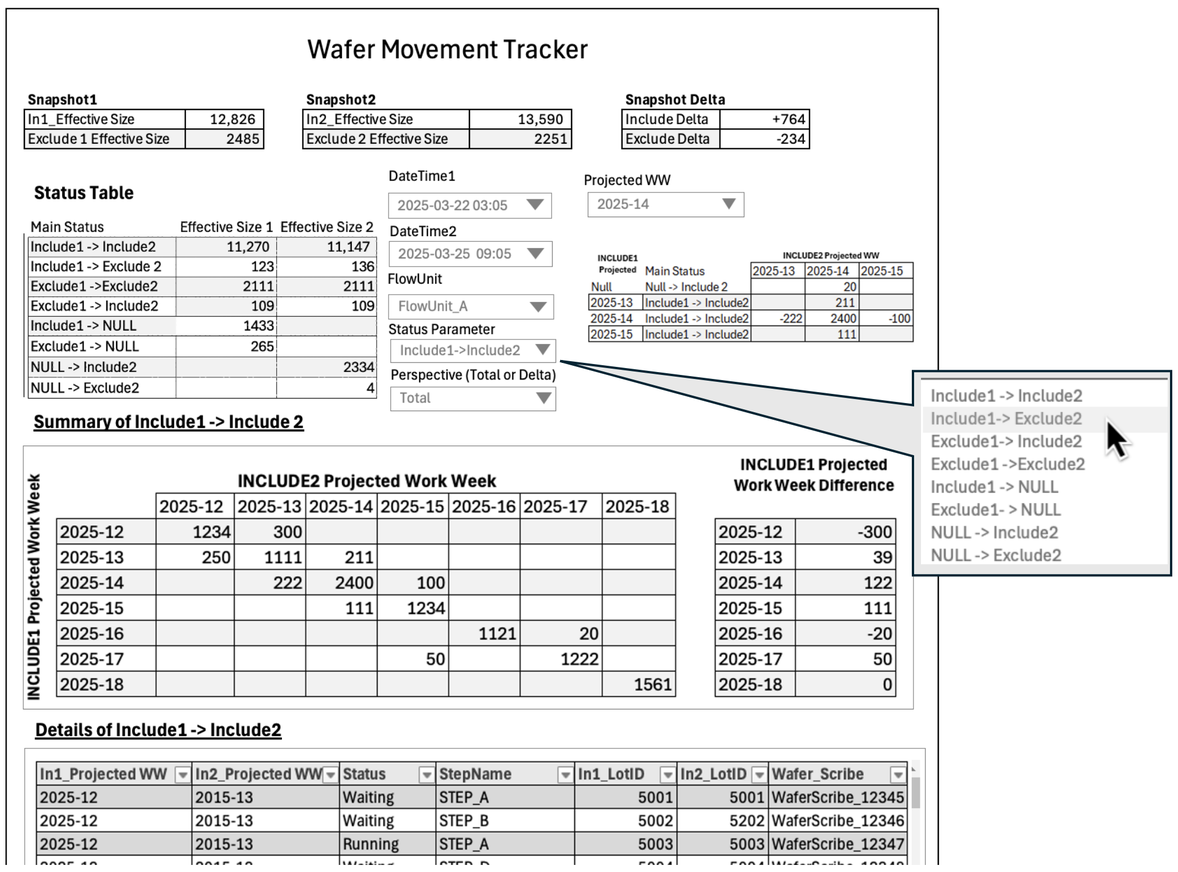


Key Steps

- **Data Extraction**: Extract data on lots included/excluded from shipment, wafer status, and transfer history from relevant tables.
- **Data Merging**: LotIds from the included/excluded table are merged with the wafer status table to get the corresponding wafer scribe numbers, the unique identifier of each wafer. It is then merged with the wafer transfer history to recover missing wafer-to-lot mappings to ensure full traceability.
- **Data Transformation**: Standardise and consolidate all wafer records into a unified format.
- **Upload to SQL Server**: Load the cleaned dataset back into SQL for visualisation on the dashboard.

5. Phase 2: Dashboard for Wafer-Level Comparison

The processed wafer-level data is visualised through an interactive Tableau dashboard designed to support efficient comparison, analysis and investigation of wafer movements between timestamps.



Core Dashboard Features

- **Timeframe and flow unit selection**: Users can choose any two timestamps and flow units for comparison.
- **Tabular result display**: Key metrics are presented in structured, easy-to-read tables.
- **Summary and detail views**: Switch between an overview and a detailed breakdown for specific wafer flows.
- **Parameter switching**: Enables users to toggle between different wafer transitions (e.g., Include1 → Include2, Include1 → Exclude2).
- **Projected Work Week filters:** Users can isolate specific projected work week to see all the wafer movements for that week and their wafer details
- **Matrix visualisation for cycle time analysis**: Displays wafer movement across projected work weeks to highlight delays or accelerations.
- **Interactive drill-down**: Clicking on matrix cells reveals wafer-level details such as STEPNAME for further inspection.

6. Comparison of results

Criteria	Previous Manual Method	Improved Automated Method
Granularity of Detail	Lot-level tracking	Wafer-level tracking
Data Preparation Time	~30 minutes	~2 minutes
Cycle Time Visualization	Not supported	Matrix clearly shows timing shifts
Accuracy	Prone to human error due to manual steps	High accuracy through automation
Root Cause Analysis	Manual effort required to trace and analyse affected wafers	One-click drill-down to wafer-level details

7.Future Directions

With the foundational work of Phase 1 (ETL) completed, the database is now well-positioned for further enhancements. The current solution effectively identifies wafers impacted by shifts in projected work week. A future step could involve understanding the root causes behind these shifts, such as process delays, bottlenecks, or accelerated steps. Incorporating process timing data would support proactive issue detection, improve control and drive continuous improvement.

8.Key Technical Skill Sets