IE3100R Systems Design Project. Department of Industrial & Systems Engineering AY 2025/2026

Line Stop Management System

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Introduction

Micron Technology is a global leader in memory and storage solutions, delivering high-performance DRAM, NAND, and NOR products under the Micron® and Crucial® brands. Within its semiconductor fabrication facilities, the Planning New Product Introduction (NPI) Team plays a critical role in monitoring part type performance indices and driving Best-in-Class cycle time outcomes. A key challenge in this process is the management of Line Stops, unplanned production halts that disrupt scheduling, impede wafer throughput, and result in measurable manufacturing losses.

Problem Statement

The NPI Team currently relies on fragmented, manual data entry to track Line Stop events, a repetitive process prone to human error and communication delays. Data remains inconsistent and impact assessments stay subjective, preventing a standardised or reliable view of overall operational performance to necessary stakeholders.

Current Business Flow

Line Stop is raised via Microsoft Forms that lack the necessary formatting and filtering to provide clear operational visibility. It is routed to Sharepoint for data to be extracted manually where impacted Wafers-In-Progress(WIP) and Cycle Time(CT) calculations are then done in Excel with oversimplified formulas that fail to capture the true impact of Line Stops.

Proposed Solution & Objectives

An automated Line Stop Management System that streamlines data collection through a platform, standardises reporting, and delivers real-time insights through integrated dashboards. It is designed to reduce response latency, improve stakeholder communication, and provide leadership with the actionable intelligence needed to minimise cycle time impact.

Project Methodology

Problem Formulation
Defined project objectives, identified key stakeholders, and scoped Line Stop reporting details within Micron's NPI workflow.

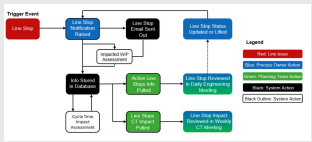
Process Improvement
Performed gap analysis of existing business flow and stakeholder requirements to isolate specific inefficiencies and failure points.

System Design
Developed a centralized Mendix application, utilised a structured SQL data schema and integrated automated flows to move data into Tableau.

Implementation & Validation
Built and validated the end-to-end system, including the platform, automated notifications, and interactive dashboards.

System Design & Implementation

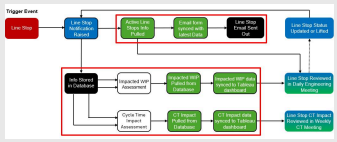
Old Process Flowchart



Fragmented Manual Process

- Data is tracked on outdated platforms and manual handling is required to pull information from existing databases.
- Processes cannot be scaled up as there is inconsistency in data reporting across different teams.

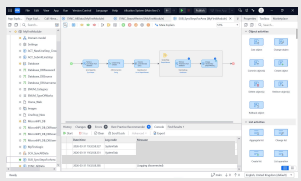
New Process Flowchart



End-to-End Scalable Process

- Automation of notifications and dashboard updates (Red Box) eliminate the need of manual processes and boosts data integrity.
- Linkage to modern data-driven platforms allow operations to be scaled up as needed.

Data Collection: Mendix Form Input



- Built on Mendix platform where dynamic dropdowns are sourced directly from the production database.
- Submissions auto-write and sync to a centralized input table.
- Validated dropdowns replace free-text fields across all mandatory inputs.
- Form logic enforces completeness before submission such that every record meets downstream quality standards.

Data Processing

Database Schema & Logging

- Two core tables created: Form Input Table (primary key: Form_Input_ID) and Logs Table (foreign key links back to Form Input).
- Every submission auto-generates a new log entry, enabling full audit trail of Line Stop events.
- Log entries are referenced in downstream SQL calculations for WIP and CT impact.

Entity Relationship Diagrams

WIP Calculations

$$\text{ETA} = \text{Now} + \sum_{\text{Current Step}}^{\text{Destination step}-1} \text{Step CT}$$

$$\text{Proj WIP} = \sum_{\text{ETA}-\text{Now}}^{\text{Release}} \text{Wafers}$$

Total Impacted WIP =
WIP At Step + Incoming WIP

CT Calculations

$$\text{Step CT Impact} = \text{Step CT}_{\text{Overall}} - \text{Step CT}_{\text{wo LS}}$$

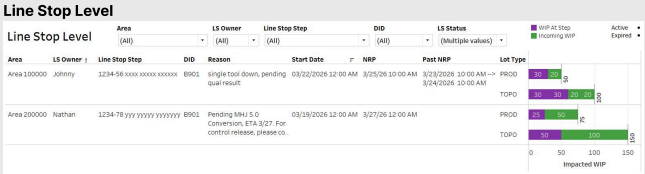
$$\text{Step CT} = \frac{\sum_{\text{Lot}} \text{CT} \times \text{Wafers}}{\sum_{\text{Lot}} \text{Wafers}}$$

CT Impact =
Standard Step CT - Line Stop-adjusted CT, weighted by wafer volume

Data Visualisation

Impacted Wafers-In-Progress(WIP) Dashboard

Line Stop Level

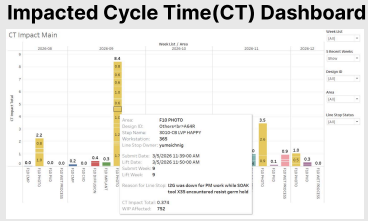


- Accumulated WIP at step alongside Projected Incoming WIP are shown in colour-coded stacked bar charts, enabling forward-looking capacity planning.
- Users can isolate line stop cases by different operational parameters, including area, equipment owner, line stop step, and wafer lot ID.

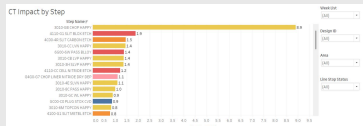
Lot Level

- Lot Level chart monitors lot quantities across manufacturing steps that may be affected by the line stop.
- Key operational parameters for each lot, such as criticality levels, WIP limits, lot classifications, and forecasted ETAs to line stop step are included.

Impacted Cycle Time(CT) Dashboard



- The main CT Impact chart displays weekly CT Impact by Area and Step, with its individual CT Impact numbers also displayed. Hovering over bars provides all required info about Line Stop at that Step.
- Weekly average accounts for lot size variation and reflects true throughput degradation.

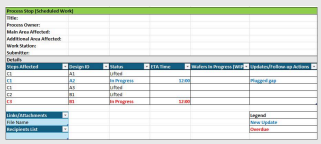


- The first supplementary chart displays the CT Impact by step, ranked by the CT Impact. This helps the team understand which Steps are the most impacted.

- The second supplementary chart displays all existing Line Stops, and also lifted Line Stops in that current Work Week. This helps the team pinpoint recent or updated Line Stops to zoom in on.

Automated Reporting: Line Stop Email Notification

- Messy format making it hard to see and filter relevant data.
- Calculations required to be done manually and added to email notifications sent out.
- Unnecessary time spent on data cleaning due to inconsistency in user input formats from free text fields.



- New email design makes it easier for team members to see important information as it is neatly organized in a clear and concise manner and the latest important updates are highlighted.

Outcomes & Recommendations

Impacts

- **Resource Optimisation**: Eliminates 3 hours of non-value-added manual reporting per week, allowing NPI Planning capacity to be reallocated to strategic analysis.
- **Reduced Decision Latency:** Accelerates stakeholder response times via automated notifications that precisely quantify WIP and Cycle Time (CT) impacts.
- **Centralised Ecosystem:** Replaces fragmented tools with a fully integrated, seamless reporting framework.

Skills & Takeaways: Systems Integration & Architecture, Manufacturing & Supply Chain Operations, Advanced Data Visualisation and Predictive Analytics & Modelling.

Action Item 1
Secure Mendix form via Micron access systems for secure roles and audit tracking.
Action Item 2
Enhance Tableau with predictive models to forecast line stops and enable proactive scheduling.