

AnyLogic Conference 2026

From Simulation to Optimization: Improving Tool Utilization and Wafer Throughput in Semiconductor Manufacturing

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Back Grind & Metallization (BGM)

01 Wafer Taping & Back Grinding

Protective tape is applied to active circuit frontside. Mechanical grinding reduces wafer thickness down to ultra-thin levels (e.g., $< 100\text{ }\mu\text{m}$).

02 Stress Relief & Surface Preparation

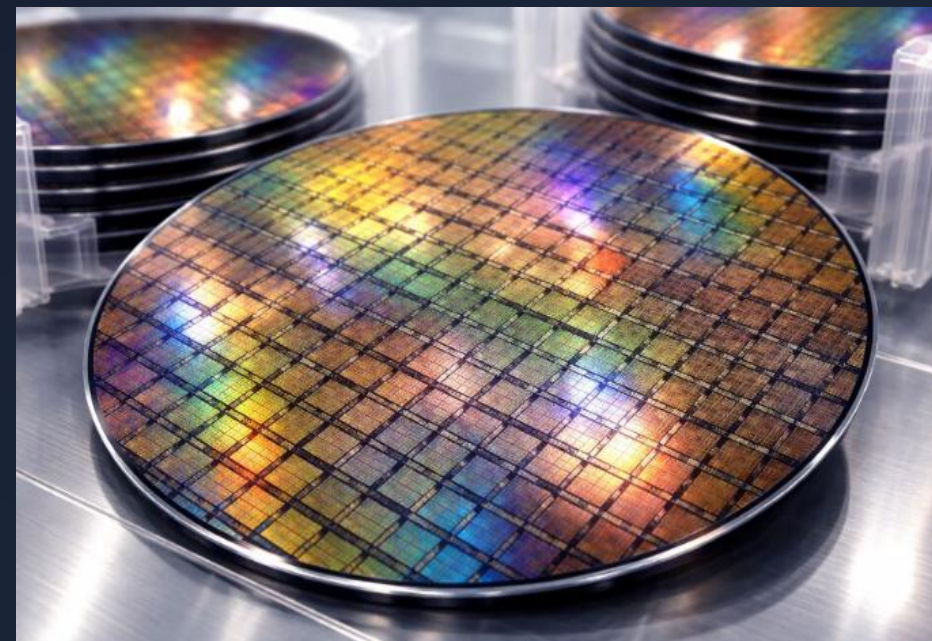
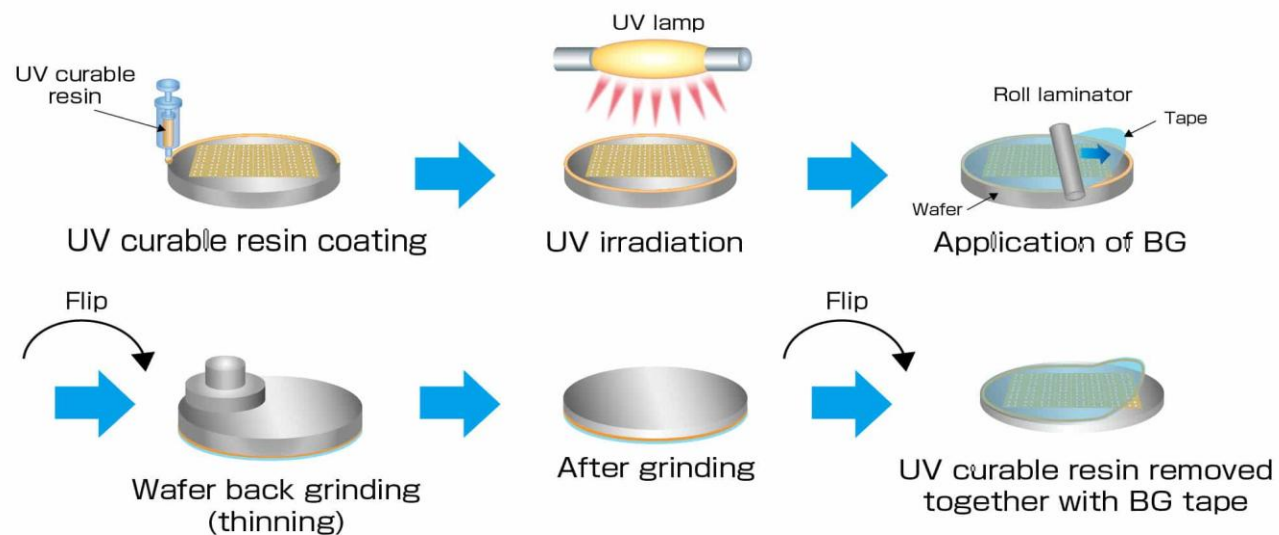
Chemical Mechanical Polishing (CMP) or chemical etching removes micro-cracks and subsurface damage caused by mechanical grinding.

03 Backside Metallization (BSM)

Physical Vapor Deposition (PVD sputtering) deposits thin metal films (e.g., Ti/Ni/Ag) on the wafer backside for electrical contact and heat dissipation.

04 De-taping & Inspection

Protective tape is safely removed; wafers undergo automated optical inspection (AOI) before moving to dicing and packaging.



Wafer & FOUP Movement in Fabs

What is a FOUP?

Front Opening Unified Pod is a sealed, high-purity enclosure carrying up to 25 silicon wafers (300mm) under nitrogen micro-environments.

AMHS & Overhead Hoists

Automated Material Handling Systems utilize ceiling-mounted **Overhead Hoist Transport (OHT)** vehicles to fly FOUPs across tool bays at high speeds.

Load Ports & EFEM

FOUP docks onto an **Equipment Front End Module (EFEM)**, which automatically opens the door in ISO Class 1 clean air to transfer single wafers into process chambers.

FOUP Cleaning Cycle

After wafer unloading, FOUPs go through specialized automated washer units to eliminate airborne molecular contaminants (AMCs) and particulate residue.



AnyLogic Simulation: BGM Model



Problem & Opportunity

- Current tools (PowerBI, DOTS, JMP) only look at **historical & current status**.
- Need a **predictive model** dedicated to the BGM factory module.
- Proactive **downtime planning** and throughput optimization.
- Accurate forecasting of inventory builds vs. reductions.
- Early identification of manufacturing **bottlenecks & constraints**.

Predictive Intelligence



Model Considerations

- Scheduled Maintenance windows
- Initial Machine Loading conditions
- FOUP variations (Thick vs. Thin Wafers)
- FOUP Cleaning logic & cycle times
- Wafer Types & dynamic dispatching
- Machine Types & Resource Pool constraints

Fab Operational Logic



Optimizer Enhancement

- Integrated mathematical **Optimization Engine**.
- Recommends the **minimum number of machines** of each type required.
- Ensures 100% target alignment with forecasted production schedules.
- Reduces capital expenditure (CapEx) while preventing bottleneck formation.

Decision Support System

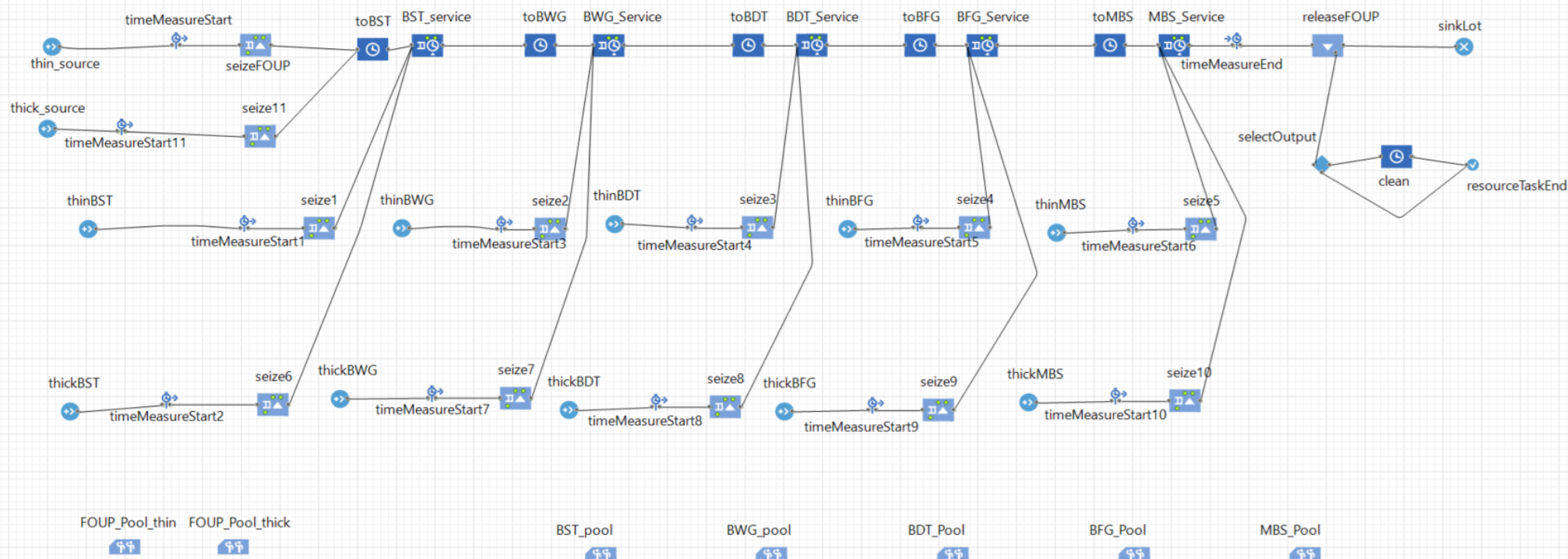
BGM Model Logic

BGM
Simulation

Logic

Graph

Date



BGM Model Parameters/Variables

	 parBSTcount	
	 parBWGcount	
	 parBDTcount	
	 parBFGcount	
	 parMBScount	 scheduleBST
		 scheduleBWG
 Thick_lots_per_week	 cleaning_cycle	 scheduleBDT
 Thin_lots_per_week		 scheduleBFG
		 scheduleMBS
 Thick_wafer_out_mbs	 parFoupcountThin	 ThickLotSchedule
 Thin_wafer_out_mbs	 parFoupcountThick	 ThinLotSchedule
 cumulative_wafer_out	 dataset_thick_wafer_weekly	
 N_wafer_system	 dataset_thin_wafer_weekly	
 N_wafer_foup		
 statistics_system		
 N_wafer_complete	 dataset_wafer_complete	 toBWGdistribution
 N_wafer_BST	 dataset_wafer_BST	 toBDTdistribution
 N_wafer_BWG	 dataset_wafer_BWG	 toBFGdistribution
 N_wafer_BDT	 dataset_wafer_BDT	 toMBSdistribution
 N_wafer_BFG	 dataset_wafer_BFG	
	 event	
	 event_weekly	

BGM Model KPI Architecture

A structured blueprint mapping simulation dashboard outputs to critical operational performance metrics.



Resource & Scheduling

Monitors equipment allocation patterns and tracks idle states to optimize tool utilization rates.

WEEKLY MACHINE SCHEDULE

Tracks planned vs. actual runtimes for tools (BST, BWG, BDT, BFG, MBS).

HOURLY IDLE MACHINE COUNT

Identifies transient bottlenecks and tool starvation across hourly intervals.

CORE OBJECTIVE

Maximize machine OEE and minimize idle-state bottlenecks.



Throughput & Product Mix

Measures physical output volumes and wafer type distribution across daily and weekly periods.

DAILY WAFERS OUT / COMPLETED

Monitors actual daily completed wafer counts versus production design targets.

WEEKLY LOT & THICK/THIN OUTPUT

Evaluates product-mix ratios to maintain balanced thin and thick wafer production.

CORE OBJECTIVE

Ensure output predictability and fulfill customer batch commitments.



WIP & Queue Dynamics

Analyzes line-loading, queue buildup points, and cycle time variability across stages.

DAILY TOTAL WAFERS IN SYSTEM / FOUP

Tracks inventory accumulation in the active system vs. intermediate FOUP queues.

AVERAGE TIME PER LOT

Evaluates distribution of batch lead times to identify long-tail cycle anomalies.

CORE OBJECTIVE

Minimize manufacturing cycle time and optimize inventory holding costs.

No of FOUPs for Thin Lots

75

No of FOUPs for Thick Lots

60

Current Thin Lots in BST

12

Current Thick Lots in BST

11

Current Thin Lots in BWG

14

Current Thick Lots in BWG

13

Current Thin Lots in BDT

2

Current Thick Lots in BDT

1

Current Thin Lots in BFG

2

Current Thick Lots in BFG

1

Current Thin Lots in MBS

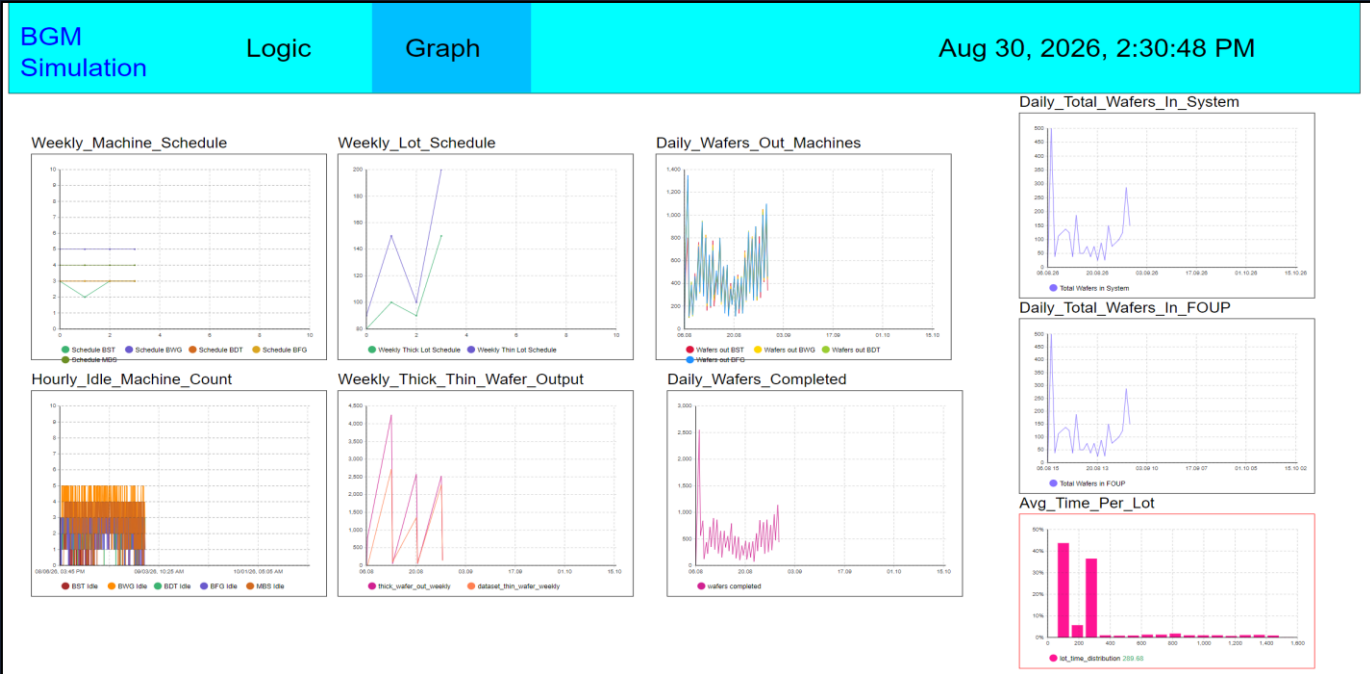
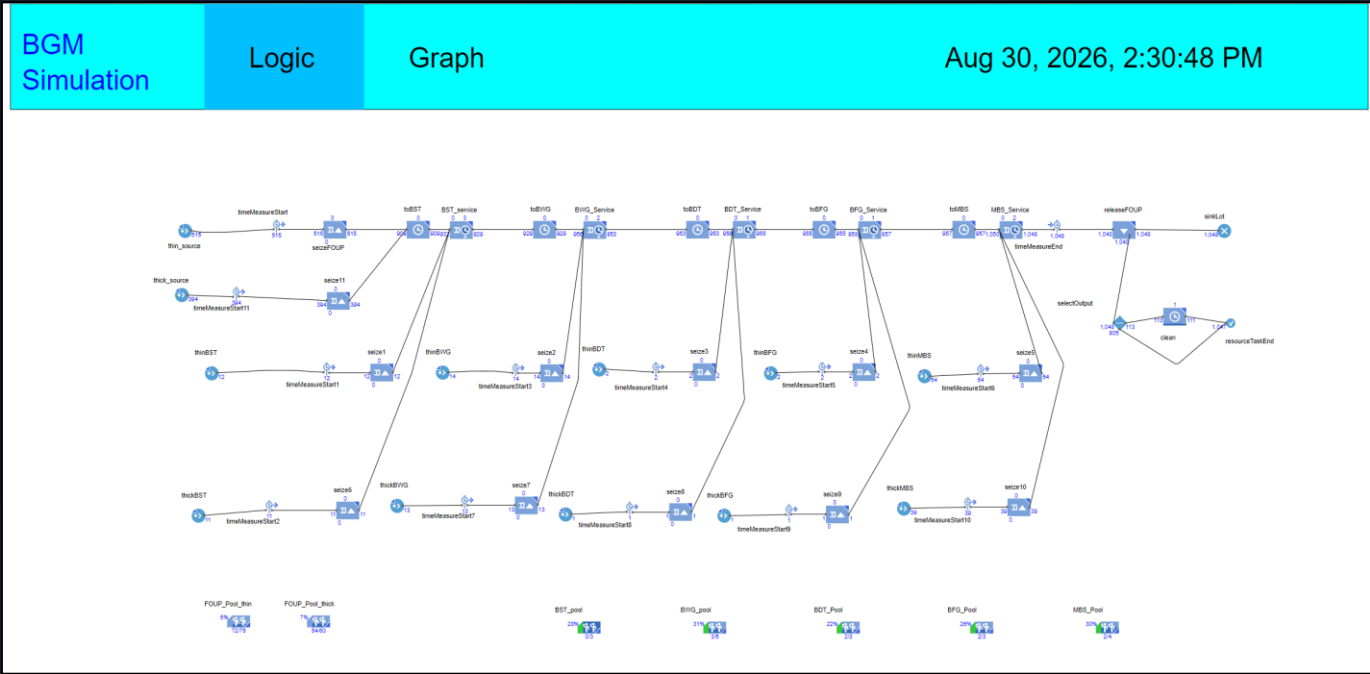
54

Current Thick Lots in MBS

39

bgm_tool_count_optimization : Optimization

	Current	Best
Iterations completed:	12	2
Replications:	2	10
Objective: ↑	0	11
Parameters	Copy best	
parBSTcount	2	2
parBWGcount	3	2
parBDTcount	4	2
parBFGcount	5	2
parMBScount	3	3
parFoupcountThin	75	75
parBSTlot	12	12
parBWGlot	14	14
parBDTlot	2	2
parBFGlot	2	2
parMBSlot	54	54
parBSTlot1	11	11
parBWGlot1	13	13
parBDTlot1	1	1
parBFGlot1	1	1
parMBSlot1	39	39
parSourceThin	92	92
parSourceThick	66	66
parFoupcountThick	60	60
cleaning_cycle	10	10



THANK YOU

Questions & Discussions