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PLAN STABILITY AS A KEY PERFORMANCE INDICATOR IN SEMICONDUCTOR WAFER PLANNING: A COMMERCIAL CASE STUDY

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ABSTRACT

In semiconductor wafer planning, long lead times and volatile demand signals pose significant challenges. Reacting to every demand change introduces nervousness and inefficiencies, particularly in backend operations. This case study presents NXP's Wafer Workbench, a decision-support tool that enables planners to assess demand changes through simulation under various capacity scenarios. By comparing new demand signals with existing wafer plans using KPIs such as Expected Service Level and Capacity Utilization, the tool enhances visibility and coordination. The Wafer Workbench has significantly reduced planning workload and infeasibilities while improving plan quality. Future enhancements include flexible scenario simulation, stochastic optimization to address demand uncertainty, and generative AI agents for automated plan adjustments.

1 INTRODUCTION

Semiconductor wafer planning is inherently complex due to long production lead times and fluctuating customer demand. Traditional planning approaches often react to every demand change, leading to system instability and suboptimal backend starts. Recent literature emphasizes the importance of stability in production planning (Graves et al., 1993; Stadtler, 2005). This paper explores how NXP Semiconductors addressed these challenges by introducing the Wafer Workbench, a simulation-based planning tool.

2 WAFER WORKBENCH OVERVIEW

The Wafer Workbench is conceptually depicted in **Figure 1**. It allows planners to simulate the impact of demand changes under different capacity scenarios (constrained, and unconstrained). Hence, the latest demand is confronted with these capacity scenarios, making use of Linear Optimization Models. Using those scenarios, planners can derive conclusions on necessary actions to be taken within the wafer plan, using KPIs such as Expected Service Level and Capacity Utilization. This approach provides real-time insights and fosters collaboration among planners, especially when products share resources.

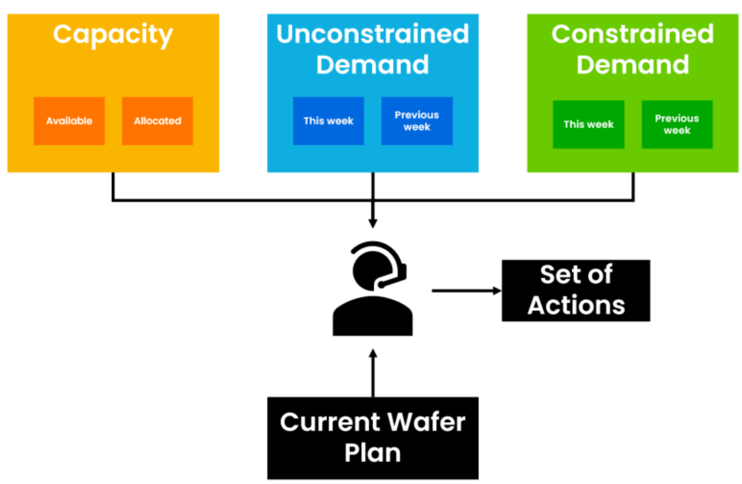

Figure 1: Conceptual depiction of Wafer Workbench.

3 IMPACT ON PLANNING

The introduction of the Wafer Workbench has transformed NXP's planning process. Planners now have full visibility into demand changes, the expected impact of those changes to the plan quality, and peer planning decisions. Wafer Workbench preserves NXP wafer loading plan of record, which is only changed with planners' deliberate decision to do so. It eliminated capacity infeasibilities and reduced workload and plan changes significantly, while keeping service levels at the desired level. All key performance indicators are depicted in

Table 1.

Table 1: Key Performance Indicators around Wafer Workbench.

Key Performance Indicator	Change through Wafer Workbench
Plan Infeasibilities/week	Reduced to 0/week
Weekly Wafer Planning Effort	Reduced by approx. 40%
Plan Changes/week	Reduced by approx. 80%

4 FUTURE ENHANCEMENTS

Three key developments are planned to further enhance the Wafer Planning with Wafer Workbench:
1) *Flexible Scenario Simulation:* Currently, the set of simulation scenarios visible to the planners is fixed and limited on capacity scenarios. Incorporating discrete-event simulation tools to allow custom capacity and demand scenarios (Rosman et. al., 2024).
2) *Stochastic Optimization:* Currently, the demand scenarios used in the simulations are deterministic, and are therefore not considering the observed demand uncertainty. Hence, in a next step models that account for demand uncertainty to create robust wafer plans are introduced (Weijers et. al., 2025).
3) *Generative AI Agents:* Currently, analyzing the simulation results against the existing wafer plan, and adjusting the wafer plan where necessary, is a manual task and requires wafer planning experience and technical skills. Therefore, enabling AI-driven analysis and execution of plan adjustments to support planners in a dialogue-based interface is identified as a potential next step to further boost productivity around Wafer Workbench.

5 CONCLUSION

Plan stability is a critical KPI in semiconductor wafer planning, which can conflict with existing KPIs like service level and capacity utilization. NXP's Wafer Workbench demonstrates how simulation-based decision-making can enhance planning quality and efficiency. Future advancements will further integrate flexibility, robustness, and AI-driven support into the planning process.

REFERENCES

Graves, S. C., and Willems, S. P. 1993. Supply chain design: Safety stock placement and supply chain configuration. MIT Sloan School of Management.

Stadtler, H. 2005. Supply chain management and advanced planning—basics, overview and challenges. European Journal of Operational Research, 163(3), 575-588.

WSC BoD (Winter Simulation Conference Board of Directors). 2025. Winter Simulation Conference. http://www.wintersim.org, accessed 11 October 2025.

Rosman, C., E. Weijers, K. Schelthoff, W. van Jaarsveld, A. Akcay, and I. Adan. 2024. "Aggregated Simulation Modeling to Assess Product-Specific Safety Stock Targets During Market Up- and Downswings: A Case Study". In 2024 Winter Simulation Conference (WSC), 1931–1942 https://doi.org/10.1109/WSC63780.2024.10838984.

Weijers, E., N. Sluijter, G. Hogers, K. Schelthoff, I. Adan, and W. Van Jaarsveld. 2025. Improving Plan Stability in Semiconductor Manufacturing through Stochastic Optimization: a Case Study. Proposed to 2025 Winter Simulation Conference (WSC). IEEE.