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STRATEGIC PRODUCTION TRANSFORMATION THROUGH SIMULATION-DRIVEN DECISION SUPPORT

Prashant Tiwari[1]

[1]Cargill Inc., Wayzata, MN, USA

ABSTRACT

To lead in delivering safer, premium-quality food ingredients, one of our plants is undergoing a strategic transformation. This initiative reflects a forward-thinking commitment to innovation and excellence, not just regulatory alignment. By transitioning to a new class of high-quality products, we are enhancing safety, expanding our portfolio, and positioning ourselves to better serve evolving market needs. This shift introduces operations complexities-frequent product changeovers, tighter inventory control, and outbound capacity constraints. To address these, we developed a robust simulation model, offering comprehensive view of plant operations. The model enables us to test new configurations, quantify cost impacts, and proactively identify supply risks. Beyond immediate improvements, the simulation supports smarter infrastructure investments by evaluating storage expansion and modeling demand growth scenarios. This data-driven approach strengthens long-term flexibility and resilience, ensuring our operations remain agile and aligned with future market dynamics.

1 INTRODUCTION

In response to rising product quality standards and evolving regulatory expectations, one of our plants is reevaluating its product specification and processing configurations. One proposed response is to shift from a two-product to a three-product setup on a critical production line. This change would allow tighter control over product purity and enable differentiated offerings but introduces operational complexity.

Key considerations include 1) Production scheduling: Increased product changeover may reduce run lengths and complicate planning, 2) Storage utilization: Additional product could strain existing inbound and outbound storage infrastructure, and 3) Inventory management: Higher buffer stock requirements may increase the risk of overflow or stockouts.

2 SIMULATION METHODOLOGY AND BUSINESS QUESTIONS

To support strategic evaluation, a discrete-event simulation model was developed to replicate the plant's operations under both current and proposed configurations. The model incorporates 1) Storage capacity constraints: Real-time tracking of unloading/loading rates for inbound and outbound storages, 2) Changeover logic: Downtime and cleaning requirements modeled for each product switch, and 3) Demand variability: Stochastic modeling of outbound demand to test robustness under uncertainty.

The simulation model was used to explore key business questions 1) What is the operational impact of transitioning to a three-product setup? 2) Can existing infrastructure support the increased complexity without compromising service reliability? and 3) What are the economic implications of infrastructure expansion versus alternate mitigation strategies?

3 OPERATIONAL CHALLENGES AND MITIGATION SCENARIOS

Simulation results highlighted several potential challenges 1) Changeover frequency: Increased switching may reduce throughput due to shorter run lengths and more frequent downtimes, 2) Inventory pressure:

Outbound storage may frequently approach capacity limits, increasing the risk of forced downtime or overflow, and 3) Stockout risk: Limited outbound storage space combined with demand variability could lead to supply gaps.

To mitigate these risks, several scenarios were evaluated 1) Volume redistribution: Shifting a portion of production to an alternate facility reduced stockout risks, though it may introduce logistical overload and a loss in potential revenue, 2) Enhanced planning tools: A dynamic scheduling interface can be developed to integrate simulation outputs into daily planning workflows.

4 INFRASTRUCTURE PLANNING AND STRATEGIC OUTLOOK

Capital investment scenarios were modeled to assess long-term feasibility such as 1) Partial expansion: Adding inbound and outbound storages can improve flexibility. Simulation results highlighted this but having additional storage may not have significant impact during peak demand periods or long emergency downtimes, 2) Full expansion: Doubling product storage capacity would significantly reduce changeover-induced downtime and can improve service reliability. While this could simplify operations and align with emerging regulations, simulation result revealed risks related to 1) Supply chain volatility, 2) Cost premiums, and 3) Market acceptance.

5 CONCLUSIONS

This simulation-driven study provides a robust framework for evaluating the operational and economic feasibility of transitioning to a three-product configuration. By quantifying risks and testing mitigation strategies, the plant is equipped to make informed, forward-looking decisions that balance compliance, product quality, and strategic growth.

More importantly, this initiative reflects a broader ambition to lead in delivering higher-quality food ingredients and to future-proof operations through innovation and sustainability. The proposed shift not only supports regulatory alignment but positions the plant to offer superior products and expand its portfolio in a rapidly evolving market.