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FLEXIBLE SIMULATION FOR OPTIMIZING SEEGRID'S AUTONOMOUS MOBILE ROBOT SOLUTIONS

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ABSTRACT

This case study examines how Seegrid, a leading manufacturer of autonomous mobile robot (AMR) solutions, partnered with Simio to develop a comprehensive discrete event simulation template model that reliably represents Seegrid AMR solutions, enabling better visualization of vehicle interactions, congestion reduction, and optimal fleet sizing. Simio's template-based approach enables Seegrid's large team of skilled Application Engineers to quickly and accurately build models of customer automated workflows. The collaboration demonstrates how simulation can transform solution design for modern industrial autonomous material handling, providing both immediate operational insights and a foundation for future innovation.

1 THE CHALLENGE

While Seegrid's Application Engineering team continues to leverage a dependable Excel-based model to support solution design, they needed to expand their approach with simulation modeling. This will provide deeper insights and greater flexibility when planning for more complex workflows that may have short cycle times, large AMR fleets, and production critical processes.

2 SOLUTION: SIMIO DISCRETE EVENT SIMULATION

In 2024, Seegrid began collaborating with Simio to develop a discrete event simulation model that could accurately represent their AMR operations. The solution focused on several key capabilities:

1. **Comprehensive Route Network Modeling:** The team developed a Python script that extracted AutoCAD routes, which then populated data tables in Simio. This allowed for quick and accurate creation of the vehicle travel network.
2. **Data-Driven Template Design:** Simio's main deliverable was a template model file, tailored to Seegrid's requirements. This architecture allowed end users to build a baseline model quickly.
3. **Job Sequencing Simulation:** A common complex workflow in material handling is "hot swapping"—the process of replacing empty containers with full ones at assembly lines with minimal time disruption. The Simio simulation model consistently represented this process by coordinating two AMRs—one to remove the empty container and another to deliver the full container—with appropriate sequencing logic to ensure the full container arrived only after the empty one was removed.
4. **Intersection and Traffic Management:** The model incorporated Seegrid's enterprise fleet management logic, Fleet Central, for handling intersections, including: resource allocation at traffic intersections, proper handling of reverse operations, and a visualization of queuing and wait times at each intersection.

5. **Experimental Design Capabilities:** The model included robust experimentation capabilities to determine optimal Seegrid AMR fleet sizes based on utilization targets. By running multiple scenarios with different vehicle counts, the team could identify the ideal fleet size that balanced utilization (avoiding both under and over-utilization) with customer throughput requirements.

3 RESULTS AND BENEFITS

The implementation of Simio's discrete event simulation delivered significant benefits to Seegrid's autonomous solution design process:

- **Enhanced Visualization and Understanding:** The simulation provided a clear visual representation of Seegrid AMR movements and interactions, enabling the team to identify potential issues before being presented to the customer.
- **Improved Bottleneck Identification:** The model's ability to track wait times at intersections allowed the team to pinpoint specific congestion points and develop strategies to mitigate them.
- **Optimized Fleet Sizing:** Through experimental capabilities, Seegrid could more exactly determine the optimal number of vehicles needed for each application, avoiding both under-provisioning (which would fail to meet throughput requirements) and over-provisioning (which would unnecessarily increase costs).
- **Scalable Solution Design:** The model's ability to start with a baseline and then scale up by adding more pick and drop locations or increasing throughput requirements delivered a flexible foundation for autonomous solution designs that could adapt to changing customer needs.

4 CONCLUSION AND FUTURE DIRECTIONS

The partnership between Seegrid and Simio demonstrates how discrete event simulation can drive smarter design for autonomous material handling applications. Looking forward, Seegrid plans to expand their simulation capabilities by adding more features to support additional workflows, incorporating new products as they are developed. Sydney Schooley, Seegrid Application Engineering Manager, "Our aim wasn't perfection—it was to build a solid, practical model supported by a strong partnership with a simulation developer that positions us well now, and for the future."