Proceedings of the 2023 Winter Simulation Conference
C. G. Corlu, S. R. Hunter, H. Lam, B. S. Onggo, J. Shortle, and B. Biller, eds.

SIMULATING THE MATERIAL DELIVERY PROCESS FOR AN AUTOMOTIVE BODY SHOP

Joseph Hugan

TriMech, LLC
4991 Lake Brook Drive #300
Glen Allen, VA 23060, USA

ABSTRACT

Increasing product customization and a continual need for higher productivity has led to more complex automotive vehicles being built in more compressed spaces. The material delivery networks supporting these processes have also had to adapt to deliver a wider variety of parts in smaller packaging at an increasing frequency. The author will discuss the development and analysis of an automotive delivery network simulation with a focus on delivery times, the resources required, the data model used to drive the simulation, and the analytical techniques used during the project. The presentation will also include a discussion on the model construction, the time required to construct the model, and the challenges encountered in the project.

1 INTRODUCTION

As part of working with an automotive OEM, TriMech developed a parametric simulation to address material delivery for the welding systems for two separate body shops. The focus of the study was to validate and optimize the organization of the material handing resources. This included forklifts and AGVs organized into overlapping teams. The end result was the delivery of a flexible simulation to the OEM to analyze future changes to production volume and material placement through an Excel interface. The remainder of this presentation will detail the data model, analysis techniques, model construction, and simulation results of the initial analysis.

2 SYSTEM OVERVIEW

The scope of the simulation was defined by the four walls of the facility. The model included the inbound and outbound trucking schedules, the pickup and put away of inventory to a series of warehouses, and the management of the lineside material bins that are used by weld operations in the two body shops. The current organization of responsibilities in body shop meant that six teams of forklift operators managed all the lineside deliveries. During peak times, their geographical assignments within the facility would change in priority. If their first level of responsibility included 10 stations, they could also have secondary stations where they would assist if time allowed. Analyzing utilization, congestion, and lineside material shortages informed decisions on potential changes to these responsibilities.

3 MODEL CONSTRUCTION

TriMech constructed a FlexSim simulation to analyze the system and provide the model to the OEM for future use. The model included over 20 parameters, five (5) performance measures, a series of analytical dashboards, and six (6) Excel spreadsheets to create the environment required to answer the questions posed by the project team. The model began with an AutoCAD layout as a backdrop. All of the potential aisles and intersections were modeled with traffic control rules and over 200 pickup and dropoff points. 737 individual SKUs were tracked and resupplied by the material handling teams that consisted of 38 forklifts initially spread across six (6) lineside delivery teams. The resulting model was run through a series of experiments that measured, utilization, distance travelled, congestion, delivery times, and any stockouts that occurred lineside. The production areas were modeled as black boxes that had adjustable line and mix rates.

4 VALIDATION AND ANALYSIS

As an existing system, the data to drive the model was readily available to allow for the validation of the current condition. The densities of the existing packaging, their location in specific warehouses, and historical data on mix percentages within a specific body style made validation straight forward. As different scenarios were envisioned, box plots for delivery times, the number of intersection crossings, utilizations, and a log file of stockout conditions allowed the team to validate that the rules for the material handling teams were be followed.

5 CHALLENGES

The number of parameters in the models coupled with the number of SKUs created too many combinations for a brute force analysis of potential ideas for improvement. By identifying stockout and determining the cause of each occurrence, the project team was lead through a series of potential opportunities to improve the system by alleviating each series of recurring stockouts. These problems were solved by a combination of team assignments, route changes to avoid congestion, or the placement of an additional bin lineside to address unreasonable turnaround times between deliveries. In the end, the simulation was used as a tool to guide the project team on a journey to address the nuances of a system that will continually change as product mix and bin densities are updated for each model year update.

6 CONCLUSIONS

Many times simulations are constructed to address specific questions during a design phase of a project. In this case, we were able to make a series of recommendation to changes in work assignments, forklifts assigned per team, and vehicle routings. While models can be valuable in avoiding design weaknesses in a specific scenario, simulations that have continual use for recurring challenges are often more useful and more difficult to construct in a way that makes them adaptable to potential changes that may or may not have been predicted when the initial model was envisioned. This project was challenging in the number and types of parameters included to facilitate flexibility. Its future use will be an ongoing benefit from the initial time investment made by the project team.