Discrete Event Simulation Modelling of a Job-Shop Manufacturing Plant

Overview
The Penn State Apollo team partnered with Armstrong World Industries, a ceiling tile manufacturer based out of Pennsylvania, to create a simulation model of their made-to-order manufacturing plant known as ACGI. The Apollo team focused on modeling one of the three main products that come out of this plant: the grille. This simulation model was created on a discrete event simulation modeling software called Simio which allowed students to leverage knowledge from another Penn State Industrial Engineering course. The goal of the project was to find solutions to improve the throughput and lead time of orders in the real manufacturing plant.

Objectives
The objectives were to create a model of the ACGI plant that can understand varying queue sizes, processing rates, travel times, physical distances between workstations, and crew or vehicle requirements. Additionally, that model would be used to simulate production flow given certain conditions to highlight limitations of the system. Finally, another objective of this project was to teach Armstrong World Industry employees how to use Simio and understand it so they can alter the model to reflect future changes to the manufacturing plant.

Approach
- Data collection from Armstrong: distances between workstations, order frequency/size, operation time of each station, travel times
- Model bones created (servers and pathways laid out in Simio) then data entry completion
- Verification: visual inspection of model, checking all inputted data, data collection & comparison to real plant
- Simulation studies were run to identify weaknesses in system
  - Study 1: verify model’s accuracy and completeness
  - Study 2: analyze system response to various arrival rates (constant & random distributions)
  - Study 3: overload the system to see bottlenecks and weak areas
  - Study 4: increase capacity in most utilized station to reflect potential improvement to plant
- Teach Armstrong team Simio, how to interpret results, and how to model with instruction sessions and an extensive instruction manual

Outcomes
The Penn State Apollo team generated the following results for Armstrong World Industries
- An accurate simulation model of their made-to-order manufacturing plant
- Weekly meetings and instructional sessions to learn to use Simio software
- Study results showing most highly utilized stations and bottlenecks in system