Simulation Modeling with Simio at Lockheed Martin Aeronautics

FABRICATION & MATERIAL FLOW TRANSPORTATION MODELS

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Overview

One of the world's leading defense contractors

Current largest contract is the F-35 Joint Strike Fighter

- 5th generation, multi-role stealth fighter
- CTOL, STOVL, and CV

F-35 JOINT STRIKE FIGHTER
U-2 DRAGON LADY
SR-71 BLACKBIRD
F-117 NIGHT HAWK
C-130 HERCULES
F-16 FALCON
F-22 RAPTOR

Modeling Challenges

- Very fluid production line
  - Increasing rate (low rate to full-rate)
  - Changing factory configurations as capacity increases
  - Production line never truly reaches steady-state before the next configuration is introduced
  - As production flow changes, the cadence, work schedules, and manpower requirements change, each reflected in an analysis.

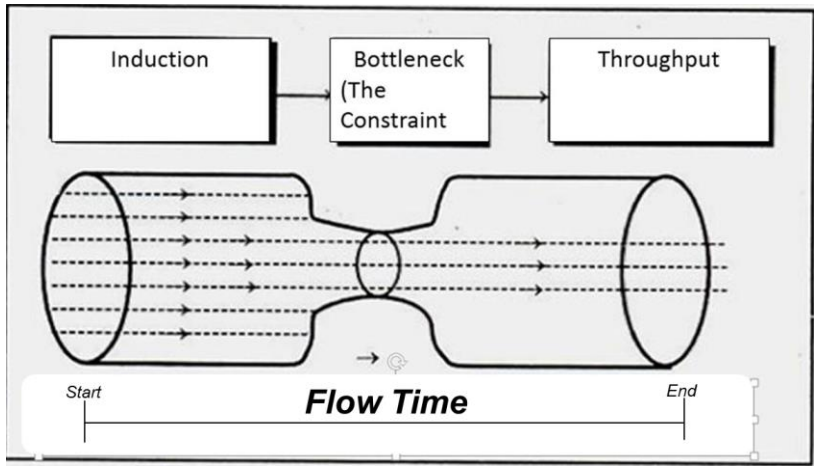
- 3 different aircraft designs flowing through same production line

- Performance of the system over the entire simulation does not fully capture the performance of the system over time.
  - Time-phased statistics at pre-defined periods of time
  - Allows us to assess the system as the configuration, work schedules, and cadence changes.

Theory of Constraints

Fabrication: Mixed model shared resource environment

- Manage the Bottleneck: Capacity analysis
  - Incorporate process improvements for increased throughput
- Induction Methodology: Reduce flow time
  - How/When you induct work into the system can have a large impact on flow time



Littles Law

Flow Time = ⬇ WIP / Throughput ⬆

Fabrication

Objective: Provide a model to experiment with capacity and throughput; incorporating different induction methodologies and deployment of resources to meet increasing demand.

Scope:

- Large number of parts
- Complex routing logic
- Labor distributions for every step of the process

Model Parameters

- Resource Allocation
  - Incorporate staffing by shift
  - Resource pools based on shared skillsets
  - Maximum capacity of each area

- Induction Methodology
  - First In First Out (FIFO)
  - Prioritize based on schedule finish date
  - Weighted server

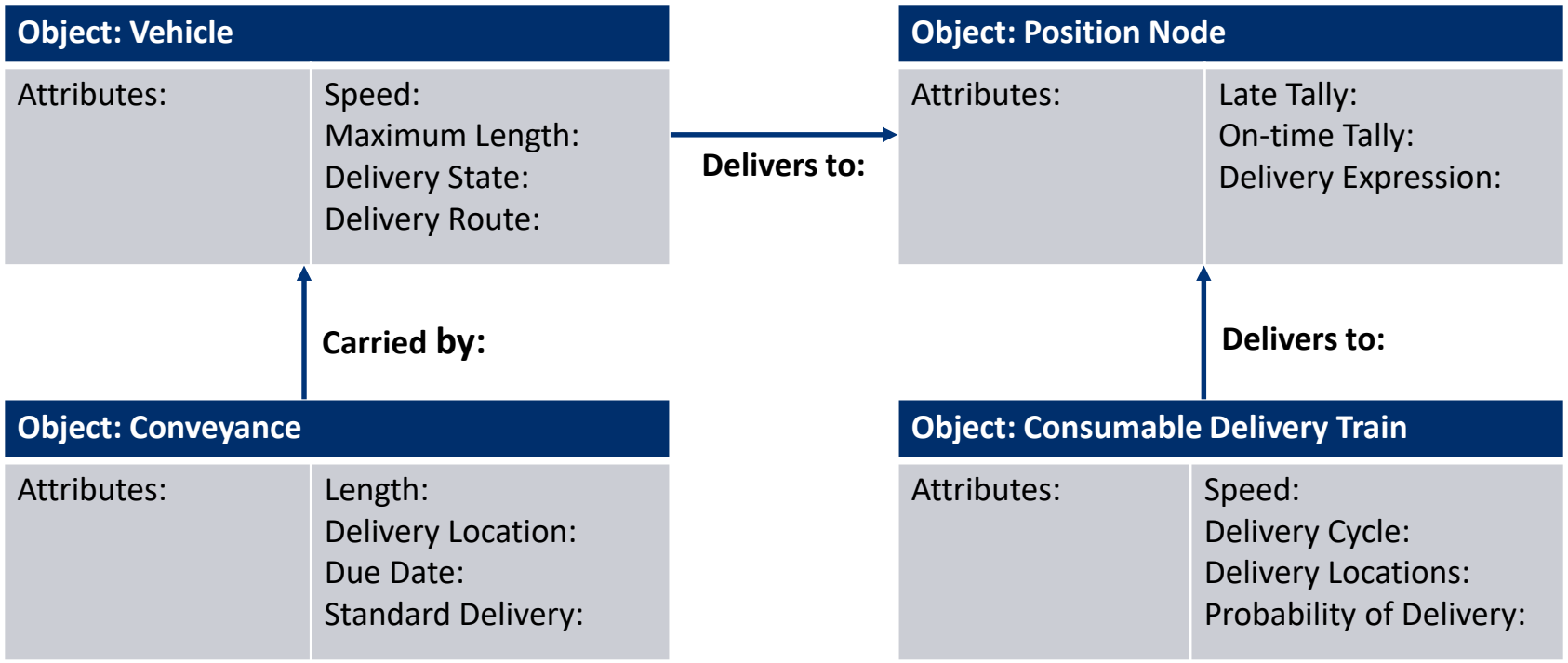
$$ModelEntity.InductionPriority = \sum_{i=1}^{n} \frac{\left(\frac{1}{Seq\ \#\ of\ Server_i}\ X\ \frac{Server\ Load_i}{Server\ Capacity\ when\ onshift_i}\ X\ Server\ Processing\ Time_{part\ type,\ i}\right)}{n}$$

Material Flow Transportation Model

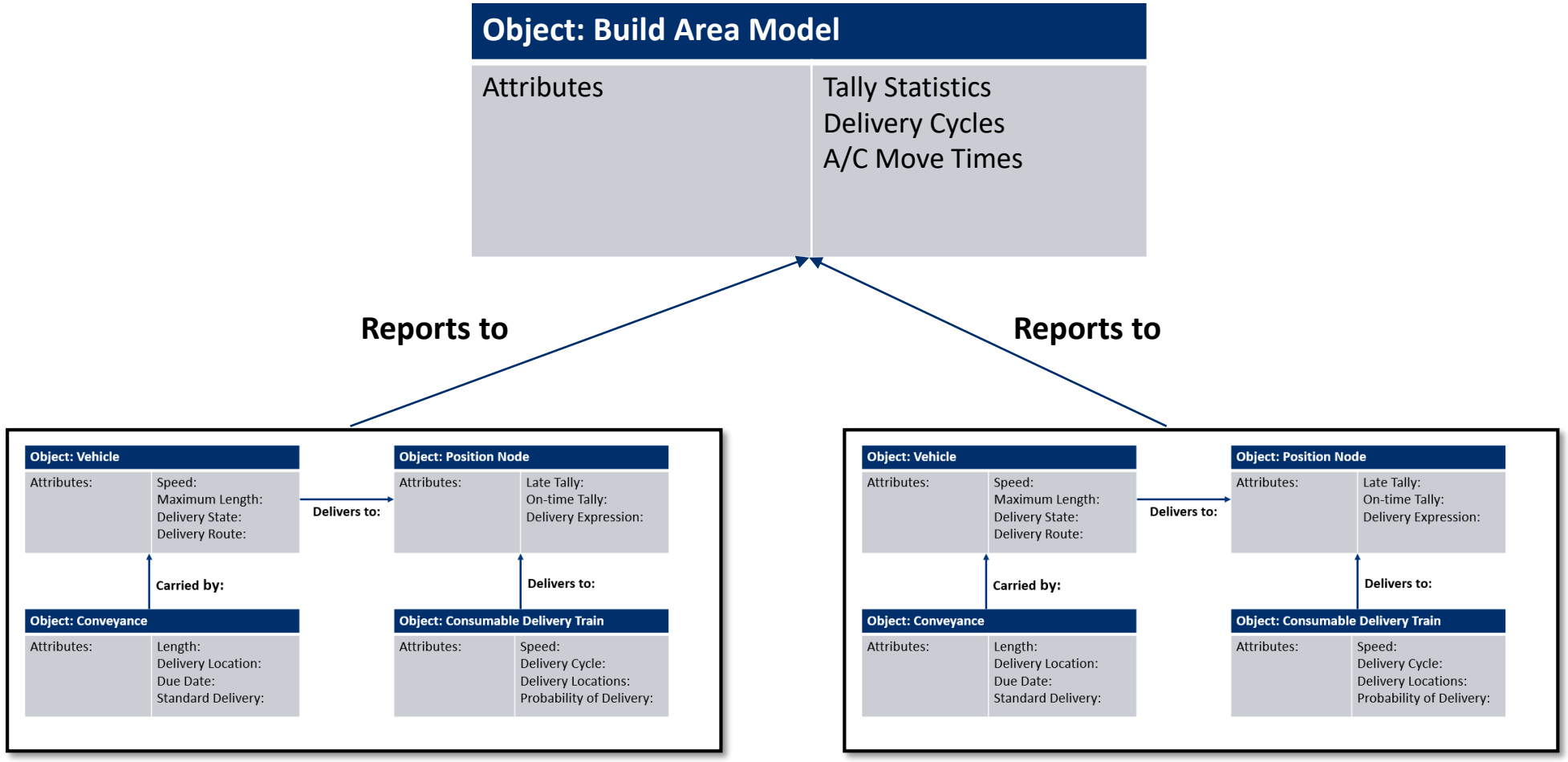
Objective: Identify high-congestion areas along the main aisle and help solidify the delivery plan for all materials to the floor at full rate

Model allows virtual experimentation and adjustments to the plan prior to deployment

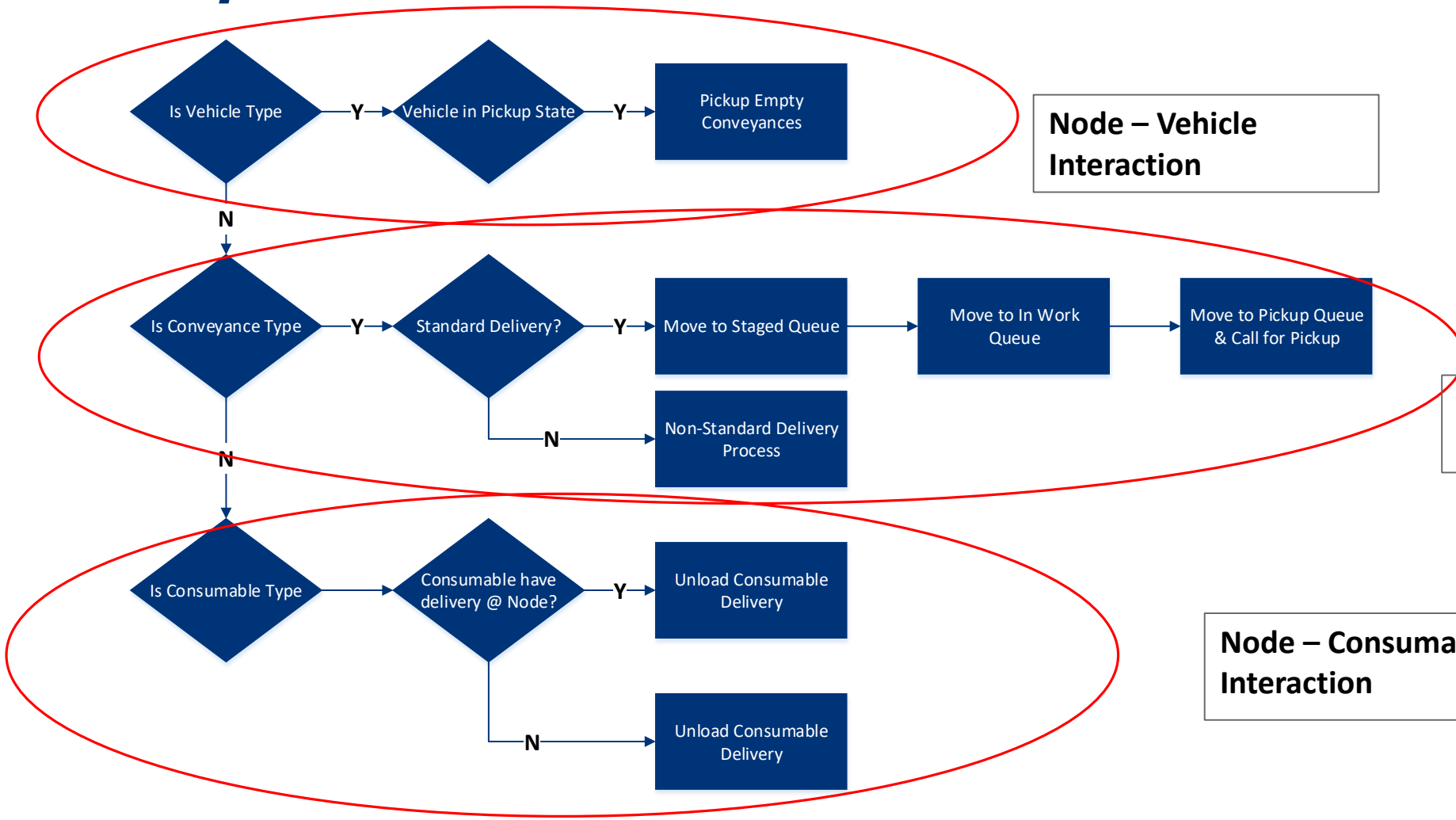
Aircraft Position Model



Build Area Model



Delivery Node Sub-Model



Node – Vehicle Interaction

Node – Conveyance Interaction

Node – Consumable Interaction

Advantages of Simio Objects

Modeling object interactions within Simio provides several advantages:

- Better model scalability: Quickly create new instances of objects and the behavior remains consistent
  - Quickly add positions / entire build areas by creating new object instances
- Flexible model changes: Any change to the object definition is reflected in all object instances
  - Any changes to the object definitions are reflected across all object instances. Reduced change roll-out time
- More structured & systematic model development:
  - Object Oriented modeling provides a structured development approach.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