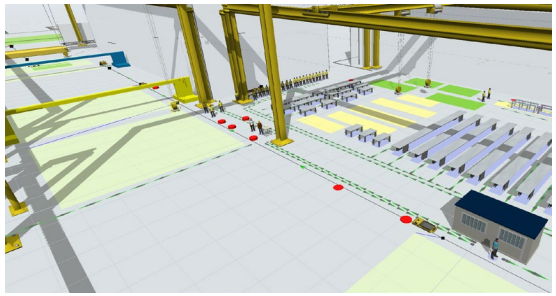
Digital Twin for Shipyard Management

Integrated Production Processes, Planning and Facilities Management



3D Model

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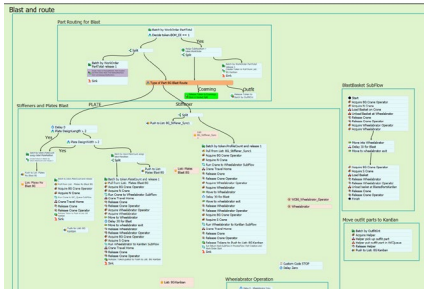

Process Flow Logic

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Digital Twin

"The digital twin is the virtual representation of a physical object or system across its life-cycle. It uses real-time data and other sources to enable learning, reasoning, and dynamically recalibrating for improved decision making."

https://www.ibm.com/blogs/internet-of-things/iot-cheat-sheet-digital-twin/

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Introduction to FlexSim Digital Twin Concepts

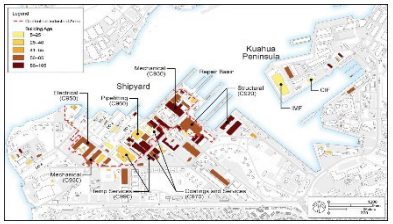
- Data driven, resource constrained process flow and 3-D simulation model
- Extends 3D Visual Build Plan generated by CAD to 4D production simulation
- Built with FlexSim simulation modeling software
- Provides dimensionally accurate representation of buildings, floorspace and workcenter footprints
- Process Flow defines detailed process steps and resource requirements
- Durations calculated by time required to process at the piece part level vs using parametrics at the subassembly level or by weight
- “Hidden” costs of operations such as riggers, QA/QC, crane hold ups and fork truck wait times captured
- Allows for adjustments to plan for missing material, broken equipment or personnel shortages using Excel input
- Simulates the plan “as planned” and generates re-plans on the fly with a forward impact assessment
- Allows direct connection to machine states and digital job statusing systems to capture real time data and promote use of manual analysis and AI to optimize processes

Why Build and Use a FlexSim Digital Twin?

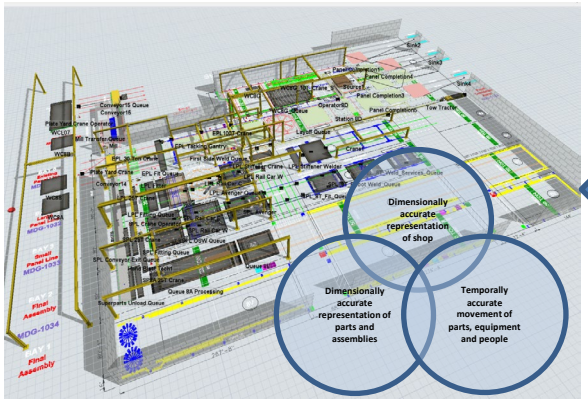
- **Visualize the build on the shop floor in 4 dimensions before you build it**
- **Validate the plan as planned**
- **Rapidly develop alternative plans when the tactical situation changes**
  - Missing and Late Material
  - Planned and Unplanned Equipment Downtime
  - Planned and Unplanned Personnel Absence
- **See the downstream and future impacts of localized changes to plan and schedule**
  - Technology Insertions
  - Process Changes
  - Alternative Work Locations
  - Shift Adjustments
  - Outsourcing
- **Plan the Unplanned Resources**
  - Capture, Plan and Control the unplanned resources including cranes, fork trucks, yard trailers, tools with limited availability (x-ray, specialty welding fixtures), projected inspection times for QA and signoff etc.
  - Manage stock and WIP transport and laydown
- **Link to machine telemetry and job statusing systems to incorporate real time changes to operations**

How to Build and Use a FlexSim Digital Twin

Google Earth OverLay

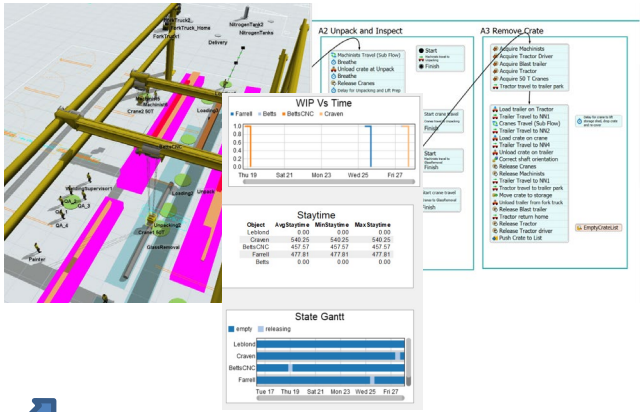


2D Cad Layout



FlexSim 3D Model

Detailed WorkCenter Process Models Linked to 3D Model and DashBoard Output



FlexSim Process Flow Model

PWBS from Product Model

BOM Data from Product Model

FlexSim Input Data Tables

WorkOrder Level PWBS based Planning Data

Generic Platen Assembly Model

- Built as training model and demonstrator
- Incorporates the basics of integrating data, process flows and 3D visualization
- Steps to building the model
  - Define the system to be modeled
  - Create the data set that will run the model
  - Lay out the physical plant in 3D (usually over a 2D overlay)
  - Create resources and task executers
  - Develop Process Flows that load flow items and define activities for each resource
  - Run, debug and refine the model
  - Create Dashboards for output visualization

Generic Platen Assembly Model

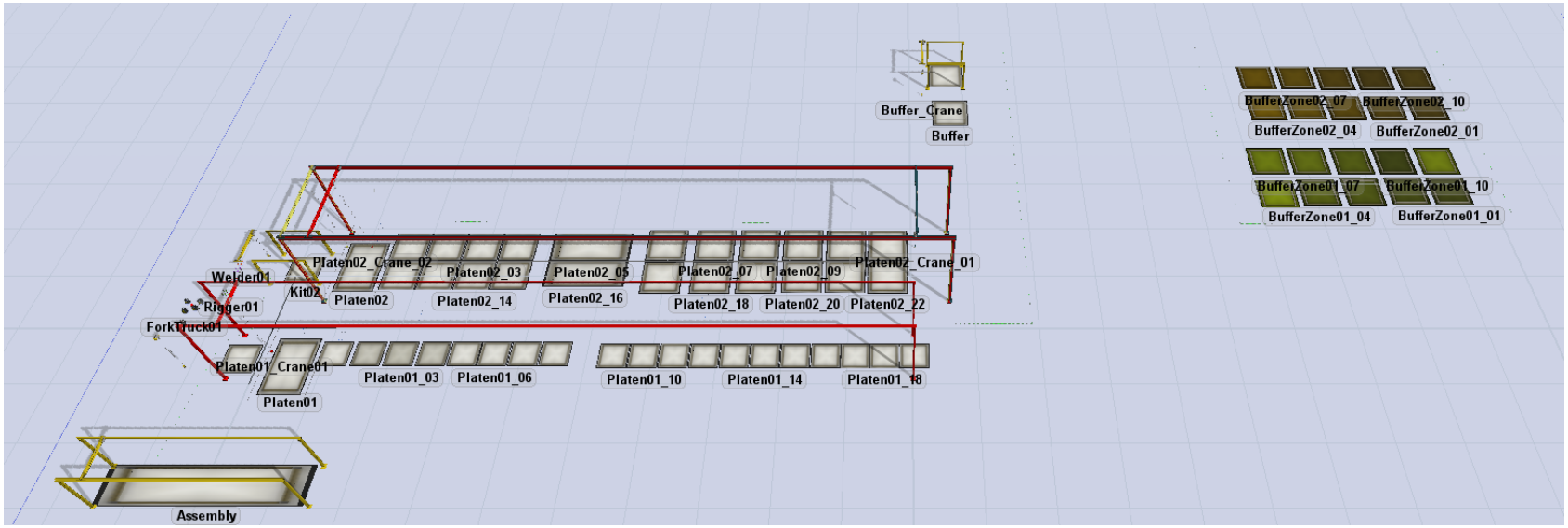
- **Define the system to be modeled**
  - Basic shipyard assembly platen for unit construction
  - Requires building a jig on each platen before assembly
  - Fitters and Welders are separate
  - Platens have a dedicated laydown area for material kits
  - Each platen has cranes and riggers

Generic Platen Assembly Model

- **Create the data set that will run the model**
  - Model structure requires structured data
    - Work Package
      - » Start date, Work Location, Material Kit area, Number of Parts by type of part, consuming Work Package, finished product destination
    - Parts (Plates, Stiffeners, Coamings, Outfit Parts)
      - » Availability date, part number, consuming Work Package, dimensions, material

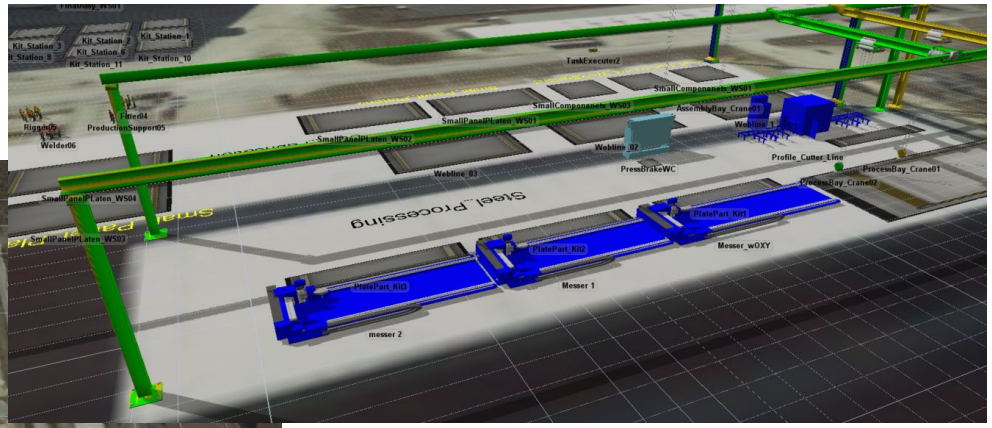
Generic Platen Assembly Model

- **Lay out the physical plant in 3D**



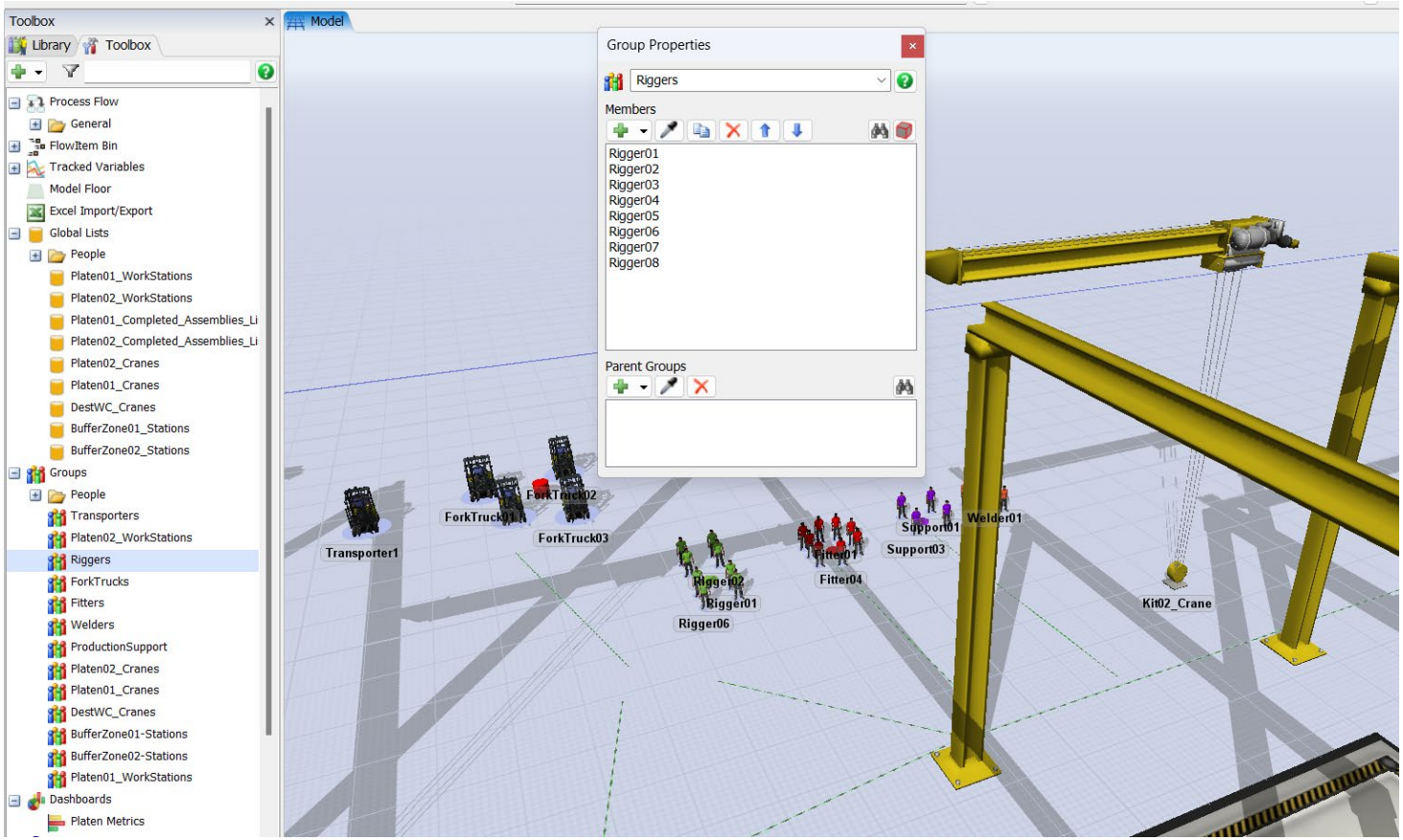
W International Basic Model

- Basic layout from google earth and website
- "Best Guesses on cranes and work station definitions
- Additional work to flesh out shops, resources and flow lanes
- Process Flows need to be adjusted to reflect shop capabilities and constraints
- Work Package schedule and BOM data needed to run model



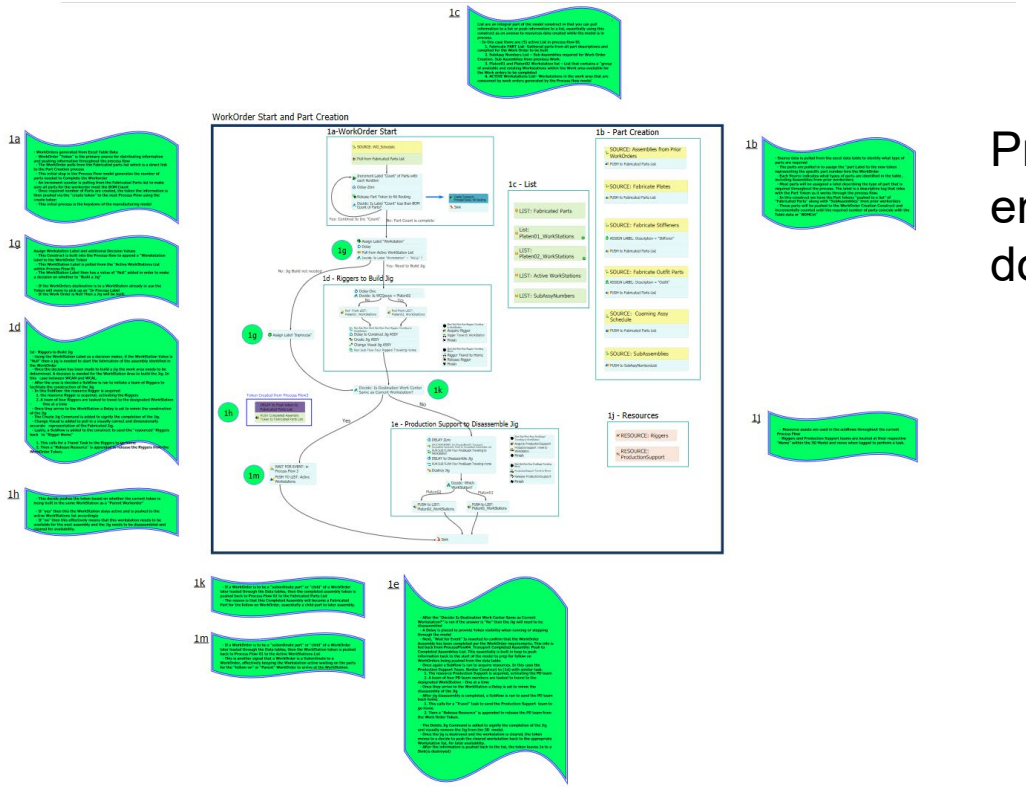
Generic Platen Assembly Model

➢ Create resources and task executers



Generic Platen Assembly Model

- **Develop Process Flows that load flow items and define activities for each resource**

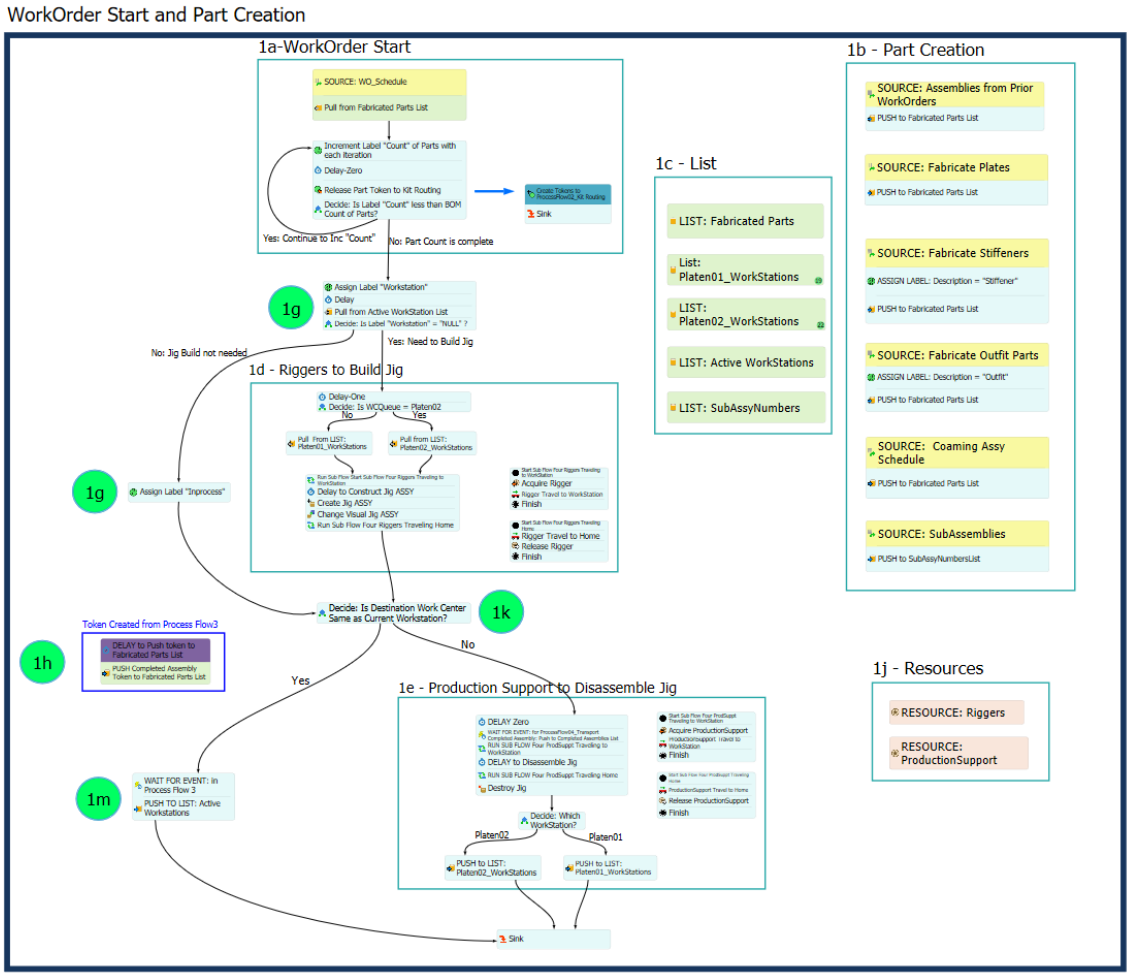


ProcessFlow 01 with embedded documentation

Generic Platen Assembly Model

Develop Process Flows that load flow items and define activities for each resource

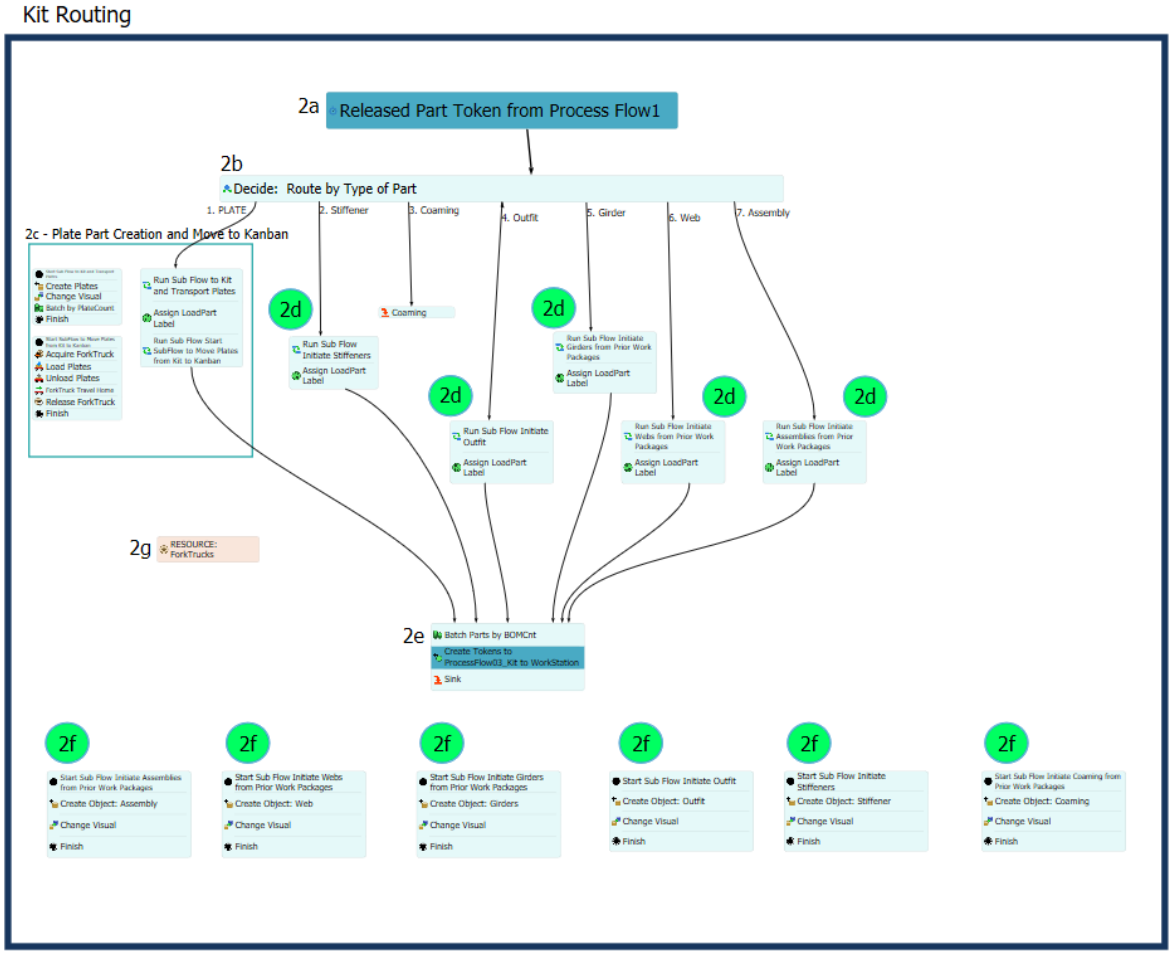
Process Flow creates Work Order and Part t0kens, builds a jig and then disassembles jig



Generic Platen Assembly Model

- **Develop Process Flows that load flow items and define activities for each resource**

Process Flow Kit Routing creates parts in the 3D model and routes them to a kitting area

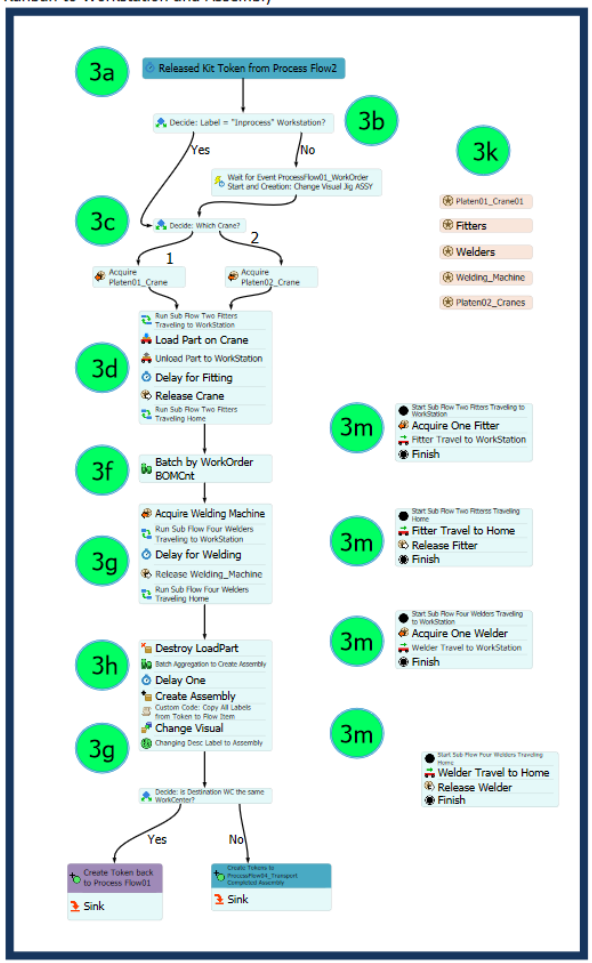


Generic Platen Assembly Model

- **Develop Process Flows that load flow items and define activities for each resource**

Process Flow Kanban to Workstation and Assembly sends parts to the right workstation and assembles them

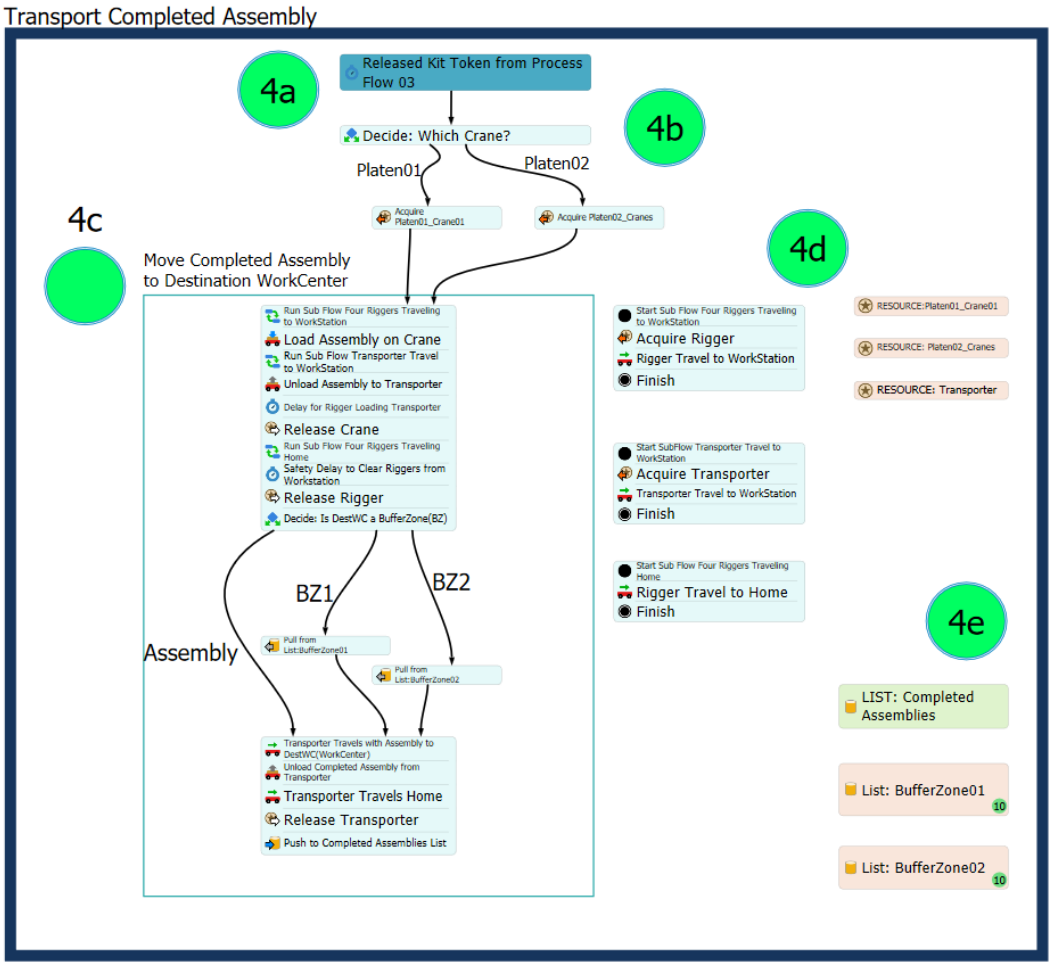
Kanban to Workstation and Assembly



Generic Platen Assembly Model

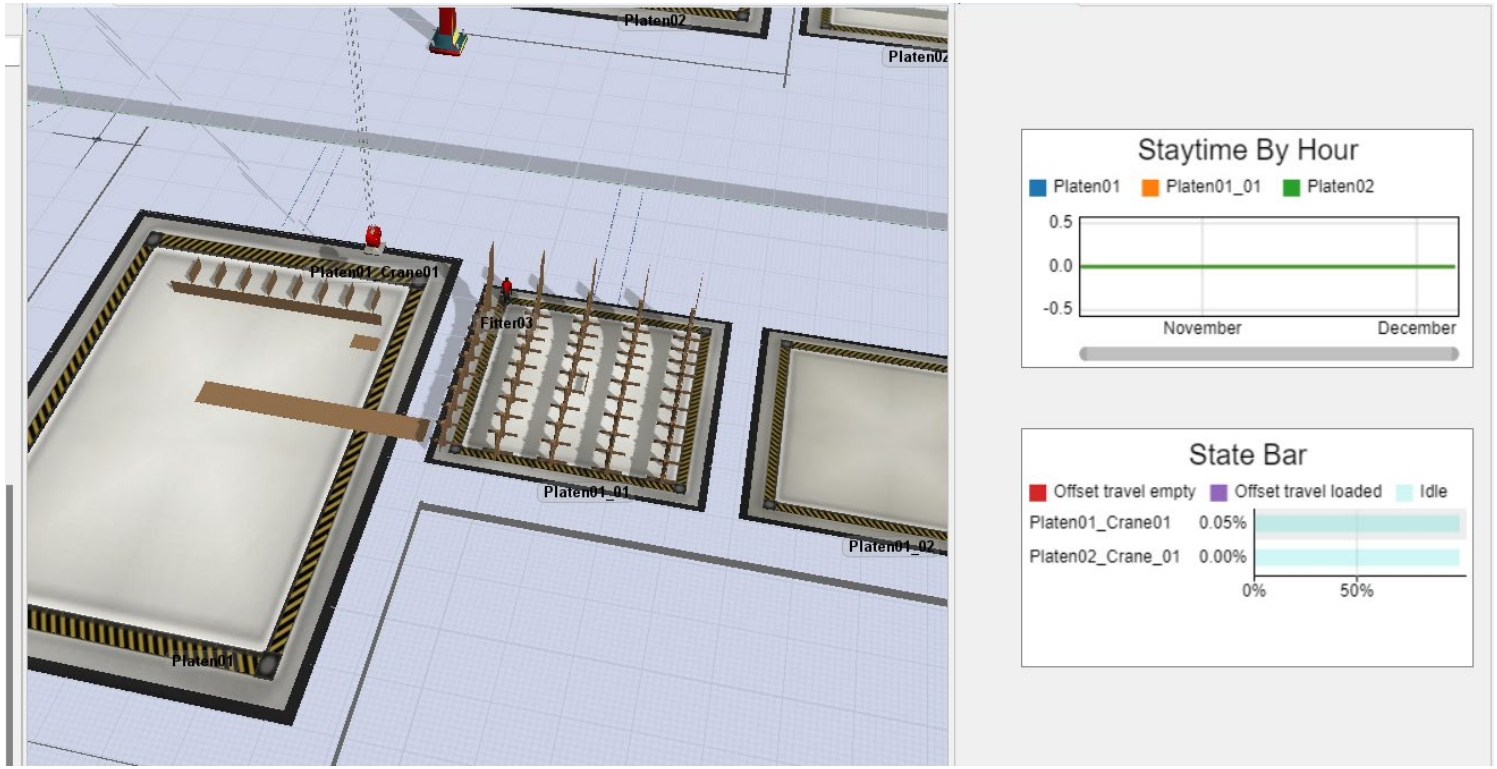
Develop Process Flows that load flow items and define activities for each resource

Process Flow Transport Completed Assembly sends finished assembly to it's next destination



Generic Platen Assembly Model

- **Run, debug and refine the model**
- **Create Dashboards for output visualization**



Conclusion

- 3D Simulation models can be used for tactical planning at the shop floor level
- Models run at the piece part and discrete resource level
- Models document processes and process steps at the lowest level
- OTS software and relative ease of use make it accessible to all

- Questions?

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