Modeling of Autonomous Case Handling Robots (ACR) in a Warehouse Environment

THE ANYLOGIC CONFERENCE 2024

Intel + ORMAE

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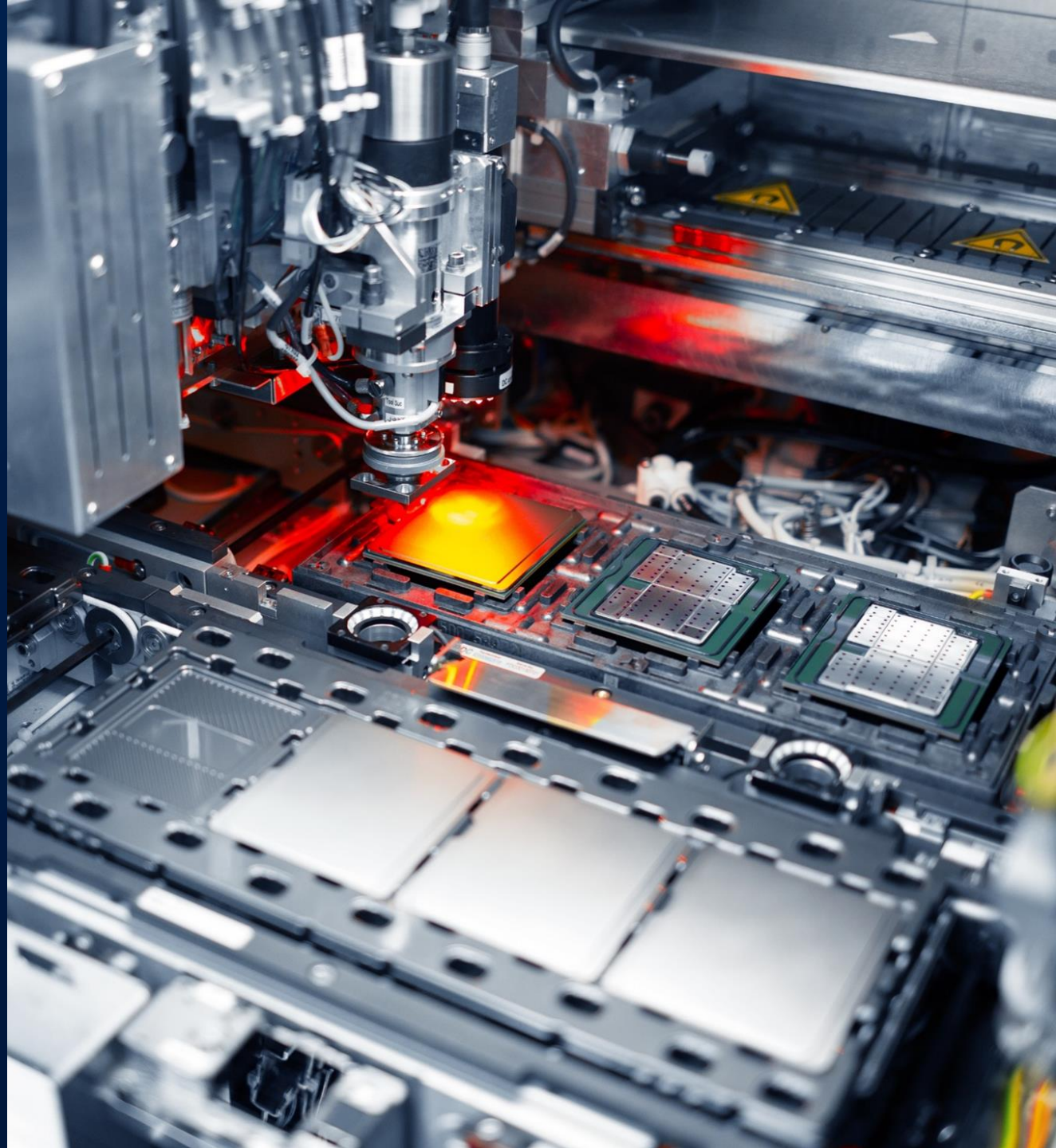
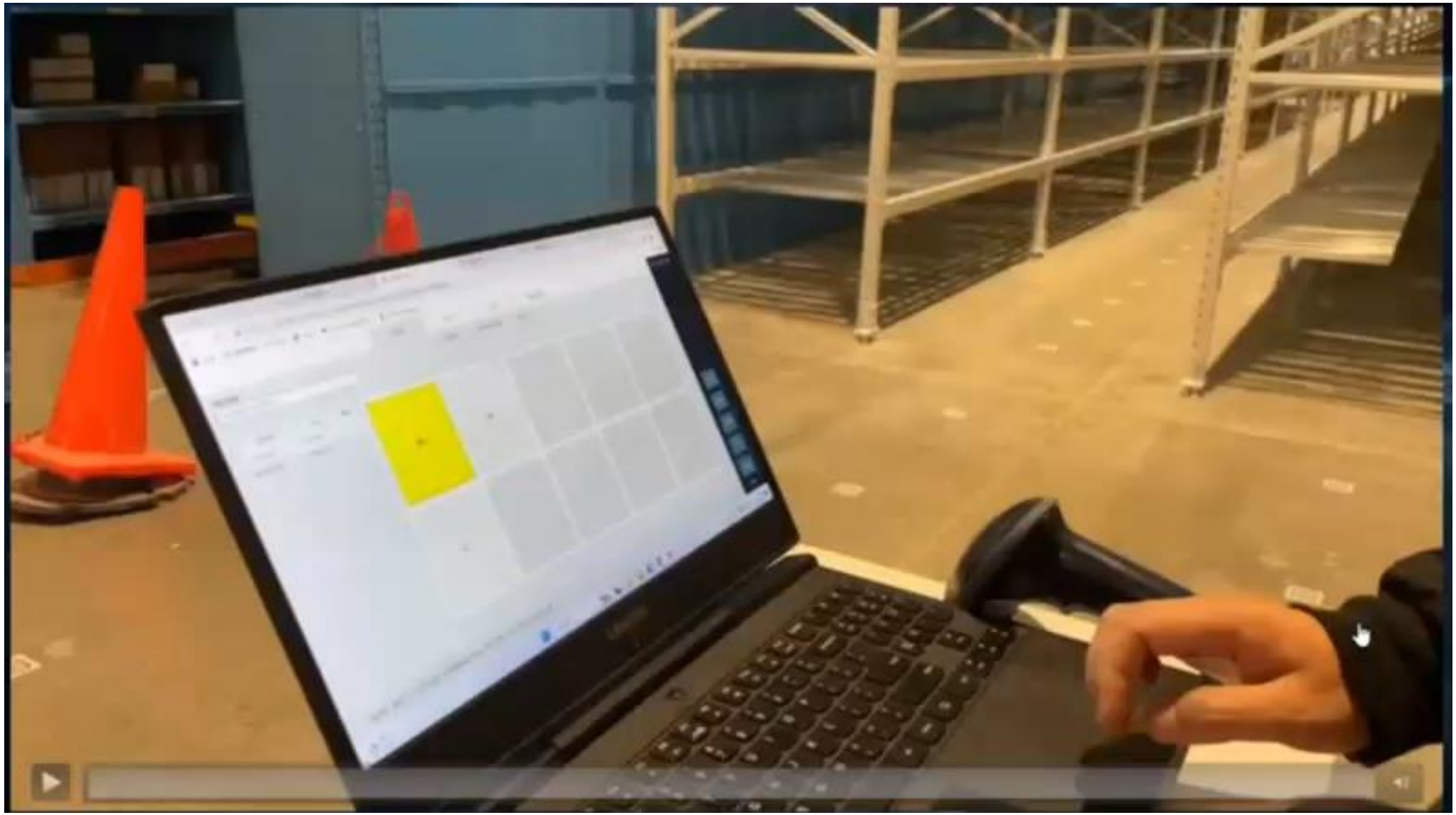


Agenda

1. Background
2. Objective
3. Physical Model and Logical Model
4. Demo Video
5. Diagnostics and Stress Test
6. What-if: Outer Layer vs Both Layers
7. Next Steps

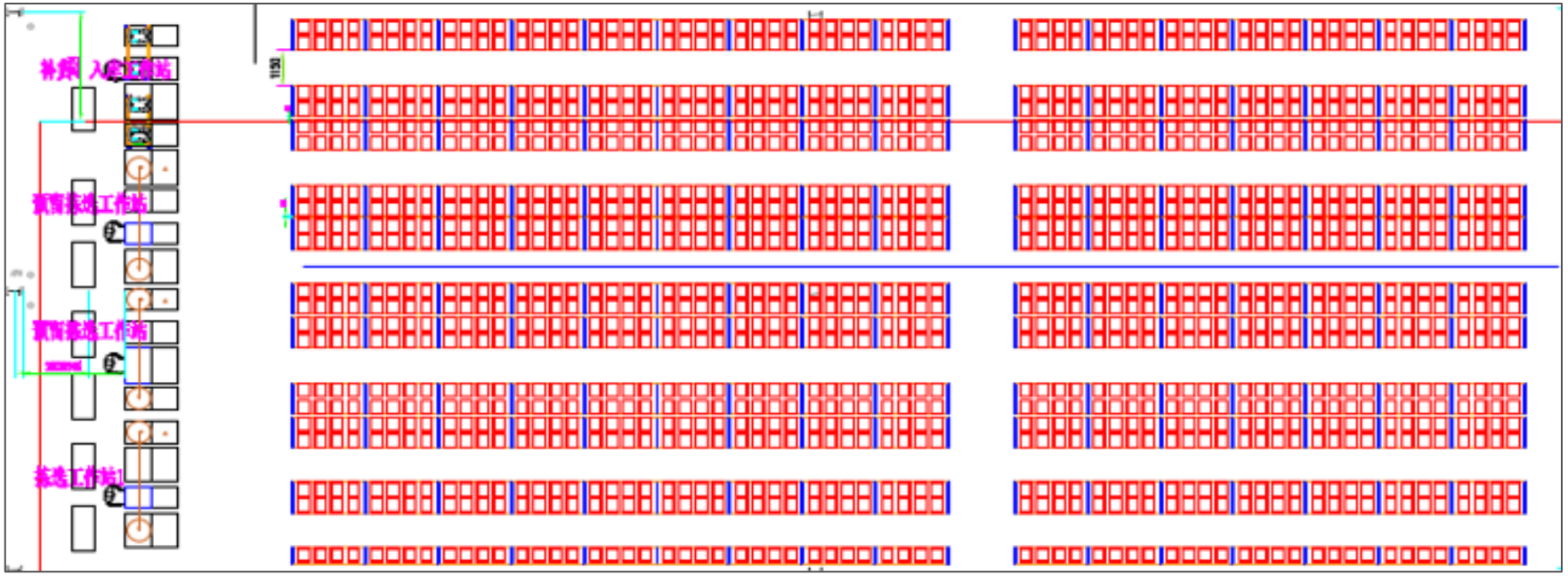
Background

- Warehouse Automation Pilot
- Robots to replace manual picking and placement tasks
- ACR: Autonomous Case Handling Robots
- 4 Big ACRs
- 8 Small ACRs



Objective

- Simulation Model to mimic Robot Logic at Warehouse
- Ability to Ingest Actual/Generated Order Data
- Generate and measure KPIs (Robot Utilization/ Warehouse Productivity)
- Do what-if scenario analysis

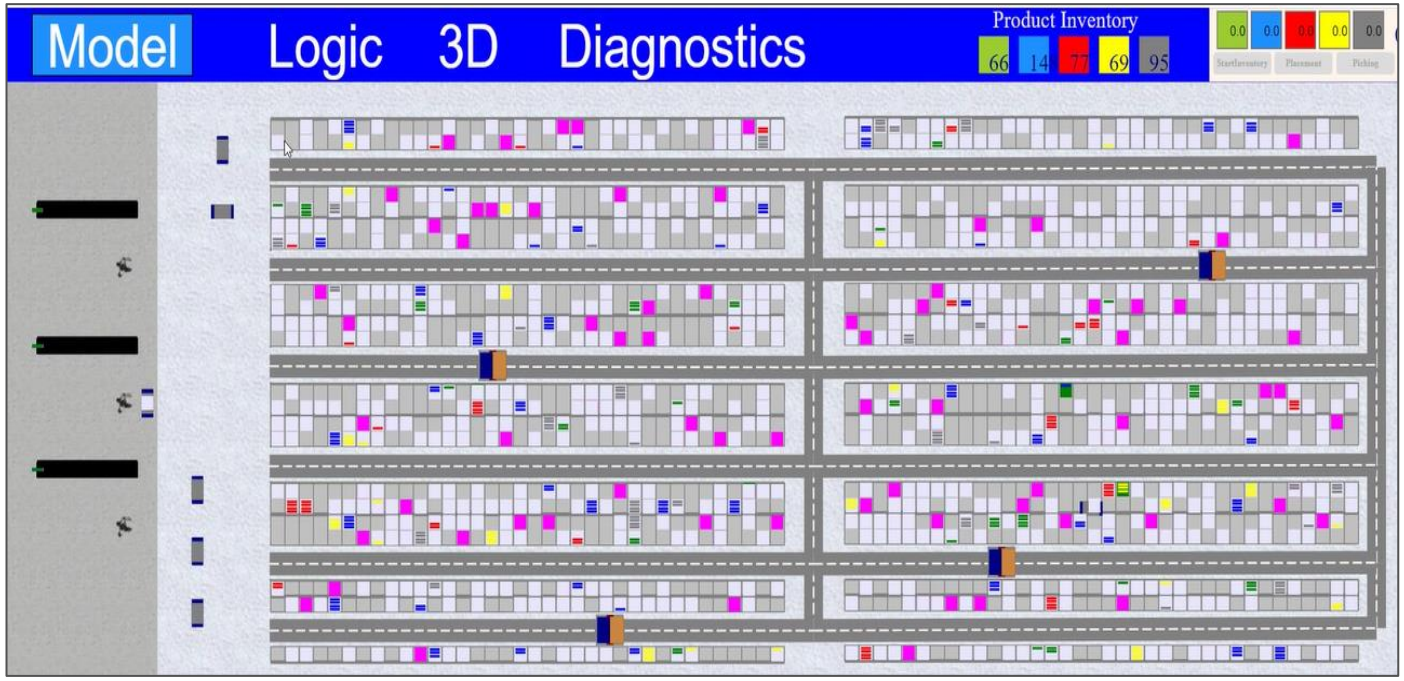


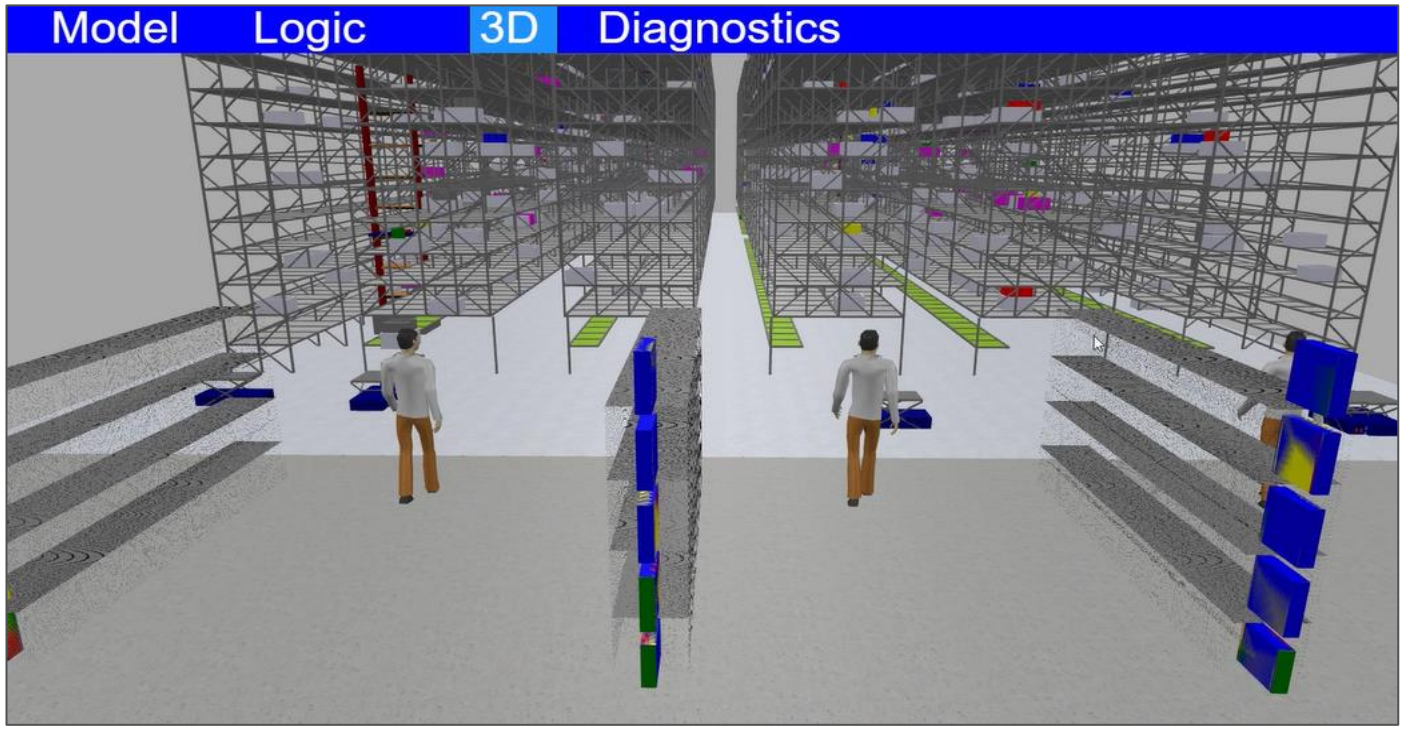
Physical Model

- Design and develop the physical objects constituting the warehouse:
  1. Warehouse Layout and Paths
  2. Workstations and Buffer Racks
  3. Big Robots and Small Robots
  4. Storage Racks (Main, Transfer Rack)
  5. Totes and I-boxes

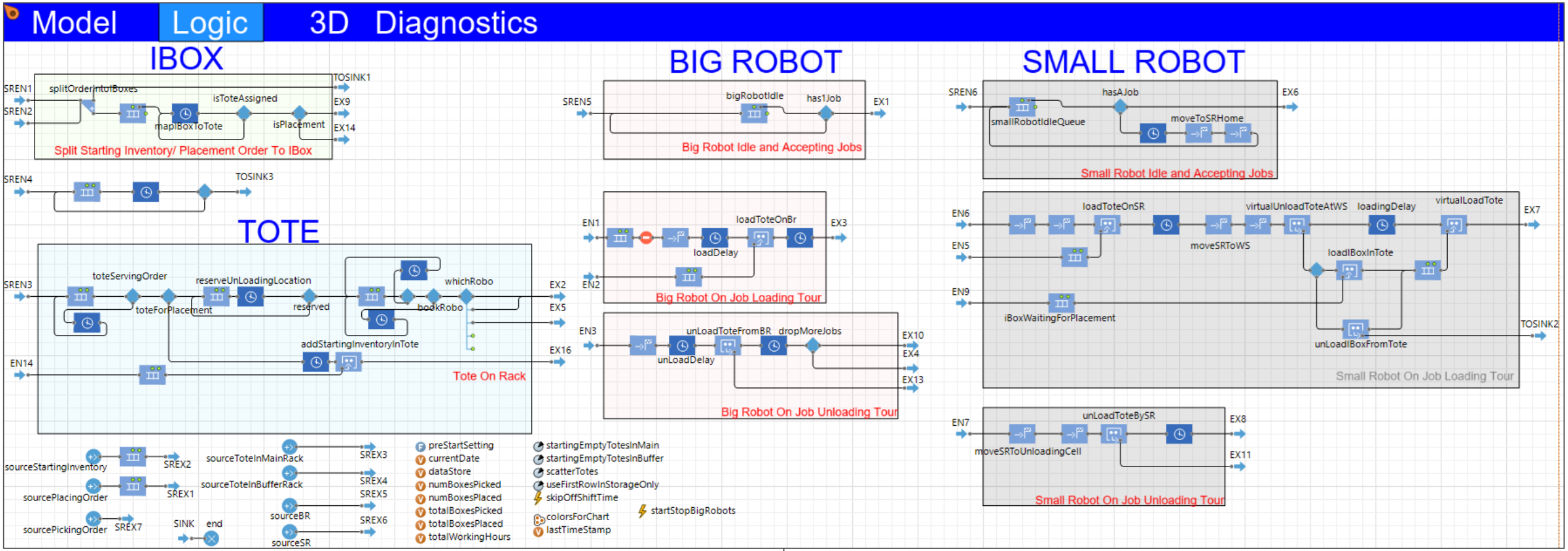
- Physical characteristics of objects are defined within their respective object screens (Dimensions, Speed, Weight etc.)

- 2D and 3D Animations





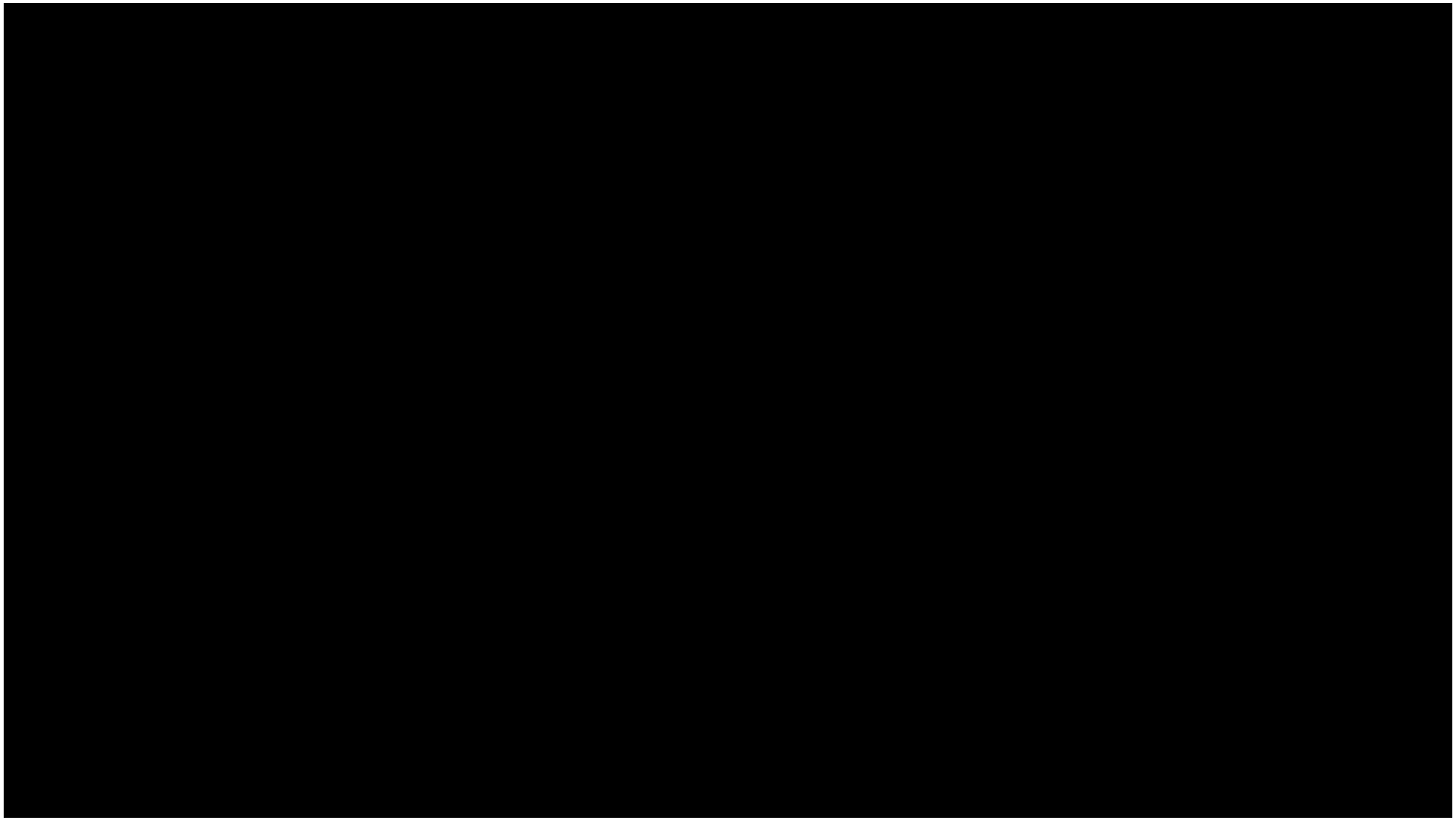
Logical Model



- Valid paths for BR and SR
- Order Prioritization (Picking > Placement)
- Tote and Rack Location Selection (Zone wise Random)
- BR Assignment (Zone)
- Robot Movement and Collision Avoidance

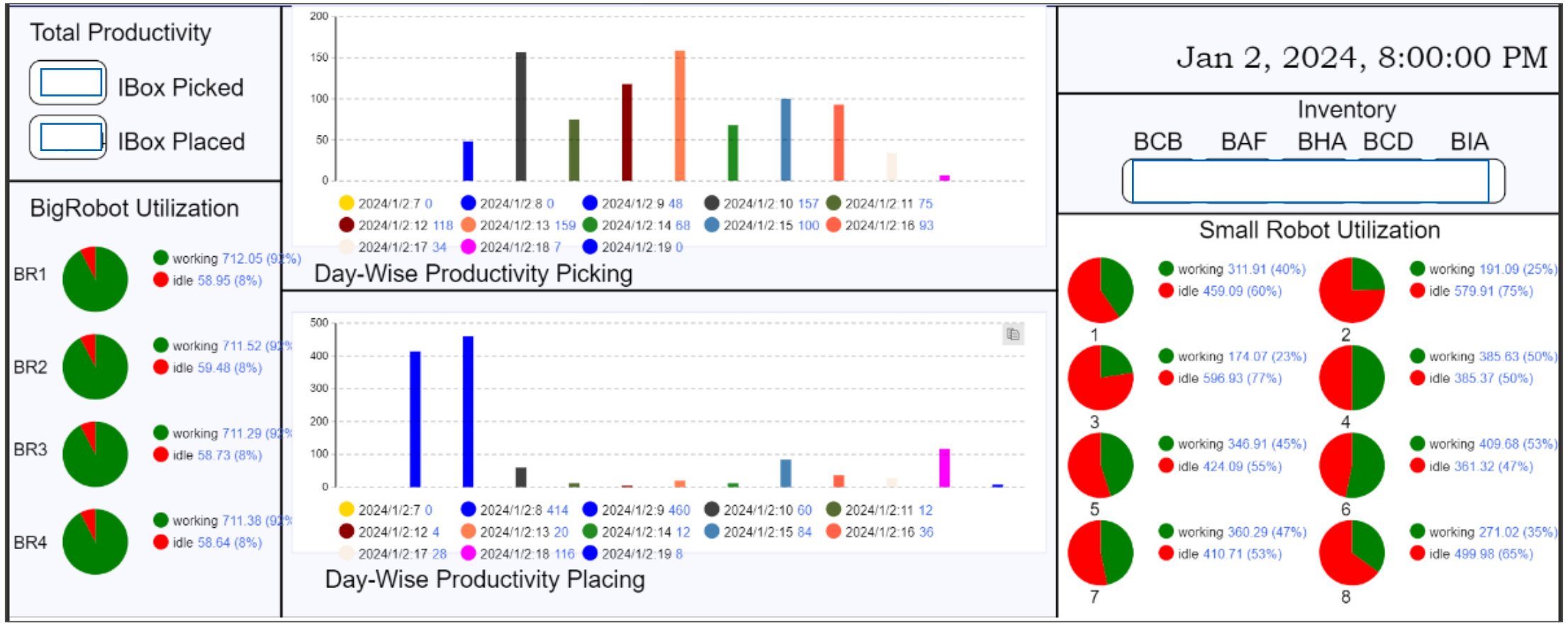
- Inner/Outer Tote Picking
- Tote Transfer from Main Rack to Transfer Rack (Nearest Empty)
- SR Assignment (Nearest Idle)
- Ibox-Tote Mapping
- Tote Placement in Main Rack

Solution Demo

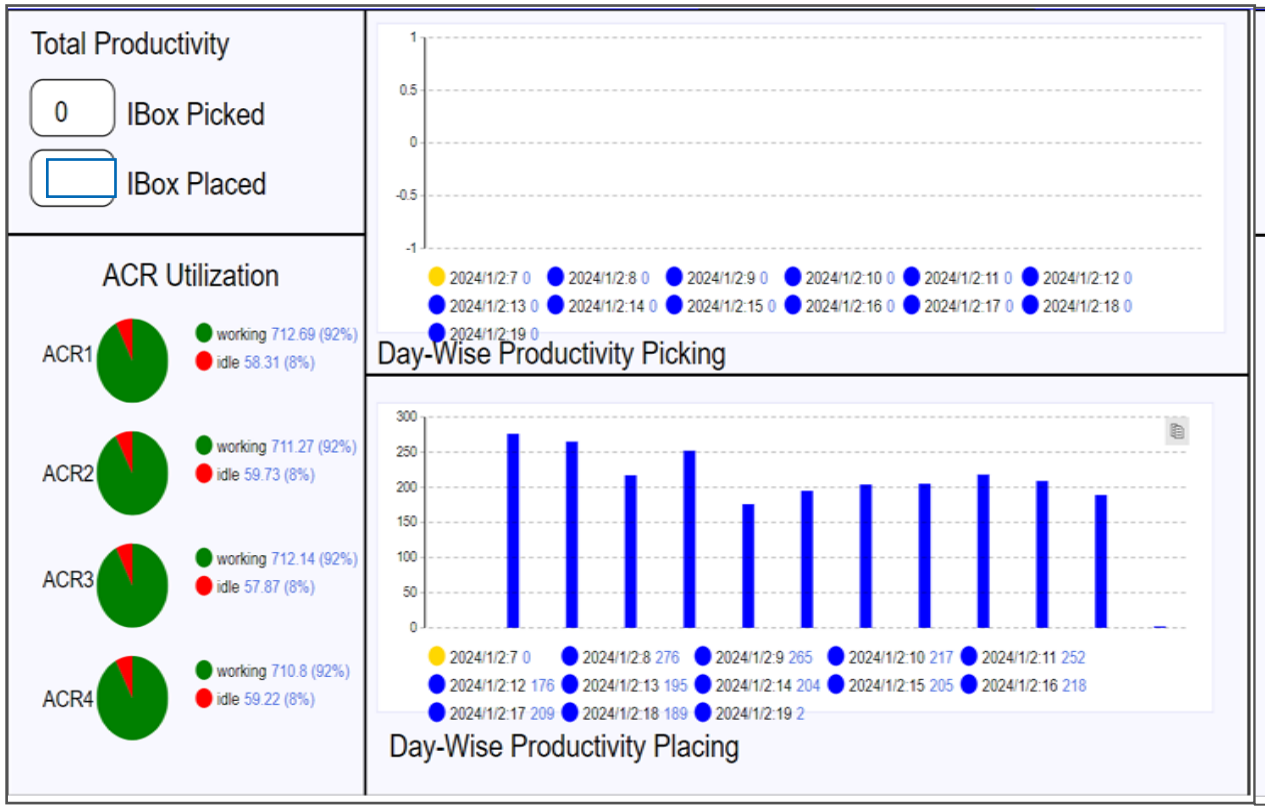


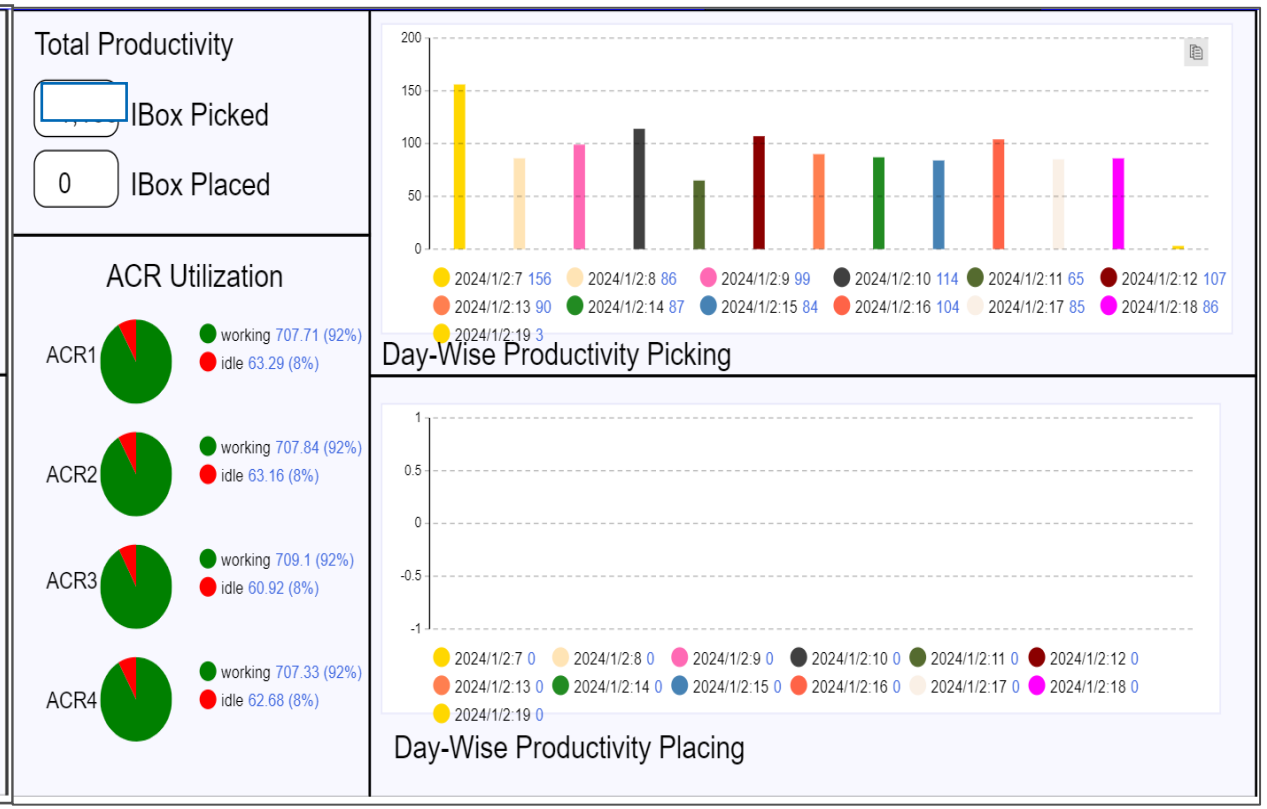
- Actual Order Data
- Simulated Order Data
- Live Order Generation
- Disable Inner Layer

Diagnostics



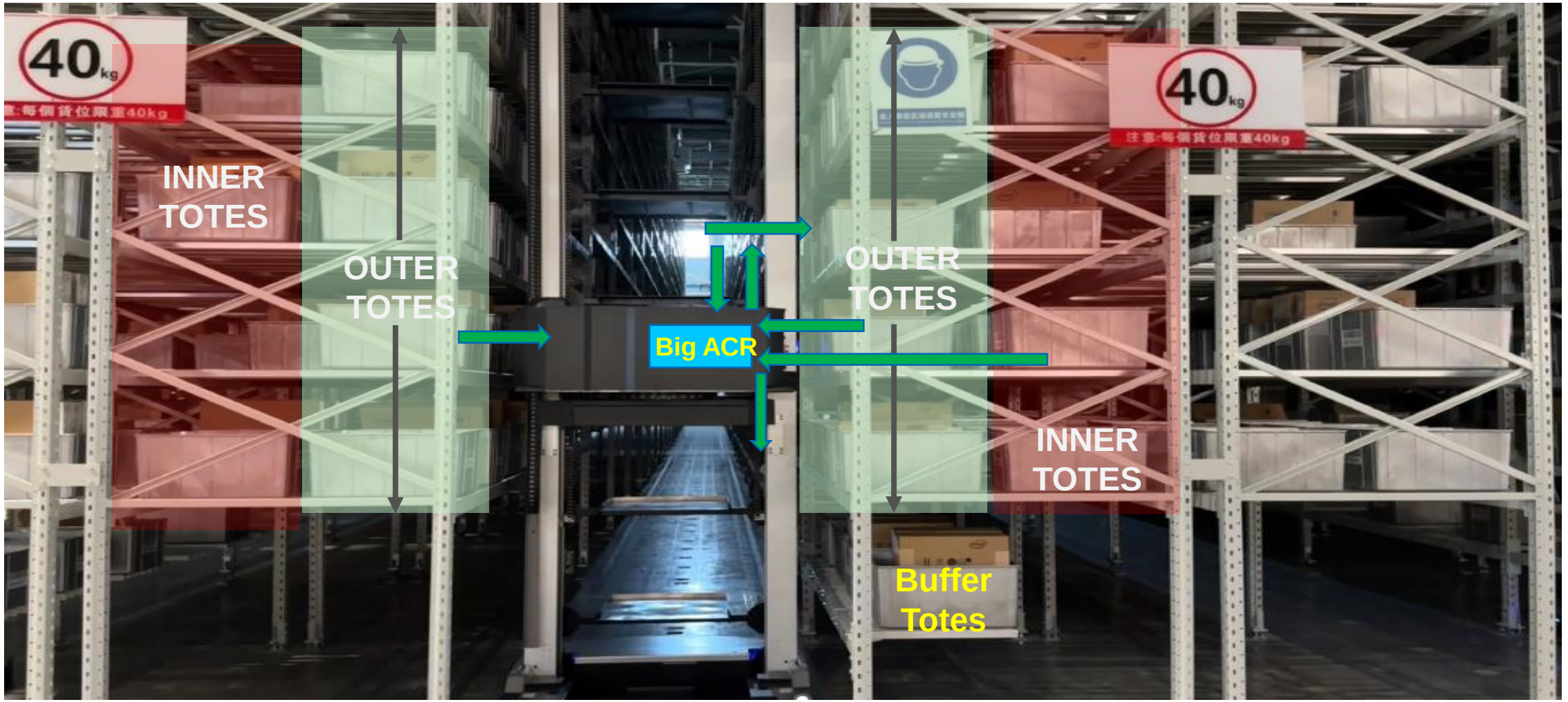
Stress Test



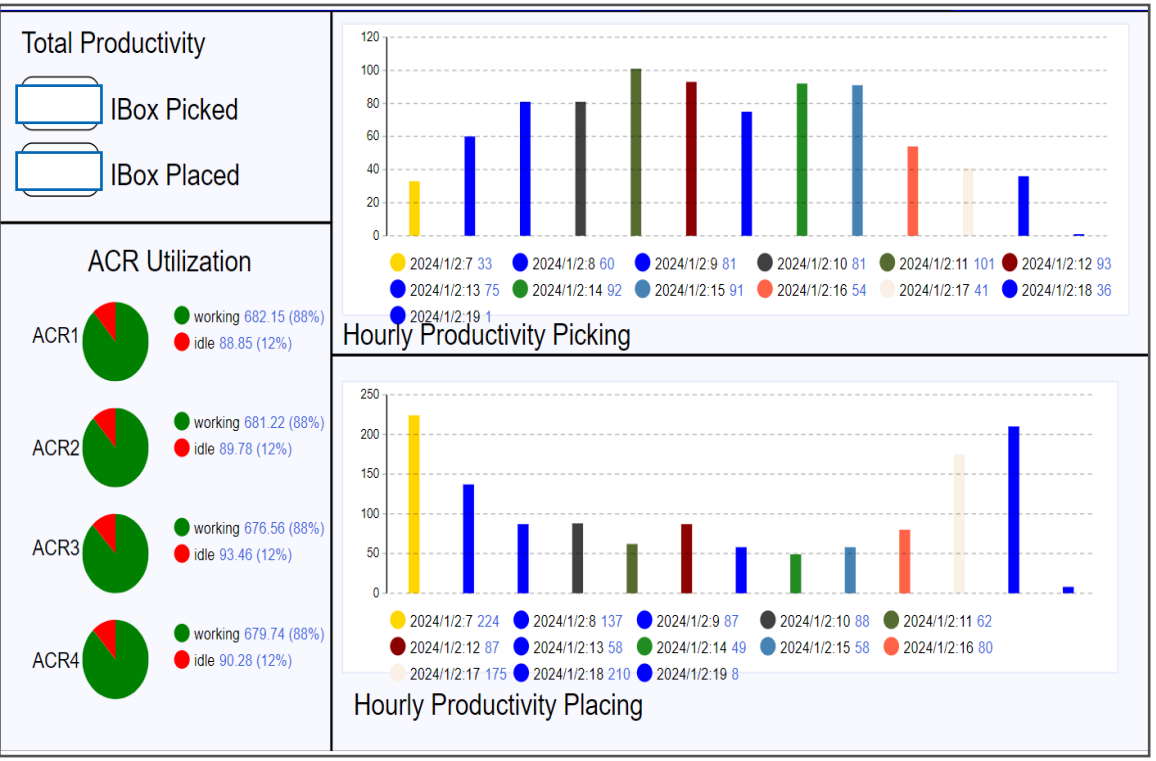


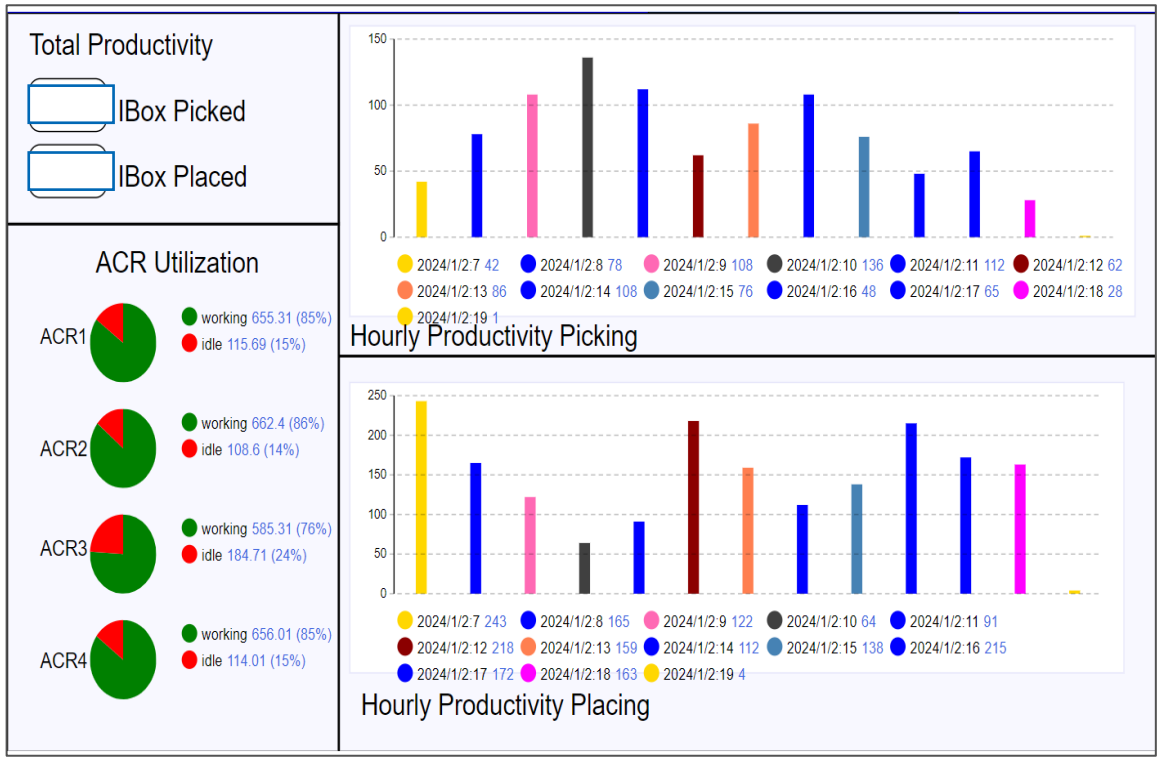
Stress testing to see maximum load that can be handled by the current robot configuration for picking and placement independently.

What-if Scenario Analysis



All Layers vs Outer Layer Diagnostics





- Efficient Robot Utilization
- ~30% increase in Overall Productivity
- ~15% more Boxes Picked
- ~40% more Boxes Placed

Benefits

- Able to load actual/simulated data to the model
- Able to measure robot utilization to assess if we have excess or less robots
- Able to measure productivity of system to optimally load the warehouse
- Able to perform what-if analysis to suggest outer tote placement to increase productivity by 30%

Next Steps

- Implement and validate model recommendations
- Extend model to other warehouse layouts
- Find optimal number of robots required
- Compare alternate order assignment & robot routing algorithms

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