Learning from Live SAP S/4HANA Data to Speed the Supply Chain

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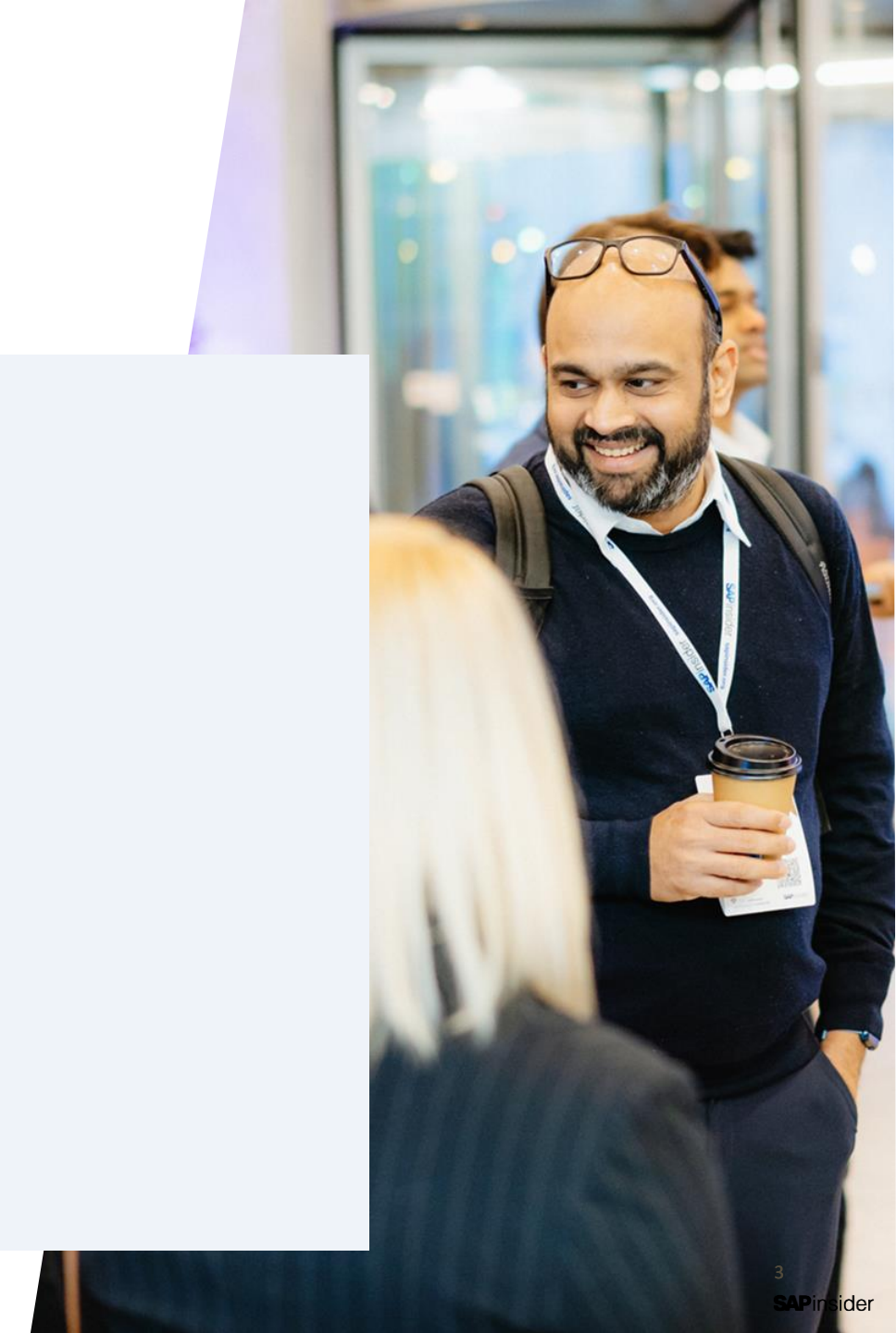
SAPinsider

In This Session

- Learn how a genetic algorithm, machine learning and AI can simulate product placement and measuring performance gains using a live connect to SAP S/4HANA.
- Explore how regular cadence of re-slotting led by an AI can set up employees for success.
- Determining the best position for a material or finished good can directly impact warehouse and employee performance.

What We'll Cover

- Building the Digital Twin
- ML Simulations in the warehouse
- Re-slotting a warehouse with ML
- Integrating with SAP S/4HANA
- Wrap Up



What is a Digital Twin?

Digital Representation of Physical World

- ✓ Spatially correct
- ✓ Easy to understand visualization

Real-time Depiction

- ✓ Conveys status of physical object or space
- ✓ Joins data from multiple sources

Digital Actions Translate to Real World Actions

- ✓ Software interacting with physical world
- ✓ More than analytics or data illustration

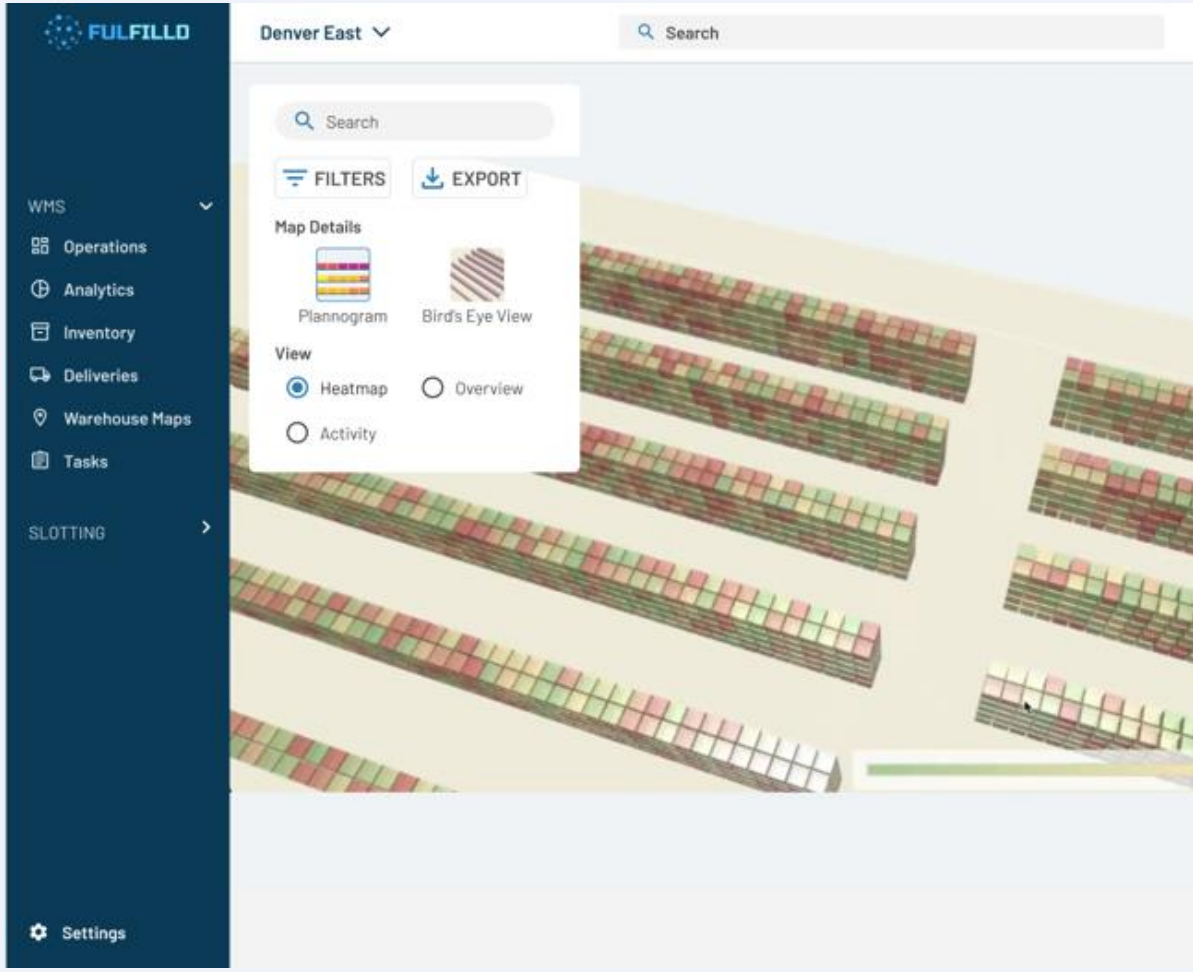
Building a Digital Twin

Backend Components

- Persist the layout of the physical space
- Option #1:AutoDesk Platform APIs for spatial information
- Option #2: Store layout as polygons in a JSON object
- Multiple options…

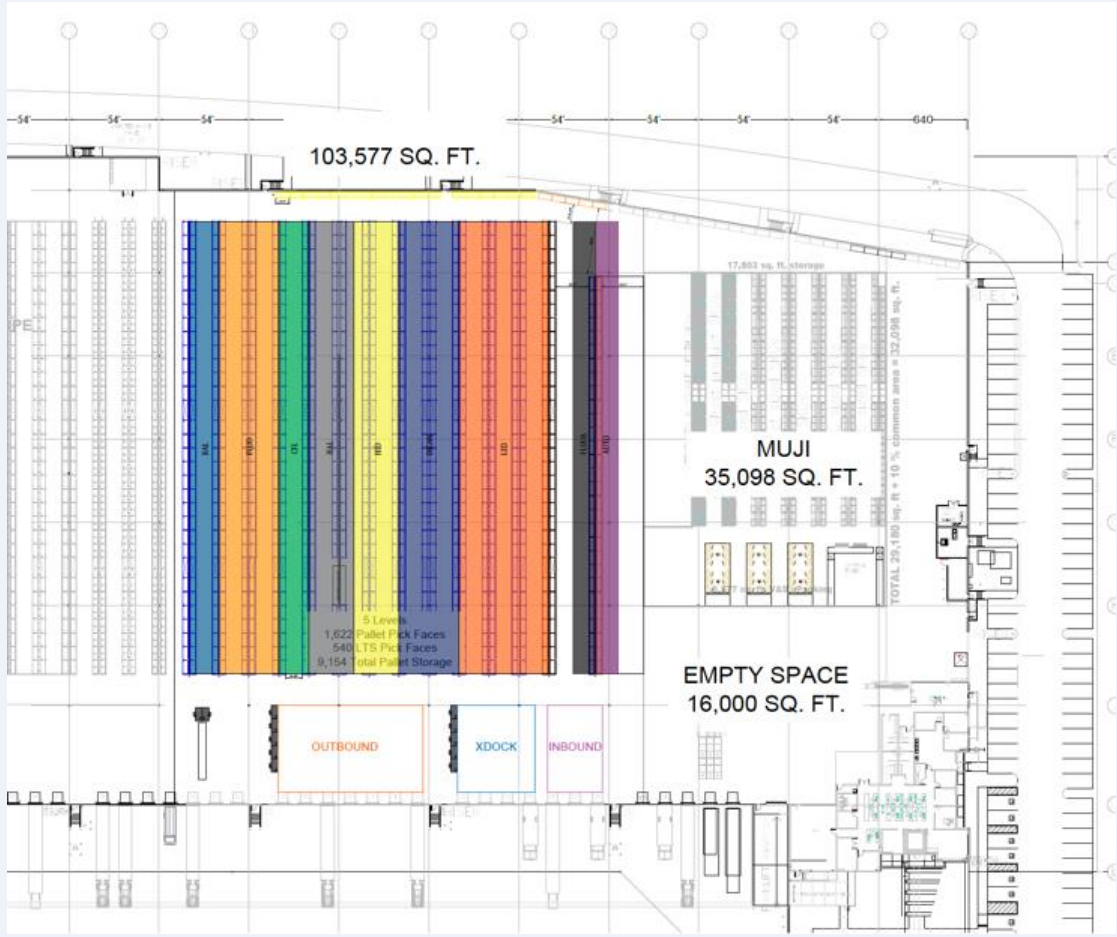
Front End Components

- Web components to display the digital twin to the end user
- Leaflet.js, Nvidia, <insert more>



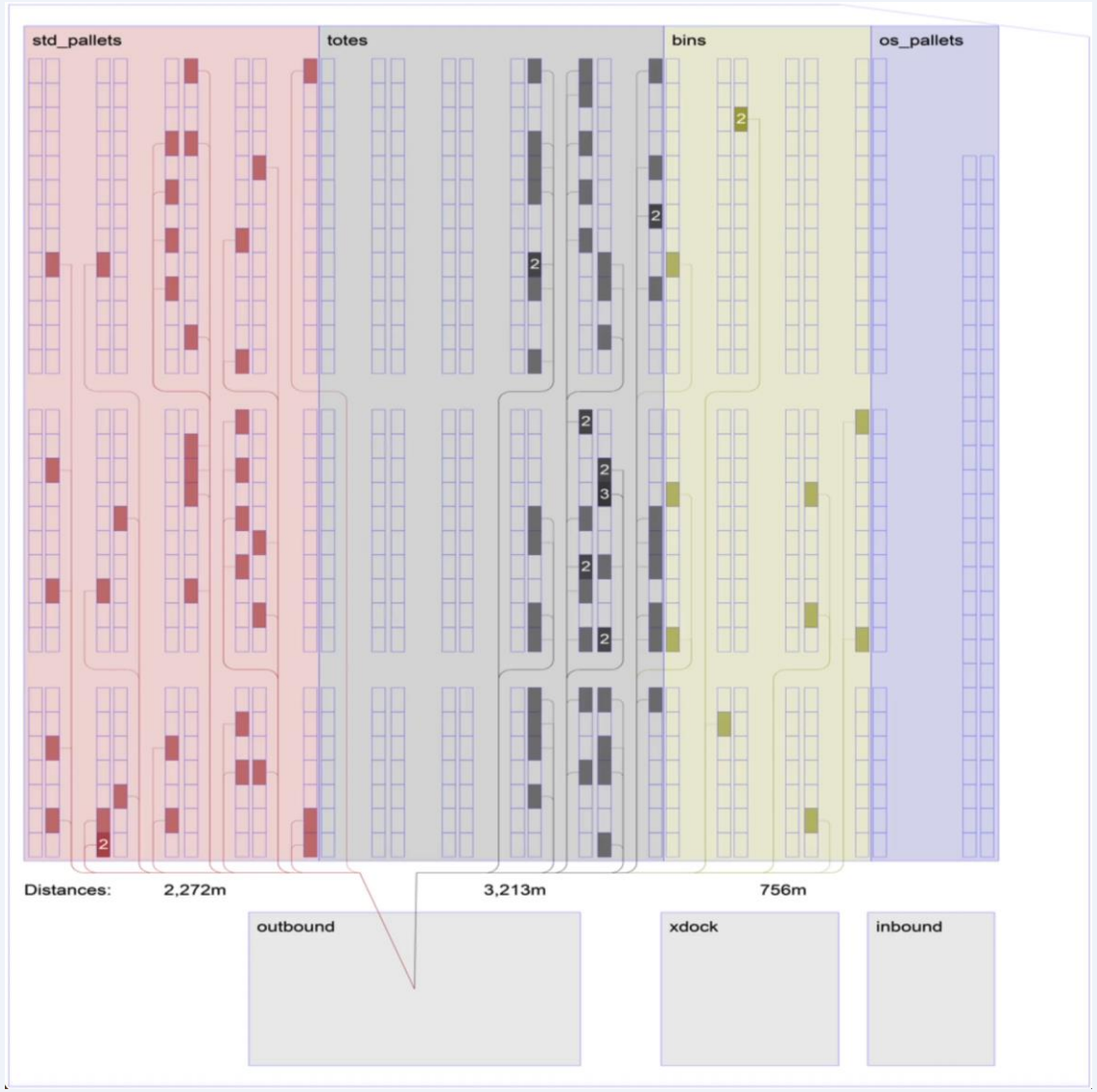
Starting Point

- Warehouse CAD Drawing
- Delivered with building purchase; or racking build out
- Required for all robotic projects
- Dimensionally correct information



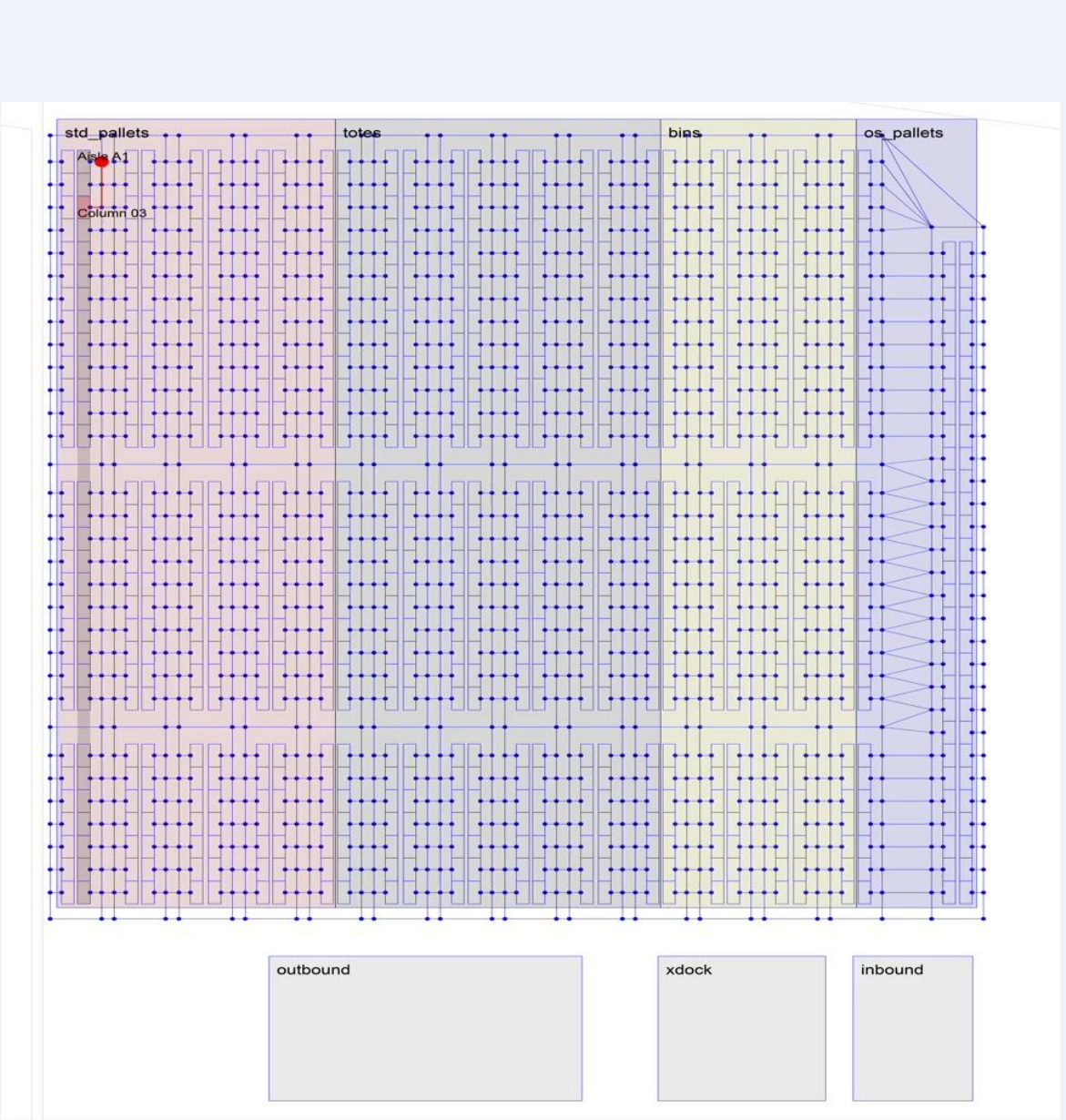
Travel Distance Analysis

- Travelling sales-person analysis
- Shortest path from one bin to another?
- Shortest path from inbound or outbound lanes and bulk storage?
- Determine distances so we can apply travel speeds by equipment to define time
- Visualization is 2D; but we are very concerned with 3D.
- What is the height of shelves and how fast can a forklift move to level 5?



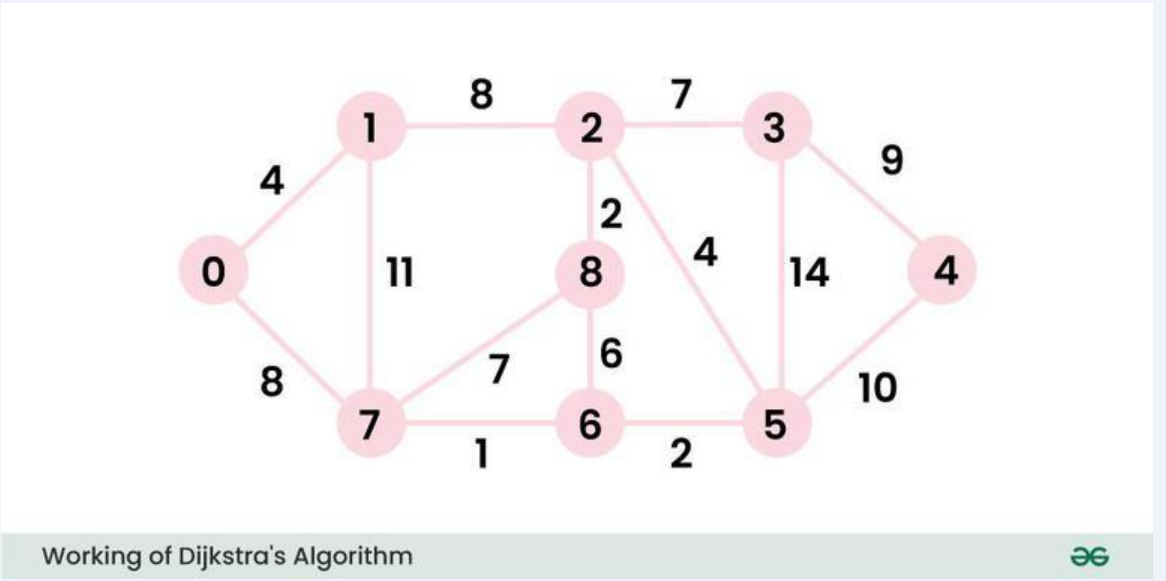
Travel Path Analysis

- Travelling sales-person analysis
- What are the paths a human could travel in the warehouse?
- What about other modalities?
- Are specific aisles one way? Vehicles only?
- How are shelves loaded? Push-back racks or gravity fed racks?



It's Good to be Greedy

- Greedy algorithms tackle problems by making the best choice they can at each step.
- They focus on finding a solution that's optimal in the short term.
- This approach aims to lead to a solution that's overall good, even if it might not be absolutely perfect.



Working of Dijkstra's Algorithm

Output: *0 4 12 19 21 11 9 8 14*
Explanation: *The distance from 0 to 1 = 4.*
The minimum distance from 0 to 2 = 12. 0->1->2
The minimum distance from 0 to 3 = 19. 0->1->2->3
The minimum distance from 0 to 4 = 21. 0->7->6->5->4
The minimum distance from 0 to 5 = 11. 0->7->6->5
The minimum distance from 0 to 6 = 9. 0->7->6
The minimum distance from 0 to 7 = 8. 0->7
The minimum distance from 0 to 8 = 14. 0->1->2->8

Source:GeeksforGeeks.org

Warehouse ML Use Cases

Can we answer the following?

- Is the rearrangement cost greater than the potential savings?
- Where are we spending too much time picking? Or on putaway?
- What products should we keep close together?
- If we introduce new products, how does that impact the warehouse?

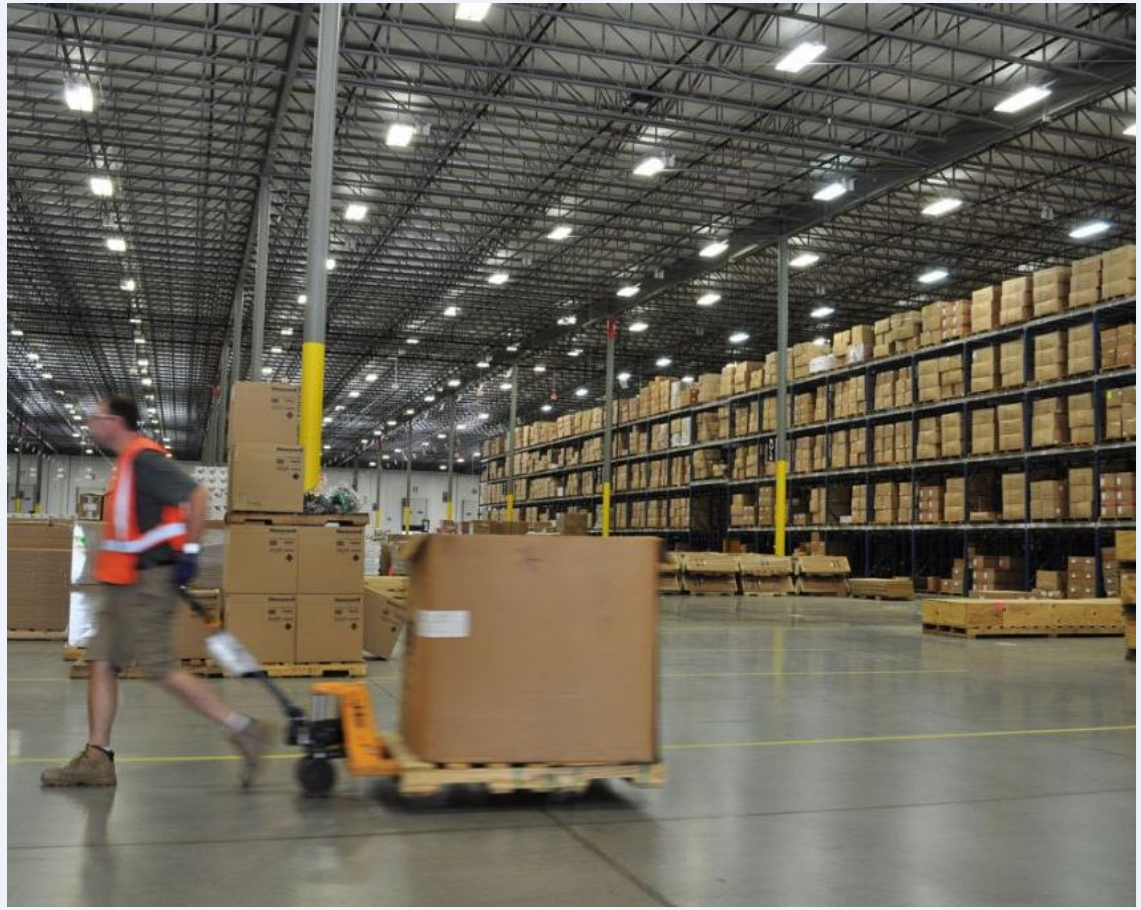
Potential Outputs

- Rearrangement recommendations to reduce travel time or congestion
- Data that supports hiring or capital purchase decisions?
- Do we hire/transition X resources?
- Do we purchase a new forklift
- Do we deploy robots?
- Can we consolidate warehouses?

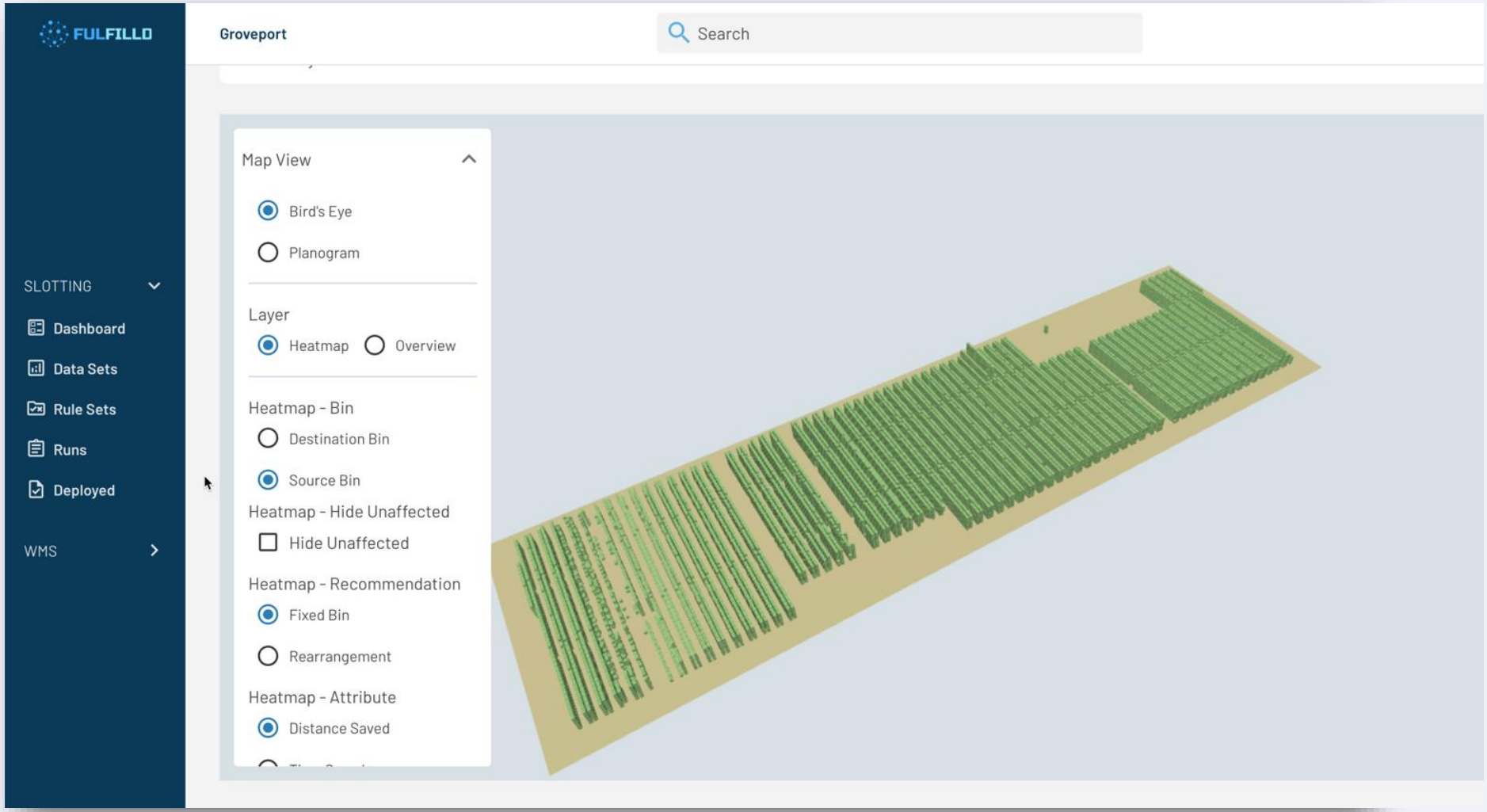
Example Warehouse

Industrial Parts Manufacturer

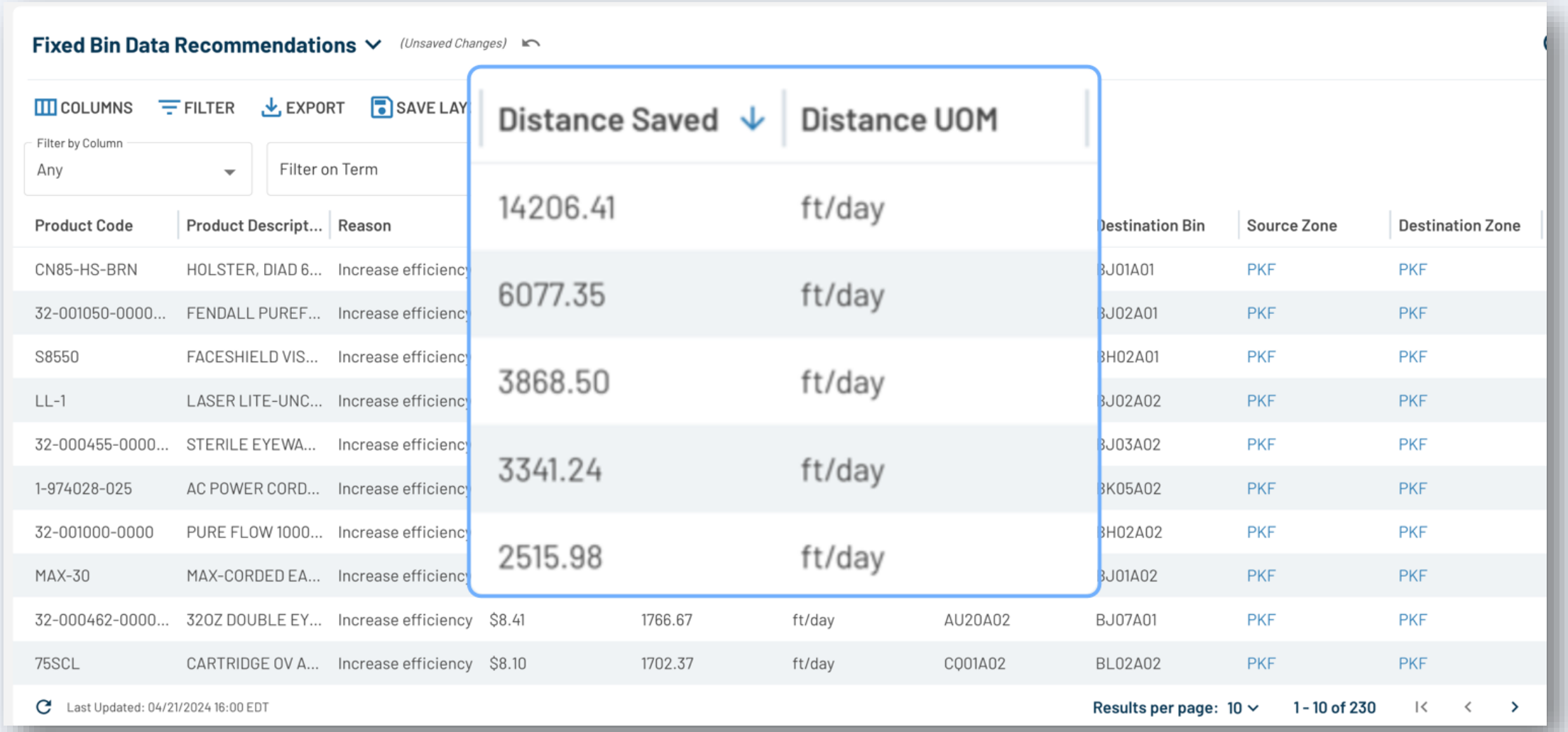
- Multiple Zones
  - Bulk, Case, Each-pick Zones
  - Zones by Product (i.e. Hazardous)
- 500,000+ sqft & 50K SKUs
- 30+ Employees & 10+ Vehicles
- Goal: Save 10,000 linear ft per day in wasted travel



Apply Different Rules to Affect Simulation



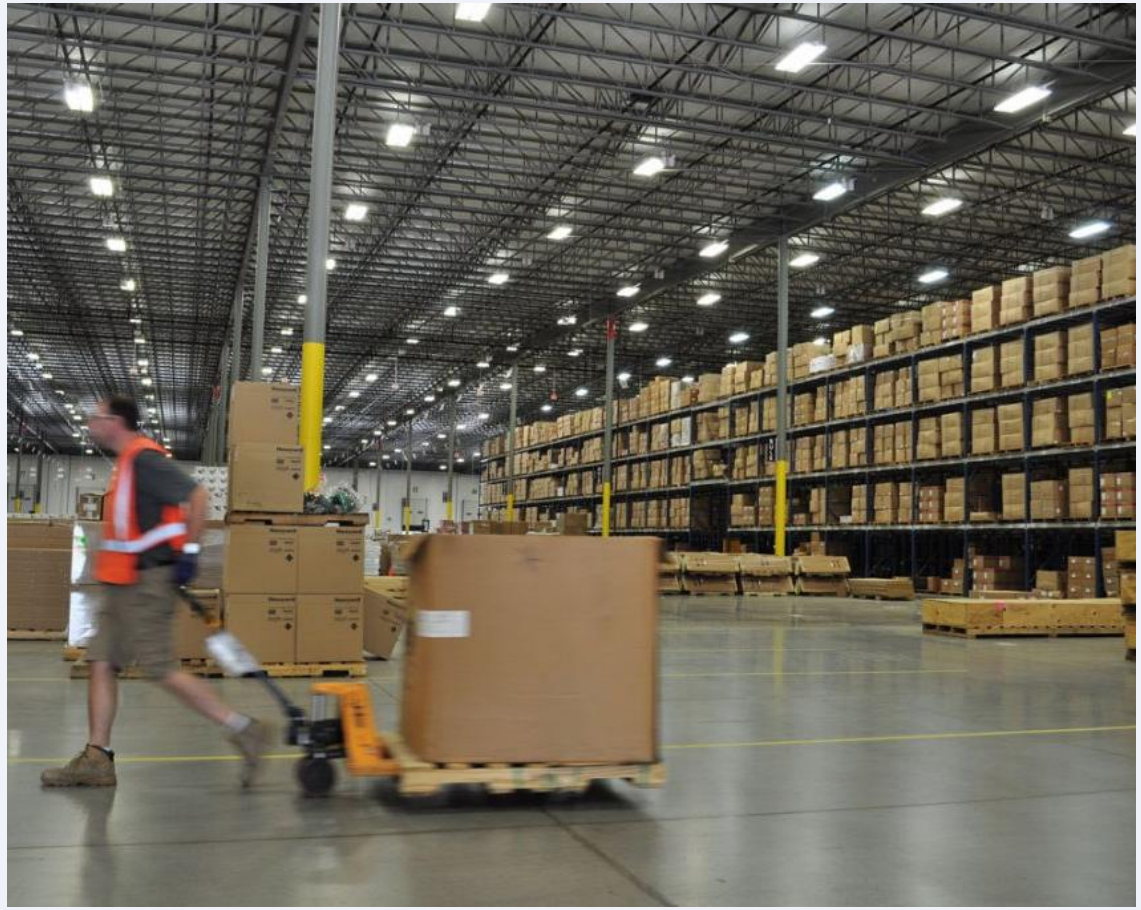
Easy to Understand Recommendations



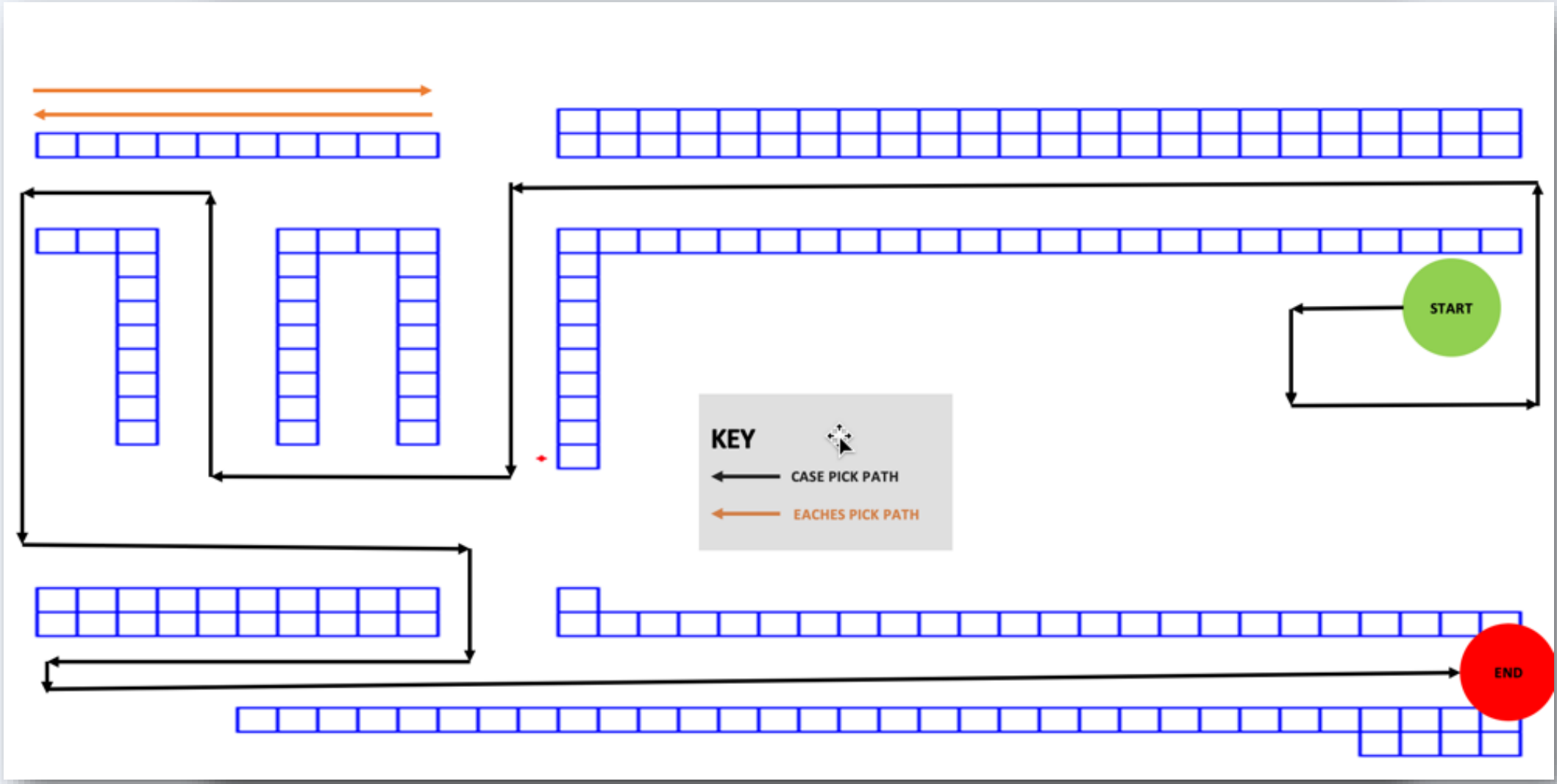
Example Warehouse

Consumer Packaged Goods

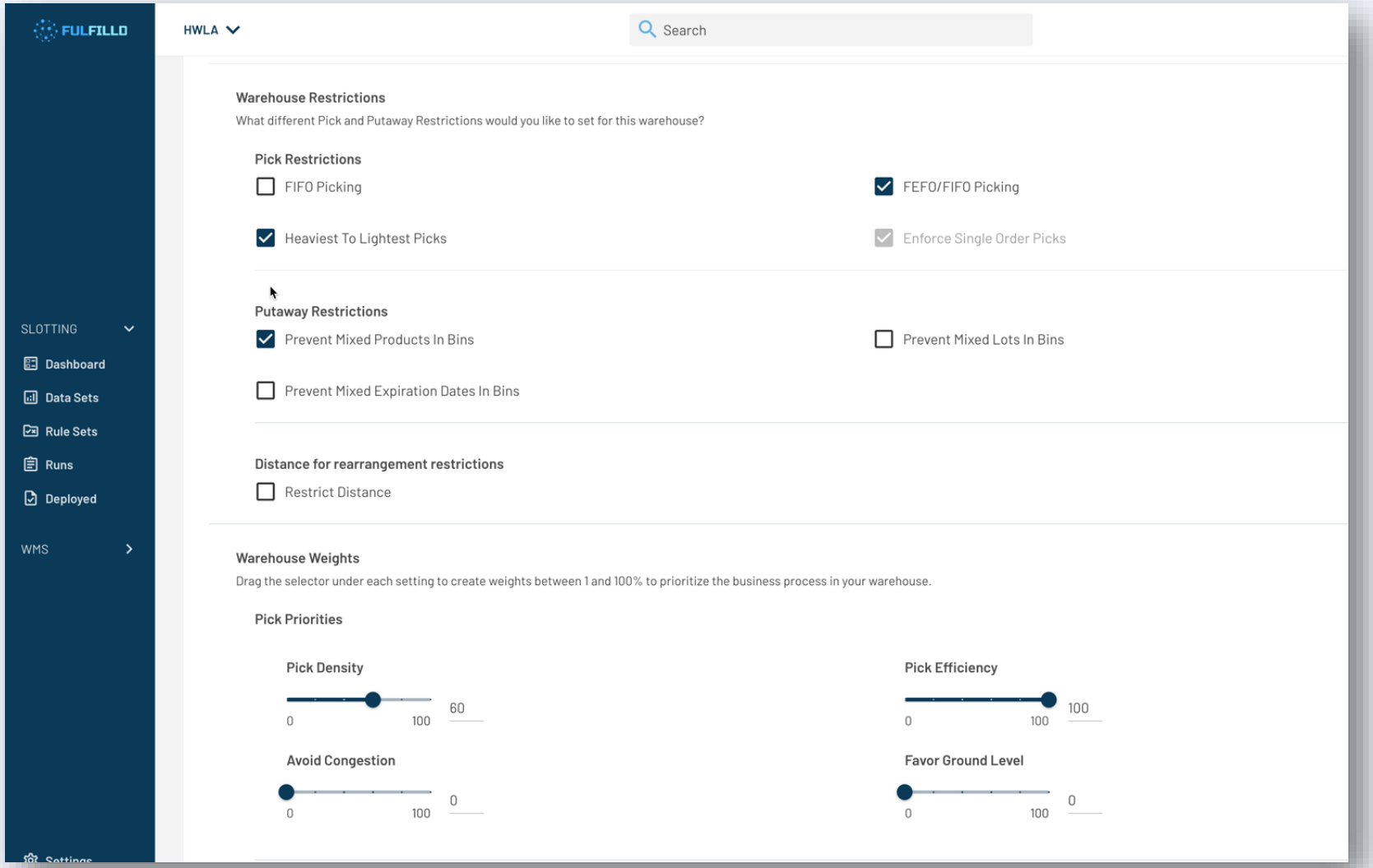
- Multiple Zones
  - Bulk, Case, Each-pick Zones
  - Zones by UoM
- 100K+ sqft & 2K SKUs
- 15+ Employees & 5 Vehicles
- Goal: Increase Case per Hour (CPH) by 5% a Week



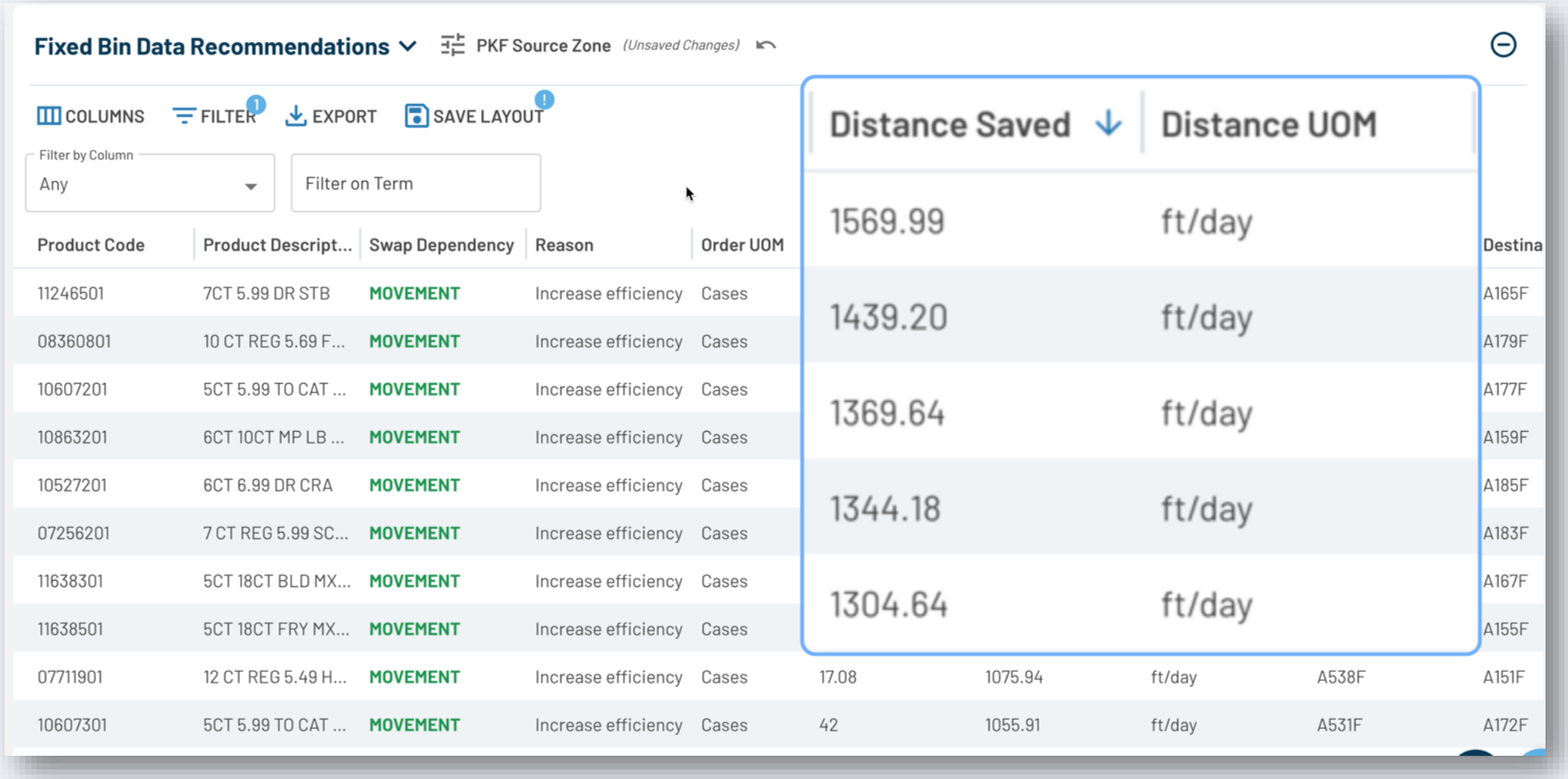
Warehouse Pick Path



Simulation Ruleset



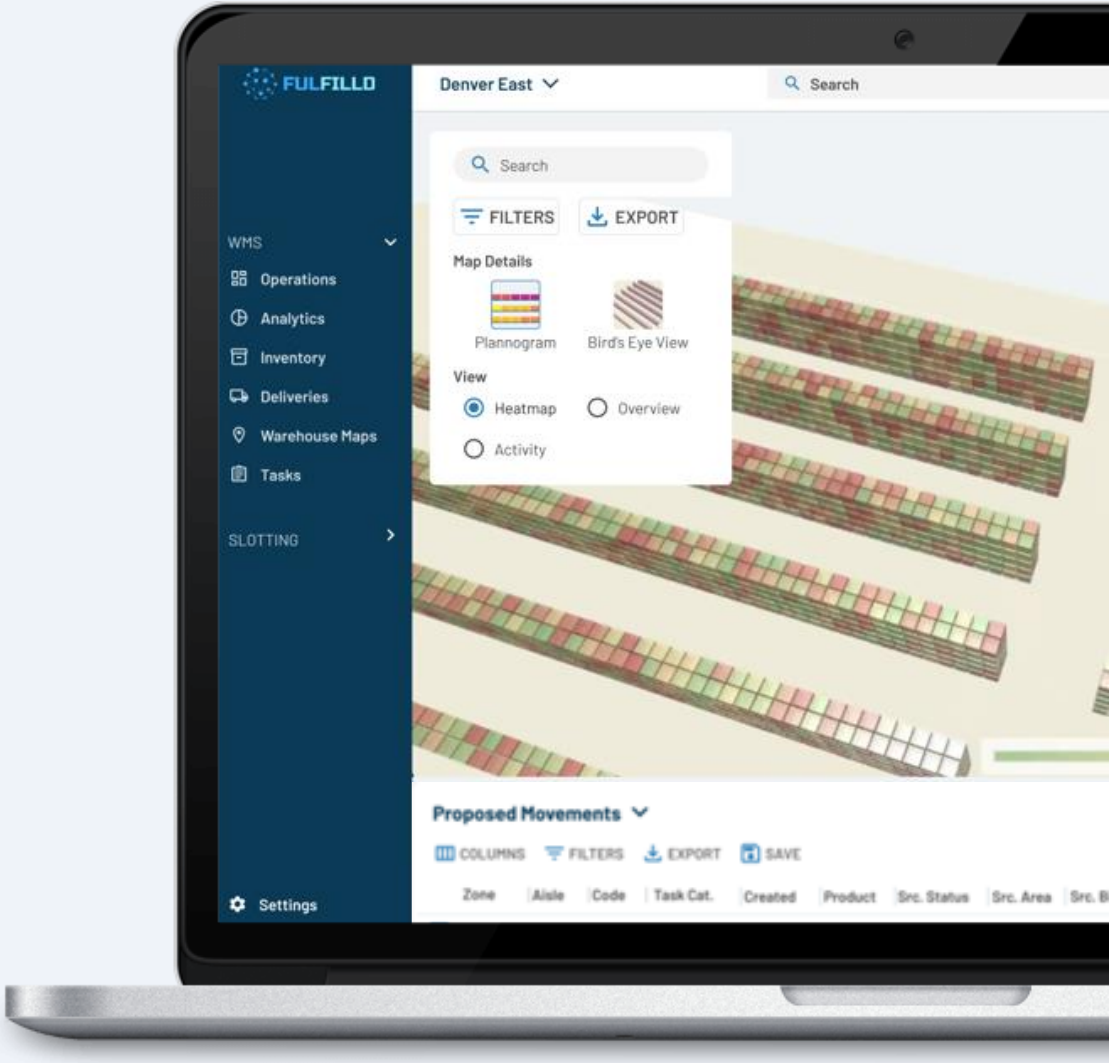
Pick Density Drives Improvement



Product Code	Product Descript...	Swap Dependency	Reason	Order UOM					Destina
11246501	7CT 5.99 DR STB	MOVEMENT	Increase efficiency	Cases					A165F
08360801	10 CT REG 5.69 F...	MOVEMENT	Increase efficiency	Cases					A179F
10607201	5CT 5.99 TO CAT ...	MOVEMENT	Increase efficiency	Cases					A177F
10863201	6CT 10CT MP LB ...	MOVEMENT	Increase efficiency	Cases					A159F
10527201	6CT 6.99 DR CRA	MOVEMENT	Increase efficiency	Cases					A185F
07256201	7 CT REG 5.99 SC...	MOVEMENT	Increase efficiency	Cases					A183F
11638301	5CT 18CT BLD MX...	MOVEMENT	Increase efficiency	Cases					A167F
11638501	5CT 18CT FRY MX...	MOVEMENT	Increase efficiency	Cases					A155F
07711901	12 CT REG 5.49 H...	MOVEMENT	Increase efficiency	Cases	17.08	1075.94	ft/day	A538F	A151F
10607301	5CT 5.99 TO CAT ...	MOVEMENT	Increase efficiency	Cases	42	1055.91	ft/day	A531F	A172F

Digital Twin Benefits

- Replay real transactions from SAP S/4HANA
  - Dataset can be rolling 30, 60, 90 day.
  - Analyze a specific period (Q2 2023)
- Simulate varying resource types
- Run multiple simulations and commit one to a plan
- Measure results; planned vs actual



Integration with SAP S/4HANA

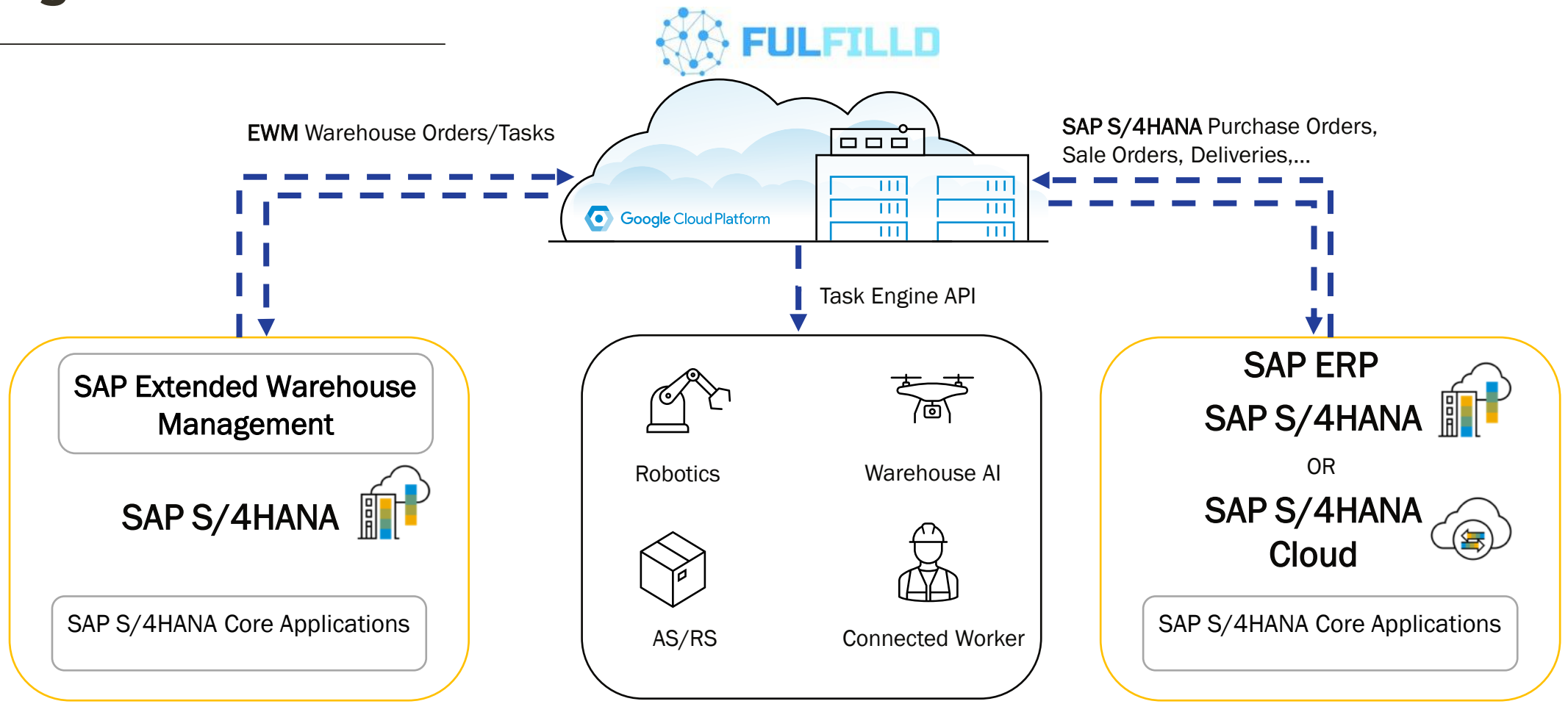
SAP S/4HANA

- Manufacturing
- Accounting
- Sales
- Quality Assurance
- Analytics

FULFILLD WMS (Or 3rd Party)

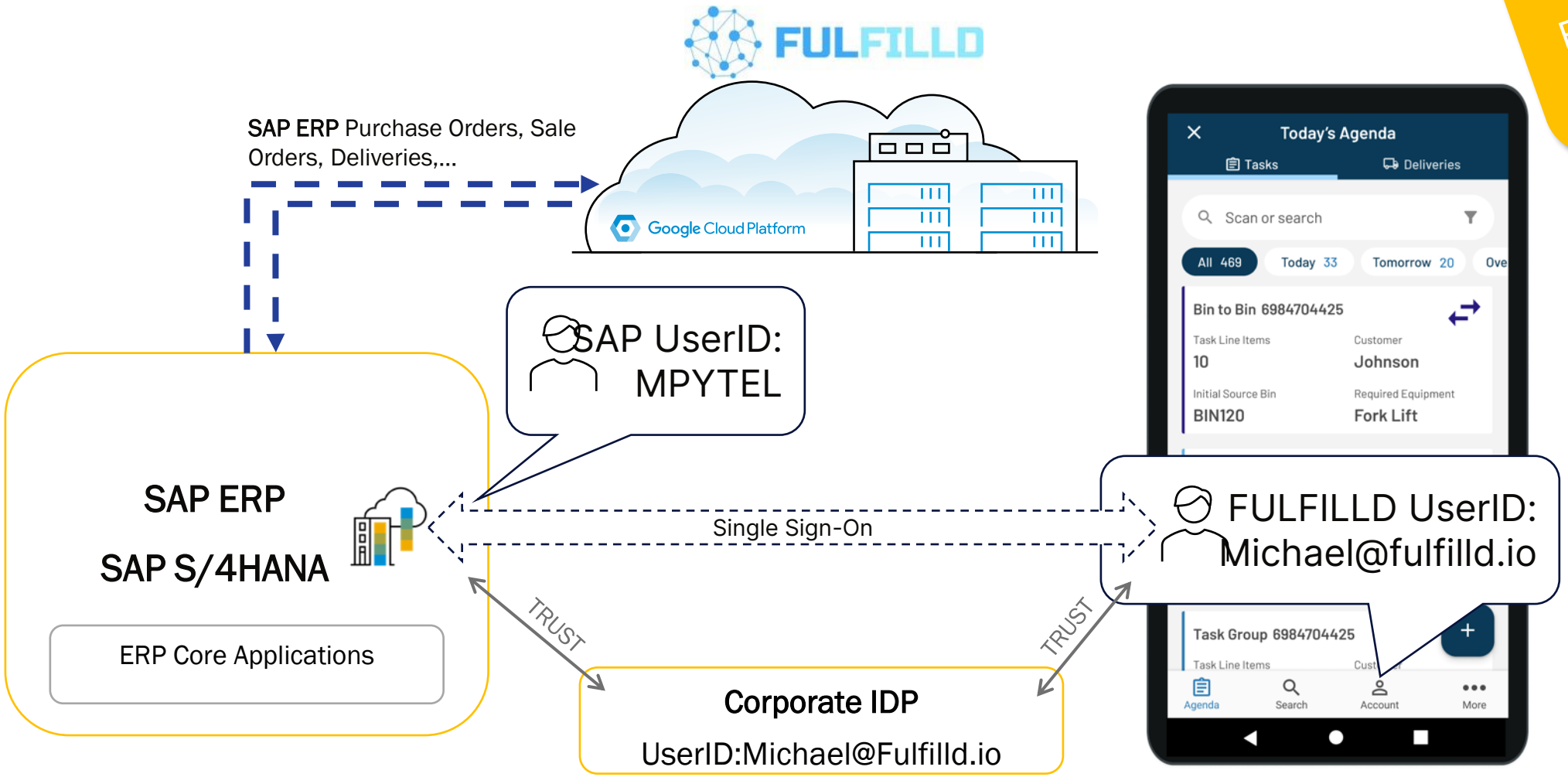
- Inventory Management
- Warehouse Management
- Warehouse Execution
- Door Scheduling
- Analytics

Warehouse Integration



Transaction Traceability

IDOC FREE ENVIRONMENT



Integration Best Practices

- Leverage REST APIs delivered with SAP S/4HANA 2020 and above
  - Production/Process Order Confirmation
  - GR/GI with SAP Deliveries
  - Picking, Delivery Complete, etc
- ”Push” from SAP to Third Party available with addition licenses
  - SAP BTP
  - Third Party Apps
- Standard integration (aka Free) requires “polling” for changes in SAP
- Utilize OAUTH for SAP Single Sign-on to avoid digital access licenses

Wrap Up

- We can adapt standard algorithms with the constraints of the warehouse to solve the complex challenges of determining where to place a product in the warehouse.
- Decision making previously was based on human experience and intuition. Leveraging these models – we can simulate multiple decisions to provide the best supporting information for employees.
- SAP has provided customers with an open platform to integrate. We can leverage historical data live or from a data warehouse to answer logistics challenges.

Where to Find More Information

SAP API Hub > https://api.sap.com Filter by S/4HANA

Using REST APIs with S/4HANA In Premise > https://help.sap.com/docs/SAP_S4HANA_ON-PREMISE/8308e6d301d54584a33cd04a9861bc52/1e60f14bdc224c2c975c8fa8bcfd7f3f.html

Google ORL Tools & Examples > https://developers.google.com/optimization/examples

Key Points to Take Home

- A Digital Twin is more than a read-only view of something in the physical world.
- SAP REST APIs are available out of the box; and we can build custom APIs in SAP S/4HANA as needed.
- We can train ML models on physical spaces to permit the simulation of multiple potential changes to the environment.
- We can use proven algorithms to solve the best-fit challenges in the warehouse
- Site level business rules can be included in the algorithms for warehouse specific optimization

Thank you! Any Questions?

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