AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

ROB201

Optimizing robotics and autonomous systems with AWS and Amazon

Christine Osik
Head of Simulation
Amazon Robotics

Eric Anderson
General Manager
AWS Robotics

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Agenda

Intro to operations at Amazon

Intro to simulation

How Amazon uses simulation

AWS RoboMaker simulation

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Robotics at Amazon

AMAZON KNOWS ROBOTICS

Fulfillment



Material movement



More all the time!



Manipulation



Logistics



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Amazon’s robotics at a glance



175+ FCs worldwide

40+ Sort Centers

50+ robotic FCs worldwide

350,000 drive units

150,000,000 square feet of FC space

1,000,000+ people worldwide

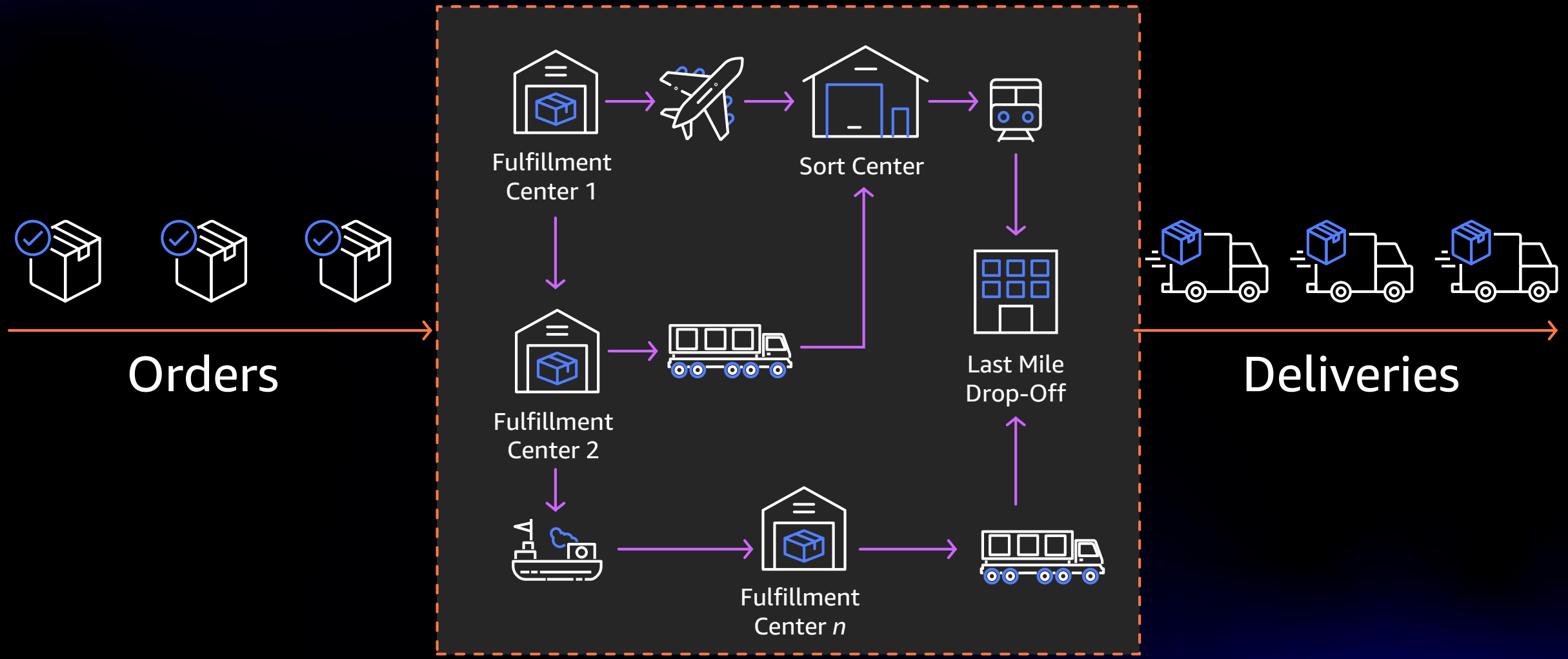
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Amazon is a function from orders to deliveries



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Look one level down



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One more level down and things get complex

How to make this work?

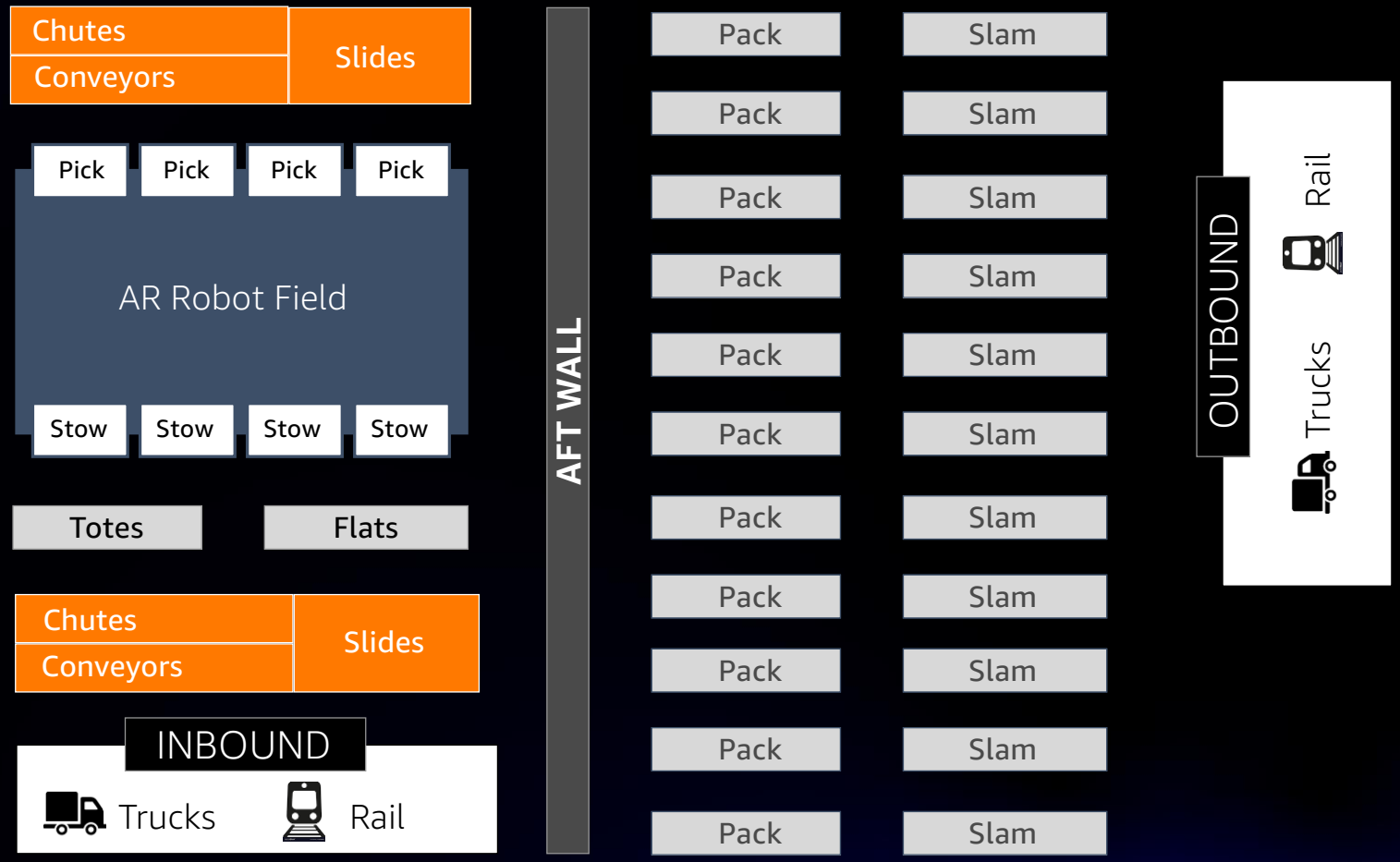
Business processes?

How many robots?

Miles of conveyance?

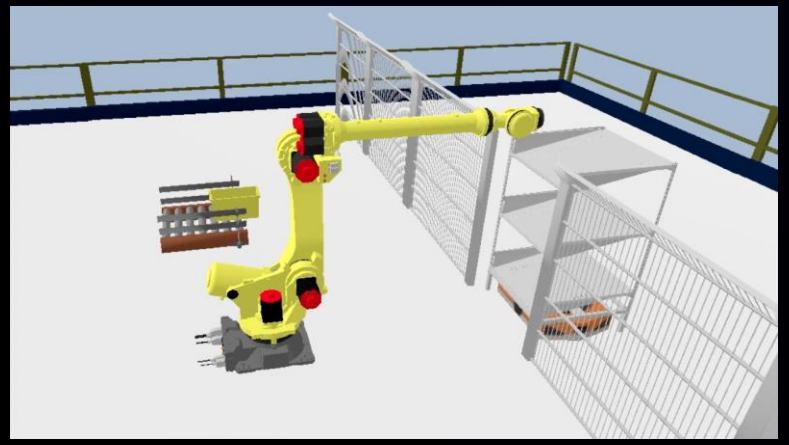
Safety? Construction costs?

Lots of questions…



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How simulation improves robotics operations



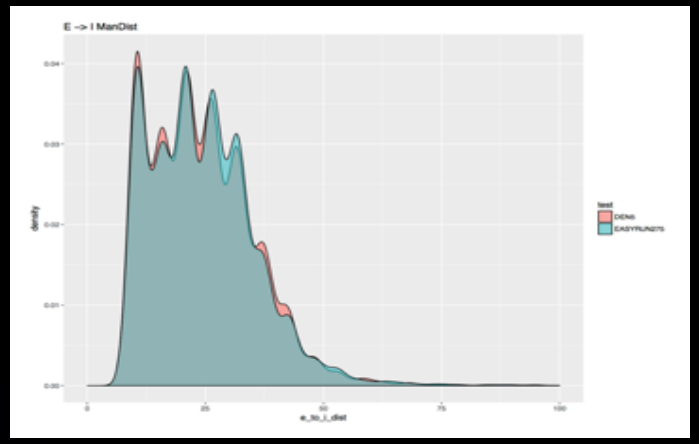
Concepts

Do what-ifs
Prototype tech



System designs

Identify constraints
Redesign workflows



Qualification

Validate
Benchmark

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Amazon uses simulation in many ways

1. Visualize how robots will work to non-roboticists
2. Accelerate robotic solution delivery
3. Design new perception system
4. Train ML models with synthetic data
5. Optimize robotic configurations with generative design



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Train ML models with synthetic data

Problem

Robots need to be able to accurately perceive their environment and objects in it to operate

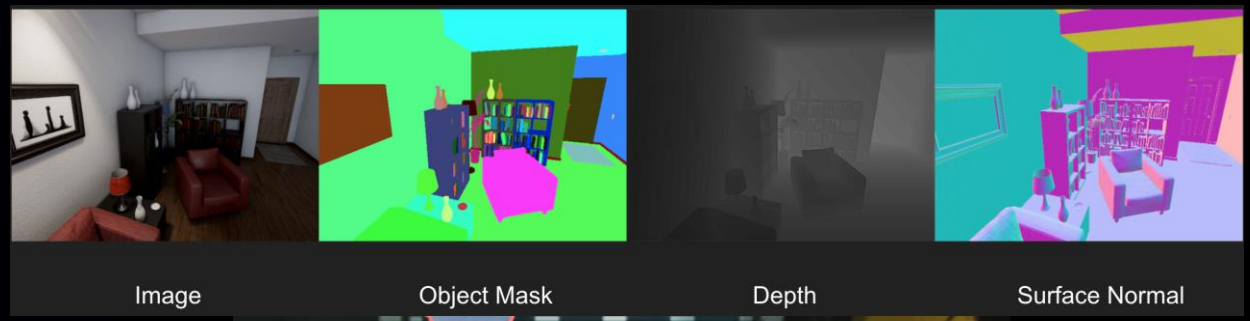
Solution

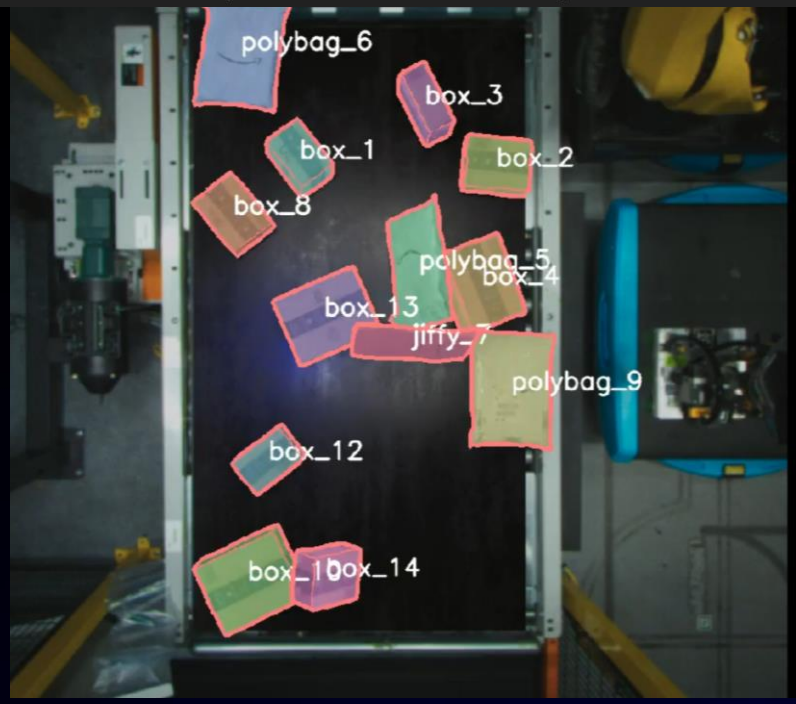
Use simulation to generate synthetic data to train perception systems

Perception Data Augmentation – Use 3D objects to model rare or complex scenarios for model training

Domain Randomization and Variations – Automatically generate variations (size, shape, color, texture)

High-Fidelity Images – Model sensors, environmental (lighting, pose) conditions to ensure fidelity to real world





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Optimize robotic configurations with generative design

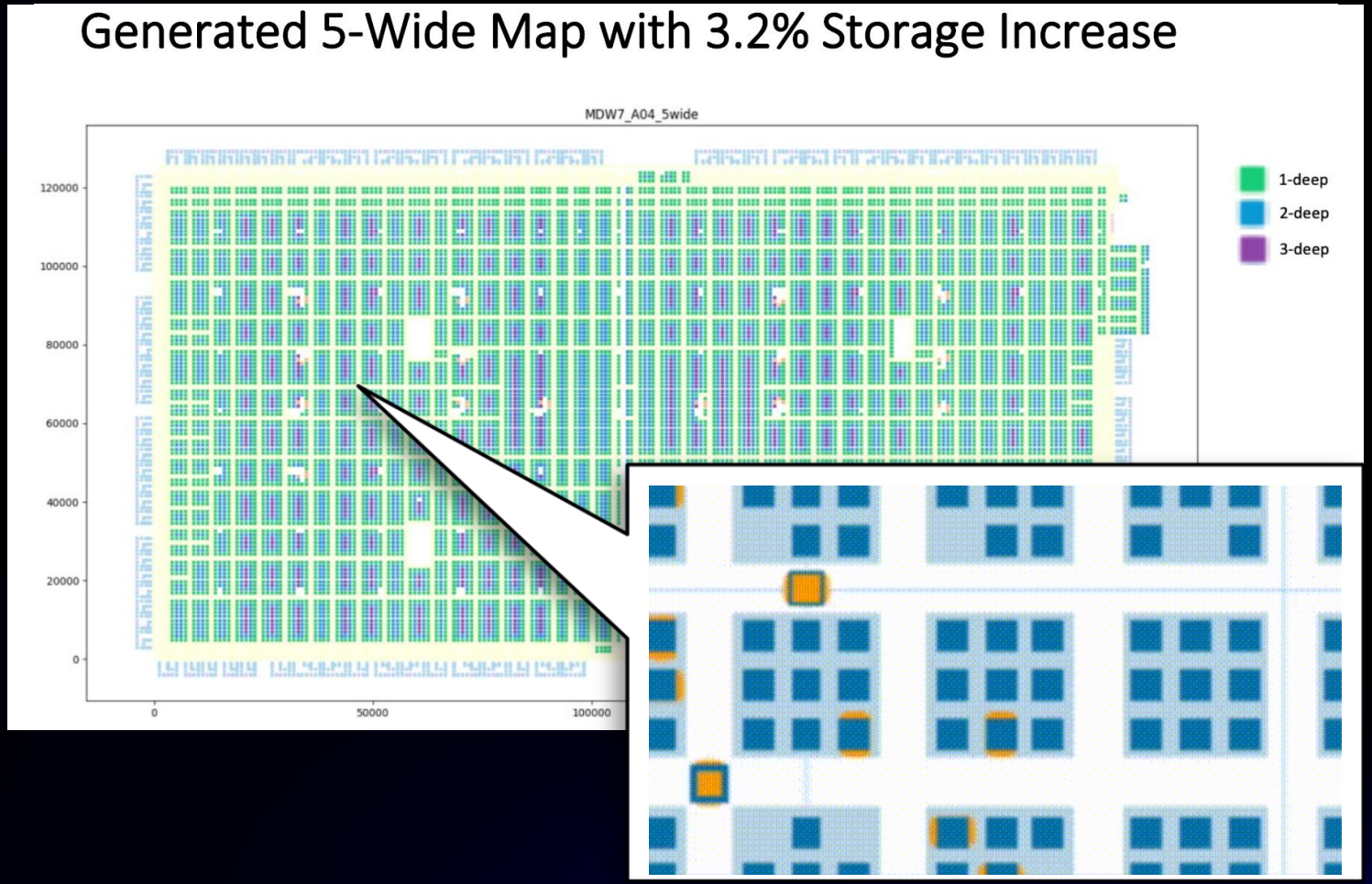
Problem

Amazon needed to increase the amount of product stored in existing buildings

Solution

Used simulation in the loop to generate maps with denser storage

- Produced better maps faster
- Measured and ensured no negative impacts of map changes
- Optimized maps for increased product storage



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AWS RoboMaker

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AWS RoboMaker is a cloud-based simulation service that enables robotics developers to run, scale, and automate simulation without managing any infrastructure

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AWS RoboMaker

Serverless container-based simulation

Execute simulation without managing compute, storage, etc.

Batch simulation

Use in generative design and reinforcement learning applications

World-building

Generate hundreds of worlds for your robot to operate in

CI/CD for robotics

Incorporate high-fidelity simulation into CI/CD workflows



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AWS RoboMaker customers

MiLVUS ROBOTICS

Milvus implemented a RoboMaker simulation CI pipeline and can now easily test robots in different environments, resulting in a huge quality improvement



Jetbrain

RoboMaker simulation enabled Jetbrain to cost effectively expand and speed up their robotics development without sacrificing code quality or safety



room_.e

RoboMaker helped Roomie save 5.5 weeks of development time by making is possible to test robotic protypes in real-world scenarios

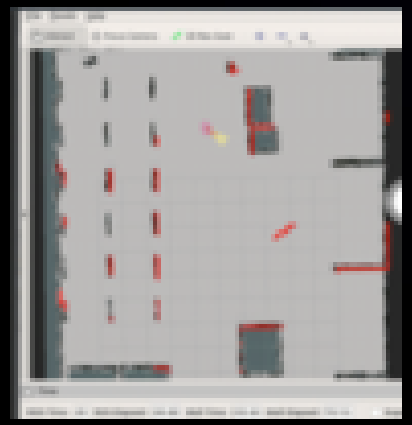


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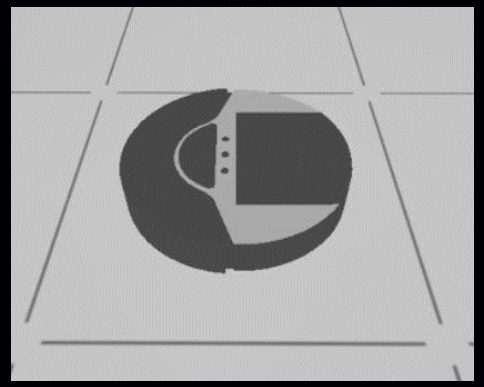
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Getting started with AWS RoboMaker

AWS can advise and help you through each of these steps



Decide on test scenarios, simulation fidelity



Build a robot for simulation



Choose or generate a simulation world

```
Json
{
    "scenarios": {
        "<SCENARIO_NAME>": {
            "robotEnvironmentVariables": {},
            "simEnvironmentVariables": {}
        }
    },
    "simulations": [{
        "scenarios": ["<SCENARIO_NAME>"],
        "params": CreateSimulationJobParams
    }]
}
```

Define test cases

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Learn more!

Read about **fleet simulations, batch simulations,** and more in the **AWS Robotics Blog**
https://aws.amazon.com/blogs/robotics/

Get hands-on with AWS RoboMaker workshops
https://robomakerworkshops.com/

More details on AWS RoboMaker
https://aws.amazon.com/robomaker

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