MFG203

AWS innovation within Amazon

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Agenda

Overview of Amazon’s fulfillment centers

AWS usage in Amazon fulfillment centers

AWS guidance for supply chain

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for industrial

simplifies the process of locating, building, and deploying innovative IoT, AI/ML, analytics, and edge solutions to achieve step change improvements in operational efficiency, quality, and agility

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This is the kind of challenge we're built for

For over 25 years, Amazon has designed and manufactured smart products and distributed billions of items across our global network

We use cutting-edge automation, IoT, machine learning and AI, and robotics, all with cloud at their core

Amazon continuously transforms itself to drive customer-delighting goals like cashierless convenience, one-day shipping, and net-zero carbon shipments



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Amazon fulfillment center overview

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Amazon’s scale at IPO in 1997

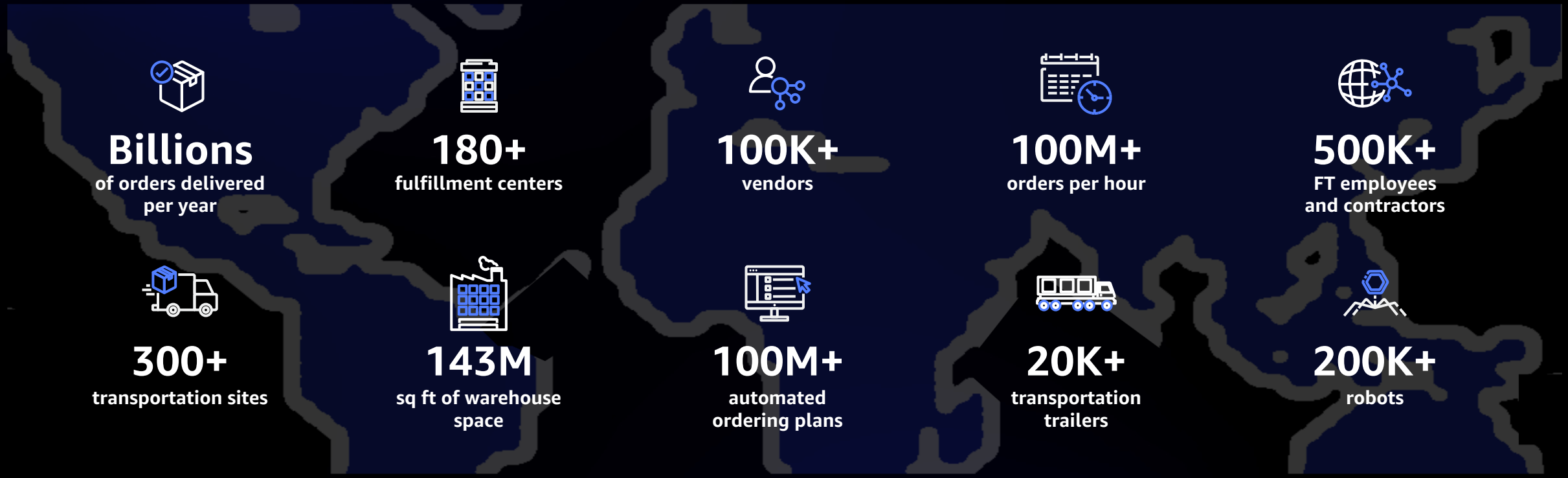


1 Marketplace

2 Fulfillment centers

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Amazon’s retail business scale today



Billions
of orders delivered per year

180+
fulfillment centers

100K+
vendors

100M+
orders per hour

500K+
FT employees and contractors

300+
transportation sites

143M
sq ft of warehouse space

100M+
automated ordering plans

20K+
transportation trailers

200K+
robots

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Amazon scales through automation & simplicity



Automated forecasting
Multi-year and weekly for 480M+ products

Capacity optimization
Regional and local demand distributions by segment

Automated buying
Deep system integration allows for 99% inventory automation

Automated placement
Prediction and routing of inventory between fulfillment centers

Automated fulfillment
Real-time optimization among hundreds of shipping options

Connected logistics
Continuous optimization between internal and external delivery networks

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Customer experience is evolving too

1997
Amazon.com IPO

2000
Super Saver Shipping, free for orders over $100



2005
Prime membership, free 2-day shipping

2010
Super Saver Shipping, free for orders over $25



2014
Prime Now, free 2-hour delivery

2017
Amazon Key offers in-home delivery with keyless entry

2019
Prime Free One Day

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Typical sortable fulfillment center specs



2,000 associates

Amazon robotics in approximately 65% of total square footage

Built to have the ability to ship 1M units in a 24-hour period

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Key inbound/outbound processes supported by robots

Place order
A customer clicks “buy” on Amazon.com from millions of available items

1. Inbound
Products arrive from manufacturers and suppliers to be stored at our fulfillment center; we support thousands of small businesses that sell on Amazon





2. Stow
Products are then placed in coded bins and entered into inventory so they can be located when needed

3. Pick
When an order arrives, associates pick the products and place them into bins; robotics help bring the products to associates



Amazon robotics floor



4. Pack
The bins are then moved by conveyors to associates who carefully pack the products into our well-known smile boxes and smart packs

5. SLAM
Stands for scan/label/apply/manifest – this is where the package goes through its final processing and is routed to the proper outbound truck to be transported to a sortation center



6. Shipping
The package is then brought to a sortation center, routed to the proper outbound truck, and shipped to a delivery station



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1. Inbound

PRODUCTS ARRIVE FROM MANUFACTURERS AND SUPPLIERS TO BE STORED AT OUR FULFILLMENT CENTER; WE ALSO SUPPORT MILLIONS OF SMALL BUSINESSES THAT SELL ON AMAZON

Powered by machine learning

- Daily forecasting for 480M+ items
- Real-time inbound carrier and delivery location selection
- Network regional redistribution

Driven by AWS

- Amazon Forecast
- Amazon SageMaker



High price variability



Regional vs. national demand



Slow-moving products



New products



Highly seasonal products

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2. Stow

PRODUCTS ARE THEN PLACED IN CODED BINS AND ENTERED INTO INVENTORY SO THEY CAN BE LOCATED WHEN NEEDED

Powered by automation, IoT, machine learning

Randomized stow maximizes the probability that an item will be closer to a picker when ordered

Driven by AWS

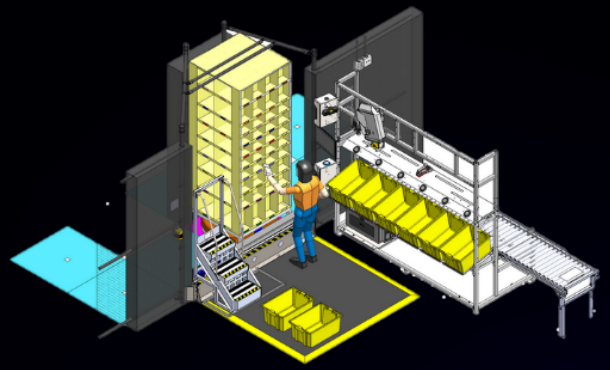
- AWS IoT (analytics, connectivity, device services)
- Amazon SageMaker







Scanning at all touch points: order receive, box storage location, item stow



Computer vision assisted placement



Cognitive load reduction

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Automation at scale: Amazon robotics

MINIMIZES HUMAN ERRORS AND REDUCES ORDER CYCLE TIME

Powered by robotics, machine learning

- Can lift up to 1,250 lbs. traveling 5 mph
- 22% smaller buildings, ~20% lower operating expenses compared to non-robotic fulfillment centers
- Reduced cycle times from 60–75 minutes to ~15 minutes



Driven by AWS

- AWS database, data streaming, and analytics services
- Amazon machine learning services

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3. Pick

WHEN AN ORDER ARRIVES, ASSOCIATES PICK THE PRODUCTS AND PLACE THEM INTO BINS; ROBOTICS HELP BRING THE PRODUCTS TO ASSOCIATES

Powered by automation, IoT, machine learning

Pick selection is optimized for fulfillment center, then floor level, pod, and bin to reduce transportation time to customer

Driven by AWS

- AWS IoT (analytics, connectivity, device services)
- Amazon SageMaker



Identify the optimal pod with the item for picking



Robot is paired with a pod and the designated picking station



Pods are hauled to the picking station and queued for the fulfillment center associates



After picking, the pod is placed in a location based on prediction of next pod usage (picking/stowing)



Robot goes to a charging station or for maintenance as needed

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Quality check for stow/pick: Visual bin inspection

DRIVES IMPROVED INVENTORY ACCURACY AND REDUCES TIME TO CYCLE COUNT

Powered by computer vision, machine learning

- Counts the number of items it sees in a bin (empty, 1, 2, or >3)
- If low confidence in model, sends images to associates to classify the images and train more Amazon SageMaker Ground Truth data for our model

Driven by AWS

- Amazon SageMaker
- Amazon SageMaker Ground Truth



Computer vision scan of pod face after each pick

Associate intervention when system detects a mismatch

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4. Pack

THE BINS ARE THEN MOVED BY CONVEYORS TO ASSOCIATES WHO CAREFULLY PACK THE PRODUCTS INTO OUR WELL-KNOWN SMILE BOXES AND SMART PACKS

Powered by machine learning

Deliver packaging optimization: packaging (boxes, mailer envelope, or no packaging) is selected to optimize for smallest container for item and lowest waste impact

Driven by AWS

- Amazon SageMaker



Corrugated cardboard boxes



Mailers (75% lighter, 40% less space)



Zero packaging



Tape used to secure the box is matched to the box size and dispensed by the appropriate length

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5. and 6. SLAM and shipping



STANDS FOR SCAN/LABEL/APPLY/MANIFEST – THIS IS WHERE THE PACKAGE GOES THROUGH ITS FINAL PROCESSING AND IS ROUTED TO THE PROPER OUTBOUND TRUCK TO BE TRANSPORTED TO A SORTATION CENTER

THE PACKAGE IS THEN BROUGHT TO A SORTATION CENTER, ROUTED TO THE PROPER OUTBOUND TRUCK, AND SHIPPED TO A DELIVERY STATION

Powered by IoT, machine learning

Carrier/route selected via ML seconds before the label is applied

Driven by AWS

AWS IoT Greengrass



Conveyors/PLC monitored in real time; notifications for when out of defined thresholds



Final quality check conducted for weight based on order

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Goal with robotics

Amazon is customer obsessed and will make sure the customer is satisfied

There is a promise behind that: offering items at a low cost and delivering quickly and at an agreed time

Amazon robotics helps drive that efficiency by working with our fulfillment center employees



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AWS in the Amazon fulfillment centers

Behind the scenes

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Amazon Monitron use case: Amazon warehouse mass adoption

Tens of thousands of sensors and gateways are being installed in Amazon fulfillment centers across Europe in 2021

The same scale will be completed in North America in the coming months

Monitron is projected to mitigate **thousands of hours of equipment downtime** per year, **hundreds of thousands of lost production hours,** and **tens of millions of delayed shipments** (customer late deliveries)





https://www.youtube.com/watch?v=0XRjuX7WRt0

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Thank you!

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