FIND YOURS.

Collaborative Robots & the Supply Chain of the Future

Presented by:
Locus Robotics
Karen Leavitt
CMO
Locus Robotics
We’re Playing in a Big Market

The US e-commerce market is growing at a 10% compound annual growth rate. Total domestic e-commerce revenue will top $650 billion by 2021.

Of the $504,000,000,000 (that’s billions) in e-commerce sales last year, Amazon sales accounted for about 1/3.

Warehouse workers have seen their hourly wage increase by more than 30% since 2001.

While you’ve been reading this slide, 39,642 items have been picked from warehouse shelves in the USA.
Today’s Warehouse Challenge

Piece (“each”) Picking
The Amazon Effect

Forecast E-Commerce Revenue Growth (10% CAGR)

E-Commerce Labor

VIP Service
Express Delivery
Gift wrap

Consumer Expectations
The Amazon Effect

Forecast E-Commerce Revenue Growth (10% CAGR)

E-Commerce Labor

VIP Service
Express Delivery
Gift wrap

Consumer Expectations

FIND YOUR WOW
Demand for Labor is Highly Seasonal

Typical E-Commerce Warehouse Pick Volume

- **Peak Season**: Peak:Average = 4X
- **Peak:Low = 13X**
- **Peak:Average = 4X**
- **Low Season**

- **Layoff 80% of workforce here**
- **Hire here: 5X workforce**
- **Train workers @ $1,000 each**

- **Average Volume**

- **January**: Layoff 80% of workforce here
- **February**
- **March**
- **April**
- **May**
- **June**
- **July**
- **August**
- **September**
- **October**
- **November**
- **December**

<table>
<thead>
<tr>
<th>Month</th>
<th>Peak Season</th>
<th>Average Volume</th>
<th>Low Season</th>
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Solving the Piece-Picking Puzzle

Productivity

Flexibility

Innovation

Insights
Typical E-Commerce Scenarios

Back to School
- Gym shorts
- Spiral notebooks
- Backpack
- Penny loafers

Office Supplies
- Multivitamins
- Razor blades
- Cosmetics
- Paper clips
- Post-it notes
- USB drives
- File folders

Holiday Shopping
- Katie: camera drone
- Roberto: video games
- Ahmed: Building blocks
- Simone: 3D puzzle
- Caroline: perfume

Personal Care Purchases
- Penny loafers

Household Purchases
- Batteries
- Paper towels
- Dog treats
- Cleaning wipes
Typical E-Commerce Scenarios
Traditional Cart Picking

- Worker walks 10 – 15 miles per day, including ...
  - Non-productive walks between picks
  - Non-productive time between aisles and pack stations
- Worker must push cart
- Worker must carry RF device
G2P Robotics: High Productivity / High CapEx

• Expensive and time-consuming to set up (requires green-field warehouse)
• Poor capital utilization
  • Workers are productive, but robots are inefficient
• Inflexible
  • Fixed capacity; cannot expand or contract on demand
AMRs: Productivity + Capital Efficiency

- Workers remain in the aisles to minimize unproductive walking
- Upon completion of picks, robots transport orders to pack stations
- Robots move autonomously and efficiently to pick locations
- Workers pick closest robot
- Orders may be picked by one or many workers, based on proximity to pick
Does the worker follow the robot, or does the robot follow the worker?

Neither
Whether the worker follows the robot or the robot follows the worker, the result is the same: the worker is always “attached” to one robot.

For as long as the robot is in the aisles, the worker is occupied with that robot.

How to avoid forcing the worker to do all this unnecessary walking? Disconnect the worker and the robot.

The worker travels as much as the robot until the robot exits the pick aisles to go to packing.

Worker

“FollowBot”
How it Works
5 Easy Steps to Significant Productivity Gains

1. Locus Retrieves Order From the WMS
2. Tote is Inducted
3. Bot Travels to Pick Location
4. Associate locates item, scans & drops into tote
5. Bot directs associate to next robot & moves to its next pick location

Key Differentiator: Multiple bots work with multiple associates

2-3X Increase in Productivity

Completed orders are transported to pack area
Why it Works:
A Whole New Paradigm
Multi-Robot Collaborative Picking

Workers and robots operate as independent agents, allowing parallel processing, as each robot is shared by many workers.

Orders are assigned to robots to “flood the zone”. I.e., orders are selected for their close proximity to one another, as well as proximity to a worker.

Robot order assignments are designed to “sweep” across the warehouse, continuously delivering work as associates are directed through the aisles.

Workers pick to the nearest robot, without worrying about which order they’re picking, or whether a particular order is close to completion.

3 - 4 robots per worker

Workers and robots operate independently
Multi-Bot Pick “Sweeping” in the Real World
## Locus Reduces Both Pick Time & Walk Time

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<tr>
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<th>RF Cart Picking</th>
<th>FollowBot</th>
<th>Locus</th>
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<tbody>
<tr>
<td>Pick Time</td>
<td>Pick</td>
<td>Pick</td>
<td>Pick</td>
</tr>
<tr>
<td>Walk Time</td>
<td>Walk</td>
<td>Walk</td>
<td>Walk</td>
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<tr>
<td>Pick:Walk %</td>
<td>20%</td>
<td>25%</td>
<td>40% - 60%</td>
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- **FollowBot** saves only about 15% of walk time.
- **Locus** saves 55 - 60% of walk time.
- Locus’s hands-free operation and directed work logic substantially reduce pick time.

*2-3X Increase in Productivity*
Powerful Results

Same number of picks in less than half the time
User Experience is Key
UX Drives Productivity AND Accuracy

Robot automatically detects associate

Screen language automatically changes based on worker’s profile
Accuracy as Well as Speed

Large, clear type identifies pick location and SKU

Product photo helps worker identify correct SKU

One tap confirms and dismisses robot
Before rolling away, robot directs worker to next nearest robot.
Intelligent Tote Direction

At induction, robot indicates number of remaining orders and units.

Robot directs worker to induct tote type optimized for work density.
On-screen color-coding directs pick into correct tote compartment.
Actionable Insights
Reports, Recommendations, Best Practices

LocusView

Daily

Monthly

Daily Performance

Robot Map

Pick Map

Loop

FIND YOUR WOW
Reports, Recommendations, Best Practices
Historical pick data mapped to physical locations provides guidance into better inventory storage to further enhance pick optimization.
Real World ... Real Customer Data

Following post-deployment optimization, pick rates > 100% improvement over baseline.

RF baseline of 72 UPH
Scale to Meet Seasonal Demands
Questions?
Thank You!
For more information

Karen Leavitt: karen@locusrobotics.com
Website: www.locusrobotics.com

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