ForwardX Robotics
灵动科技

AMR Fleet Solutions based on 5G Deterministic Network from ForwardX

Introduction

ForwardX Robotics is an industry-leading developer of visual Autonomous Mobile Robots (vAMRs). Founded in 2016, we have raised more than USD$30M over the course of 5 rounds of financing. Investors include China Merchants Capital, CDH Investments, and more.

01 Commercialization

The only commercialized visual AMR company in the world with large-scale cluster scheduling capabilities.

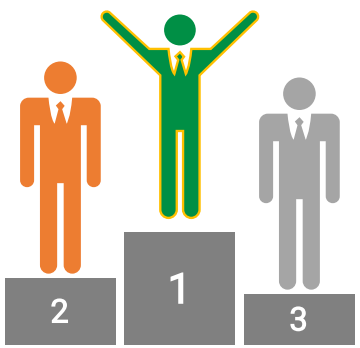
02 R&D Input

300 million+ RMB cumulative R&D investment

200 Patents Pending

99 International Patents

11 U.S. Patents



03 Certifications

ISO9001

EU：CE-MD/CE-EMC/FCC

04 Awards

- The team currently has 260 people, 50% of the R&D employees, 10+ post-doctorate
- Computer algorithms: ACM Multimedia 2013 Best Paper Award, 6 international ACM-GDCPC winners, silver medal in the 20th Computer Olympiad (ICGA), gold medal in the Amazons project of TAAI 2017 International Competition, champion of the National Computer Game Competition, etc.
- Robots: 4 winners in the National Robot Competition (Robocoon), 3 winners in the Freescale Smart Vehicle Competition in the world
- Pedestrian detection: No. 1 in the world for two TRECVID competition detection tasks
- Multi-object tracking: VOT-RT 2018 World No. 1 and IEEE Multi-camera Pedestrian Detection and Tracking Competition PETS World No. 1
- Pedestrian re-identification: Market1501, DukeMTMC-ReID, MSMT17 test set are the best in the industry
- Object detection: Microsoft Image Recognition Challenge (MSRIRC) champion

05 Partners

- 5G DNA Council Member
- Intel's Excellent Partner

Our Honor

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Government Awards

- First prize of the 2nd "Blooming Cup" 5G Application Contest of the Ministry of Industry and Information Technology
- Named to the first batch of “Specialized, Specialized, and New" SMEs in Beijing in 2020
- ZGC Frontier Enterprise
- 2018 ZGC Frontier Technology Innovation Competition-No. 1 in the field of industrial Internet and intelligent equipment
- Guangdong Province's industrial Internet benchmarking demonstration for promoting high-quality economic development
- National High-Tech Enterprise

Media Awards

- Investment Circle：China’s top 50 most investment-worthy enterprises in 2020 (Venture 50)
- 2020 "New Infrastructure" Industry Unicorn TOP100
- 2020 "China Entrepreneur" Magazine-Top 100 Chinese Science and Technology Enterprises
- 36Kr "Top 100 Venture Companies Concerned by Chinese Investors in 2020"
- Science and Technology Daily: Innovative China’s 2018 "UP and Coming Technology Enterprise" Award
- Cyzone 2019 China Top 100 Innovative Growth Enterprises
- Analytics Insight: The 10 Most Disruptive Robotics Companies of 2020

Product Awards

- The 22nd China International Industry Fair in 2020, CIIF Robot Award
- GGII 2020 "China Robot Industry Chain TOP50"
- Awarded "Excellent Technical Equipment Supplier" by China Federation of Logistics and Purchasing

Industry recognition

- In August 2020, became the governing unit of Huawei's 5G Deterministic Network Industry Alliance
- In July 2020, became the partner of Intel® IoT Market Ready Solutions
- 2019 Deloitte Haidian Hi-Tech "Rising Star"
- As the only AMR company in Asia, entered the IDC “2020 Digitally-Enabled Robotics" report
- Named to Jazzyear’s “Top 20 Cool Vendors” list

Intellectual Property Awards

IP Daily 2019 "China's Top 30 Coolest Black Technologies"

Pain Points: Manufacturing

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Pain points

Low Flexibility

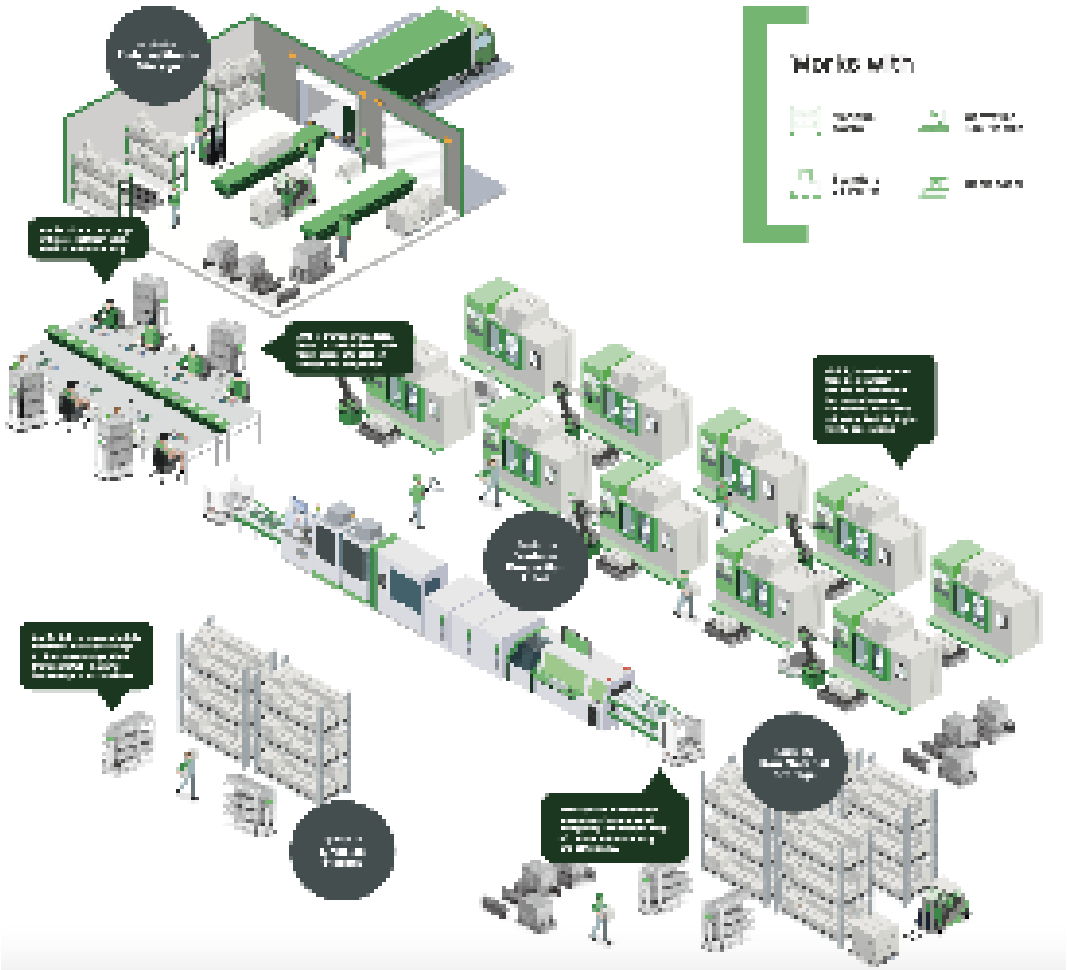
SKUs are increasing and product life cycles are decreasing. This means production lines must change to keep up, but current operations are too rigid.

High Labor Costs

Labor intensity is high, turnover is fast, recruitment and training costs are high. This causes huge labor costs pressures for manufacturers.

Complex environment

Multi-level factory elevators are usually the bottleneck of cross-floor transportation. If the elevator capacity cannot be maximized, operations will not be able to unlock new levels of productivity and efficiency.



The Core Goals of Smart Manufacturing

Automation	Flexible Manufacturing	AI
Digitalization	IoT	Data Mining

Our Solutions: Manufacturing

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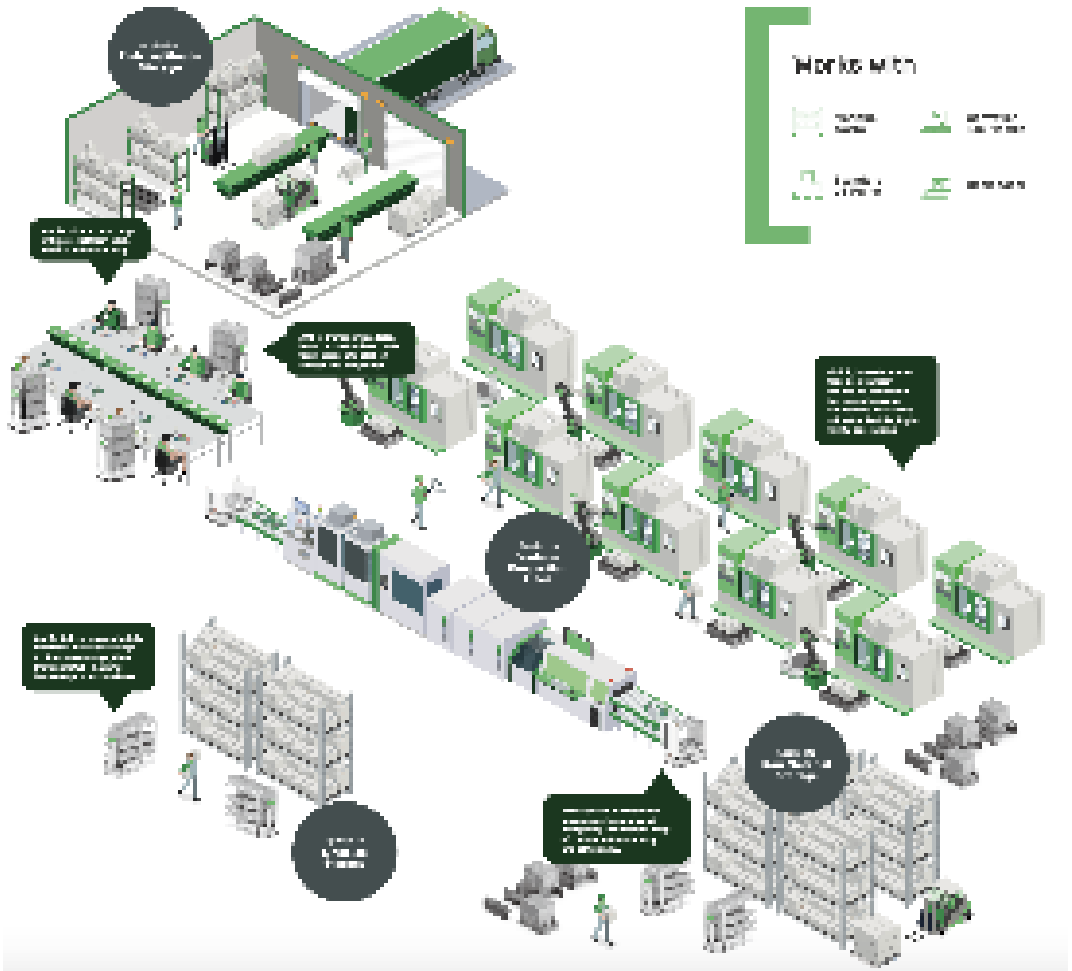
Industries

Electronics 3C | Semiconductor | Automotive Parts | Home Appliance

- Reliability: Increased Uptime Availability to 99.5%
- Flexibility: Increased Changeover Speed
- Efficiency: Reduced Cycle Time
- Savings: Reduced Labor Costs by 50%
- Payback: Guaranteed ROI in 2-3 Years



Advantages of 5G deterministic networks to AMR solutions

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Lower Latency

- The time delay of a Wi-Fi network fluctuates from 10ms to 1500ms, and the response of an AMR in some areas will be significantly slower due to a large number of reconnections, affecting the efficiency of human-machine collaboration.
- Requirements: The time delay network should not exceed 20 ms at any time.

Large-area Network: Reliable Switching

- Each AP of Wi-Fi covers a range of about 20 meters, and in large factories, switching between different APs causes a network break (e.g., in and out of an elevator, or in and out of the workshop, etc.), leading to a large number of disconnections, cause the robot to stop.
- Requirement: The switching delay of each network should not exceed 20ms at any time.

Larger Upload Bandwidth

- Wi-Fi provides more download bandwidth and less upload bandwidth.
- Requirements: AMR needs to continuously upload robot status, updated business data, environmental data, etc., so upload bandwidth has greater demand than download.

Multi-connection

- Wi-Fi has a limited number of simultaneous access points and limited traffic
- Requirements: At least 30 AMR units in the same workshop are running at the same time, requiring simultaneous communication.

Our Platform

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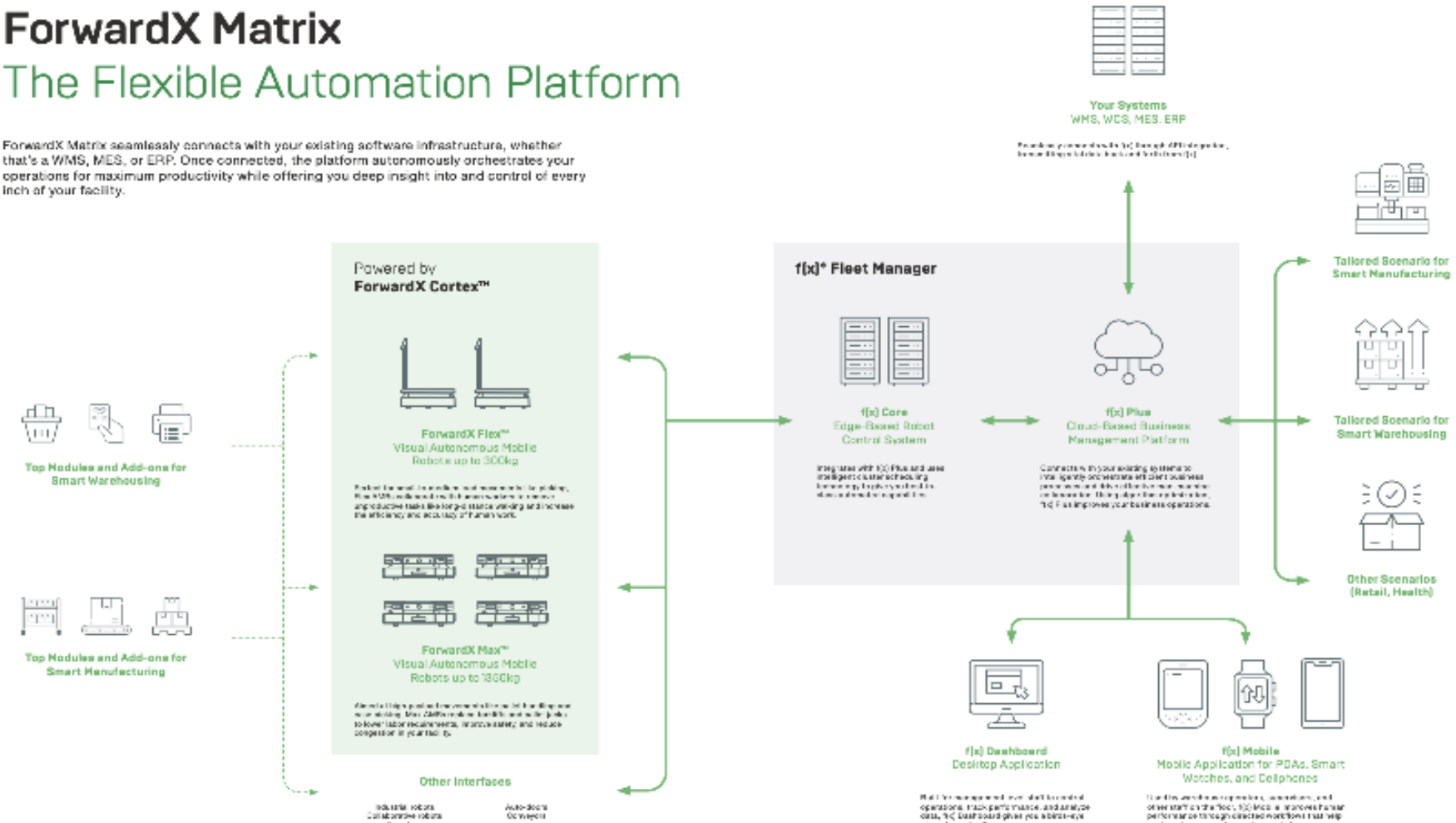
ForwardX Matrix

The Flexible Automation Platform

ForwardX Matrix seamlessly connects with your existing software infrastructure, whether that's a WMS, MES, or ERP. Once connected, the platform autonomously orchestrates your operations for maximum productivity while offering you deep insight into and control of every inch of your facility.



ForwardX Max

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Sensors & Cameras

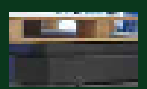
Intel® RealSense™ 3D Camera

vSLAM Camera

RGB Camera for Autonomous Navigation

LiDAR Scanners

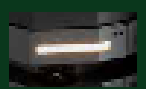
Configurations



Lift Module

Bumper Strip

Emergency Stop Buttons



Turning Indicator

Light Strip

Max **600** Standard

Max **300** Lift

Max **1200** Lift

Cortex Technology

Sense

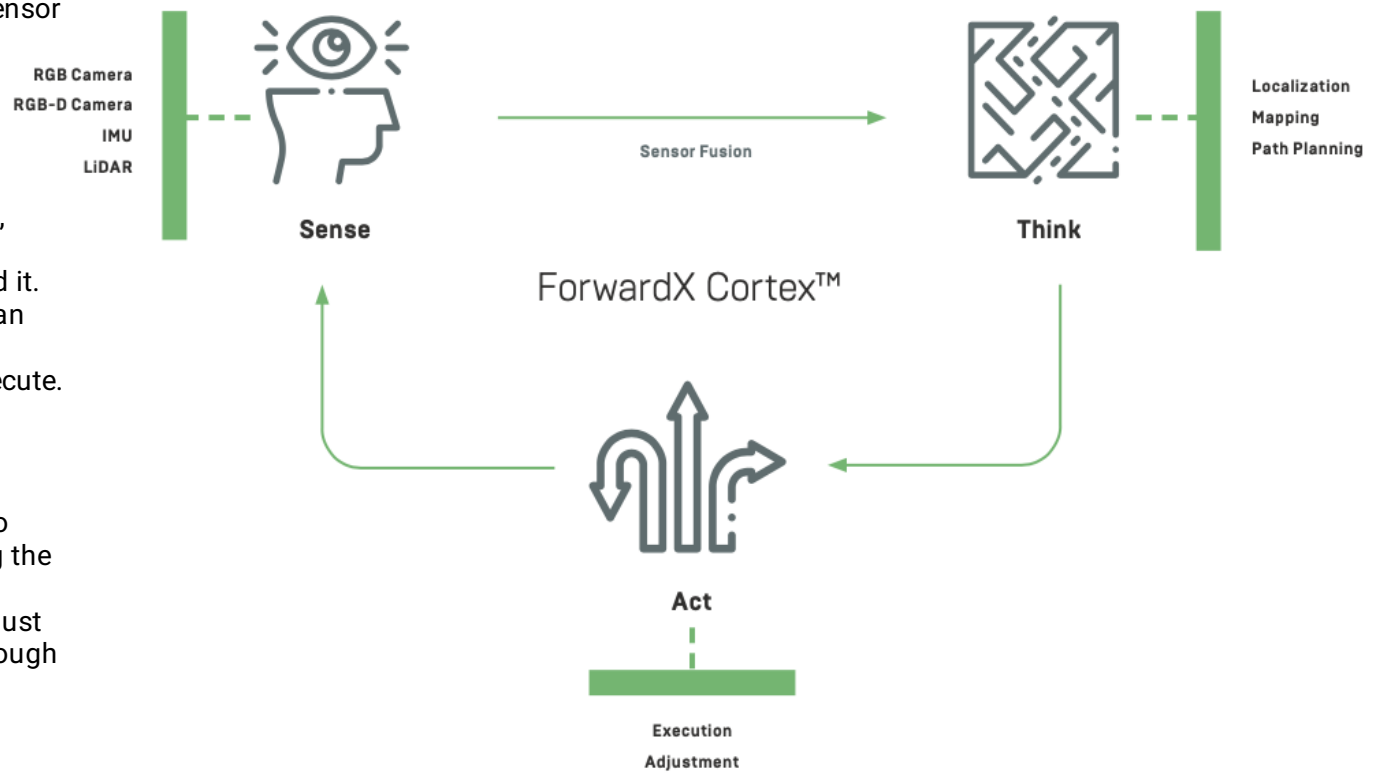
Our AMRs use onboard sensors, from visual sensors like image and depth cameras to LiDAR scanners and IMUs. Combining these varying datasets using proprietary sensor fusion techniques, ForwardX Cortex gathers a deep, multidimensional understanding of its surroundings.

Think

Using sensor fusion to make sense of the environment, Cortex employs visual Simultaneous Localization and Mapping (vSLAM) to truly understand the world around it. Reinforcement learning algorithms are then used to plan optimal paths to complete each task as efficiently as possible. With paths planned, it's time for Cortex to execute.

Act

Once a route is planned, ForwardX robots use Cortex to plan the specific requirements for its movement during the journey. Cortex allows each AMR to execute precise movement its jour execute precise movements and adjust to minor environmental changes for optimal travel through your facility.



Visual AMR

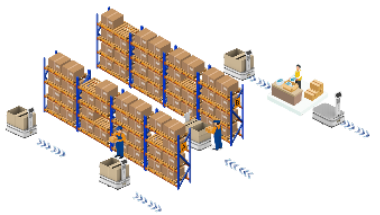
Flexible ability to cover the whole scene end-to-end unmanned transportation

Putaway

Replenishment
(Pallet-racking, floor-level stacking)

Piece & Case Picking
(Floor- level stacking)

Piece & Case Picking
(Multi-level pallet-racking)



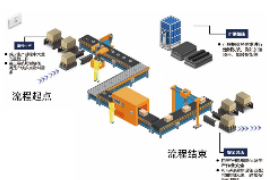
Cage Movement

	AMR	AGV
Warehousing	No infrastructure required. Full process automation can be achieved from putaway and replenishment to picking, packing, sorting, and shipping.	Large-scale changes to environment required. Only covers singular parts of the process, like picking, and cannot achieve flexible automation.

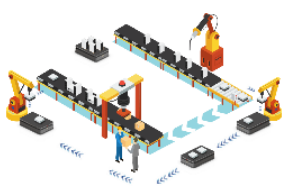
Putaway

Picking

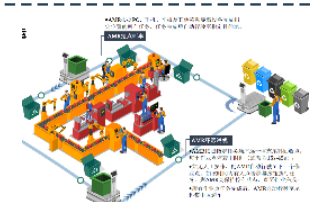
Materials shipping to production line



Transporting between production lines



Tailings Cycling



	AMR	AGV
Manufacturing	No infrastructure required. Full process automation can be achieved from putaway, picking, raw material delivery, WIP movement, finished good storage, and material recycling.	Fixed infrastructure required. Only covers singular parts of the process, like production line movements, and cannot help achieve flexible manufacturing.

Manufacturing Business Case - Global OEM for Apple

Customer Pain Points

Frequent Changeovers
Production lines in the facility change every 6 weeks on average. The company needed a flexible, agile solution that could be deployed quickly

Unpredictable Tempo
Unstable production tempo required a significant buffer stock and reduced space utilization. Instability made production more complex and led to many errors.

Safety Concerns
Poor space utilization led to a crowded shop floor which made human-machine interaction dangerous. They needed a safe solution that offered comprehensive obstacle avoidance.

Outdated Facilities
Elevators are used to move material through multiple production floors. However, the elevators are old, few, and are raised 3cm above the ground. Traditional equipment could not handle elevator navigation.

ForwardX's Solution

Flexibility
AMRs are able to adjust and remap on-the-fly in a dynamic environment. f(x) can be used to instantly make changes to workflows at zero cost.

Autonomy
Material handling workflows are now fully automated, giving the facility truly hands-free material transfer.

Safety
360° obstacle avoidance above 5cm significantly increased human safety during human-machine interaction within the facility.

Durability
AMRs are durable enough to withstand the unlevel path from elevator to production floor. Material can be moved between floors seamlessly.

Connectivity
f(x) interacts with connected devices, like elevators, allowing 4 AMRs to enter an elevator at once. The fleet can operate efficiently across multiple floors without human intervention.

3
Floors of Production

22
Pick-up & Drop-off Points

Max 300
Lift
AMRs Used

Results

Implementing 30 ForwardX AMRs across the facility, the company were able to realize fully autonomous operations within the raw material warehouse, production line, and finished goods warehouse.

By adopting our solution, the company's material handling capacity has increased from 1,700 trips per day to 2,218 trips per day, an increase of 30.4%. Furthermore, autonomous material handling has led to a 51% reduction in annual labor costs and led to ROI in under 2 years.

Logistics Business Case – SF DHL

Customer Pain Points and Needs

Increase Productivity and Reduce Errors
The warehouse used paper-based cart picking methods with manual sorting. Low levels of automation made it impossible to keep up with growing volume. The large warehouse area meant unproductive travel time for workers was long and tedious.
Reduce errors
With many SKUs and a large network of stores, the paper-based method led to frequent errors. A lack of digitalization made error discovery slow resulting in significant financial losses.
Reduce Training and Recruitment Costs
Seasonal peaks meant that many temporary workers were hired annually, resulting in high recruitment costs. Training time was high due to complicated processes for picking, checking, and sorting.
Upgrade
An intensifying competitive landscape, low levels of efficiency, and a high error rate made the need for digitalization more serious.

ForwardX's Solution

Process Simplification
AMRs navigate between pick locations and the sorting area autonomously. f(x) intelligently coordinates workers and AMRs for simplified workflows. Simplification results in higher accuracy and efficiency.
Waste Reduction
With AMRs handling long-distance movements, workers are responsible for a smaller area of the floor and spend more time on productive tasks.
Precision
More data is captured, collected, and analyzed
by management. Process improvements result in increased productivity, lower operating costs, and real-time monitoring of operating flow.
Flexibility
Deployment is quick and requires no modifications to layout or infrastructure. Workflows are adjusted quickly, and the solution is easily modified to meet new circumstances.

Results

- Error rate reduced by 90%;
- Worker efficiency increased by 50%;
- Labor costs reduced by 30%;
- Overall process improvement through directed workflows and real-time data monitoring;
- Increased agility through increased speed to start and seamless transitions between picking and sorting.

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Thank you