Celestica™

The Rise of the Robots

Overcoming robotics scaling challenges in logistics applications

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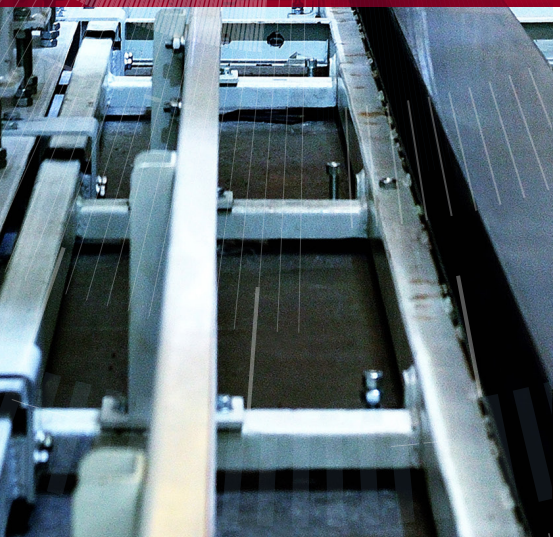


INTRODUCTION

Designing robots is hard.

Building them should not be.

A combination of global economic forces and advancements in technologies such as artificial intelligence (AI), machine learning (ML), and computer vision are fueling the rise of a specialized field of robotics focused on creating solutions tailored for the logistics industry.

Demand among retailers and logistics companies for robots to perform work in their massive warehouses and fulfillment centers has spiked in the last 18 months - a trend industry watchers expect to continue.

For OEMs developing robotics solutions for logistics applications, these technology advances and demands create exciting new opportunities and enormous pressure to move their innovative prototypes into mass production.

Robotics OEMs in the logistics market must ask:

- **How can we grow faster?**
- **How can we maximize our resources?**

Product launch resources are finite and costly. This white paper examines the unique challenges facing robotics OEMs developing solutions for the logistics market, and explains how they can avoid expensive delays by maintaining a focus on innovation and leveraging experts to support production of their innovative solutions.

Why Robots?

The Current State of Employment and Logistics

The coronavirus pandemic has had a profound and permanent impact on manufacturers, retailers and global supply chains. A June 2021 Institute for Supply Management (ISM) survey reveals that although manufacturing output is returning to pre-pandemic levels[1], companies and their suppliers continue to struggle to meet increasing demand levels. The ISM found that record-long lead times, wide-scale shortages of critical basic materials, rising commodities prices, and difficulties transporting products continue to affect all manufacturing segments.

These factors all pose tremendous challenges for retailers who experienced surges in their e-commerce sales volumes over the last year and expect that demand to increase in 2021 and beyond.

Handling ever-growing shipment volumes is just one challenge for retail logistics professionals. E-commerce operations typically require workers to perform tasks like individual picking, packing, and shipping per item much more frequently than what the bulk transportation models of traditional brick and mortar retail require.

In 2020, UPS, FedEx and DHL hired more than

200,000

new employees

in North America

Amazon added

427,300

employees in 10 months

Despite hiring sprees, logistics companies still face

labor shortages

Even as these companies continue to hire additional workers, they're also investing heavily in robotics and automation technologies.

Robotics can be applied to a wide variety of areas within a logistics operation. Examples include: Transportation of Goods, Goods-to-Operation Picking, Goods-to-Robot Picking, Non-conveyable Transportation, Robotic Item Picking, Robotic Put Walls and Robotic Sorting.

For example, autonomous mobile robots (AMRs) leverage cutting edge technologies including AI, ML, and computer vision to navigate without requiring additional infrastructure or human operators. They collect and analyze millions of data points in real-time to "learn" how to perform specific tasks more efficiently.

Not only do these robots complement the jobs human employees perform, they also significantly reduce the risk of injury. Many of the tasks in logistics applications are dull, dirty and dangerous. They are physically demanding jobs that require constant repetitive motion as well as potentially lifting heavy equipment. Robots won't get tired or hurt while performing these tasks day after day, hour after hour. They free their human counterparts to focus on tasks that require critical thinking and problem-solving skills.

An automated warehouse is broken down into several sub-areas.

Receiving Operations - In these areas, items are physically brought into the facility, identified and routed based on the current need for the product as determined by the Warehouse Management System (WMS).

Storage/Retrieval - These are systems that products are stored in and pulled from by warehousing operations. These systems range from fully manual to fully automatic, but all systems integrate into the WMS.

Fulfillment Operations - In these areas items are broken down from pallet, to case to item level. The items are placed into storage for removal by picking operations.

Shipping Operations - In these areas, products are packed out into boxes, transported to common areas where they are loaded into trucks for delivery.

Research and Markets predicts the warehouse automation market will reach:

$30 Billion

(USD) by 2026 - 14% CAGR

due to growth in the e-commerce industry and the globalization of supply chain networks[2].

However, as the global e-commerce industry continues to grow, logistics professionals are discovering that they cannot repurpose industrial robots to work in their enormous warehouses and fulfillment centers.

Custom-built,
Not Repurposed

General purpose industrial robots have historically dominated the robotics industry in terms of the number of units installed. They have proven to be extremely useful and capable in reliably and consistently performing manufacturing tasks such as welding, picking/placing and palletizing.

But logistics companies are increasingly deploying a mixture of general purpose industrial robotic solutions and alternate physical form factors better suited for the end application. They need solutions designed to navigate facilities that cover millions of square feet to locate, select, and transport specific products from shelves and pallets to the shipping operation.

And one robot cannot handle all of that work alone. One facility requires fleets of robots that work together to perform their tasks as quickly and efficiently as possible, 24 hours a day, 7 days a week, and all year long.

By 2025, over

4,000,000 commercial robots

will be installed in over

50,000 warehouses

up from just under **4,000** robotic warehouses in 2018[3]

Bridging the Gap

Between Prototype and Mass Production

"There are unique challenges with integrating advanced technologies with industrial robotics. Engineers must account for many factors such as payload, reach, tooling design, cabling management and much more," says Matthew Wicks, Director of Robotics at Celestica. "When designing a robotic solution from ground-up, engineers must account for many more factors such as complex kinematics, motion control, software integration, machine safety, full system reliability, lifecycle performance and testing."

Logistics is a relatively new field in the robotics industry. It is dominated by nimble OEMs in their early stages of growth, as opposed to other more mature fields, such as industrial manufacturing, served by well-established multinational companies that have spent decades building their global manufacturing operations and supply chains. Innovation is the core competency of these early-stage OEMs. Their priorities are designing and demonstrating their latest prototypes to attract new investors and customers.

Robotics OEMs must balance the technical solve with the design decisions required to scale.

Embrace

A Design for Manufacturability Mindset

Whether developing robotics solutions for logistics, healthcare, or any other industry, all robotics OEMs face mechatronic design challenges. Space constraints, weight, power, controls, user interface, vision systems, software - all present unique challenges and are highly dependent on how the end-user will deploy the robot.

Additional challenges associated with documentation, change management, supplier/supply chain management, testing/validation, quality assurance, manufacturing and assembly present a myriad of issues to OEMs.

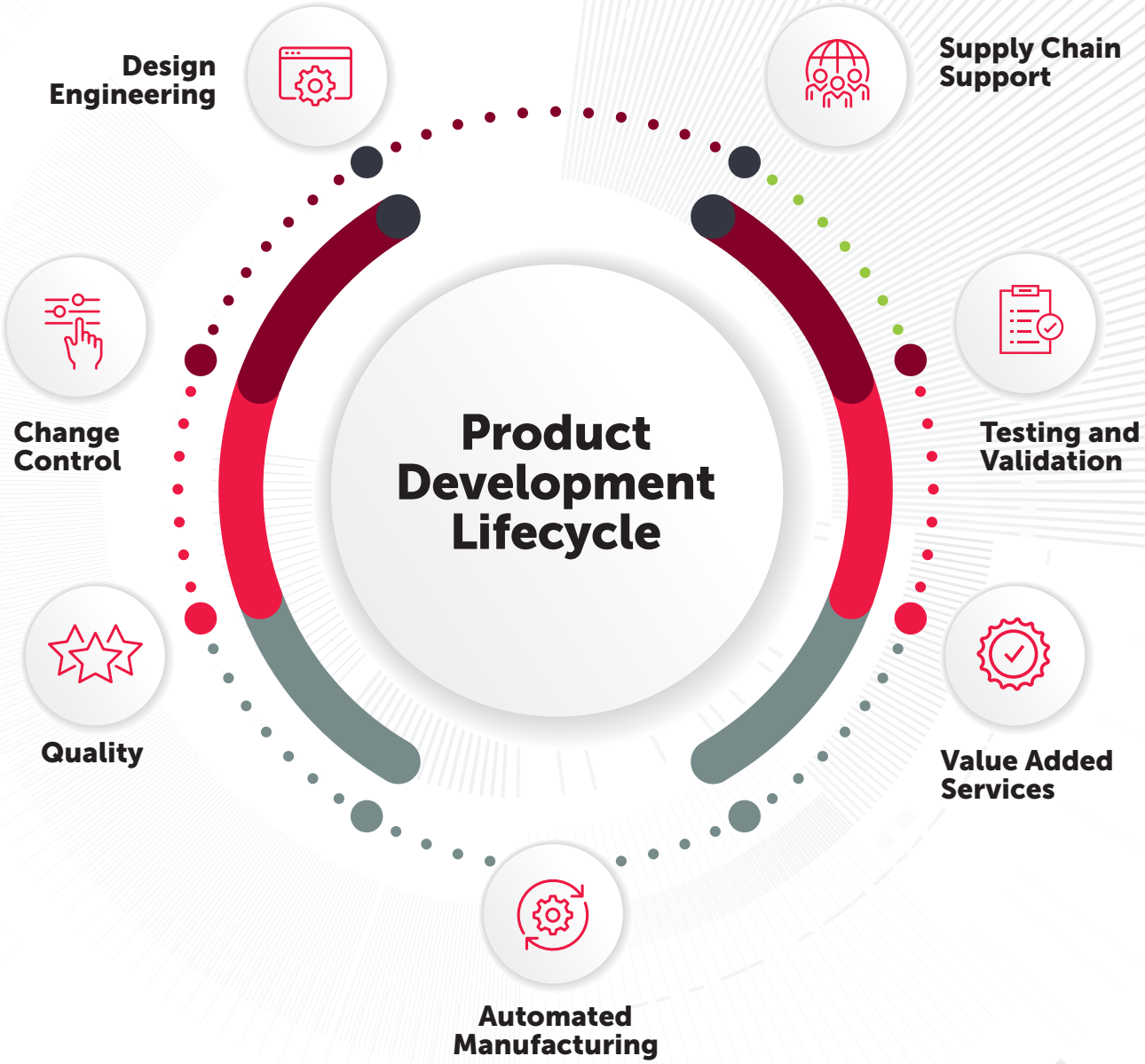
While designing robots is difficult, building them should not be. But the hurdles that OEMs must overcome when trying to scale production can be quite daunting. Tapping a qualified manufacturing partner to assume these responsibilities, including managing engineering staffing, equipment, quality processes, testing and validations, and navigating any regulatory review and approval documentation processes, enables the development teams to remain focused on their core competency: **innovation.**

"The difficulty and value of manufacturing is underappreciated."

- Elon Musk

Celestica Robotics Center of Excellence:
A Single Source Solution

Celestica partners with OEMs to drive tremendous value across the product development lifecycle, optimizing the design process and easing the transition from design to commercialization and volume production.



It is critical to involve your manufacturing partner early in the design process.

They serve as an extension of your robotics engineering team to speed the entire product development lifecycle—from design to scale to delivery.

Design Engineering

Expertise in manufacturing robotic solutions can extend well into the core design phase of a robotics program. Decisions made and components selected can have a massive impact on the manufacturability of the robotic solution and the core design. Engineering decisions and direction that take into account manufacturability can have a positive impact on the design and functionality of the products.

Supply Chain Support

Robotics systems are made up of a wide variety of very complex components, including better management systems, precision mechanisms, optical systems, power management systems, customized power and compute hardware. A good partner will have a strong bench of supply partners who can be leveraged to optimize many different aspects of the robotic solution. They will also take into account cost, quality, compliance, obsolescence, and mass production when selecting parts.

Change Control

Having a manufacturing partner who can work hand in hand with your design engineering teams can be a lifesaver in any robotics program. Updating bill of materials (BOMs), handling revision controls, sourcing alternate suppliers, providing feedback to the cost/schedule impact are all requirements to any change management program and a good partner will be there every step along the way.

Testing and Validation

Designing the robot is only part of the equation. Extensive component and system lifecycle testing services add the confidence and reliability assurances needed for full scale production.

Quality

Assembly and testing of the robotics system is a big component of the manufacturing process, but identifying the processes required along with the testing/validations of these processes add considerable value to the overall manufacturing operations. These processes and tests must be engineered and thought through to ensure a high quality end product.

Value Added Services

The robotics system goes beyond just putting the hardware together. Oftentimes specific configurations and/or procedures must be completed to ensure the solution is functional and operational as sold/designed. Software configurations, calibrations and other specific processes are all areas to leverage your manufacturing partner.

Automated Manufacturing

Depending on the volumes of the robotic solution, automating some or all of the manufacturing process may be appropriate. Evaluating the current and future production requirements and planning for growth is another area where an experienced partner can leverage expertise and experience that adds real value to your solution and bottom line.

CONCLUSION

Aligning product development, design engineering, manufacturing and supply chain

The pressure is high to strike that elusive balance between innovation and accelerating product development and delivery timelines. It is virtually impossible for an OEM to do both.

The Celestica Robotics Center of Excellence (COE) delivers industry-leading engineering, manufacturing, and product lifecycle support services to enable customers' in-house teams to focus on growth through innovation.

The COE brings talented, experienced design, engineering, manufacturing and automation teams to provide expert insights and experiences - helping robotics companies move their innovative new solutions into full-scale production and distribution.

"Innovative companies don't need manufacturing suppliers, they need manufacturing partners who serve as an extension of the development engineering team. One that applies the same engineering discipline to the manufacturing processes that governed the design and development of the first prototype. It's one thing to design a prototype, and quite another to design for assembly in order to be able to build and deliver thousands of units on a short timeline."

- Matthew Wicks
Director of Robotics at Celestica

To learn more, visit: www.celestica.com/robotics

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