OMRON

Leveraging flexible manufacturing to manage complexity in the automotive industry

Trends, challenges and strategies

White paper | August 2019

automation.omron.com

Introduction

Just as engineers must streamline vehicles to promote better gas mileage, manufacturers must streamline their operations to deal with the challenges of an increasingly complex industry. Whether they're seeking to customize products by geographical location, increase the output of custom vehicles or address the changing demands of highly specific market segments, automakers are tackling the challenge by making their operations more flexible.

The ultimate goal of flexibility is to increase throughput and lower the time-to-market, all while responding as quickly as possible to variations in demand. Although there are costs involved in flexibility – both in terms of the equipment itself and the slightly reduced throughput due to constant product changeover – these costs are outweighed by the potential expense of producing vehicles that don't sell or letting an entire line be idle once its dedicated product isn't in demand anymore.

This white paper will discuss several flexible manufacturing trends in the automotive industry today as well as strategies for overcoming typical challenges associated with implementing flexibility. Topics include:

- Minimizing system changeover
- Continually improving the visibility into the manufacturing process
- Meeting demands for customization and in-car technologies
- Building multiple vehicles in one facility
- Implementing traceability to deal with vehicle complexity
- Investing in a highly skilled workforce and advanced technology

OMRON

Contents

Minimizing equipment changeover on flexible production lines

Automakers have discovered that today's consumers appreciate customization, so they've sought to make their factories more capable of producing vehicles in a way that reduces waste and keeps throughput as high as possible. The goal is to increase the volume of customized products from existing manufacturing processes or design new ones to meet demand.

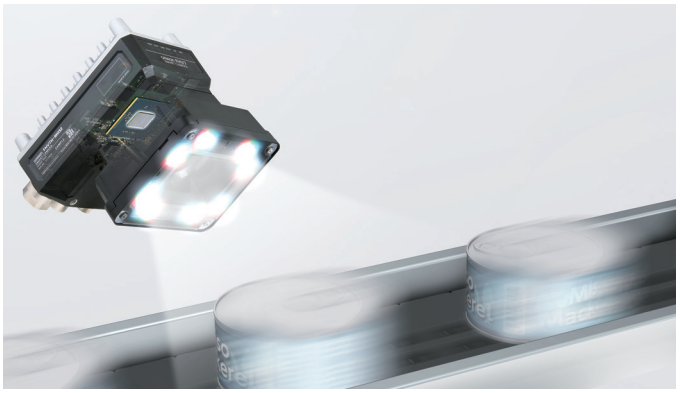
Minimizing production line changeover is a basic necessity for a flexible manufacturing system. Wherever possible, manufacturers seek to utilize existing equipment so that they can quickly adapt to changes, rather than fully reinvesting in capital equipment every time something new comes about. This isn't just a matter of doing more with less – it's a required strategy for minimizing downtime and keeping throughput as high as possible. Since automobiles are such valuable products, the time that a line isn't actively producing vehicles is extremely expensive. Quick changeovers, therefore, are crucial.

One of the most effective solutions for minimizing manual changes is the use of robotics. Robots are very easy to re-task, and a certain category of robots – collaborative robots – are designed to work seamlessly with human operators. Whether collaborative or not, robots of all types can work wonders especially when paired with vision. Since machine vision smart cameras can locate the correct parts using pattern recognition, the system can simply send changeover data electronically to jump-start the production of a new vehicle.

Omron offers several first-rate vision systems, including the compact yet powerful MicroHAWK smart cameras that can be easily mounted on a robotic arm. Built on the highest-performance imaging engine in its class, MicroHAWKs come fully-integrated with optics, processor, lighting, and communications. They can be used with either AutoVISION software for barcode reading and basic machine vision tasks (including location, counting, presence/absence detection, OCR and more) or with Visionscape for more advanced applications.

Minimizing production line changeover is a basic necessity for a flexible manufacturing system.

Omron MicroHAWK with weblink software for precision traceability and inspection solutions.



FHV7 Smart Camera with up to 12MP Resolution Image Sensor.

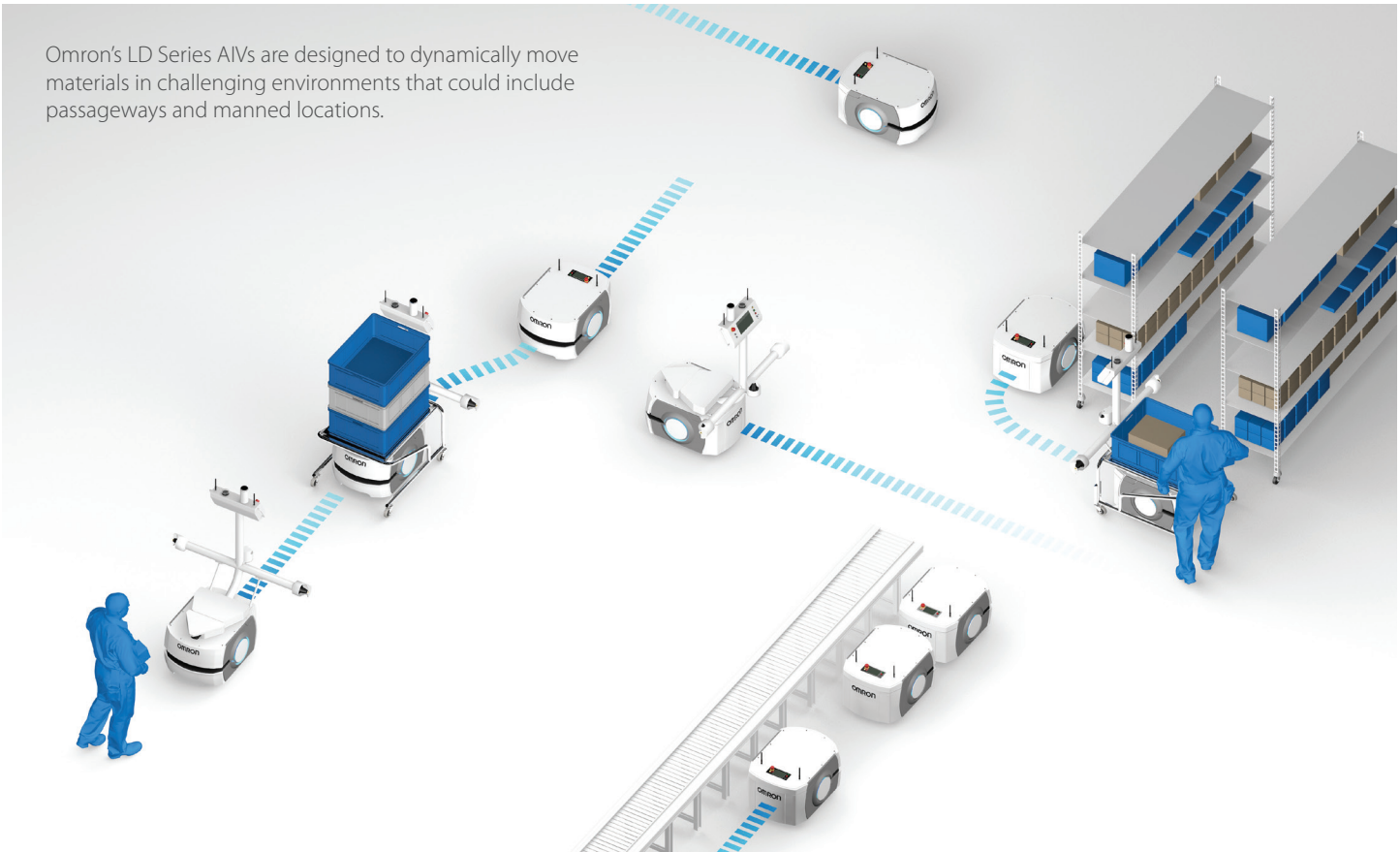
Building multiple vehicles in a single facility

If demand is high enough for a certain type of vehicle, then it's possible to dedicate an entire plant to that vehicle without incurring unnecessary costs. For low-volume vehicles, however, it's much more economical to build them all in a single facility. This makes it critical to use floor and aisle space as intelligently as possible.

Floor and aisle space can be used most effectively with a modular approach, whereby different stages of production can be connected in a variety of ways depending on which vehicles are being produced at the moment. This, however, creates another challenge, since the conventional method of connecting different parts of a production line with conveyors doesn't adapt well to flexibility. Conveyors are difficult to move due to their weight and their fixed lengths. In addition, having unpredictable configurations means that a conveyor could very likely end up blocking a hallway.

Omron has a unique solution to this problem in the form of its mobile robots. The LD Series is a family of self-navigating Autonomous Intelligent Vehicles (AIVs) that are designed to dynamically move materials in challenging environments that could include passageways and manned locations. When modules can be connected at an advanced level to act like one line using mobile robots, more flexible and productive operations can fit into a much smaller space.

Unlike traditional automated guided vehicles (AGVs), the LD mobile robots don't require any facility modifications like floor magnets or navigational beacons, so deployment is cost-effective and simple. The robots use Omron's proprietary software and controls to intelligently navigate around people and unplanned obstacles, and they can be programmed and functional within a day.



Omron's LD Series AIVs are designed to dynamically move materials in challenging environments that could include passageways and manned locations.

Dealing with the complexity of today's vehicles

Today's automobiles aren't just designed to help people get from Point A to Point B. They're also meant to satisfy the driver's need for comfort, connectivity and entertainment. In essence, driving has become more about the experience in the vehicle than simply a mode of transportation.

This shift in demand has caused vehicles to gain complexity with increasing amounts of in-car technologies. Advanced infotainment and navigation, wi-fi and heated seats are becoming the default rather than a luxury. With so many internal variations, a single car platform could have dozens – or even hundreds – of different versions. How can manufacturers ensure that the correct parts get incorporated into each version of a vehicle? One of the most important strategies for this purpose is to build a fully automated, real-time traceability system.

Traceability is the practice of marking individual parts with machine-readable codes to automatically track their progress throughout production. In addition to providing easy look-up for individual parts, traceability makes it much easier to follow production "recipes" and ensure, for example, that the correct seats get paired with the correct version of a specific luxury vehicle. When mismatches are discovered, the system will sound an alarm to alert operators of the mistake.

Due to the complexity of today's vehicles, it's possible that as many as 20,000 different parts will need to be marked for a single vehicle. Omron's MX-Z fiber laser markers provide a fast, reliable and durable way to apply direct part marks (DPMs) to products so that they will bear identifiers as long as the part is in service. The MX-Z series offers great marking flexibility thanks to its advanced connectivity and ability to integrate easily with other systems and controls. Easy integration is a major advantage when so many different parts need to be marked for every new vehicle.

To read the markings, barcode reading equipment must be installed in a variety of locations throughout the production line. Since the factory floor typically has harsh conditions, including high heat, dust, grease and corrosive chemicals, it's important to choose barcode readers that can withstand this environment. Omron's HS-360X handheld barcode reader has been ruggedized to ensure a high level of tolerance to industrial fluids and vibrations.

Investing in a skilled workforce and advanced technology

The combination of more complex vehicles and the need for advanced tooling for flexible stations requires a more skilled workforce. Flexible manufacturing requires the presence of employees with advanced skills in networking and IT so that they can set up machines to intelligently share information.

It can be difficult to find employees to fill these challenging roles. Fortunately, Omron is committed to making its technologies as accessible to as many customers as possible. The NJ-SQL programmable logic controller (PLC) has client software for SQL databases so that the average programmer can easily understand the software and reconfigure the database, as is often necessary for flexible production lines. The NJ-SQL also plays an important role in enhancing traceability by allowing low-level machines to communicate work-in-progress location and status information to higher-level computers.

Another technology that helps overcome a lack of skilled workers is the collaborative robot.

Collaborative robots are designed to work safely with human operators, so they can be taught new tasks in an intuitive, hand-guided manner. Omron's TM Series Collaborative Robot features a very simple teaching mechanism by which operators can simply move the arm to one position, press a button, move the arm somewhere else, press a button, and so on until the task has been fully replicated.

Flexible manufacturing requires the presence of employees with advanced skills in networking and IT so that they can set up machines to intelligently share information.

Omron's TM series robots help companies produce a high mix and low volume of products, as well as harness the true potential of human resources.

Omron's NJ101 SQL Client CPUs are designed to address basic industrial controller applications in a wide variety of industries including: automotive, semiconductor, infrastructure, and food and beverage packaging.

Summary

Flexibility is a strategy that helps maximize throughput and uptime while ensuring that production lines can adapt quickly to changing customer demands. In the automotive industry, downtime is extremely expensive, and it's crucial to minimize the amount of time and effort necessary to change over from one particular vehicle to another.

The right strategies and technologies can help ensure that the astronomical cost of downtime is kept to a minimum. These include investments in robust, real-time traceability systems comprised of marking equipment and ruggedized barcode readers as well as robotic innovations such as vision-guided robots, collaborative robots and mobile robots. Although a flexible manufacturing system takes detailed planning and up-front investment of advanced equipment, the improvement in throughput and reduction in downtime provided by an intelligently designed system will greatly outweigh the initial cost.

In addition to providing highly user-friendly technologies, Omron offers a wide variety of educational services to help manufacturers ensure that their team gains the skills necessary to succeed in a more flexible and automated environment. From basic application skill builder sessions to the prestigious TÜV Functional Safety Certification, Omron's training programs are designed to meet every need at the convenience of the customer.

OMRON

Omron Automation | 800.556.6766 | automation.omron.com

U77I-E-01a

Sensing | Control | Safety | Vision | Motion | Robotics