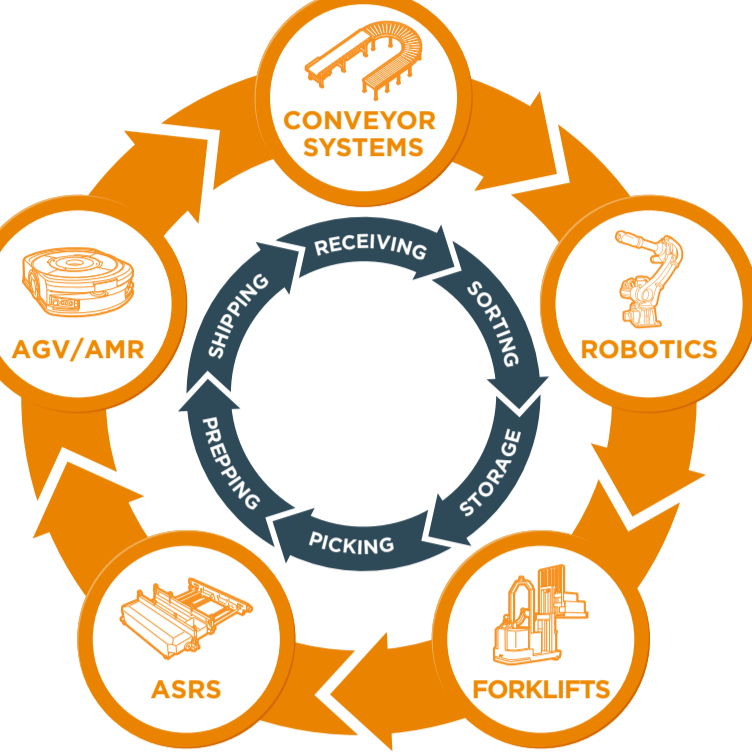


# ANATOMY OF A SMART WAREHOUSE

The daily life of an automated warehouse is built on routine and process. Goods are received at the warehouse, sorted, stored, picked and placed, prepped for shipping, and sent out 24/7/365. In a well-run warehouse, these events happen smoothly and efficiently through an interconnected set of conveyors, robotics, forklifts, automated storage and retrieval systems (ASRS), automated guided vehicles (AGVs), and autonomous mobile robots (AMRs) all moving in a coordinated dance.



This equipment makes warehouse automation possible; they are the “bodies” that move the goods from point A to point B. And just like human bodies that rely on a nervous system and cardiovascular system, the machines in an automated warehouse rely on a series of smart systems to power and guide their actions. The connectors, sensors, contactors, and relays are the nerves, muscles, and connective tissue that help make the system run.

**The four areas below are especially critical for the equipment in an automated warehouse to function successfully.**

## BATTERY MANAGEMENT SYSTEM (BMS)

### What it is:

A system that uses integrated firmware and hardware to manage lithium-ion battery packs within a piece of equipment.

### Where to find it:



### Critical for:

- ✔ Efficient battery usage
- ✔ Opportunistic charging
- ✔ Reduced downtime
- ✔ Preventive maintenance
- ✔ Condition monitoring
- ✔ Cell balancing
- ✔ Charging status

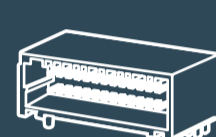
### Key challenges:

- ➔ Reduce battery failure, increase equipment uptime
- ➔ Increase charging power levels to decrease charging time
- ➔ Reduce size
- ➔ Reduce energy loss and heat dissipation with electrical components with resistances

### Trend to watch:

- ➔ BMS working in tandem with autonomous charging connectors that also have power connector capabilities

### Related TE Connectivity components:



Dynamic D-1100 Series



BCON+ integrated cell connection system



Kilovac DC contactor



Power PCB relay

## CHARGING STATION

### What it is:

Location where equipment is recharged. At a manual charging station, a human operator uses a cable to connect the vehicle battery to a wall-mounted or box-style device to charge. In the case of autonomous charging, the AGV, AMR, or ASRS shuttle docks itself to the charging unit.

### Where to find it:



### Critical for:

- ✔ Efficient battery usage
- ✔ Opportunistic charging
- ✔ Reduced downtime
- ✔ Fast charging

### Key challenges:

- ➔ In autonomous charging, connectors must allow for significant mechanical alignment tolerances due to the limited position accuracy of the equipment attempting to charge itself.
- ➔ To allow for safe charging (current ramping), communication is required to set up the charger to fit battery specs.
- ➔ Increasing charging power requirement due to opportunistic charging
- ➔ Increasing number of charging periods (mating cycles for connectivity) due to opportunistic charging

### Trend to watch:

- ➔ Contactless charging (especially in lower charging power applications), and robotic charging where the charging connectors are plugged and unplugged by a robotic arm

### Related TE Connectivity components:



ENTRELEC DIN rail terminal blocks



Dynamic Series power distribution connectors



DBL power distribution blocks



Multi-function inlet filters

## MOTOR AND DRIVE

### What it is:

A combination of several distinct parts that enable a vehicle to move, steer, and stop as needed. There are three types of motors: asynchronous AC motors, permanent magnet synchronous motors (PMSM or servo motors), and DC motors.

### Where to find it:



### Critical for:

- ✔ Vehicle power
- ✔ Vehicle control
- ✔ Safety
- ✔ Protecting against system overload

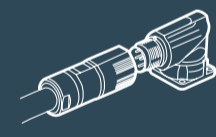
### Key challenges:

- ➔ High power density requirements, reliability in an extreme environment, maintaining efficient energy use, and handling complex connectivity and feedback demands

### Trends to watch:

- ➔ Motor feedback systems with improved accuracy
- ➔ Hybrid connectivity for position and signal in one connector and one cable

### Related TE Connectivity components:



INTERCONTEC industrial servo motor connectors



Braking resistors aluminum-housed sealed power resistors



AMPMODU modular signal interconnects



Ring terminals servo motor feedback

## CONTROLS, SENSORS, AND VEHICLE WIRING

### What it is:

A mix of automotive components, industrial automation components (such as photoelectric sensors), and dedicated equipment that allows vehicles to be controlled.

### Where to find it:



### Critical for:

- ✔ Safety
- ✔ Vehicle control

### Key challenge:

- ➔ Components must retain accuracy and precision through high-shock and high-vibration conditions

### Trend to watch:

- ➔ Increasing need for data rates by cameras, which will accelerate the demand for high-speed Ethernet-based connectivity across all applications in the warehouse

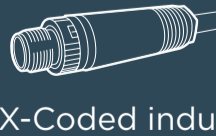
### Related TE Connectivity components:



Micro-MaTch flat cable connectors



Circular Plastic Connectors (CPC) rugged plastic connectors



M12 X-Coded industrial-sealed Ethernet



Battery disconnect switch

## CONNECT WITH US

TE Connectivity makes it easier to take your warehouse automation goals to the next level. Visit [te.com/support](https://te.com/support) to chat with a Product Information Specialist and find the expert support you need.