

# How To Automate Packaging:

A Guide To Robotics & Automation For Efficient, High-Quality End-Of-Line Packaging



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# Introduction

**P**ackaging finished parts and products is usually a labor- and space-intensive part of any production line: final inspection, setting up cartons, filling and sealing packs, transferring cartons to a pallet or other area for shipping, etc. Supplies, workstations, and traffic flow all take up valuable floor space that could be better utilized.

Then there are risks to employees from sharp tape cutters, hot glue guns, repetitive motion injuries, lifting and reaching, and fatigue. This leads to job dissatisfaction at best, errors and injuries at worst. It's no wonder companies have a hard time filling positions and retaining workers in these roles.

For these reasons, packaging operations are one of the first areas employers look to when considering automation and robotics. But what are the options and the advantages? What is involved in the transition, and where do you even start? This guide has all the details you need to know to get started with end-of-line packaging automation.

## What is End-of-Line Packaging Automation?

As in manufacturing and other industrial settings, automated end-of-line packaging usually involves employing robots and other programmable equipment to accomplish tasks traditionally done by humans.

### Common Packaging Tasks

It's helpful to break the process down into its component tasks or steps in order to determine how automation can be incorporated. Common tasks in packaging include:

- > Sorting
- > Stacking
- > Wrapping (e.g., banding)
- > Palletizing
- > Positioning Products
- > Coiling/spooling/winding



- > Inserting items in boxes/bags
- > Filling containers with loose product
- > Folding/assembling cartons
- > Gluing
- > Taping/sealing
- > Inspecting for product placement/orientation
- > Quality control/inspection
- > Kitting/subscription box assembly
- > Labeling/direct printing on packages
- > Monitoring data

## Types of Equipment Used for Automated Packaging Tasks

While robots are usually top of mind in terms of automation, many [additional pieces of equipment](#) are often employed to enhance robot capabilities and to create a functional system, including:

- > End-of-arm tools for grasping, vacuum cups, specific tools
- > Vision cameras
- > Sensors (e.g., motion, weight, temperature, force/torque)
- > Conveyors
- > Gantries

- > Roller tables
- > Chutes
- > Autonomous mobile carts
- > Carousels/rotating platforms

## Robots and Automation Take Packaging to the Next Level

Automation technology is constantly evolving to expand what a robot can do, as well as the precision and dexterity it has for complex tasks. Ancillary equipment and software add another level of functionality too.

### Robot Motion

Today's industrial robots are nimble and able to easily reach over, under, around, inside, and through obstacles thanks to these critical features:

- > Variety of available payloads (i.e., weight-carrying limits)
- > Reach capacities (i.e., the distance it spans)
- > Multiple axes of motion (i.e., the ability of a "joint" to rotate around a directional line)



## Control Software

Robots are programmed to repeat the same motions with precision and accuracy. However, unlike past generations of robots that were designed and built for a single task, modern robots are much more flexible. They can be reprogrammed readily and have the ability to store and recall multiple programs for quick changeover, for example, for switching box sizes or gluing patterns.

## Data Tracking and Management

Most robots can be used with data collection and management software to track things like:

- > Product traceability data (e.g., manufacturing dates, “use by” or “freshness” dates, lot or batch numbers, plant numbers)
- > Productivity data and KPIs (e.g., cartons erected or filled per hour, number of damaged items rejected, conveyor/line speed)
- > Consumable and supply usage (e.g., amounts of tape or glue dispensed, glue temperatures and reservoir volumes)

## Sensors and Cameras

One of the most important uses for sensors and cameras is ensuring worker safety. They can detect the presence of a person (or even just a limb or hand) and stop or slow down moving equipment to avoid collision or injury.

Sensors and cameras are also used for end-of-line inspection and sorting by comparing an item with stored “reference” images of what it should look like. This capability can also be used to verify correct placement of items in a package or kit. Some cameras can even help robots orient their grippers to pick up objects presented in random positions, such as small parts scattered on a tray and bin picking.

## Gripper Design

End-of-arm tooling and grippers expand robots’ repertoire of tasks. Examples include hand-like “fingers” with sensor-driven dexterity, calipers, vacuum cups, as well as tools like blades or tape dispensers. The latest generations can handle even delicate materials and products without damage.



## Automated Packaging Adds Value and Efficiency

Many industries and product types benefit from automating some or all packaging processes. First, more product is prepared for shipping. And second, because robots move with great precision and repeatability, they meet strict packaging requirements that minimize damage or tampering in transport. All of these can benefit from automated packaging:

- > Food and beverage
- > Pharmaceuticals and supplements
- > Health and beauty
- > Automotive and vehicle parts
- > Home, office, garden products
- > Consumer electronics/computers
- > Appliances
- > General manufacturing
- > Co-packing and third party logistics

## Streamlining Operations and Protecting Quality

The factors below add up to improved workflow and packaging quality, as well as the potential for higher profit margins:

### Uniformity

Robots repeat the same motions identically in each cycle, which means they produce results with minimal variability, from erecting cartons to filling bags to stacking cases.

### Continuity

Robots and other automated equipment are programmed to move in concert, which practically eliminates idle time and keeps throughput high. And in contrast to humans, they do not require breaks or time off.

### Waste Reduction

Because they are programmed to perform precise movements, integrated packaging equipment can cut materials to exact measurements, dispense specified amounts of adhesives, and avoid damaging packing materials and products. This standardization cuts down on any extra consumables a human worker might use in the same tasks.

### Ramped up Production

Sometimes robots move faster than people do, sometimes they do not. But in either case, because a robot is moving continuously, productivity is higher overall.

### Traceability

Onboard software can track lot or batch numbers, manufacturing dates, and “use by” or “freshness” dates on products as they are packed, which makes it easier to keep records of what is produced and shipped, when, and where.

### Quality and Appearance of Packaging

Precision movements make for consistent and uniform application of tape, labels, and glue. The result is more secure packaging that protects contents as well as better overall appearance, both of which are important to consumers.

### Efficient Inspection

It's often possible to [integrate end-of-line inspection](#) or other final processing with packaging so that products progress from the production area directly into



packaging. Cameras and sensors can also identify items that don't pass inspection and trigger an arm, pusher, or air jet/blow-off system to eject them from the packaging line without stopping.

## Robotics and Automation Impact the Workforce and Employees

Even though multiple steps are involved in packaging and large amounts of data are being tracked, most packaging work is low or unskilled. You may have wondered if employees performing packaging tasks might be more valuable to your workforce in other areas of production. Or, you may be having trouble filling these jobs at all.

As it does with other applications, automation and robotics can make many jobs more interesting and challenging, less physically demanding, and provide opportunities for new skills or training. And don't underestimate the "wow factor" of working with high-tech equipment.



Instead of filling and sealing boxes, for example, workers can oversee a bank of robots, troubleshoot issues, monitor and analyze data and KPIs, or even be redeployed to tasks in other areas of production that require more skill and experience.

Especially in times when jobs go unfilled, automation can fill the gaps so workers can be reassigned to jobs that are harder to automate. Examples may include order picking, packing custom kits, wrapping fragile items, or working with very small items. Automation and robotics allow employers to make the most of the employees they already have.

# Pairing Automation Equipment and Packaging Materials

Any time machines handle packing materials and products, compatibility with equipment is a concern, such as:

- > How complex are boxes and cartons to construct? (e.g., full flap, half flap, corrugated or paperboard)
- > Is tape suitable for higher speed application? (e.g., paper or plastic, cutting methods)
- > Are glue and dispensers flexible for rapid application or changing types of packing material (e.g., cardboard or plastic, temperature, line speed, dot or line patterns)
- > If you package products for multiple sellers, is there a system to avoid intermingling cartons and labels?
- > Will your manually applied labels also work with a machine? Many labels will not, especially if they are printed on sheets instead of rolls. What's more, the surface a label is affixed to can be a challenge to orient for a machine, such as flat vs. curved surfaces, plastic, slick vs. matte finishes, etc. Labels designed for automated use may have a significantly different price point. Also consider if direct printing on packages is a viable alternative.
- > And perhaps most important, is your current packaging process reproducible by a non-thinking, non-human machine? We often don't notice the small adjustments or changes we intuitively make to a process, such as having

to realign flaps on very full boxes, apply extra pressure to some kinds of tape, or “shimmy” items to make them fit into a carton correctly. Even the most advanced sensors and grippers can’t compensate for “close enough” fit and finish the way a person can. If your current process is too variable for automated equipment, are you open to modifying the product and/or packaging (e.g., simplifying folds and flaps on cartons, switching to multi-purpose glue, modifying box dimensions)?

## Automation is Compatible with Sustainable Packaging Initiatives

Many companies incorporate sustainable packaging with the goals of conserving natural resources and responding to consumer demand. Some strategies include:

- > Reducing plastic
- > Minimizing overall packaging size and volume
- > Switching to recyclable materials
- > Developing multi-use/reusable packages
- > Replacing existing packaging with sustainable alternatives (e.g., renewable resources such as plant-based materials, higher post-consumer recycled content (also known as PRC))
- > Direct printing on packages instead of labels
- > Using lightweight paperboard instead of heavier corrugated cardboard



One of the challenges with automating sustainable packaging is avoiding damage to lightweight or thin materials. This may require some adjustments like slowing line speeds, loosening tolerances, or adjusting adhesives to achieve desired results. The trade off, however, is that once tuned, the equipment can perform delicate operations predictably cycle after cycle.

## Reduces Waste and Adapts to Innovative Packaging Strategies

Many of the advantages offered by robots and automation contribute to sustainable packaging initiatives, even using traditional materials, because they reduce waste and contribute to energy efficiency. Examples include:

- > Applying consumables consistently
- > Dispensing the correct amount of glue
- > Maintaining proper glue temperature
- > Proper label alignment
- > Dexterous grippers and vacuum tooling for delicate or thin materials or paperboard
- > Programmability of precise speeds and operating parameters to minimize tears, jams, and waste

# Getting Started with Automated Packaging Systems

Packaging is always a multi-step process and there are many ways to automate it, some more comprehensive than others. It's important to define the scope of any packaging automation system in order to prioritize your biggest goals.

## Defining the Scope of Your Project

It's surprisingly easy for the scope of an automation project to surpass original plans. One way to keep things in check is to determine the specific goals you want to achieve and challenges you want to solve. Then do your utmost to avoid adding in extras. Remember that you can always build in space for additional equipment or expansion at a later time.

One helpful rule of thumb is to start with what is sometimes called the "low hanging fruit." In other words, look for the easiest tasks to automate, the areas that cause the most errors or injuries, or the places where throughput is consistently bogged down. Some examples include:

- > Taping box flaps
- > Applying labels
- > Coiling long products like hoses, cords, or ropes
- > Lifting awkwardly-shaped products into cartons
- > Fitting uniformly-sized jars, bottles, or cans into a cardboard grid in a carton



The biggest benefit from robotics and automation comes from parts of the process with the most standardization and least variation in terms of products or materials. It's also a good idea to invest in automating the steps or tasks where equipment will have the highest utilization in order to maximize runtime and, in turn, value and ROI.

## Comprehensive vs. Partial Automation

It's not always necessary to automate the entire packaging line from start to finish. It's more important to identify where automation will have the biggest impact on your goals. This may take the form of a fully integrated system or it may be one or more smaller workstations for separate tasks. Partial automation is helpful when certain packaging or inspection tasks are bogging down an otherwise smooth process, such as a palletizing and shrink-wrapping system that handles custom-order cases of product filled by workers.

## Other Ways to Add Value with Automation

Consider if the processes that immediately precede packaging, such as assembly, inspection, or other finishing processes, can be integrated into the larger packaging system. Tasks that come at or near the end of the manufacturing line are great candidates for automation because they can feed directly into the packaging

workflow to keep product moving. It may also be a way to further optimize how your workforce is allocated.

## Working with a Robotics Integrator

You are the expert on your products, packaging materials, and process. But an automation integrator has the advantage of experience with multiple facilities and types of equipment to find unique solutions.

An integrator brings familiarity with the many types of packaging equipment available and can bring together different options for the best system for your needs. Even in situations where off-the-shelf options exist, an integrator may be able to make them more efficient as part of a customized system.



## Steps to Plan for and Implement End-of-Line Packaging Automation

- > Define your process in detail, breaking it down into component steps and tasks from start to finish along the packaging line.
- > Figure out which packaging tasks have the least variation, are extremely repetitive, or impact throughput and workflow the most. Also consider which tasks take up the most of the workers' time.
- > Detail your challenges (e.g., product damage, staffing shortages, wasted packaging, package appearance).

- > Prioritize your goals (e.g., increase throughput, consolidate space, redeploy workforce).
- > Look at examples of automated packaging lines (such as those in the Additional Resources at the bottom of this page).
- > Set your budget and begin [ROI calculations](#).
- > Talk with an automation integrator to get suggestions, remembering there is more than one way to automate packaging processes.

## Tips for a Successful Automated Packaging Project

We recommend keeping these tips in mind before and during your project:

- > Communicate about your budget, timeline, process details, future plans that impact packaging needs, feedback and preferences, and to clarify mutual understanding.
- > Maintain a clear idea of the scope of project, and don't let it creep unnecessarily.
- > Try not to worry about **how** the system will be built or what components are best. Leave the details of design and programming to your integrator and stay focused on the outcomes and goals you want to accomplish.
- > Remember, the project is not just about the robots! Sensors, cameras, conveyors, grippers, and other ancillary equipment have roles to play too.
- > Keep employees in the loop about the automation project, especially those whose jobs and roles will be directly impacted.
- > Be prepared to cultivate a mindset in employees that focuses on keeping a smooth workflow to maximize machine uptime.

Even though it's often the last step in the manufacturing process, packaging is critical to your success and your customers' satisfaction. Packaging carries your products and your messaging, so quality counts. There are many areas for automation and robotics to add value to the packaging process: streamlining workflow, reallocating workforce, incorporating inspection and quality control measures, and modernizing your facility. Please [get in touch](#) to discover how we can help you reach your goals.

# Additional Resources

## Video and picture examples

- > <https://www.forcedesign.biz/automated-coiling-and-packaging-line> (video)
- > <https://www.forcedesign.biz/robotic-vision-inspection-cell> (video)
- > <https://www.forcedesign.biz/end-of-line-tester>
- > <https://www.forcedesign.biz/collaborative-robot-system>

## Free downloadable ebooks

- > [Automation Equipment Planning: A Step-By-Step Guide for Manufacturers](#)
- > [Working With Your Automation Vendor](#)

## Packaging and automation articles

- > [Sustainable packaging](#)
- > [Machine data collection](#)
- > [Automated packaging in a post-COVID world](#)
- > [PMMI sustainable packaging report](#) (executive summary)