

Getting Started with Manufacturing Automation

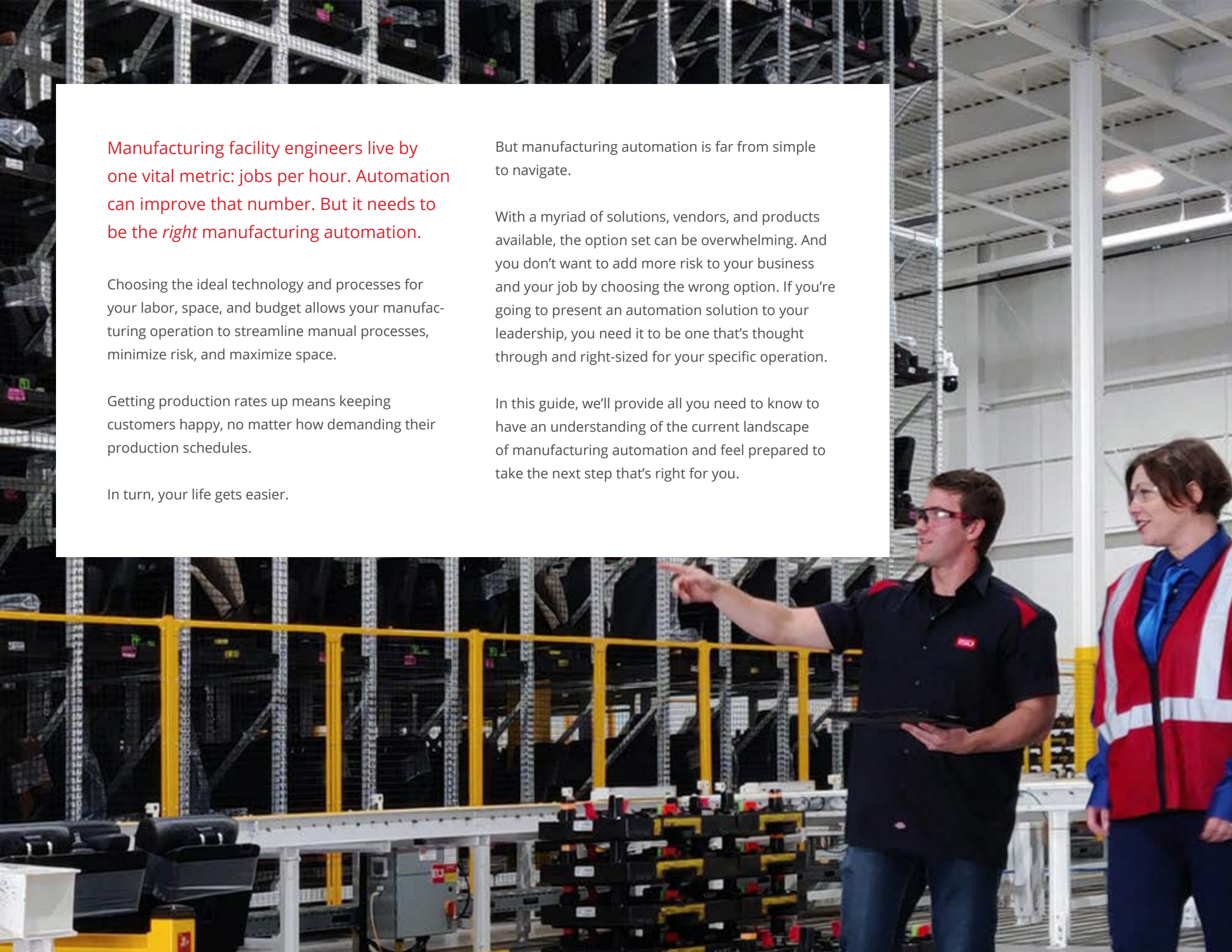


Know where to start with manufacturing automation for your operation



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Manufacturing facility engineers live by one vital metric: jobs per hour. Automation can improve that number. But it needs to be the *right* manufacturing automation.

Choosing the ideal technology and processes for your labor, space, and budget allows your manufacturing operation to streamline manual processes, minimize risk, and maximize space.

Getting production rates up means keeping customers happy, no matter how demanding their production schedules.

In turn, your life gets easier.

But manufacturing automation is far from simple to navigate.

With a myriad of solutions, vendors, and products available, the option set can be overwhelming. And you don't want to add more risk to your business and your job by choosing the wrong option. If you're going to present an automation solution to your leadership, you need it to be one that's thought through and right-sized for your specific operation.

In this guide, we'll provide all you need to know to have an understanding of the current landscape of manufacturing automation and feel prepared to take the next step that's right for you.

Together, we'll review:

- 4 types of manufacturing automation
- 10 manufacturing processes that can be automated (including time-consuming tasks like assembly and inspection)
- 7 most common manufacturing automation technologies (including autonomous mobile robots or AMRSs)
- 7 benefits of manufacturing automation

Additionally, you'll see examples drawn from the hundreds of automation projects ISD has done for factories of all sizes, as well as hear perspectives from seasoned operations experts and researchers.

After you've read this guide, you'll have an understanding of the landscape of manufacturing automation and be ready to evaluate the options available to you — and to present them to your stakeholders.

**Ready to shift your thinking
on automation?**



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Manufacturing Automation 101



What exactly is manufacturing automation?

Manufacturing automation is the process of using advanced technologies to enable and execute industrial operations, including production and shipping, with minimal human intervention.

Factories can be partially or fully automated. Manufacturing automation often starts with replacing a repetitive or dangerous task with hardware and software, but can expand into complex operations like order management and custom production.

For example, a factory could use a **conveyor system** (on the simpler side) or **autonomous mobile robots, or AMRs**, (on the more complex side) to automatically move parts around the factory floor. That automated solution would reduce the need for time-consuming, risky, and labor-intense work from human forklift operators.

Successful manufacturing automation systems combine top-of-the-line technology with flexible software to create solutions that are customized for the needs and production schedule of every factory. Human capital and operational design play big parts in manufacturing automation.

Overall, manufacturing automation is about improving performance through technology. It provides robust, effective solutions that maintain or improve production rates, as measured in jobs per hour, while maintaining quality and reducing labor challenges.

Tom Pawlowicz, a senior account executive at Integrated Systems Design whose specialty is automotive automation, expands on how manufacturing automation helps solve labor problems: “Automation can take a mundane job away from needing manual intervention, allowing the company to reassign that resource to something else.”

Factory operation managers are increasingly exploring and investing in manufacturing automation solutions that allow them to do more, more accurately, more efficiently, and with less stress.

What are the different types of manufacturing automation?

There are **four** main types of manufacturing automation:

- Fixed
- Programmable
- Flexible
- Integrated

Most modern factory operations will already have fixed automation elements installed. For example, an automotive facility may use transfer lines — which include machining tools, workstations, and conveyor systems that produce, assemble, and move parts — for high-volume production of car doors.

Programmable, flexible, and integrated automations allow for increasingly customizable and flexible automation. The right manufacturing automation solution for you may include one or more types of automation.

Fixed automation

- Automation that relies on physical equipment designed to complete otherwise manual processes, like mass production of parts.
- It's designed for high production rates, but low flexibility and adaptability. For example, a machine that makes one design of metal hinges would need to be redesigned, with its own parts recast or retooled, if a different type of hinge was needed.
- Fixed automation replaces manual processes with machinery that completes the work without human labor but in inflexible, predetermined ways.
- Requires high initial investment to specialize equipment, and low maintenance over time (but high switching cost if changes to the production process are required).
- Example: Machinery that produces a million of the same car hoods.

Programmable automation

- Automation that combines machinery and computer programs to flexibly adjust how the system produces different objects.
- It's designed for batch production, where a factory may make multiple types of products or parts in smaller numbers.
- Programmable automation replaces manual work in metalworking and assembly with machines that make various products and software that manages how the production cycles of those parts are scheduled, set up, and run in flexible ways. However, downtime is built into the process, as time is needed for the system to change itself over between producing one part and the next.
- Requires high initial investment, but with more options for flexibility across the line. May require ongoing costs for licensing software or keeping computer programmers on staff.
- Example: A facility that makes aviation parts using CNC (computer numerical controlled) machine tools and PLCs (programmable logic controllers) to produce batches of different types of bolts for their customers.



Flexible automation

- Automation that can produce different parts and products and uses software to quickly reconfigure hardware, so there's limited to no downtime between changeovers.
- It's designed for industries with hard-to-predict demand, products with short life cycles, and customers who need significant customization. If a producer needs to make a high mix of low-volume goods, flexible automation is the best way to do that.
- Flexible automation takes the base capabilities of programmable automation and extends them through advanced control systems and technology. Human operators control computers

that control machine tools. Those tools then execute production orders, from unloading the other tools and raw materials required for each product and moving finished products to a shipping area.

- Requires considerable investment and regular ongoing cost of monitoring and maintaining the system.
- Example: An electronics manufacturer may use robotic arms, controlled by a computer, to assemble and install circuit boards for different makes of cameras and computers. The manufacturing automation can flexibly respond to different product needs.

Integrated automation

- Automation that runs through an entire manufacturing facility, connecting and integrating every business and production process within the factory. It allows the entire facility to be managed and coordinated through a centralized computer software.
- Integrated manufacturing automation may include AS/RS, computer-aided process planning (CAPP), programmable logic controller (PLCs), robots, and flexible machine systems.
- Also called computer integrated manufacturing (CIM).
- Can include elements of all types of automation — including fixed, programmable, and flexible — with a layer of integration and coordination.
- Requires significant investment in software, and that investments were already made in improving and automating manual processes in production.



Should I automate?

The answer to the question “Should I automate?” is simple: “Yes.”

The answer to the question “How should I automate?” is a lot more complex — and a lot more interesting.

McKinsey, in its research report “A New Era of Automation in Manufacturing,” lays out a helpful, linear framework for operations leaders to map where they are in their automation journey.

- **Low maturity** operations have limited automation infrastructure in place. They could benefit highly from fixed automation, as well as basic programmable automation that allows them to collect more data.
- **Mid maturity** operations have already invested in automation, including fixed and programmable. They may have sensors and technology in place that tracks their work and streamlines production. But they may not be making the most of that automation and data — they’re not achieving flexible automation.
- **High maturity** operations are fully automated on the manufacturing floor through hardware and software. Fixed, programmable, and flexible automation is installed, functioning, and requires very little human intervention to run successfully. But they haven’t applied integrated automation to transform how the facility is run.
- **Best-in-class** operations have complete manufacturing automation solutions that allow them to make the most out of automation across every process, product, and technology in their factory. Automation is fully integrated.

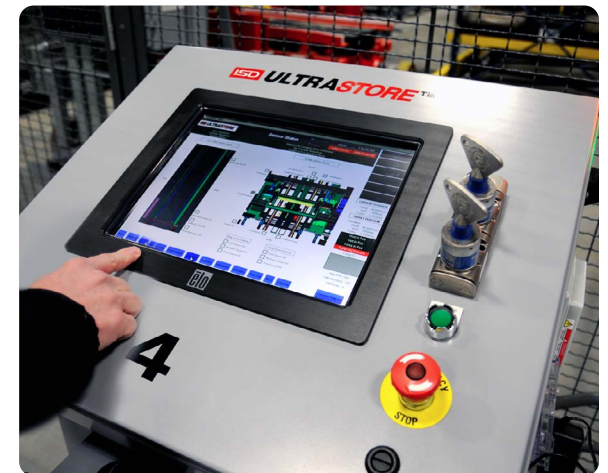
If you’re not planning an entirely new, greenfield site, knowing which stage your factory is in can help you hone in on the scope of automation that will make the most of your investment and set you up for future growth and evolution.

You don’t want to spend money for capabilities you won’t be able to make the most of, or design islands of automation that won’t integrate down the line, says Tom.

“Whoever you work with, you should be looking for a partnership. Not someone just looking to sell you a piece of equipment, but helping you understand what makes sense for where you are.”

An example:

- ISD came in to work with a facility that wanted to replace their fork trucks with **automated guided vehicles**.
- But before it made sense to become a **high maturity** operation with AGVs, they needed to automate some existing manual processes.
- First, they needed to update and automate how they **stored and received raw materials** and finished products. Then the AGVs could make the most impact.
- ISD automated and expanded their storage capacity with **AS/RS**, custom cranes, and automated inventory tracking.
- Then, with that infrastructure in place, automated guided vehicles could take over the manual, high-risk work previously done by fork truck operators.
- Later, the facility could explore automated guided vehicles (AGVs) and more computer-monitored technology to continue to automate repetitive, dangerous tasks.
- By approaching automation in stages, the facility was able to grow their business at a sustainable pace while responding to real-time industry and customer changes.





**Which manufacturing processes
can be automated?**

Many stages of the manufacturing process can be automated.

You can even automate the automation. That's called "lights out" manufacturing and refers to the fact that production is fully automated and can run without onsite human workers — or even the lights on.

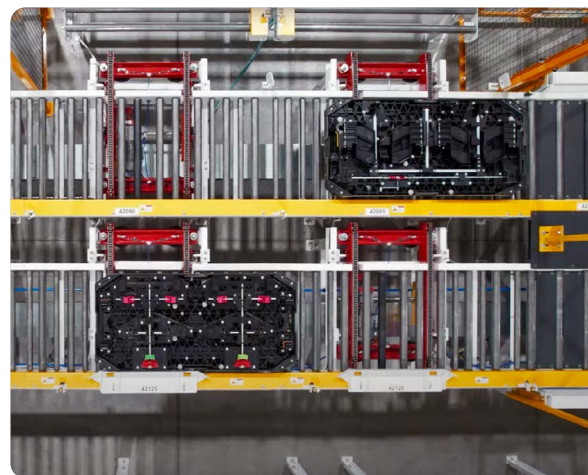
But depending on your size, space, and budget, you may want to invest in different kinds of manufacturing automation.

For instance, if you want to be able to **produce more kinds of products**, you may want to invest in:

- **Robotic tooling** that allows you to produce and customize different end products
- **Operational software** that lets you track which products are the most popular and automatically optimizes production to keep those in stock.

Whereas if your top goal was to **reduce labor costs**, you may prioritize investment in:

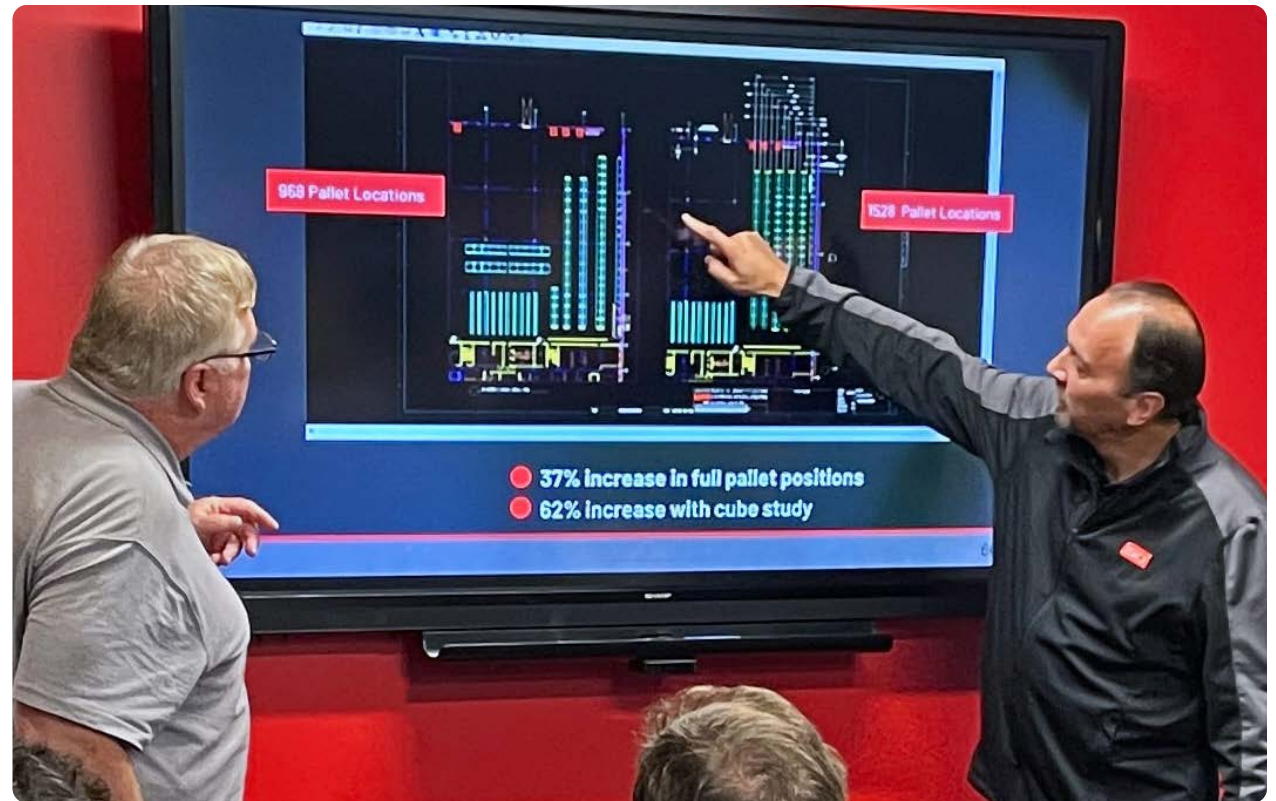
- **Autonomous mobile robots (AMRs) or automatic guided vehicles (AGVs)** that can move materials to the production line and finished productions to your packaging and shipping arena without human intervention
- **Conveyor systems** that make for easier **truck loading and unloading**
- **Automated storage and retrieval systems (AS/RS)** to reduce need for forklift operators



So what type of manufacturing automation is right for you? It depends. There is no standard materials handling operation. That's why ISD starts every automation project by understanding your operation.

- **Insights.** We start by asking questions about your business and identifying areas for improvement. There's no one-size-fits-all automation design, so we gather the research and data we need to build a custom one for you.
- **System-agnostic.** When we're developing an automation plan, we never work with only one OEM. Different technologies have different strengths. By mixing and matching different products and systems, you get automation designed for you.
- **Big to small.** Automation can mean improving one part of one process, or it can mean completely redesigning the way your factory works. Whatever size is right for you, we design systems that support your needs. And with automation that helps your business grow, you'll be primed to build on it as your needs evolve.
- **Fast ROI.** Automation vendors can make transforming your operation sound exciting — and expensive. Many manufacturing operation leaders are concerned about the price of automation and the time to implement. ISD's experts will help you automate in a way that solves your big problems, grows your factory, and measures the impact of every dollar.

Scalability that grows with you means investing in what makes sense for your business. Which process should you start with?



The top 10 manufacturing processes to automate are:

01 Assembly, which uses **conveyors**, **robotics**, and **software** to automate how products are put together.

02 Goods receiving and unloading, which is handling how materials **arrive and are unloaded** on site through **AGVs**, **conveyors**, and other automation technology.

03 Storage and retrieval, which is how goods and materials are stored and retrieved when needed, **using an AS/RS**.

04 Stock replenishment, which is automatically transporting, storing, and managing the need for raw materials going to feed the production line, relying on production **software** and **AGVs**.

05 Sorting and consolidation, which is differentiating products from multi-line orders and consolidating them by final location.

06 Packing and packaging, which is **gathering all of the requisite parts for a given order and preparing them to ship**, including **automatic packagers**, **labelers**, and **printers**.

07 Loading and shipping, which involves **putting finished orders onto trucks**, whether manufacturer-owned or from third parties, so they can be delivered to customers.

08 Inventory management, which uses **software** to track goods in different stages of production.

09 Inspection, which includes cameras, sensors, in-line scales, and other technology to **quality control products before they go out the door**, and ensure that the right goods are attached to each order.

10 Performance monitoring and optimization, which is **software** that unlocks insights from real-time data on your facility's efficiency, accuracy, product quality, and overall productivity. It identifies issues, bottlenecks, and advantages.



Understanding Manufacturing Automation Technologies

Manufacturers are living in Industry 4.0. The way that goods are produced has transformed as significantly as in the Industrial Revolution, says McKinsey. Now, instead of a steam engine or electricity, the future of manufacturing is being shaped by intelligent digital technologies.

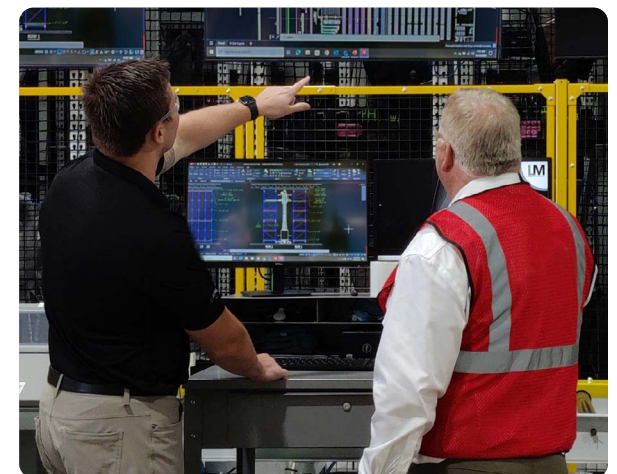
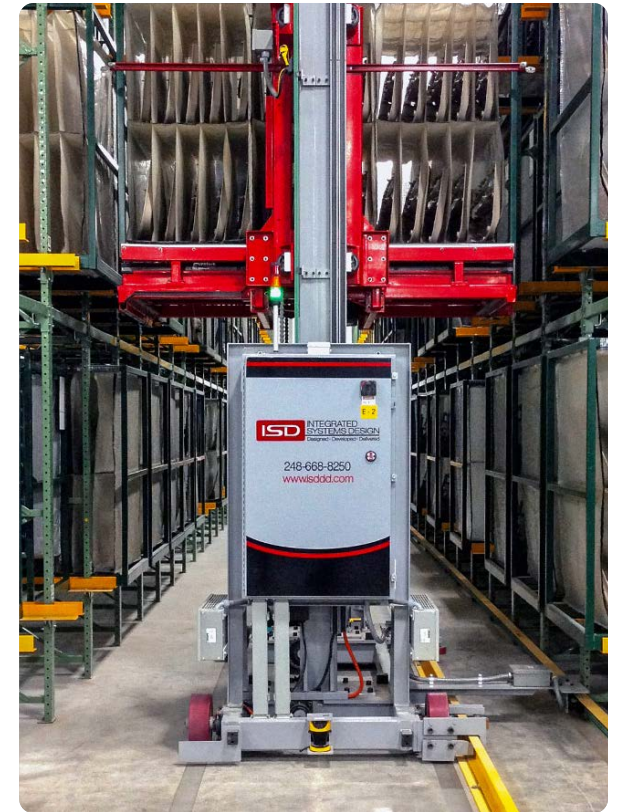
From industrial IoT networks that track every piece of inventory to autonomous robots that transport goods along the factory floor, the technology driving smart automation is changing every part of the manufacturing process.

And it couldn't come at a better time.

As the *Harvard Business Review* explains, manufacturers are facing a conflux of challenges:

- **Talent shortage.** By 2030, there will be 2 million openings for manufacturing jobs in the U.S. and no one to fill them. In Europe, 75% of companies are already having trouble finding suitable workers.
- **Retention.** As available laborers move between a range of available jobs, manufacturers see productivity plummet as they have to spend longer training and error-correcting.
- **Tight profit margins.** Raw goods cost more, and that's if you can get them. With rising costs and the need to keep consumer prices competitive, manufacturers are facing shrinking profits.
- **Fast-evolving consumer preferences.** People want custom everything, and manufacturers have to figure out how to add complexity to their product lines without losing profitability.

Manufacturing automation technology can help solve those problems in sustainable, affordable ways.





Here's a guide to the top 7 manufacturing automation technologies:

- 01 Robotics
- 02 Autonomous mobile robots (AMRs)
and automated guided vehicles (AGVs)
- 03 Traditional automated storage and
retrieval systems (AS/RS)
- 04 Conveyor systems
- 05 Storage and inventory management
- 06 Automated picking solutions
- 07 Operations management and
performance optimization



01

Robotics

Robotics is one of the most popular technologies used in manufacturing, and for good reason. Robots can:

- Take on repetitive or straining tasks
- Create safer workplaces for human workers
- Run around the clock without breaks or overtime
- Produce with little to no errors



One of the top reasons that companies are motivated to start using **robotic technology** is to automate processes (66%), found the U.S. Census Bureau. In recent years, the power to automate is more accessible than ever.

“The robotics industry has traditionally been dominated by large, complex machines that require significant up-front investment and in-house expertise to keep them running,” explains the *Harvard Business Review*. But with more flexible, more collaborative robots (cobots), even smaller businesses can harness the power of automation to improve their processes.

Robots can be used for a range of manufacturing tasks, including:

- Packaging
- Palletizing
- Screwdriving
- Welding
- Machine tending
- Reconfiguring parts

[Learn more about robotics in manufacturing.](#)

02

Autonomous mobile robots (AMRs) and automated guided vehicles (AGVs)

To make finished goods, you need to be able to get materials around your factory floor. "If parts don't move, nothing happens."

Traditional ways of moving parts and products require fork trucks and manual processes of stacking, lifting, loading, driving, and unloading.

Autonomous mobile robots (AMRs) and automated guided vehicles (AGVs) are small, portable roboticized vehicles that unlock productivity and increase jobs per hour by streamlining how parts get moved.

- **Autonomous mobile robots, or AMRs**, work to transport products or materials from one location to another using pathways that can avoid obstacles like workers or other vehicles. With precision LIDAR, QR codes, and proximity sensors, they can navigate the factory floor and create fast, consistent cycle times.
- **Automated guided vehicles, or AGVs**, transport products or materials from one location to another using fixed guided pathways. They are suited for frequently repeated travel to and from fixed locations and use laser triangulation or reflective tape to know where they are.

AMRs and AGVs can be deployed at almost any stage of manufacturing, including:

- Retrieving inventory
- Replenish parts
- Kitting
- Picking
- Sorting
- Delivering finished to shipping stations
- Replenishment (put parts back where they belong)

[See what AMRs and AGVs can do in a factory.](#)



03

Traditional automated storage and retrieval systems (AS/RS)

A more efficient storage system means that you make more efficient use of the space you already have.



Automated storage and retrieval systems (AS/RS) use computer programs and cranes or robotic shuttles to efficiently store and retrieve inventory in your facility. Traditional AS/RS includes:

- Storage racks
- Cranes, shuttles, or robots for storing and retrieving goods
- Computer system for tracking inventory (location, quantity, lot number, size, weight and more)

Depending on the type of goods you work with, your factory may use:

- Unit-load AS/RS, for full pallets or cases, where larger cranes handle goods
- Mini-load AS/RS, for totes, trays, and cartons, where smaller cranes or robots handle goods
- Horizontal carousels, for transporting parts that move quickly or in spaces with low ceilings
- Vertical lift modules (VLMs), for optimizing vertical space
- And other forms of AS/RS.

[Learn more about the impact AS/RS can make in improving your operations.](#)

04

Conveyor systems

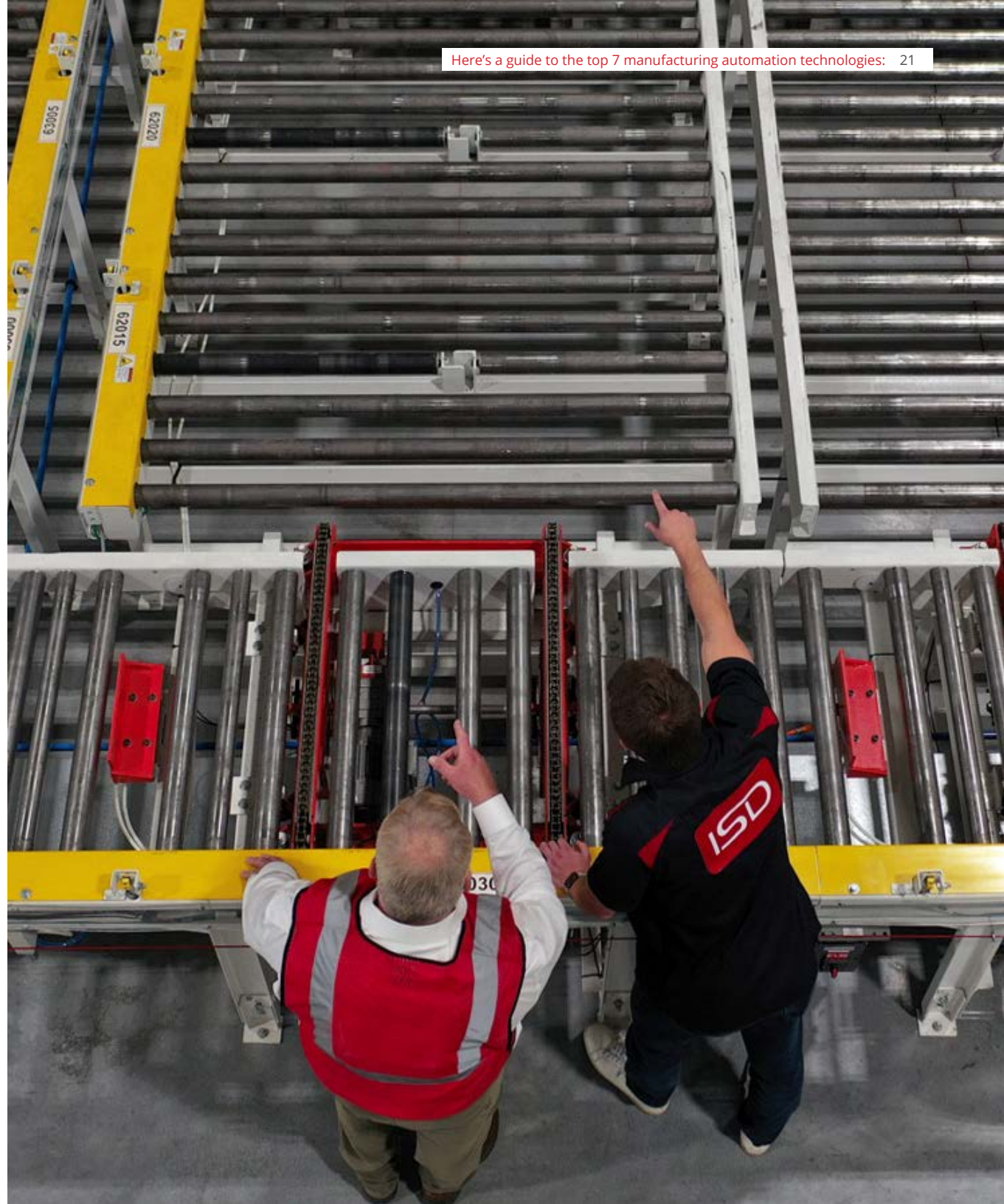
Conveyors are systems for handling and transporting materials. Items travel on belts, wheels, rollers, slats, or chains down a fixed path. They're one of the most popular technologies found in a manufacturing facility, but are also one of the most flexible and impactful.

Conveyors can:

- Keep your assembly line moving
- Transport goods between levels or floors
- Load products into trailers
- Reduce physically taxing and injury-prone tasks
- Automate receiving and storage

Conveyor systems are customizable, energy efficient, and safe.

Explore examples of conveyors in manufacturing operations.



05

Storage and inventory management

AS/RS systems aren't right for every manufacturing operation. There are a range of technologies available that can transform storage and inventory management from a mess of manual processes into a clean, smart solution for your space, product mix, and needs.

All storage systems work with an **inventory management software** program that helps you track where every last part and product is in your facility.

As Tom explains, "For instance, say you found out another manufacturer sent you the wrong components for an instrument panel. The software automatically finds and identifies that so you can fix the problem before it disrupts production."

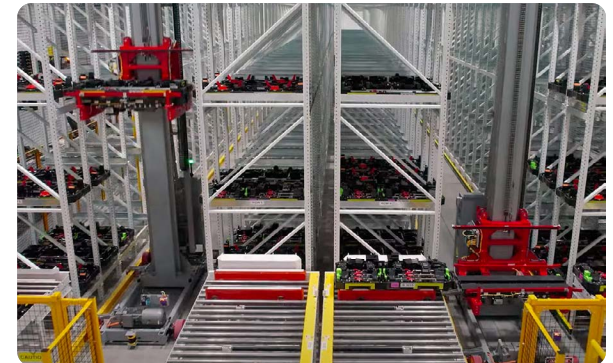
Storage technologies include:

- **Cantilever rack systems**, for long or large products, providing a solution for items (like lumber or piping) that don't fit on standard pallet racks
- **Selective rack systems**, for manufacturers managing numerous parts or raw materials that need versatile single or double deep configurations
- **Flow rack systems**, for parts or materials with medium to high turnover that are loaded one side and picked from the other side.



- **Floor rail systems**, which automate pallet movement along guided rails for optimizing smaller spaces without needing many aisles.
- **Deep reach racks**, for manufacturers with high order volumes who need double deep pallet racks (these systems can store four in a row without an aisle).
- **Very narrow aisle (VNA) selective racks**, for facilities with limited storage space with aisles as narrow as 5.5 feet.
- **Pushback rack**, for operations fast loading and storage of large quantities of the same product, using gravity.
- **Pallet flow racking**, for high-volume environments with **multiple pallets of the same inventory** where high throughput is needed.
- **Automated pallet moles**, which consist of **AMRs in pallet racks** operating within a track on every level to position under pallets, lift them, and bring them forward.
- **Static bin shelving**, for tracking and locating even the tiniest of parts in fixed locations.

Go deeper on storage options.



06

Automated picking solutions

Automating picking solutions are systems that use robots and goods handling machines to retrieve and transport inventory. In a manufacturing setting, automated picking solutions can decrease the amount of time you need to spend on manual processes to pick or sort parts for production.

Integrating automated picking with AMRs allows for automated lineside product delivery, recovering storage space, and reducing goods-to-line labor costs.

[Learn more about automated picking solutions.](#)



07

Operations management and performance optimization

Automation is meant to increase accuracy without requiring human intervention. But it can't think for you. You need to have a strategy for how to make the most of automation — but how do you build one? Is now the right time to add automation, and if so, where?

ISD is an insight-driven automation partner. We go deep to learn about our customers' business and explore those exact questions. There's no one-size-fits-all answer.

One automation technology we always rely on? Software. A family of warehouse and operations management software exist to meet a facilities applications and workflows. 94% of industrial operations say digital solutions are important to their automation programs.

Those programs include:

- Manufacturing execution system (MES), which tracks raw materials, controls machines on the facility floor, monitors quality control, and manages inventory
- Warehouse management system (WMS), which serves as the central planning and management system for orders and inventory across a facility
- Transportation management system (TMS), which handles the shipping process, including carrier management, cost analysis, rate shopping, dimensional weight management, fleet control, manifesting, and label and paperwork generation
- Warehouse execution system (WES), which adds more control and reporting to WCS functionality, including labor management in real time
- Warehouse control system (WCS), which works second-by-second to ensure that all systems in your facility are communicating and working in harmony

- Controls system, which manages and regulates machinery and processes to ensure the coordination and efficient operation of various material-handling equipment

Need to make the most of your operations management software? Looking for an unbiased, brand-agnostic partner to help you evaluate all the available options? ISD can research, design, and install the right software solutions for your performance optimization needs.

Read more about software systems.



The top 7 benefits of automating your manufacturing operation

Yes, automation enables your operation to do more with fewer resources. But that's not the only benefit:

1. Higher productivity: more jobs per hour
2. Powers your business to do more with less: reduces costs
3. No more surprises: minimizes risk
4. Safer workplace: greater safety and better jobs
5. More responsiveness: increased flexibility for customers
6. Increased added value and human capacity
7. Impactful transparency: real-time monitoring and predictive maintenance
8. Scalable growth: build your competitive advantage to grow

Read on for more context on each.

01

Higher productivity: more jobs per hour

Your production performance is calculated by looking at your actual jobs per hour compared to your target jobs per hour.

03

No more surprises: minimizes risk

When you rely on manual processes, things can go wrong. Underrated and overworked people can make mistakes. A misjudgment can send things off track. And shutting down the line because of user error is costly to both profit and customer relationships.

Automation helps reduce everyday industrial risks, which can include everything from staffing issues to safety hazards.

02

Powers your business to do more with less: reduces costs

Automotive factories in Detroit facing scarce, expensive labor are turning to robots to help reduce costs, says the Wall Street Journal.

They are one of many industries realizing that they can reduce costs in the long run by turning to automation.

04

Safer workplace: greater safety and better jobs

Manufacturing jobs are often ergonomically challenging. Lifting heavy objects and tools (including sanders, grinders, and welding equipment, among others) can wear down the body. Exposure to chemicals, heavy metals, and other industrial materials comes with its own risks.

Automation takes on the grunt work and the exposure, leaving your team to engage in quality control, programming, and design work.

05

More responsiveness: increased flexibility for customers

Customer needs are always changing. Automation helps your facility absorb those changes without any disruption to delivery.

A manufacturing operation that needed to be able to ship customer orders faster asked ISD for help. We collaborated on a solution that expanded their storage area and redesigned their pallet management.

We installed a pallet storage and retrieval system with a conveyor system and a robot station where pallets were unstacked, identified, and correctly stored. With an input of 150 pallets per hour and an output of 140 pallets per hour, they were able to cut down customer wait times through automated efficiency. [Read more here.](#)

06

Impactful transparency: real-time monitoring and predictive maintenance

Automation enables predictive maintenance, or “condition-based monitoring to optimize the performance and lifespan of equipment by continually assessing its health in real time” (IBM).

It's a shift away from preventative maintenance, which checks equipment on a predefined schedule. That itself was an improvement on reactive maintenance, which fixes failures when they happen. In predictive maintenance, AI uses past data to identify where problems are likely to occur.

Meanwhile, automated solutions provide real-time monitoring through sensors that track visual, thermal, and sound data to identify when something is wearing down or at risk of failure.

These shifts protect your facility from downtime and ensure you're achieving the highest possible productivity.

07

Scalable growth: build your competitive advantage to grow

No one knows exactly what the future of manufacturing will look like, or when it will come. A McKinsey report suggests that a software-driven (think robots on the shop floor training themselves how to quality control) future state could arrive in anywhere from five to 15 years.

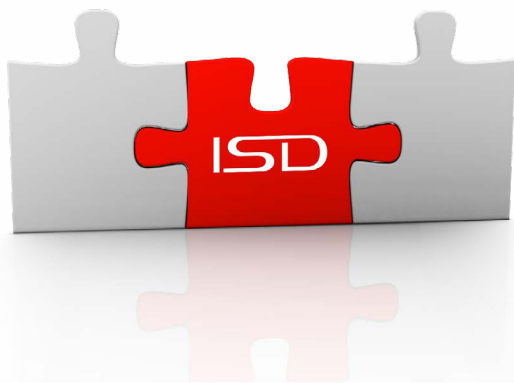
But manufacturers will want to expand their capabilities, particularly their digital ones, “no matter what comes and when.” Automation helps future-proof your business.

A photograph of two men in a large industrial warehouse. The man on the right is wearing a black polo shirt with a red 'LSD' logo and safety glasses, and is gesturing towards the man on the left. The man on the left is wearing a light-colored shirt and a red safety vest. They are standing in front of a long, empty conveyor belt system. In the background, there are tall metal shelving units and yellow safety railings. A red banner with white text is overlaid on the image.

Finding the right automation partner for your future

The right manufacturing automation can transform your facility's capabilities, ease your labor challenges, increase production, and power your business to do more with less.

The future of manufacturing is ready for you. ISD is your partner in navigating it.



Working with ISD on your manufacturing automation solution means:

- Getting **collaborative, empathetic, and insight-driven guidance** on what makes the most sense for your specific situation and goals
- Being offered a range of **flexible integration options** that are product-, system-, and brand-agnostic, so you only choose what's right for you
- Seeing a **fast return on your investment** through practical shifts and effective change management
- Working with an **expert team with a culture of continuous improvement** so you're building for the future even as you solve today's problems

ISD is here to keep your business moving.

Click to schedule a time to talk with an automation expert about your operation.

Or, call us at **248.668.8250**

If you're ready to talk to an operations expert on what automation engineered for you can look like, set up a free call with us today.

If you have more questions you want to explore on your own, consider these resources:

- **3 steps to find a successful manufacturing automation solution**
- **3 ways automation keeps your facility more competitive**

Ready to rethink your operation?