MEP National Network™

Automation 101: How to Plan for Successful Implementation

Manufacturers have much to gain from a strategic approach that leverages their people and is guided by business goals.

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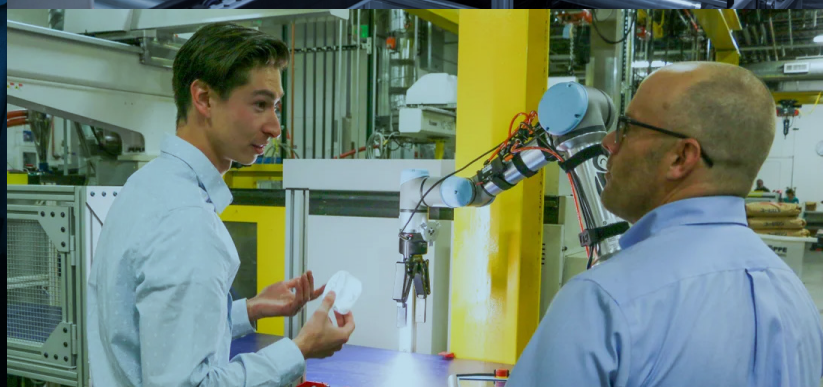


INTRODUCTION

Manufacturers face unprecedented pressure to remain competitive. According to Rockwell Automation, manufacturing investment in technology in 2024 is 30 percent higher than in 2023. With the rapid acceleration of technology adoption, automation is becoming a business imperative for manufacturers who are looking for ways to increase productivity and solve workforce issues.

In today's competitive manufacturing landscape, uncertainties are commonplace. Given these external challenges, it is essential for manufacturers to leverage their people, facilities, and equipment to create more sustainable business models. Investing in new automation could be the first step to getting more value from your existing resources.

Additional business justifications for investing in automation might include:

- **Using automation to increase productivity without adding people.**
- **Improving quality and reducing waste.**
- **Performance management.**
- **Boosting competitiveness and customer retention.**
- **Taking advantage of the growing number of lower-cost options, which include refurbishing or customizing existing equipment.**

This white paper will leverage what local MEP Center experts have learned about adopting automation, including:

- **How to use business goals to guide your process.**
- **Why an automation checklist is so important.**
- **The importance of involving your people in automation implementation.**

One of the biggest benefits of automation is that it provides the connectivity and access that can make your operations more data-driven and give you a window into how much money you are making or losing in real time. But an automation initiative also comes with risks. How might this initiative disrupt your operations? How could it take people out of their routines?

Even the smallest manufacturers can tap into the resources at local MEP Centers across the MEP National Network™ for support in adding more automation capabilities. Your local MEP Center can help guide you and your people through an automation initiative to reduce your risks and help create opportunities for future growth.

CHAPTER 1
Preparing for Automation Requires a Different Approach

Many small manufacturers operate in a dynamic environment where costs are closely tied to production levels. In a variable cost model, you may increase your workforce during periods of high demand, but when sales dip, reducing headcount becomes necessary. Additionally, many small shops have managed to survive without detailed, long-term planning or budgeting for capital investments, relying instead on a reactive approach to daily operations.

If you are like many small shops, you focus on daily operations and are consumed with workforce issues and troubleshooting equipment or inventory issues. But automation projects are more open ended, with many unknowns emerging throughout the initiative. A successful automation implementation will require you and your staff to think differently.

It is no longer a matter of "doing things the way we have always done them." You and other key stakeholders will have to focus on continuous improvement, how to leverage new technology, and ongoing training that your staff will need to operate the new technology.

Common Barriers for Small Manufacturers When it Comes to Automation

An automation initiative begins with leadership addressing the change dynamic and preparing employees. You and your company spend incredible amounts of energy on fine-tuning and honing a process that everyone understands. It's natural for people in your company to be reluctant to change routines and processes that are already working and well understood by everyone. Even with antiquated equipment, there is often a comfort level with staff because they know what they are dealing with in their day-to-day operations.

There are other barriers to automation. You may be facing challenges such as:

- You want to keep capital expenses down. Automation can be a big financial commitment that is not without risks.
- You might have lingering concerns from previous investments that didn't deliver the promised results. Perhaps your staff struggled with an ERP implementation, where they tried to make the software work for your current processes instead of adjusting processes to leverage the new technology.
- You are hesitant to invest in new technology while dealing with customer constraints on production capacity and cost pressures. You have a lot on your plate as it is.
- Learning and acquiring new skills and developing new processes can be daunting.

A Must-Do Checklist for a Successful Automation Initiative

As you adopt an initial automation strategy, it is important to connect your operational performance to your financial performance. This will help you align resources to manage automation implementation. This checklist should include:

- ☑ **Determine early on what the initiative is worth to you.** Keep ROI your focus, but be sure to think through all of the related impacts on your people and processes.
- ☑ **Don't automate anything that is not a lean process.** Automation has its roots in lean manufacturing. It is the ultimate process optimization. You will go further, faster, with a continuous improvement mindset.
- ☑ **Look first for commercial, off-the-shelf tech solutions.** The manufacturing industry has built machines to do specific tasks that are easy to automate. These options are growing and will be less expensive and easier to implement than a custom solution.
- ☑ **Don't underestimate the importance of technical specs for RFPs.** Have a plan before you ask an automation vendor for a quote. You want to be in control of negotiations with a vendor.
- ☑ **Find a tech-agnostic trusted advisor.** This is where the MEP National Network can be an invaluable partner. MEP experts are driven by a mission to help you thrive. They are not vendor-driven by a transaction. They will help you find the right solution and the right vendor.

There Is Much to Be Gained From Simple Manufacturing Automation

One way to look at your first automation project is to either: 1) solve a problem or 2) build a vision for a future state of your business. Here are some examples.

- **Solve a problem:** Your automation project should address a specific issue or inefficiency within a manufacturing process. This could be anything from reducing labor costs to improving product quality to increasing production speed. Maybe it is a bottleneck in your workflow. Maybe you can automate a process that no one wants to do.
- **Build a vision of a future state:** Alternatively, the project could be driven by your desire to create a more efficient, innovative, or competitive future for your business. This might involve implementing new technologies or processes that will position your business for growth and success. At this stage, you are creating a path for success or a roadmap for a larger transformation.

In essence, both approaches emphasize the importance of having a well-defined goal for your automation project. Without a clear understanding of the desired outcome, it becomes more difficult for you to justify the investment, allocate resources effectively, and measure success of the initiative. But there is a lot to be gained from automation, such as:

- Improving efficiency by boosting output without additional labor.
- Minimizing material waste.
- Ensuring consistent product quality, reducing defects, and rework.
- Overcoming workforce challenges and allowing human workers to focus on more complex and strategic roles.
- Improving safety, such as reducing workplace injuries and accidents by automating hazardous or repetitive tasks.

CHAPTER 2
Fostering Awareness, Education, and Opportunities for Automation

One of the most frequent concerns about starting an automation initiative is that manufacturers don't have time to adequately research applications and learn what resources and incentives may be available.

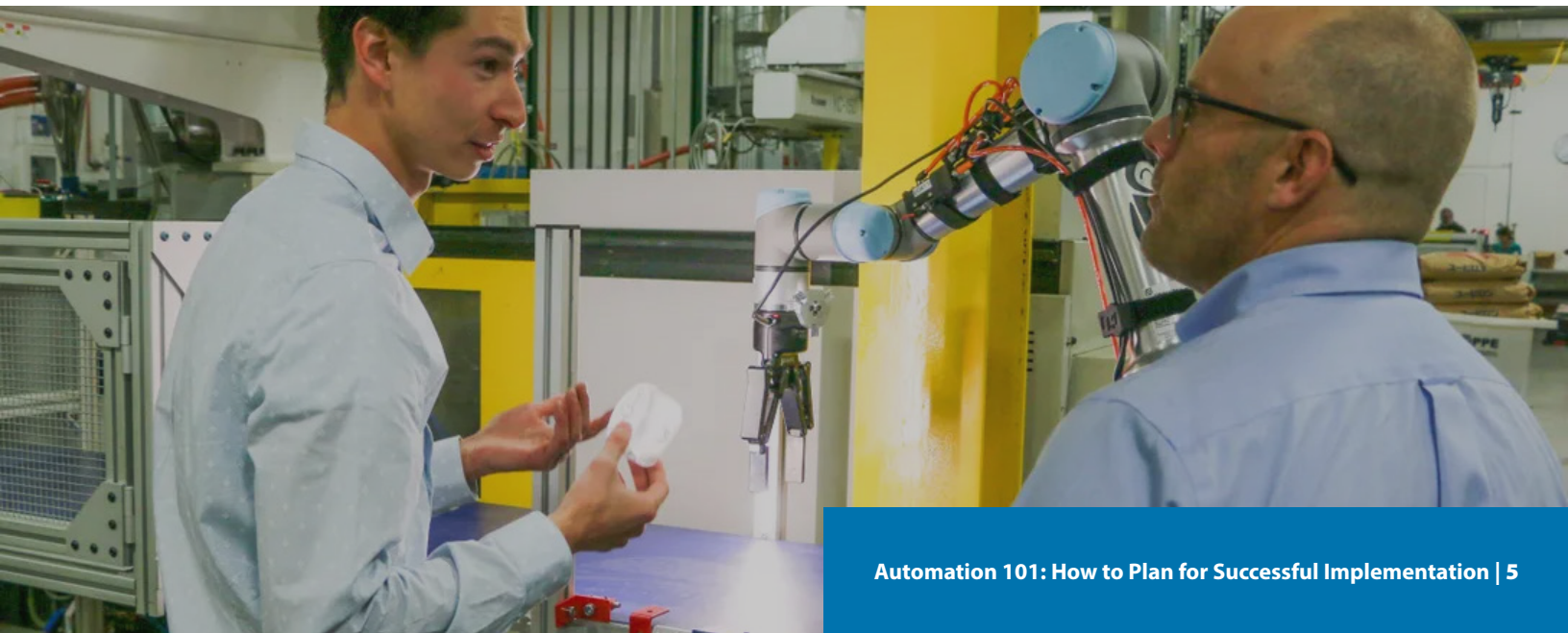
This is where your local MEP Center can be invaluable. Their automation experts can:

- Assess your operation to help you identify areas in which automation might have the biggest impact.
- Help you quantify risk versus return.
- Show you how to weigh the pros and cons of leasing or buying equipment.
- Make you aware of possible grants, tax credits, or financial incentives from various state programs and regional economic development agencies.

Pre-built automation solutions offer a cost-effective and straightforward way to streamline manufacturing processes. But the majority of small manufacturers work in high-mix low-volume (HMLV) production environments, which demand more flexible automation. While it can be significantly more difficult for you to manage all of the variables in this type of automation (from software programming to electronics and resource management) this is where the transformation occurs. If you are an HMLV shop, the most constructive and efficient steps in your automation research include demonstrations and hands-on experiences.

The Power of the Automation Demonstration

Automation demonstrations allow you to see the technology in action, address specific concerns, and assess the potential benefits before committing to a significant investment. Demonstrations, especially custom



test cases, not only empower you to make informed decisions, they are a path to reduce anxiety and risk. As automation adoption continues, there are more ways than ever to see solutions in action. Your local MEP Center may have a demonstration center, and you can often see demonstrations and hands-on experiences at incubators, universities, trade schools, road shows, and conferences.

When you attend any demos or road shows, focus on your targeted tasks. This will help you evaluate solutions and ask targeted questions. This also might help you develop a custom test case to solve a small-scale issue and arrange for a vendor or third party to bring equipment into your facility, which can help your staff embrace automation and reduce anxiety.

Common automation demonstrations include 3D printers, barcode scanners, robot end-effectors, augmented reality (AR), virtual reality (VR), and laser markers. Seeing this array of applications helps you envision what might be possible in your shop. For example, you can see how a 3D scan could be used to help reverse engineer parts or adapt something in one of your systems, or how you could use scanning for inspections.

How to Prepare Your Company for an Automation Initiative

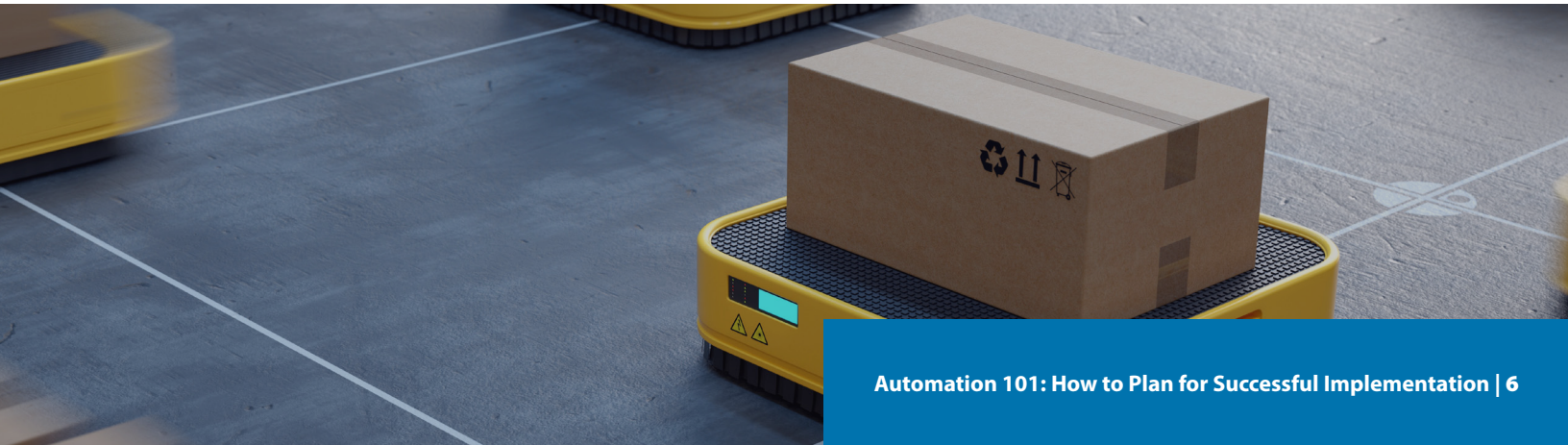
Automation is about people, processes, and technology. The technology helps you leverage the process change, but it is dependent upon the people. Some people are technically savvy and immediately see potential in automation, while others may worry that automation will eliminate their jobs. To prepare your people, you should:

- **Communicate why you need automation.** Your company may need automation because you can't solve workforce and productivity issues with more people, so upskilling the current staff is critical.
- **Rally the troops.** You must be able to articulate the connections between new behaviors and organizational success. You also must help everyone through the implementation, which doesn't really end until the staff has replaced old habits.

Let's look at five key steps to prepare your company for an automation initiative.

1. Form a Strategic Vision

You want to show a clear path for success — for the operation — and for each individual. This step can be difficult for many manufacturers who regularly struggle with how to bring strategy into such a tactical environment. Account for your company's core values. Articulate what people will be working on, and what they will not be working on. Think about this as a series of initiatives. What are you going to do with legacy machines? What about data? How are you going to analyze all the data you will be capturing?



2. Communicate What's at Stake

This early step requires a delicate balance to ensure people grasp the threats and impact of not evolving, as well as understanding the big opportunities ahead. Your goal at this stage is to inspire people to work together outside of their comfort zone. Be honest and open in gathering feedback. Involve key people to understand their concerns. Eventually, everyone involved will ask, "What's in it for me?" Keep an eye on the burdens of day-to-day activities, as you do not want to detract from ongoing operations.

3. Enable Actions by Removing Barriers

Your organizational structures and processes will need to change to accommodate technology adoption. Perhaps you can establish a task force to collaborate across silos and generate impact more quickly. Be sure to recognize the significant shift employees are asked to make. Demonstrating appreciation for new behaviors incentivizes broader adoption throughout the organization. Also, breaking down some barriers will require financial investments — such as with additional equipment or software — or a change in responsibilities for key people in the initiative or additional resources. The first time one of your existing lines shuts down from a disruption, will you have to take key people off the automation project to troubleshoot?

4. Generate Short-Term Wins

An automation project can take many months, so find ways to break down long and involved stages into segments or activities that can be measured. It might be the first time you reach a certain threshold on your way to a final goal. Be sure to celebrate early wins and frequently reward contributions, even if they seem small, to help people see value. Initiative fatigue is real. You don't want to lose momentum.

5. Sustain Acceleration

While each achievement gains you credibility and motivates the team, setbacks are inevitable (and often beyond your control). A passionate leader and strong project manager are keys to maintaining focus and discipline through disruptions. Make sure to evaluate systems and processes and reinforce new behaviors. Continuously measure and adjust accordingly, always connecting change to success.

Address Potential Gaps in Skills, Capabilities, and Infrastructure

Manufacturers should be aware of one major factor when it comes to leading an automation initiative: Managing change and all of the uncertainties associated with it requires different skills than supervising an operations line. If this is out of your comfort zone as a manager or leader, you have several options for how to approach this management challenge. You can bring in someone with experience in implementing automation or you could provide a current supervisor with specialty training in change management.

There are other areas to assess in your infrastructure and capabilities. Consider:

- **Maintenance resources:** Many smaller manufacturing operations don't have a maintenance department; they run lean and rely on experienced operators to fix things. For automation, maintenance capabilities are a cost of doing business.
- **Computer and network communications resources:** Many smaller manufacturers do not have onsite IT personnel or dedicated OT resources. You can use contract help or a managed IT provider, but as you add more automation you will need someone who understands industrial controls. You may not need a full-time IT person for your initial automation project, but you will need a contractor.
- **Cybersecurity:** Automation means a significant increase in your connectivity and sensors to collect data. Additional cybersecurity becomes another cost of doing business.
- **Servers and backup systems:** While your initial automation project may not require a shift in your computer network setup being on-site or off-site, you might want to evaluate longer-term options as you add more automation to your operation.

Your local MEP Center can help you assess your infrastructure and capabilities.

Wisconsin MEP Helps Company Use Robotic Welding Cell to Alleviate Bottleneck

The Situation

A manufacturer that does a wide variety of metalworking had a process bottleneck involving a wire sub-assembly. In its process for making circular metal frames, a machine operator had to pull a wire form out of a machine and put it into another machine so it could be welded to close the wire loop and provide additional functionality for its various uses. Not only was it a bottleneck, it was a safety concern that escalated to a major business risk.

The Solution

Wire and wire spot welding are challenging automation applications, which would require a custom provider with specific capabilities. At the Wisconsin MEP's suggestion, the client invested $7,500 in a feasibility study. This included a systematic search that took nearly six months to find the right vendor to build a custom cobot cell that would grab the metal object, move it, and then weld it. The initial project was a $107,000 investment for one cell. The feasibility study was a good way to gain confidence with the automation/technology vendor to prove capability and reduce project risk. The automation cell was an immediate success, and the client quickly added two more automation cells.

CHAPTER 3
Choosing the Right Automation: Start With an Assessment

When you are ready to begin your automation journey, an automation readiness assessment is a good place to start. This involves a comprehensive review of your operation to identify opportunities for automation and also what inefficiencies need to be addressed before a process can be automated. Your local MEP Center has experts who can guide you through this assessment to ensure you're on the right track.

Automation has its roots in lean manufacturing. We recommend that you first map out your processes to identify and eliminate waste before considering automation. Automating a process without addressing inefficiencies can lead to bigger problems down the road. If your process is not streamlined, automation could simply amplify those inefficiencies, making them harder to address later.

One key consideration is the "opportunity cost" of automation choices. You want to minimize wasted movement in your facility, as increases in output or growth could potentially lead to backlogs, jeopardizing your delivery times and customer satisfaction.

An assessment not only helps you identify these issues but also allows you to visualize the potential future state of your operations. For example, automating inspections could free up capacity to take on additional work from a customer. But it's important to remember that the benefits of automation go beyond just labor cost savings. The assessment also factors in the costs of new equipment and your projected payback period, helping you make informed decisions.

As we've discussed, many small manufacturers operate in HMLV environments, which can make adopting automation more challenging due to smaller batch sizes, frequent product changes, and limited resources. However, with the right approach and support, automation can still be a powerful tool for streamlining your operations and staying competitive.

An automation readiness assessment can help identify "flexible automation" solutions, such as:

- **Interchangeable robotic arms, grippers, and end-effectors**: These can be easily reconfigured for different tasks.
- **Automated guided vehicles (AGVs):** These vehicles can be programmed to follow different paths and transport materials between workstations, allowing for flexible material handling.
- **Flexible tooling for CNC machines:** These tooling systems can quickly switch between different tools and processes.

Select an Automation Project You Can Build On

Another consideration for choosing the right automation solution is addressing processes with low complexity. Think of this as low-hanging fruit — it is within your reach so it is easy to grab without additional resources. Change is hard, so start with something you can build upon. This might be a learning opportunity before taking on more complex and impactful processes. Adding a collaborative robot (cobot) to work side-by-side as a human assistant is an increasingly popular first step. Cobots are easy to program and can be used for tasks that would typically require a person to stand for long periods at a machine or workstation.

Use this approach to guide your strategy, especially if your shop has struggled with "change dynamics" related to other aspects of your operation. Here are a handful of considerations as you get started with automation:

- **Quick wins**: These are similar to low-hanging fruit in that they are often less complex processes, but they can have a greater impact. A quick win may require new equipment or some resource allocation, but it gets the attention of skeptics and motivates early adopters. It also may allow you to repurpose an employee into higher-value tasks. Don't underestimate the potential boost in morale.
- **Address highly visible areas:** Everyone in the shop is aware of long-standing challenges such as wasted movement, housekeeping issues, and the imbalance of operations that leads to a bottleneck. Successfully addressing highly visible problems can improve efficiency, morale, and create momentum for further improvements.

- **Low or moderate disruption to existing processes:** This could help you choose between similarly graded applications for impact as an initial jumping-off point. One option might involve a new material handling system, plus a robot arm. Whereas a second option may be a machine tending system without the need for new conveyors or frequent material movement, which would be more disruptive to implement.
- **Phased rollouts:** This can be particularly helpful when a company is doing a large portion of the installation and programming themselves. Trying to automate 100 percent of every task in a work cell will almost certainly be more painful, and take longer, than a semi-automated first step with the long-term goal of full automation.

Use Automation to Repurpose Employees Into Higher Value Work

Consider starting with low-value "D" tasks (dull, dirty, difficult, dangerous). This approach often focuses on line operations with applications such as machine tending, pick and place, or palletizing.

Automation can be a win-win from an efficiency/workforce perspective, as well as providing staff members with higher job satisfaction and improving retention. Four possibilities for automation that will allow you to repurpose employees to higher-value tasks include:

- **Autonomous vehicles and loaders:** Repurpose someone who is moving materials from the warehouse to the shop floor.
- **Quality inspections:** A robotics arm, with a camera to inspect parts, frees your employee to focus on more advanced tasks.
- **Machine monitoring:** Make your data work for you, and repurpose someone from operating one machine to monitoring an entire production cell or several machines at the same time.
- **Machine tending:** A robotic arm, with the correct end-effector, can help load and unload high volume/low mix parts to and from CNC machines, freeing the operator for more technical and hard-to-automate tasks.

Be Sure to Factor Your People Into Your Initial Automation Project

Many manufacturers know they need to invest in automation, so they buy their first cobot after seeing a demo of all the things it can do. They assume they can find a place for it in their operation. But if they haven't thought through all of the related impacts on their people and processes, their chances of automation implementation success are diminished. This is why you will want to factor in your people and their skill sets into the automation implementation, operation, and support. This includes answering questions such as:

- Who is going to build, install, and integrate the system? Will you do it in-house or hire an integrator?
- Who will teach your operators? You can program motion, but can your robot talk to tooling, grippers, etc.? Do you need to bring these automation skills in-house?
- How will you incorporate automation applications into your system so people on the floor know how to respond if a machine is down or operating at less than peak efficiency? If a dashboard is "in the red" — indicating ongoing issues — will your people feel empowered to take action?
- What will you need to support this automation long-term so you are not dependent on vendors?

The 10 Most Common Applications for an Initial Automation Project

To help you in your decision-making process, start by making a process map of your operations to confirm what causes variations and issues. This will help you determine what types of tools or automation may be in order. The most common applications are:

1. Grinding and surface prep
2. Welding and weld prep/cleanup
3. Painting and finishing
4. Pick and place for CNC
5. Pick and place for packaging or box erecting
6. Machine tending
7. Material handling
8. Flexible feeders
9. Autonomous vehicles and loaders
10. Quality inspections

Cobot or Robot?

How do you know if a process can be handled by a cobot or an industrial robot? Consider:

- Cobots are designed for safe human interaction, generally operate at slower speeds, and have lower payload capabilities. Ideal cobot applications include:
    - Loading or moving lightweight boxes
    - Bin picking with a gripper
    - Tape dispensing and similar repetitive motions
    - Machine tending
- Industrial robots typically offer higher speed and payload capacities, making them suitable for heavy-duty operations, such as:
    - A dangerous welding application
    - Painting that emits hazardous chemicals
    - Lifting heavy bags

New Mexico MEP Helps Implement Robotics So Artisans Can Do Custom Work

The Situation

Syzygy Tile Works in Silver City, New Mexico, produces high-end handcrafted ceramic tiles, which set them apart from high-volume/low-mix competitors. They were under pressure to shorten their turnaround time of up to five months per order to a maximum of two months and to triple capacity. The challenge for the owners was it took as many as three years for workers to fully learn the craft of glazing with up to three colors for unusual shapes. But only a portion of the work was custom.

The Solution

The New Mexico MEP brought in a computer-controlled robot to the facility, calibrated it for the glazing operation, and for three days tested its ability to do the simple, routine work to speed up production, leaving the complex work to the artisans. The robot relieved the bottleneck in the glazing operation, which has resulted in cutting waste by 30 percent and increasing output by 20 percent. The staff, which can now concentrate on the more difficult custom work, has embraced the robot and even nicknamed it "The Money Maker."

CHAPTER 4
Set Proper Expectations for Long-Term Success

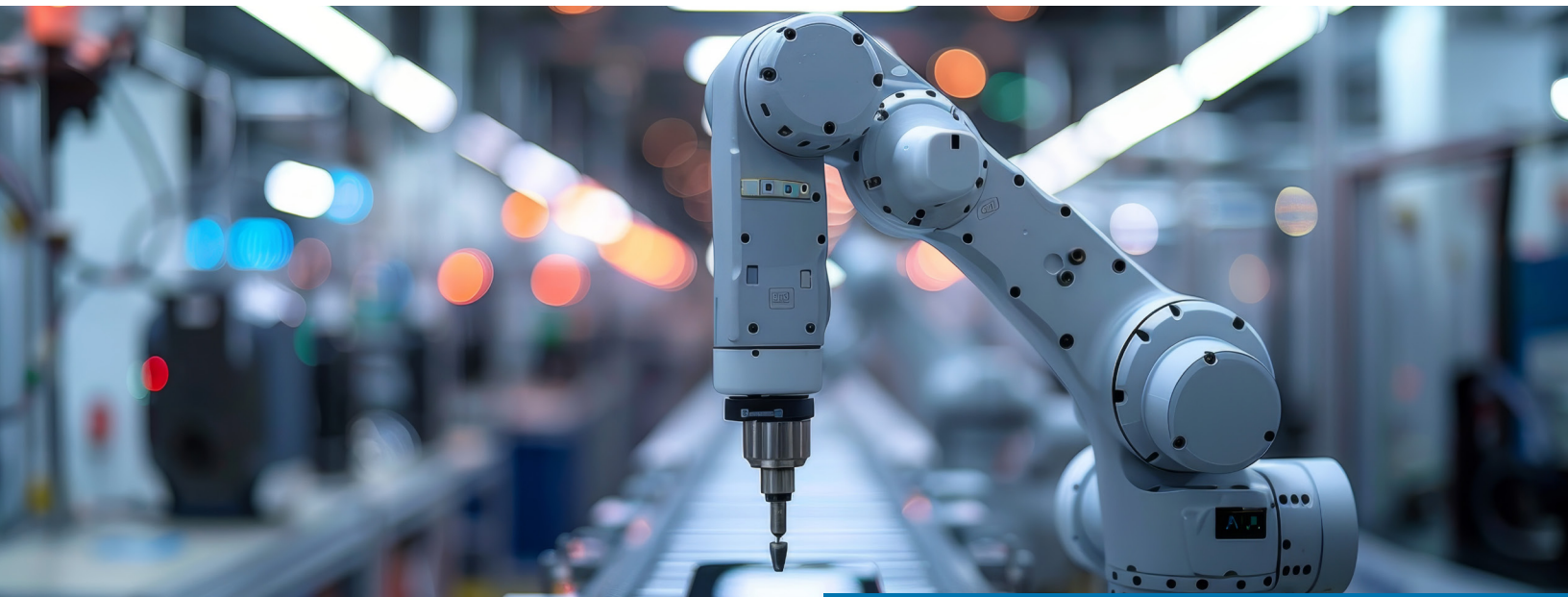
The best automation projects involve a systems approach to adoption. With clear goals in mind, you can build a system around the new technology. Doing "A" will allow you to address "B" and so on. It's part of a big-picture transition that provides more opportunities moving forward and more impactful ROI. A "one-off" or isolated task has limited impact and is less likely to succeed.

It's imperative to set yourself up for success, even if it means slowing down. For example, structuring one system or process for the first time can take several months. But if you do it right, the machine can often pay for itself in six months.

Once the system and processes are ready, you often can get a robot running in a couple of days. This is another area where your local MEP Center can be a great asset. They can help you design a complete system rather than just installing a single solution, which is often the focus of some vendors who are more concerned with getting the application online quickly.

Be realistic. Some practical considerations for automation success include:

- Plan for delays and bugs. Some new machines work right away; most do not.
- Tuning and perfecting your process requires a continuous improvement mindset. If you do not have a continuous improvement program in your facility, automation implementations can be more difficult.
- For some manufacturers, leveraging your manufacturing execution system (MES) will be the most productive, immediate step to set you up for later success with automation. An MES links your production floor to your front office.



- Many companies plan for 12-18 months to reach full production. Build on success. It's better to be the slow-and-steady tortoise than the easily distracted hare.

The First Automation Project Is the Most Difficult

The cost of entry for your first automation project, and the time needed for implementation, will almost always be higher than for subsequent projects. Keep in mind:

- Additional new resources for automation are already in place for subsequent projects, such as programming skills.
- A second, third, or fourth implementation of the same automation process will be much easier. You have proof of concept.
- Your teams will have experienced a learning curve from the initial project, which means more confidence and the ability to put "lessons learned" to use.

Purposeful leadership and organizational readiness are crucial for success in implementing new technology. Experts at your local MEP Center can help you prepare your leadership team to drive transformational change throughout your organization.

Getting Started

1. Set goals

Your business goals should drive your decisions.

- Link the initiative to financial performance.
- Address a bottleneck or key pain point, such as automating a task no one wants to do.
- Use a systems approach; "one-offs" will have much less long-term impact.
- Have a plan before getting a quote.

2. Vet scenarios

Take steps to reduce anxiety and increase buy-in from your staff.

- See automation demonstrations.
- Develop a test case for an in-house trial.
- Consider bringing in a cobot for hands-on experience.

3. Start slowly

Ensure success by being thorough as you map out the process. Account for:

- Installation and integration: Are you doing this in-house or outsourcing it to a specialized integrator?
- Operator training: Who will train your staff to operate and maintain the new system?
- Long-term support: How will you maintain and support the system so you are not dependent on a vendor?

Montana MEP: Initial Robotic Loading Success Leads to Additional Projects

The Situation

Diversified Plastics, Inc. (DPI) of Missoula, Montana, offers comprehensive services from urethane casting, thermoforming, machining, and injection molding to designing, engineering, and tool and die services. DPI was interested in automating some of its labor-intensive processes, with goals of improving output and product quality, while also reducing the reliance on trained machinery operators during a period of workforce shortages.

The Solution

DPI worked with the Montana Manufacturing Extension Center (Montana MEP) to secure a $6,000 Industry 4.0 Automation grant, which enabled a comprehensive site visit and assessment by a technology engineering specialist. DPI deployed a collaborative robot, automated water bath conveyors, and injection molding overhead robots to automate the loading and unloading of the injection molding machine in a manual swaging process (forging). The project's success
prompted them to make another investment with a fully automated cable and part-loading system for one of their injection molding machines.

CHAPTER 5
The MEP National Network Is Here to Help

Every day, MEP experts around the country help manufacturers find the solutions they need. The MEP National Network has helped U.S. manufacturers produce real impacts for business growth — such as new automation initiatives — for more than 35 years.

The MEP National Network's ability to serve manufacturers depends on support from the entire manufacturing ecosystem. We work with local and federal government, workforce development organizations, educational institutions, economic development organizations, and federal labs, among others, to provide manufacturers with the resources and support that meet each firm's unique needs.

The manufacturing technology consulting services available through the MEP National Network can serve as your guide to affordable, easy-to-implement technologies that can boost productivity without major risks. See below to learn what technologies exist and if they are a good fit for your business.

- Advanced Manufacturing Technology and Industry 4.0 Services
- Robotics and Manufacturing Automation
- Articles on Advanced Manufacturing and New Technology Trends From Our Manufacturing Innovation Blog

Connect With the MEP National Network

If you are interested in learning more about the MEP National Network or how to work with us, please email mfg@nist.gov. You can also always contact your local MEP Center to speak with a manufacturing expert, ask questions, or to learn about the resources and support in your area.

Contact your local MEP Center

MEP National Network™

The MEP National Network is a unique public-private partnership that delivers comprehensive, proven solutions to U.S. manufacturers, fueling growth and advancing U.S. manufacturing.

Focused on helping small and medium-sized manufacturers generate business results and thrive in today's technology-driven economy, the MEP National Network comprises the National Institute of Standards and Technology's Manufacturing Extension Partnership (NIST MEP) and 51 MEP Centers located in all 50 states and Puerto Rico.

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