READY ROBOTICS

Enabling Smooth Digital Transformations **in Physical Production Environments**

Introduction

The ultimate purpose of digital transformation is to leverage new technologies and processes to fundamentally improve how an organization operates and delivers value to customers.

Much has been written about the need for enterprises to engage in digital transformation, including how difficult it is to successfully implement across an organization. A McKinsey study published in October 2018 found that of 1,521 organizations surveyed, only 17% reported successfully implementing a digital transformation within their enterprise. While this has certainly improved with more organizations investing in digital transformations to address supply chain issues created by the pandemic, most of the successful digital transformations have traditionally involved technologies already tightly coupled with IT infrastructure, such as cloud, mobile, and web technologies. Conversely, digital transformation leveraging production technologies consistently occurred the least. Of organizations that successfully executed a digital transformation, only 21% did so with robotics and 13% with additive manufacturing.

In this whitepaper, we will examine the challenges you may encounter when executing digital transformation involving manufacturing equipment, such as robots, in physical production environments, as well as potential strategies for overcoming these challenges.

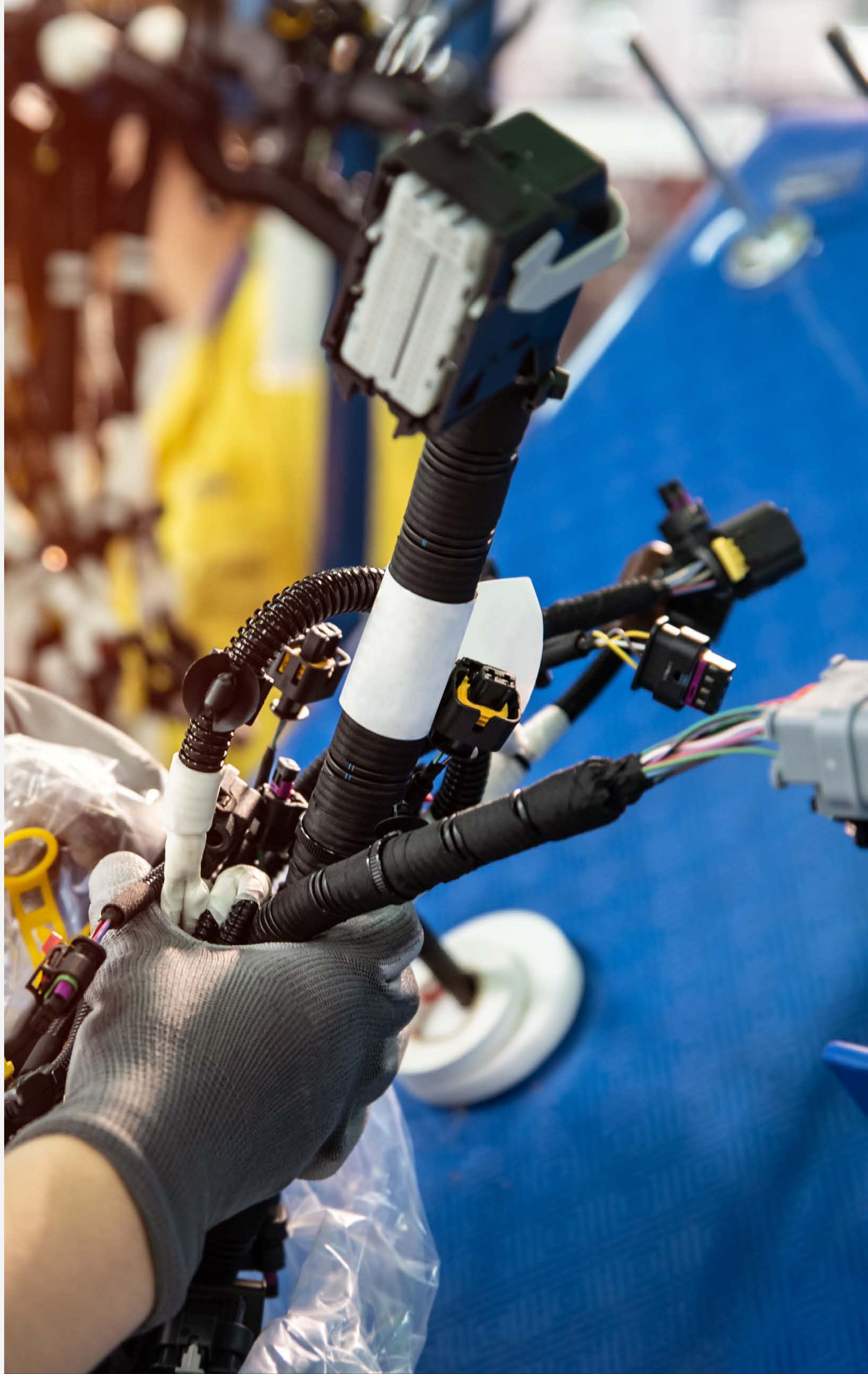
Why is digital transformation so difficult in physical production environments?

There are many factors involved in automating physical production. Here are seven reasons it can be difficult to succeed with digital transformation in a physical production environment:

1. Items require careful and/or dexterous manipulation
2. The production environment has a tremendous amount of variability that only humans are well-suited to handle
3. Changeover occurs frequently
4. Existing equipment from legacy vendors can lack digital controls
5. Individual tasks are automated, but there is no digital thread for the process
6. Programming interfaces for manufacturing equipment are highly fragmented
7. Robots are hard to use

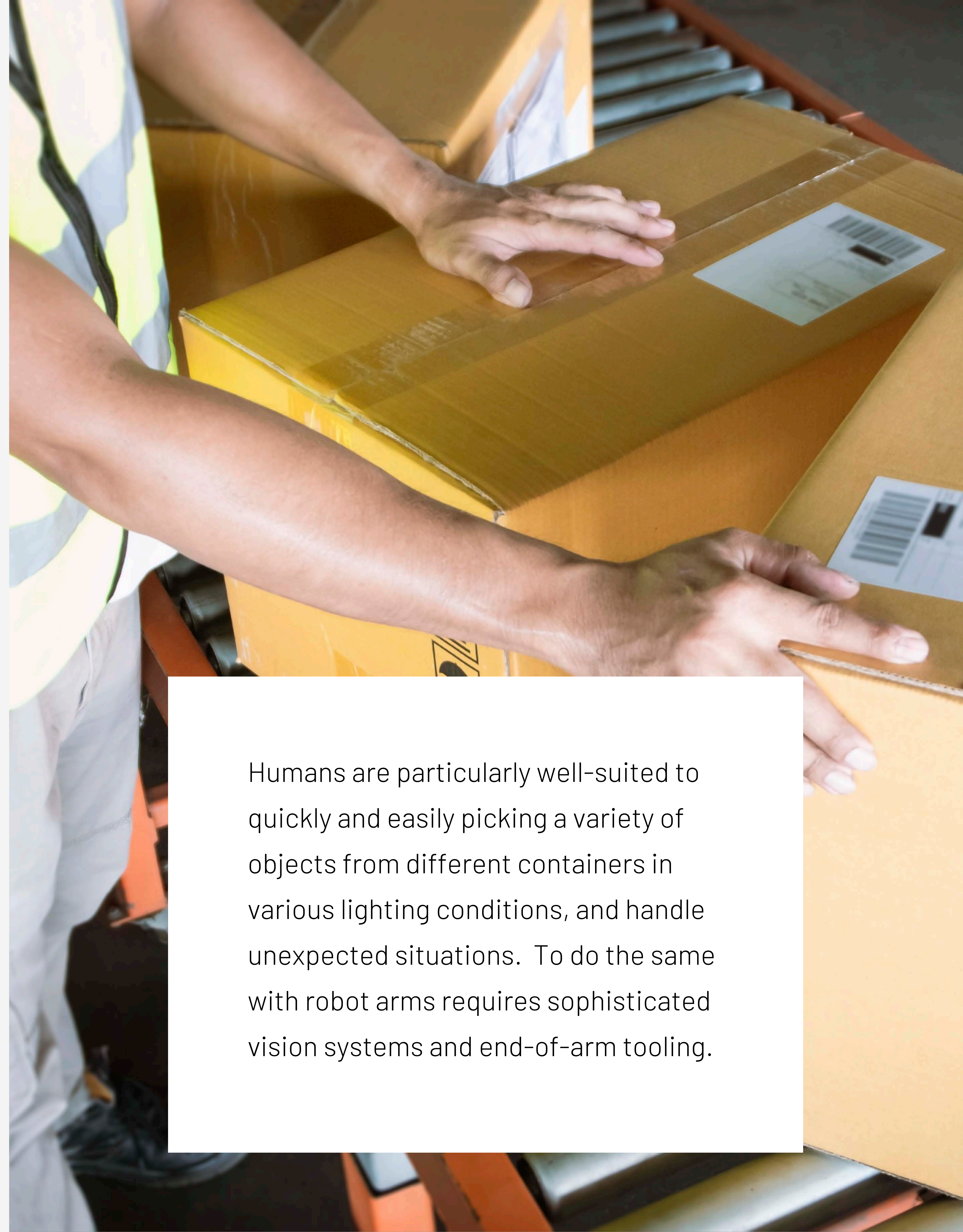
Items require careful and/or **dexterous manipulation.**

There are still classes of tasks for which robot arms are not easy to deploy, especially for tasks that involve dexterous manipulation of easily deformable workpieces, such as winding cables or threading wires. It's important to go into a digital transformation with a realistic perception of what tasks can be reasonably automated, since not all tasks are good candidates. Often the most simple tasks, such as filling a shipping pallet or loading parts into a machine, are the best tasks to automate.



The production environment has a tremendous amount of variability that only humans are **well-suited to handle.**

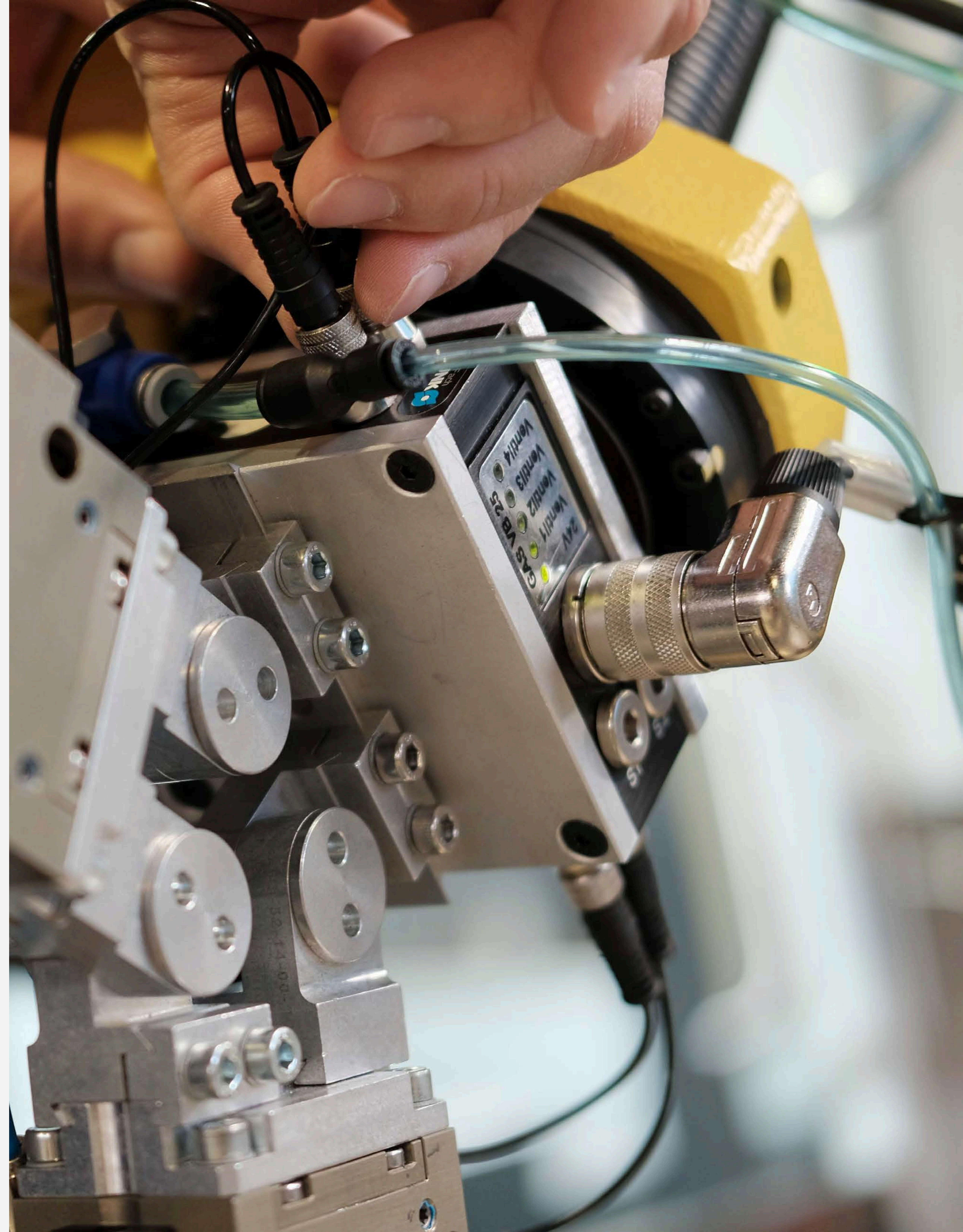
This can take many forms. Maybe boxes of items are delivered jumbled in a container. Perhaps the containers themselves arrive in an irregular pattern. Or containers are stored in a haphazard fashion. Humans can easily account for such variability, such as a shipment arriving five minutes late, or a box being delivered to a workstation an inch to the left of where the last box was placed previously, or a handing a box that has been damaged in the transportation process.



Humans are particularly well-suited to quickly and easily picking a variety of objects from different containers in various lighting conditions, and handle unexpected situations. To do the same with robot arms requires sophisticated vision systems and end-of-arm tooling.

Changeover **occurs frequently.**

It may be monthly, weekly, daily, or even hourly, but if regular changeover is required for the same equipment to produce different items, this increases the difficulty in digitalizing production. If end-of-arm tooling must be changed as well for every new item, this will increase the difficulty of automating. It's worth noting that with recent advances in automation tools, high-mix low-volume environments are no longer ill-suited for automation.



Existing equipment from legacy vendors can **lack digital controls.**

Although some equipment has long had digital interfaces, much equipment relies on a human physically operating a control system. Push buttons can be physically automated with pneumatics and controlled digitally. On the other hand, devices that require the manipulation of handles, knobs, levers, touchscreens or a keyboard and monitor can be significant obstacles to a digital transformation. Beyond manipulating the physical hardware, it is extremely difficult to get data from/to legacy systems that are ubiquitous in manufacturing and haven't been designed with an IOT or digitalization point of view.

Individual tasks are automated but there is **no digital thread for the process.**

The information to successfully fabricate a product can exist in "hard" copy, as a process document, procedure, best practice document or standard. Oftentimes though, this information is also housed in the workers and professionals that perform that process and is not strictly documented. This knowhow, built from years of setting up and running the process, is locked away in the mind of the operator, line manager, controls engineer, maintenance personnel, or other individuals that are responsible for the process.

In 2019, 50% of manufacturing workers were older than 44 years old, skewing heavily toward retirement age. In the coming years, as these millions of workers retire, they will take with them decades of valuable (some might say, priceless) expertise and know-how.

Programming interfaces that do exist for **manufacturing equipment are highly fragmented.**

For equipment with digital controls, such as CNC machine tools, programmable logic controllers (PLCs), and robot arms, the programming interfaces have not significantly advanced beyond OEM firmware. Whereas programming interfaces for IT equipment advanced to standardized software platforms operating above firmware, most interfaces for manufacturing equipment are still the firmware-based ones provided by the OEM. This fragmentation hampers the ability for pure software developers to build solutions in a scalable fashion.

Robots are **hard to use.**

Despite significant advances in robots over the past few decades, programming hasn't gotten much easier. With over 70 robot OEMs, each with its own proprietary programming language, robots are plagued by fragmentation and complexity. The highly fragmented robot programming environment prevents someone who knows how to program one brand of robot from operating robots from other OEMs. Proprietary robot programming languages are generally complex and highly technical. Consequently, they have a very steep learning curve. Visual, "no code" programming that has transformed technology sectors by empowering exponentially more people to "program," is extremely rare in robotics.

Strategies to Consider When Starting a **Digital Transformation** Initiative using Robotics

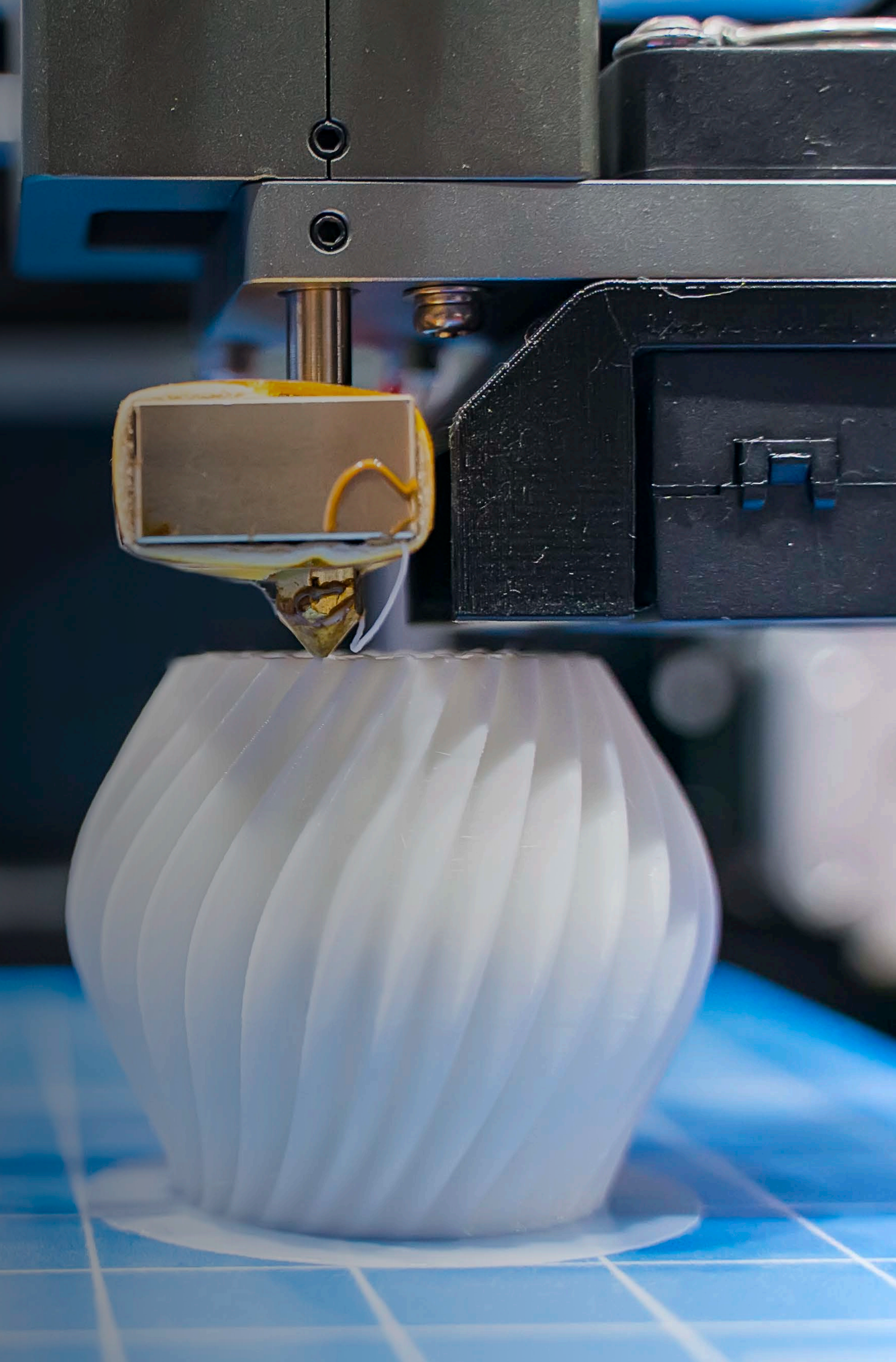
1. Build your organizational acumen for automation.

According to McKinsey, organizations that implemented enterprise-wide workforce development goals related to their digital transformation initiative were twice as likely to succeed than those that did not. Henry Ford didn't invent the car, but he did invent the factory that was able to mass produce them. To succeed in the long-term with robotics, automation design and implementation must become a core competency for your organization. Scaling up with automation work cells, especially those involving robot arms, requires skills in software development and hardware design. On the bright side, developing institutional knowledge around automation design and implementation is easier than ever with new resources like READY.Market (a single online resource manufacturers can use to research complete robotic automation solutions), and READY.Academy (an online automation education platform covering cell design, safety, parts presentation, end of arm tooling, robot programming, and more). Outsourcing automation knowledge remains a viable option, but it typically results in higher costs, and designs that are developed by third-parties who are not as familiar with your production processes as your team.

2. Aim for flexibility in the beginning.

McKinsey found that equipping your team with self-serve tools made digital transformations twice as likely to succeed. One such self-serve tool that provides a significant amount of flexibility in robotics are 3D printers. As your organization starts designing solutions, giving your automation team the ability to quickly modify hardware setups in the beginning is paramount to success. Tools such as 3D printers can be extremely useful for allowing rapid experimentation with hardware designs, especially for tooling and fixturing. Well-designed tooling and fixturing ensures robot arms can consistently pick up items that are consistently presented to the robot work cell in the same fashion, and it may take several iterations to develop an optimized design. Reducing the time of each iteration cycle will allow your team to more quickly achieve an optimal solution.

Additionally, no code programming interfaces such as Task Canvas from READY Robotics, enable robot work cells to be quickly reprogrammed without specialized knowledge. (Learn more about no code programming in our whitepaper, The No Code Revolution.) By using such a no code interface, you enable domain experts to impart their expertise into the automation task without needing them to be skilled in a robot programming language. According to Julie Shah, a professor at MIT, empowering workers with domain expertise leads to better outcomes with automation[2]. She states however that the OEM programming interfaces "...are designed to be programmed by people who understand robots," which hampers successful implementation. No code programming interfaces help overcome this issue.

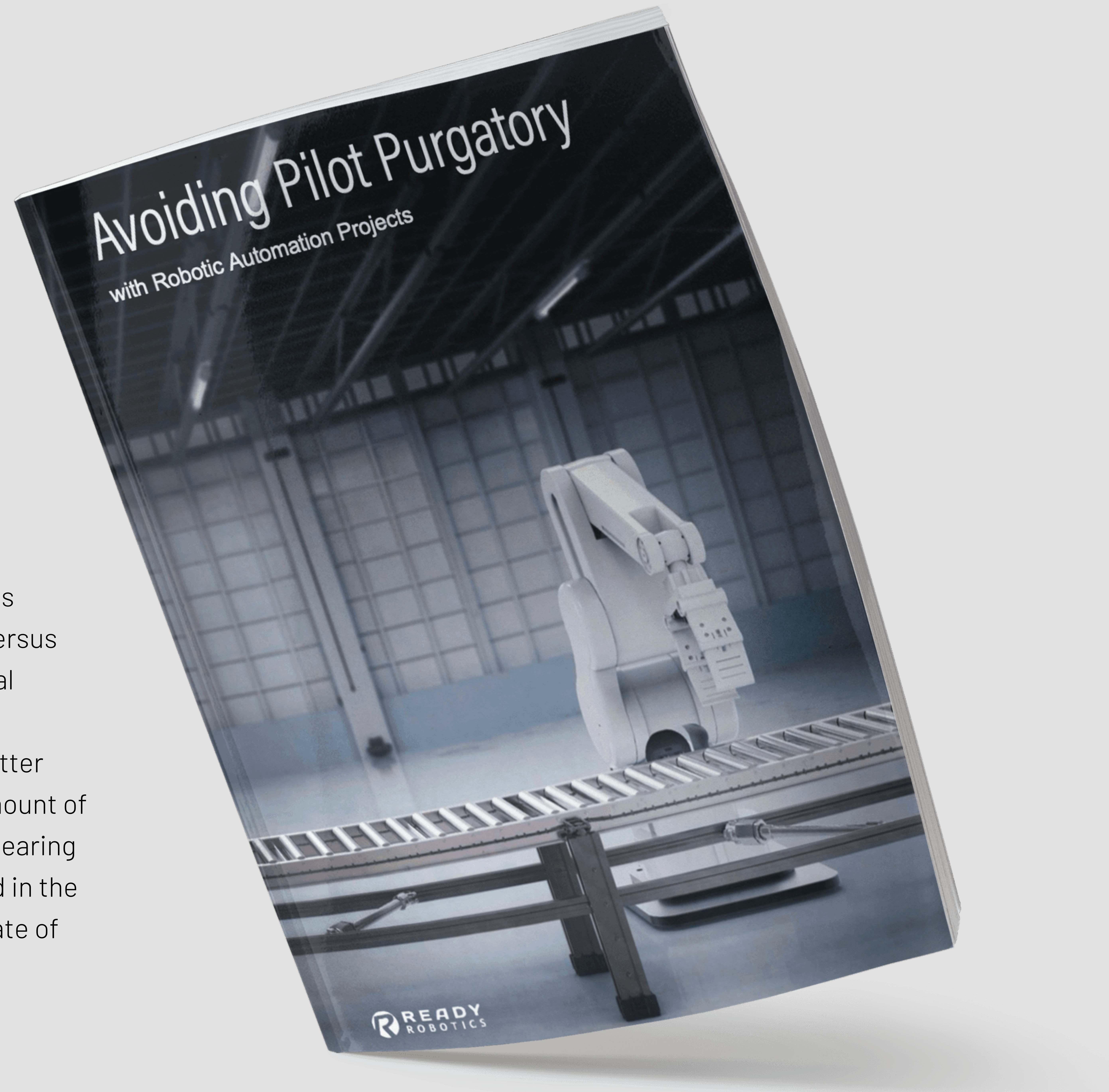


3. Tailor your environment to make it easy for robots.

The more that variability is removed from a production environment, the better the outcome with robotic automation. Reducing complexity for robotic systems will result in a higher likelihood of repeatable success. For example, if your process allows it, instead of implementing a complicated and expensive machine vision system for bin picking, consider modifying workflows such that items get singulated for easier picking by a robot arm. The ultimate goal of automation should be achieving consistent, high-quality output of the items your organization produces.

4. Don’t over-automate.

Getting this one right is critical to the success of your digital transformation with robotics. All individual automation projects involve a careful consideration of the benefits of automation versus implementation cost. The most important aspect of your digital transformation initiative should be avoiding the allure of over-automating. There are still many tasks for which a human is better suited than a robot, primarily ones that require a significant amount of hand-eye coordination or complex sensory feedback (such as hearing a connector click into place and feeling it become firmly seated in the receptacle). We cover techniques for improving the success rate of automation pilots in our whitepaper, Avoiding Pilot Purgatory.



5. Eliminate software fragmentation with a common platform.

A 2019 report on industrial robotics by McKinsey found that for organizations scaling or trying to scale with robotics, 41% reported the lack of a common programming interface[3] as a top challenge to success. Implementing a common software platform such as READY Robotics' Forge/OS 5 eliminates fragmentation for robot programming. Instead of staffing up with engineers that can program in OEM-specific robot programming languages, your organization can hire software developers. Your software developers will be able to build applications that scale across all the robots in your organization, regardless of brand.

6. Choose tools that empower your team to succeed.

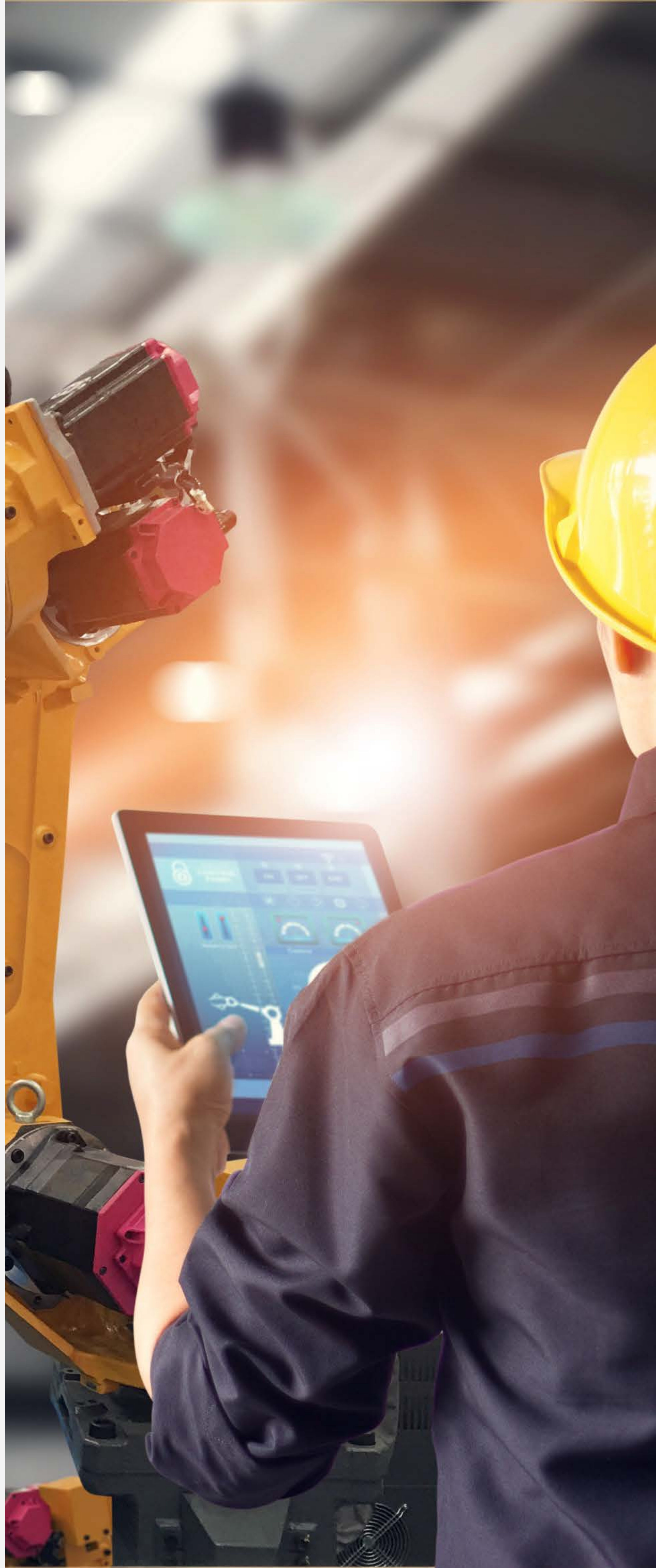
Automation is complex. This is why it remains largely underutilized outside of verticals like tier 1 auto manufacturers. By deliberating choosing automation hardware and software that your team can more quickly become proficient with, your team is much more likely to succeed with automation. Recently, getting started in automation might mean automating with a user-friendly cobot - which offers improved usability that makes automation accessible to those without automation expertise. With new software like Forge/OS and Task Canvas from READY Robotics, a universal operating system for industrial automation and an intuitive, no-code programming interface respectively, deep automation experience is no longer required in order to program and deploy automation. Now, manufacturers can control robots from many top brands, as well as the peripheral hardware in an automated work cell, with a single, intuitive programming interface that doesn't change from one brand to another.

Conclusion

From the skilled labor shortage to the fragile supply chain, there are many reasons that automation is more important than ever. Recognizing this, and taking action on it are two different matters. The digital transformation can be especially challenging in the physical production environments facing manufacturers. That said, with the right plan of attack, a digital transformation is possible in even the most challenging production environments.

By investing in building internal acumen around automation, manufacturers can double the chances of success with automation. By consciously aiming for flexible solutions, organizations can shorten the development cycle necessary for any automation design/deployment - more quickly achieving optimized automation processes that are virtually impossible to achieve without some degree of trial and error. By optimizing the physical environment around the inherent limitations of robots, manufacturers can greatly improve accuracy, consistency, and repeatability of a robotic automated process. By starting with the right tasks, and not over-automating out of the gate, manufacturers are much more likely to achieve successful automation that they can then build on. Remember, not all tasks are equally viable automation candidates! By deploying automation around a single universal platform capable of controlling robots and hardware from different brands, the learning curve for programming automation can be greatly reduced. Lastly, by deliberately choosing automation hardware and software that is more user-friendly, manufacturers can empower their process experts, who probably aren't robot programmers, to own their automation.

Taking all these strategies to heart when embarking on a digital transformation, organizations of all sizes and technical backgrounds can significantly minimize the growing pains associated with a digital transformation in a physical production environment.



Citations

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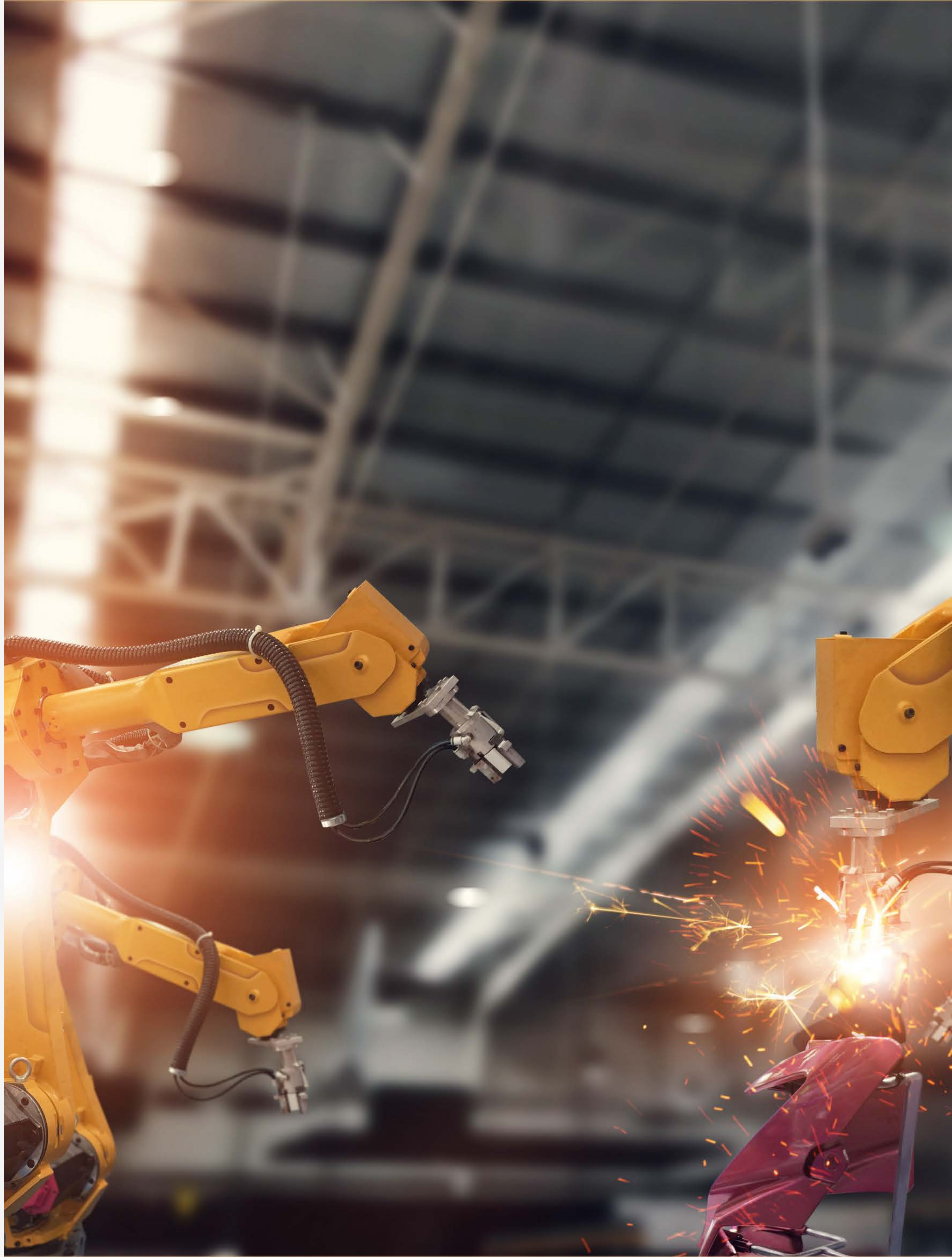

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