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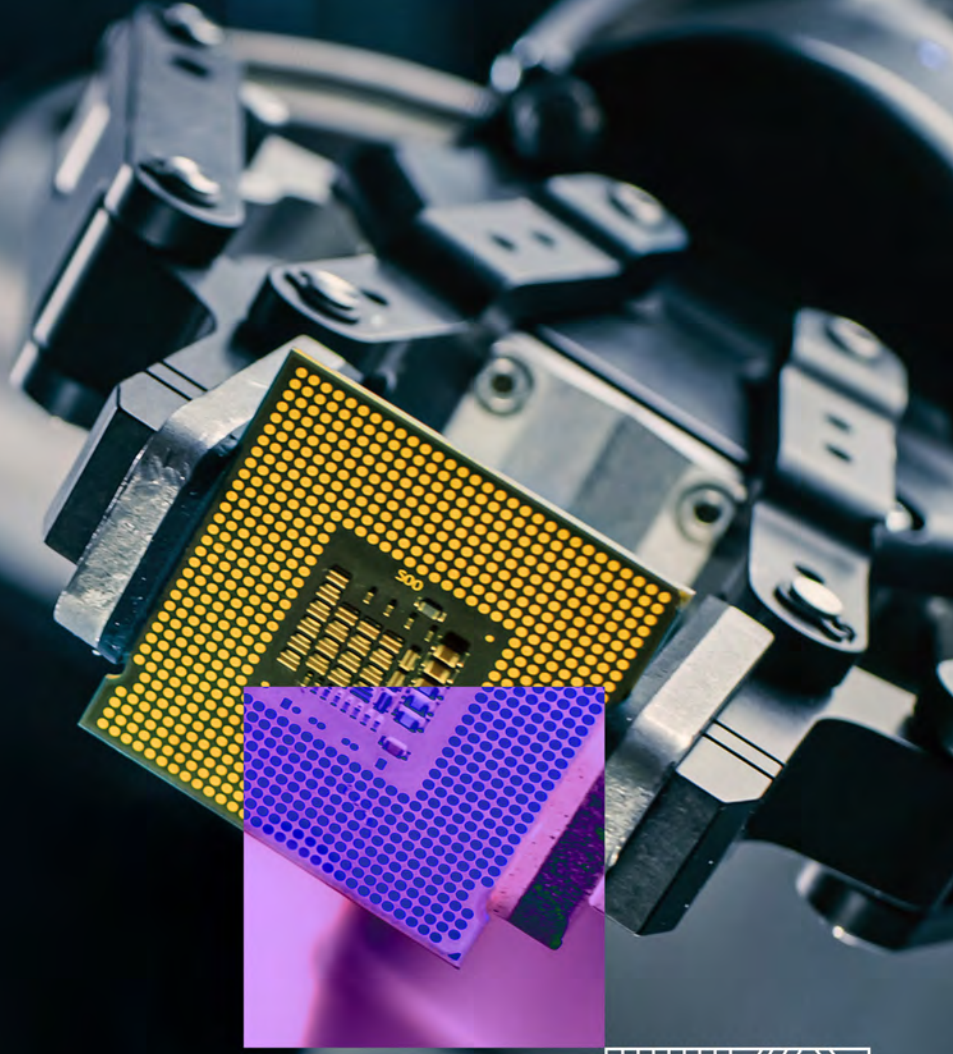


Get started with autonomous systems:

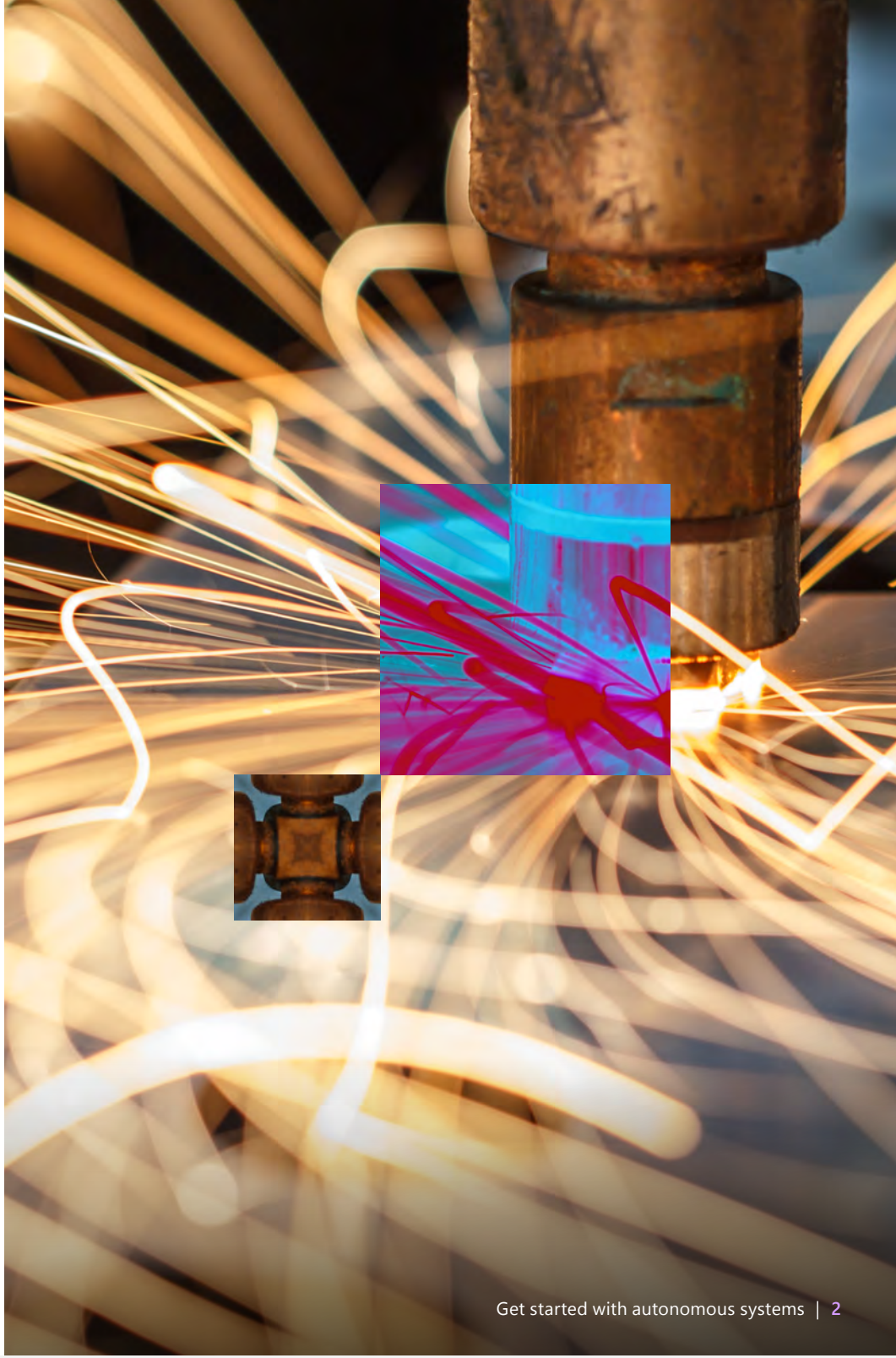
A manufacturer's use case selection guide

Introduction

From cloud-based resource planning solutions to fully automated infrastructures, modern tools have ushered in a new generation of manufacturing processes.

Autonomous systems present manufacturers with an opportunity to improve quality, increase productivity, and drive performance. Unfortunately, many companies face these opportunities for advancement with a growing list of questions:

- With dozens of controls and processes across the factory floor, what stations warrant autonomy?
- What process improvements would most dramatically affect efficiency and safety?
- What implementation areas show the highest return?



Use cases for autonomous systems

We identified four **optimization opportunities** manufacturers can explore to get started with autonomous systems:

- Yield
- Chemical Processing
- Logistics
- Commercial energy systems

These four areas represent some of the best opportunities for adding AI-powered automation for modern manufacturers. Producing consistent product, with reduced downtime and less wasted product, directly affects factory profits and efficiency.

By empowering operators to improve decision making, autonomous systems represent an accessible solution for modernizing manufacturing practices.

Why these use cases?

It's often an overwhelming experience to institute a new methodology.

Not every system or process requires the help of AI. But, at its core, autonomous systems offer unique characteristics that make it optimal in a multitude of scenarios. As factories consider starting with autonomous systems, the best use cases address the following factors:

Multiple process variables

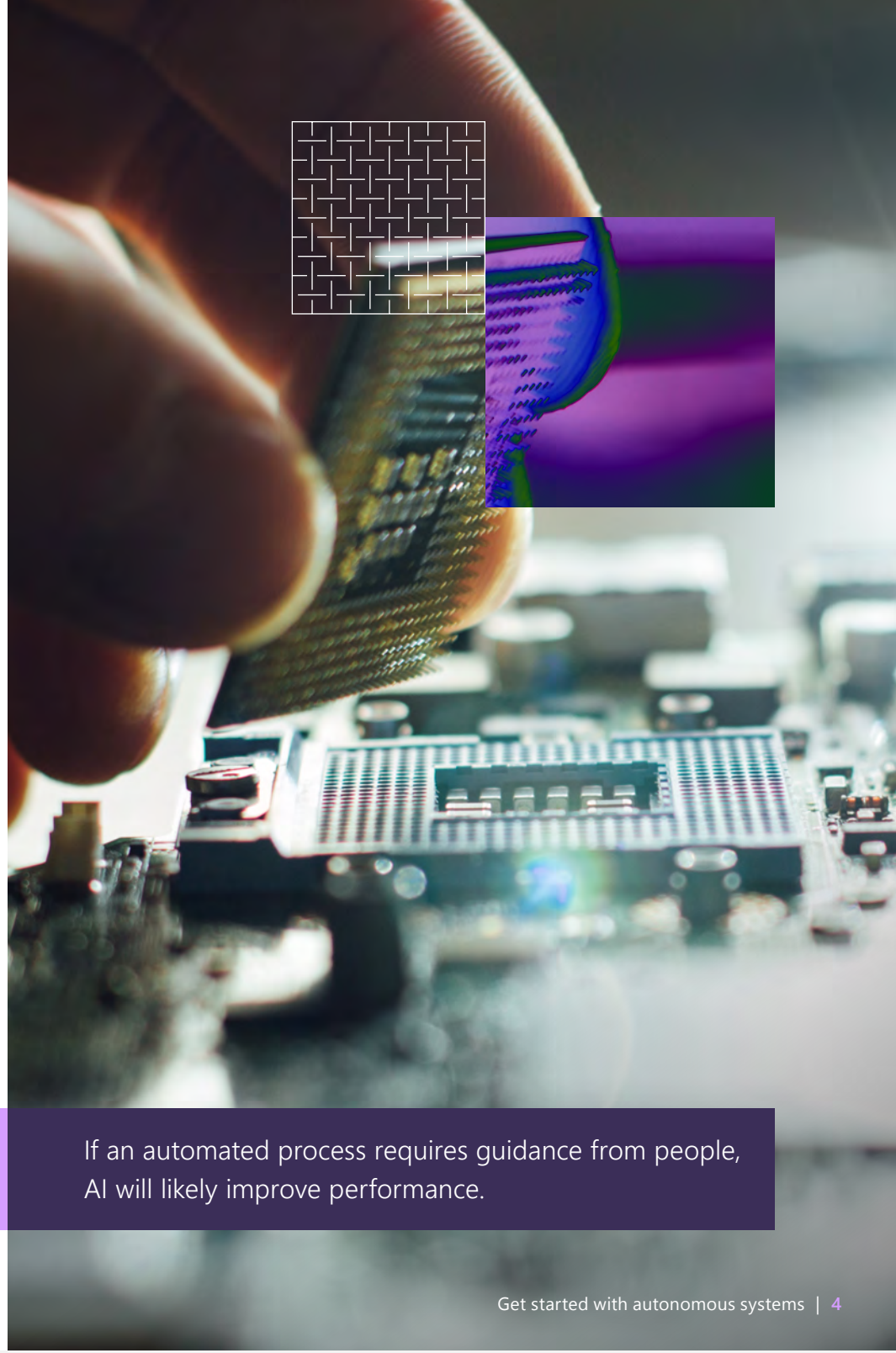
Humans can only consider so many variables. No matter how complex or simple the system, it is impossible for one person to consider every essential factor. Autonomous systems can execute actions that process thousands, if not millions, of variables in an instant.

Scarcity of expertise

Expertise takes time. As more and more factory workers retire, with them go decades of operational wisdom. Likewise, inexperience leads to high levels of variation in the final decision making. Autonomous systems can help support new employees as they develop the necessary expertise to thrive.

Time-constrained decisions

Many manufacturing optimization opportunities are short but frequent. These time-sensitive demands are difficult for human operators to observe, manage, and prioritize. Autonomous systems can perceive and execute on these instances in real time.



If an automated process requires guidance from people, AI will likely improve performance.

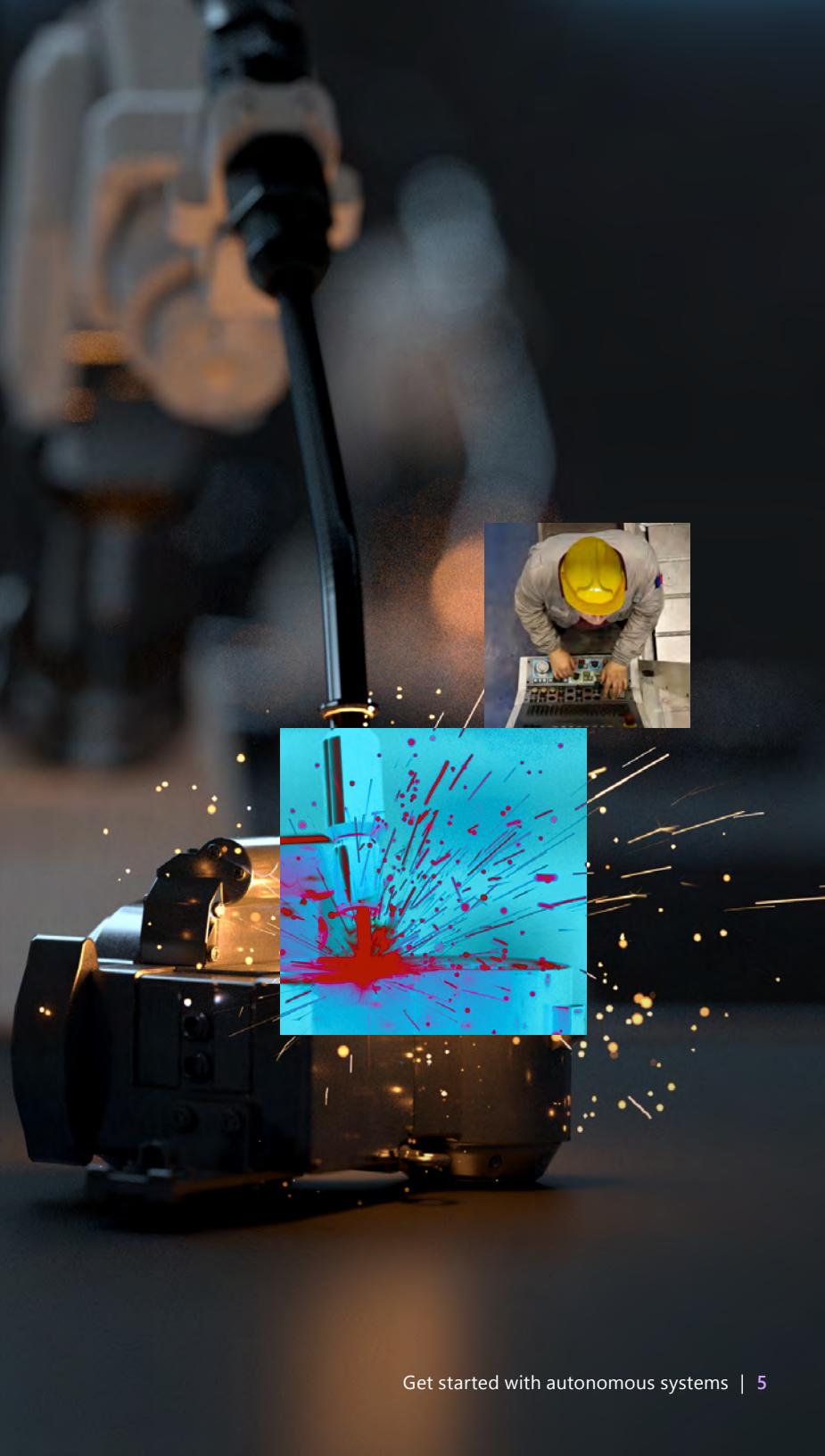
What is an autonomous system?

Before exploring how autonomous systems can help improve your business, we first need to understand what autonomous systems are and what separates them from other systems.

Autonomous systems optimize your equipment and processes using AI-powered automation that senses changes and quickly responds. Autonomous systems infuse expert knowledge into the AI and practice to perfect the strategy in a simulated environment. Within this simulation, the autonomous system prepares for likely and unlikely scenarios and identifies different solutions to achieve optimization goals.

Whether automated or manual, many existing machines are quickly approaching their end-of-life for a variety of reasons:

- They're static systems, performing the same tasks repeatedly, regardless of the circumstance.
- They can't factor in all observable inputs—sounds, smells, temperatures, etc.—simultaneously.
- They lack imagination. Existing machines follow programming but can't contribute new strategies or solutions to solving problems.



Inside the autonomous system

At its core, the autonomous system functions to either work with an operator or to perform the task independently.

By adding a layer of active education and operator oversight, autonomous systems perform beyond automation to become a scalable, intelligent system that learns to optimize even in the most complex scenarios.

Each of our four use cases represents situations in which autonomous systems can thrive, so let's dive in.

The Microsoft approach to building autonomous systems

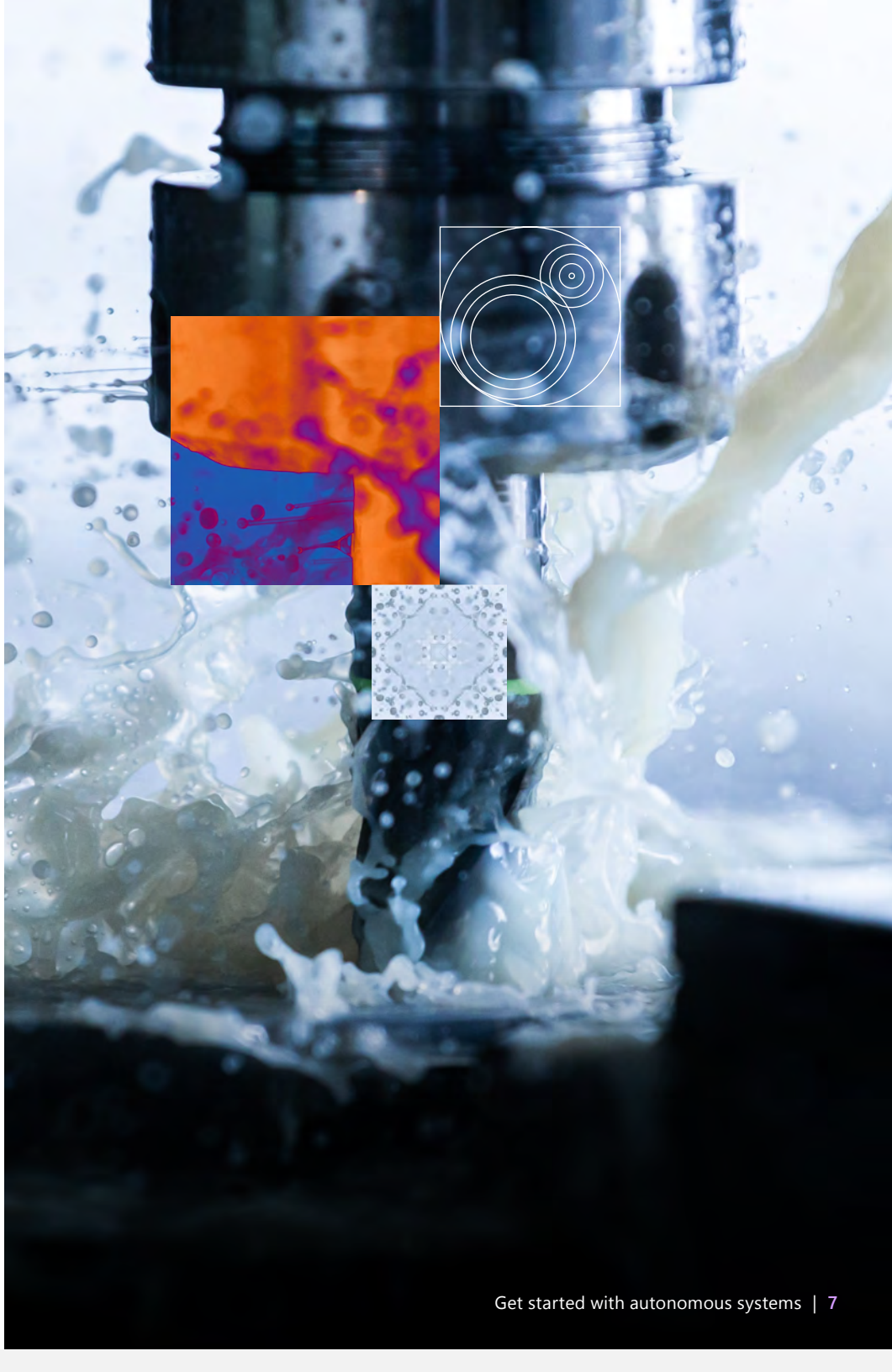
Autonomous systems learn to account for new challenges. To accelerate this learning, Microsoft has pioneered a method that allows control and process experts to teach the AI using their own expertise.

Microsoft Project Bonsai is a low-code, AI development platform that speeds the creation of AI-powered automation to improve production efficiency and reduce downtime. Without requiring data scientists, engineers can build specific AI components that provide operator guidance or make their own optimization decisions.

With Project Bonsai, engineers create AI with their knowledge and experience without requiring additional resources. You get total control over how AI supports your operators—either working independently or in partnership with operators and full visibility into why decisions were made or recommended.

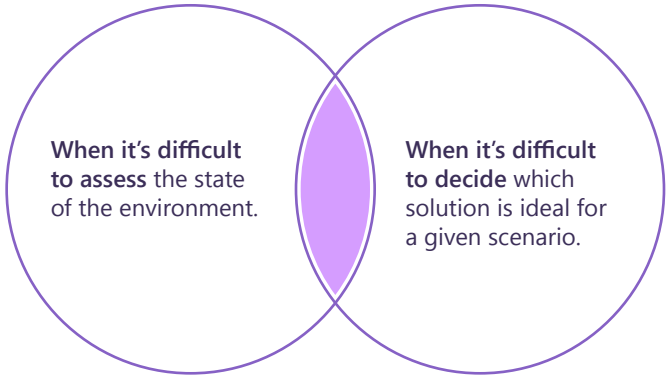
Want to learn more about autonomous systems before diving into use cases?

> Visit ***Autonomous Tomorrow: Inside autonomous systems on the factory floor*** ›



When to use an autonomous system

Autonomous systems thrive in the intersection of two conditions:



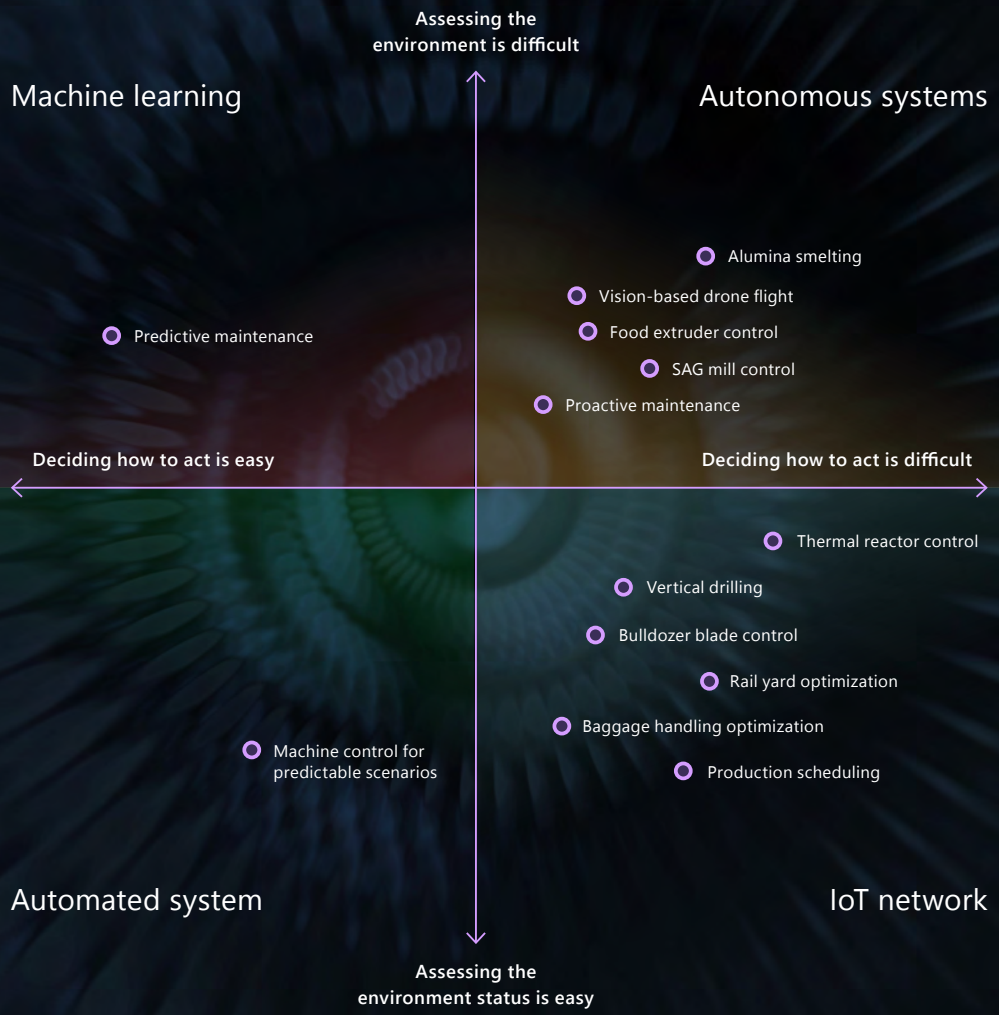
By contrast,

Automations are ideal
for simple environments with simple decisions,

IOT networks
for simple assessments with complex decisions, and

Machine learning
for complex assessments with simple decisions.

Most manufacturing scenarios fall into one of these four categories.



Yield optimization

Delivering a high-quality product while minimizing waste and downtime is critical for any factory's operational efficiency.

Operator decisions affect the manufacturer's outcome, while subtle, even imperceptible condition changes, such as temperature, humidity, and equipment age, can drastically affect results. The more in-spec product made without waste or downtime, the more profitable the manufacturing line becomes. An autonomous system can help factory managers minimize waste, preserve energy, and reduce equipment wear by applying ideal performance strategies to achieve these goals.

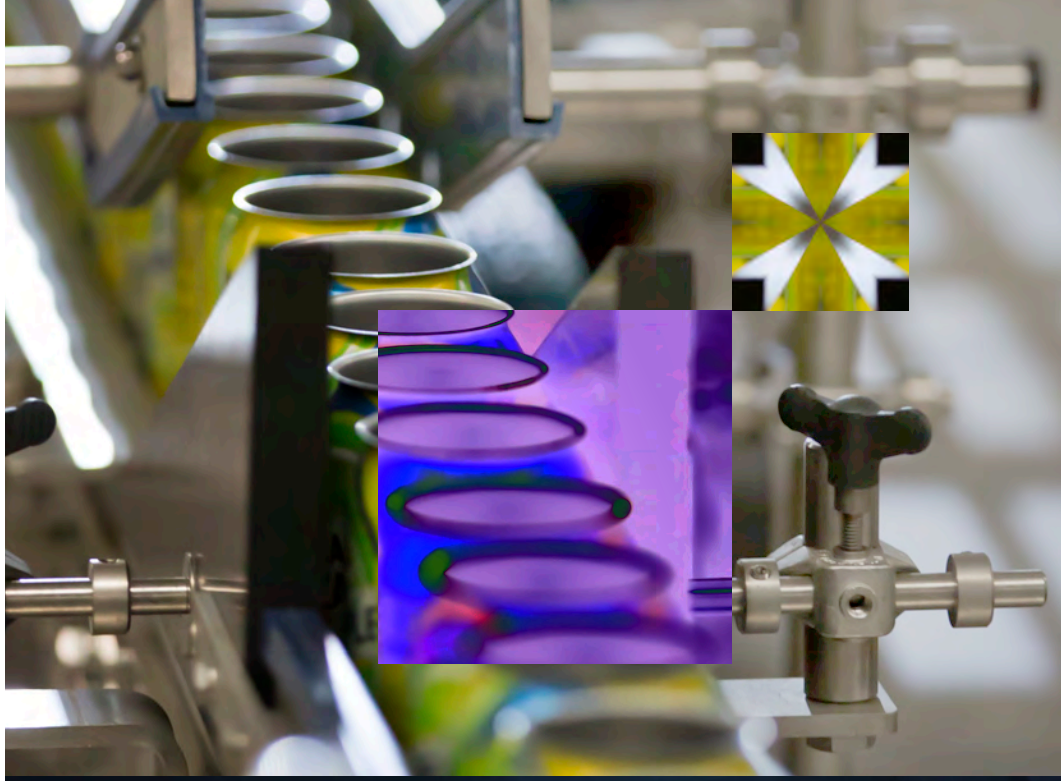
Bringing it to life

Picture a production line working to create a puffed rice cereal. Every piece of cereal has a predetermined acceptable mass and diameter, and any product outside of spec cannot be sold. During the extrusion process, wet dough is steam heated, forced through a shaping die, and cut into individual pieces before being sent through the drying process.

Imagine the opportunities for manufacturers applying autonomous systems to manufacturing lines to help achieve goals around product quality and consistency.

Operators must keep a keen eye on elements like ingredients, temperature, air pressure, sharpness, etc. to maintain the quality and safety of their station. Maintaining consistent product at every stage is a constant challenge, as quality professionals check on consistency in fifteen-minute intervals.

An autonomous system can monitor the cereal's quality in real time and recommend adjustments to keep the product in spec. Armed with extrusion expertise and operator knowledge, the autonomous system balances the key inputs and a variety of more subtle metrics, like humidity, to create recommendations that optimize the process for quality and consistency.



> **"Project Bonsai is one of the best enablers of solving a surprisingly complex problem: making consistent products without wasting resources."**
>
> Kevin Lin, Senior Research and Development Engineer, PepsiCo.

Chemical processing optimization

(including startups and changeovers)

While processes benefit from the variable adaptation of an autonomous system, the control system's ability to deliver standardized operation practices among operators can reduce optimization times and out-of-spec production.

Within the system, expert engineers teach the AI strategies and best practices to adapt performance based on a given day's goals. By adopting these expert insights, process manufacturing factories can equip new hires with immediate support for more complex implementations, eliminate uncertainty, and maintain consistency between variations.

Bringing it to life

Petrochemical companies often deliver a wide range of oil-based products—olefins, polyethylene, polypropylene, polyvinyl chloride, and more. Each product demands careful calibration of the chemical reactor to create the desired output. This adaptive process comes with a wealth of inputs and approaches that vary based on the operator's experience. Even experienced operators regularly take months to calibrate a chemical reactor to produce the optimized outputs.

Imagine the opportunities for a petrochemical manufacturing site when using autonomous systems. For example, it can reduce calibration times and limit the amount of out-of-spec polymer created during its regular chemical reactions.

With an autonomous system, a factory's most seasoned chemists and operators can rapidly train the AI in highly specialized knowledge like phase transitions, catalytic chemistry, and safety parameters. After perfecting these skills inside a simulation, the autonomous system recommended decisions and strategies that calibration time and out-of-spec product were reduced.

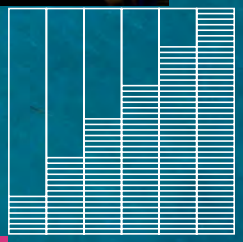
> “Project Bonsai brought a new paradigm to chemical process optimization. Within a few weeks of training, it could deliver a set of operational sequences equivalent to highly experienced operator’s know-how.”
>
> Pitak Jongsuwat, Physics Model Technology Engineer, Chemicals Business SCG

Learn more

Logistics optimization

Logistics is the art of getting things from one place to another.

Whether on-site or cross country, a site's ability to navigate trends, demand, supply chain, and production shapes how accurately and effectively it can connect its customers with its products—without being buried in undesired product. Autonomous systems use guiding optimization methods to help manufacturing sites manage this flow of human and material resources.



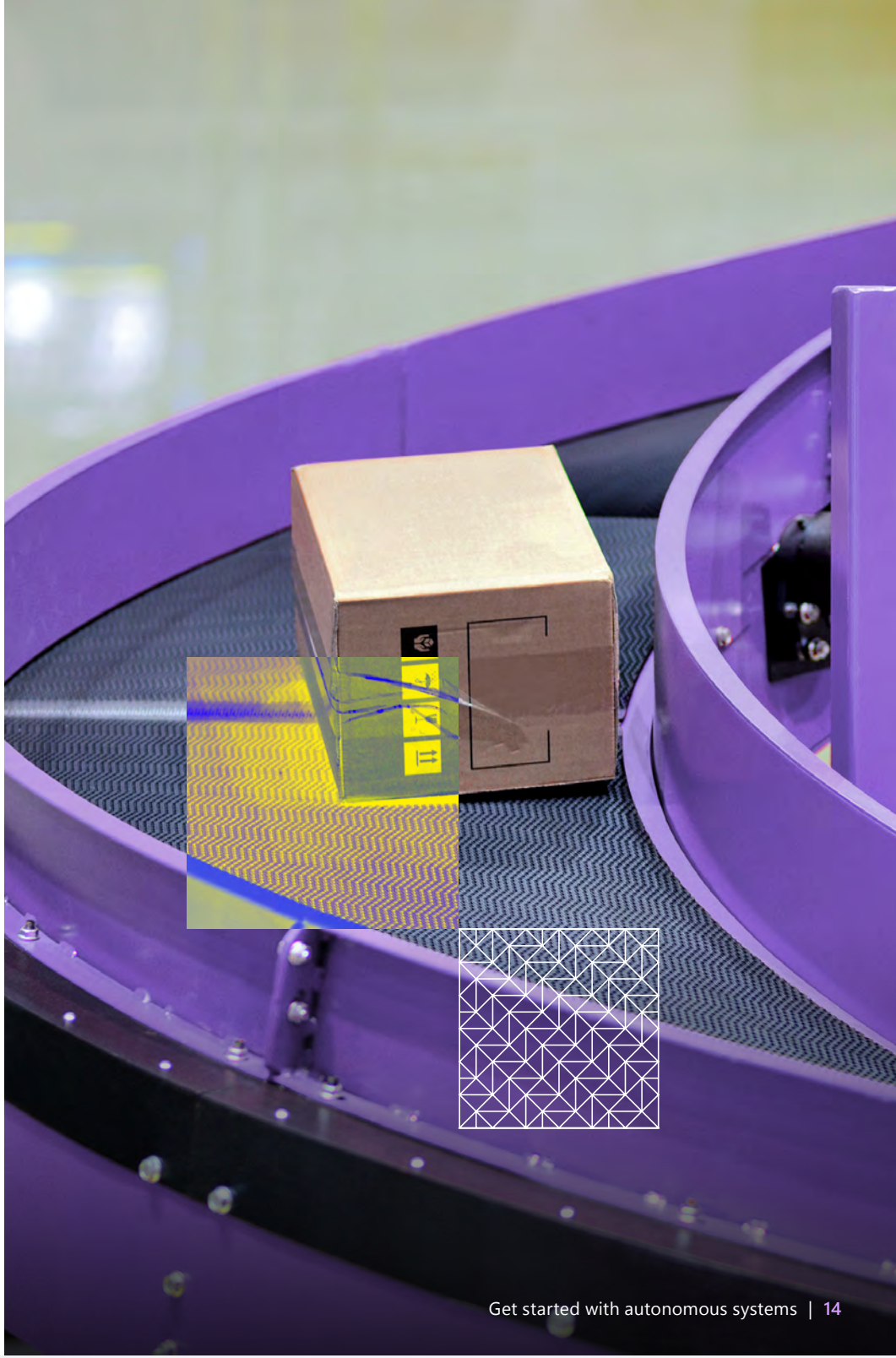
These optimizations equip the autonomous system to keep products moving from one site to the next without disrupting the supply chain. By absorbing data and processing it through operational strategies, autonomous systems can help:

- Hostlers navigate across large facilities in the most efficient route.
- Planners predict and anticipated trends to ensure just the right amount of product for a season.
- Managers optimize shipping and receiving schedules to minimize carrier overlap and reduce shortages and surpluses.

Bringing it to life

For consumer goods manufacturers, knowing when and where to build products can save millions in shipping and storage. Those decisions often hinge on global trends, regional preferences, weather patterns, and other unpredictable anticipate data points. Traditionally, OEMs use those variables along with historical sales data to make those decisions. Although when global pandemics or other unexpected forces cause forecasts to change, suddenly those strategies are thrown to the wayside.

Imagine an outdoor furniture producer who has to make high-value decisions every month concerning what products to create, where to produce them, and where those goods should be delivered.



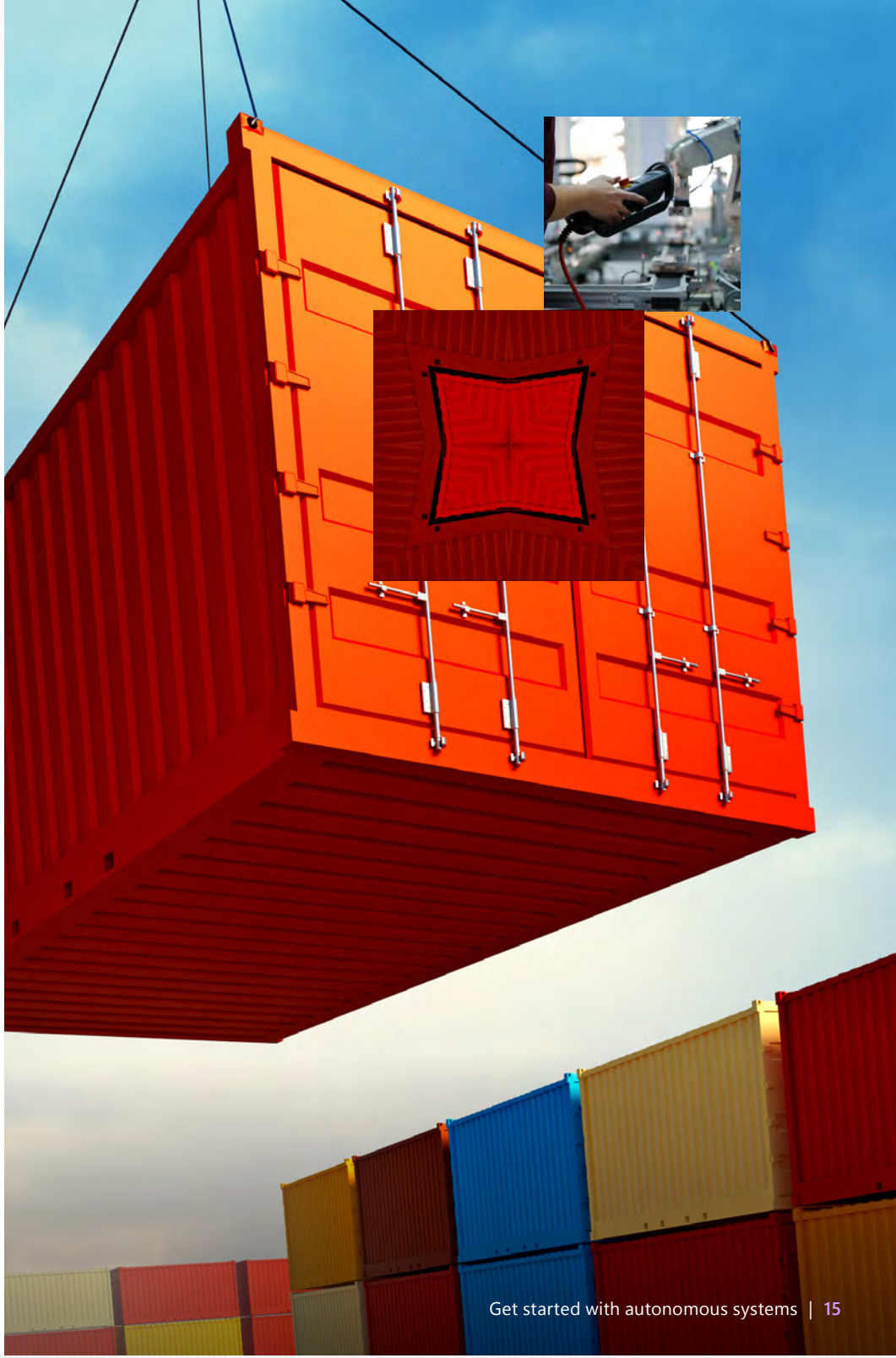
Autonomous systems can help the logistics team by understanding inputs like labor availability, consumer priorities, and product storage capabilities.

By feeding those data sources into the AI and teaching it each of the team's decision-making tactics, the autonomous system processes through millions of data points for hundreds of SKUs in seconds. This ability to process large volumes of data in seconds has helped decision makers uncover new manufacturing and distribution strategies and better anticipate the effects of world events on logistics.

Placing the right inventory in the right regions empowers the company to consistently meet customer demand while optimizing for the factory's goals.

> **"At the end of the day, this is about shortening supply chains and growing and improving our own workforce."**

Ashe Menon, Former Senior Vice President of Global Manufacturing, NOV, Grant Prideco Division

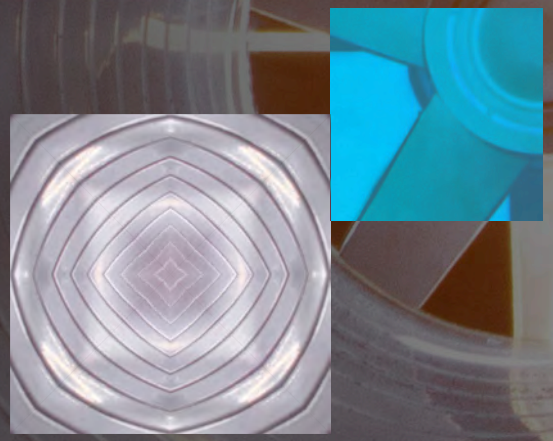


Commercial energy system optimization

As organizations worldwide push toward carbon-neutral and carbon-negative production, optimizing commercial energy systems seems like a clear first step.

Unfortunately, getting the most from an industrial HVAC system takes more than tight thermostat discipline. Enterprise-grade climate control must maintain a comfortable working environment while considering the necessary controls for expanded infrastructure like cooling towers, water pumps, and chillers. Each new variable amplifies the system's complexity, making the management of each input more and more sophisticated.

Reducing energy consumption while maintaining the desired temperature requires operators to balance variables like outside humidity and air temperature with competing controllers (temperature set point, pump delivery speed, pressure differential, etc.) to ensure proper performance.



Bringing it to life

At Microsoft, we're using autonomous systems to help reach our goal of becoming carbon negative by 2030.

In early 2020, our HVAC experts worked to teach an AI everything they knew about optimizing the systems. By onboarding the AI with necessary restrictions, limitations, objectives, variables, and controllers, our team could recreate real-world scenarios to test the system's performance. Through simulated conditions like winter storms, heatwaves, and equipment failures, the AI can apply various optimization strategies while meeting performance expectations with those restrictions factored in.

At the same time, these new optimizations allow our system operators to better monitor site health and create healthier working environments. By maintaining optimal air quality and flow, facilities can promote better health outcomes for employees.

This process has created AI that can adapt to environment, personnel, and hardware to deliver more intelligent energy solutions in the months since. In less than two weeks, the AI generated a new optimization plan for our series of cooling towers, chiller set points, and pump speeds.

As a result, we estimate a **15%** reduction in energy use.

> "If we could reduce energy consumption by 15% just by changing a few set points, I have to imagine there are a lot of other areas that need similar optimization where [autonomous systems] can help."

Tearle Whitson, Director—Critical Systems and Infrastructure at CBRE

Read more

Conclusion

Transformation starts with identifying one area in your plant that could benefit from optimization.

Examine areas with multiple process variables, limited expert guidance, and short-duration optimization opportunities to help identify a starting point.

Start a conversation

with a Microsoft autonomous systems scenario specialist to discuss bringing autonomous systems to your organization.

The opportunities to build AI-powered automation may show themselves within common scenarios like line yield, processing, logistics, and energy systems, or elsewhere across your business.

Remember, the answer to starting the next chapter in the factory operations manual isn't system wide reform but incremental change with measurable returns. Autonomous systems are built to scale, so start small, adapt accordingly, and expand when the time is right.

Want to learn more about how autonomous systems can transform your business?

Click here to connect with the Microsoft autonomous systems team