HOW AI ENABLES AUTONOMOUS INDUSTRIAL OPERATIONS

Honeywell

HOW AI ENABLES AUTONOMOUS INDUSTRIAL OPERATIONS

Envision a future where automation revolutionizes buildings, refineries, aerospace, warehouses, and manufacturing plants, driving higher efficiency and safety, with reduced environmental impact.

In buildings, smart automation systems will seamlessly manage energy, security, and comfort by integrating IoT devices and AI-driven analytics. Refineries and chemical processing plants will leverage advanced process automation, predictive maintenance, and remote monitoring to minimize downtime and enhance operational safety. The aerospace industry will be transformed by autonomous drones, advanced robotics, and AI for predictive maintenance and real-time data analytics, helping to ensure higher safety standards and operational efficiency. Warehouses will evolve with automated storage and retrieval systems, autonomous vehicles, and AI-driven inventory management, drastically improving logistics and reducing human error. Manufacturing plants will fully embrace Industry 4.0 principles, with smart factories harnessing AI, machine learning, and IoT to optimize production processes, reduce waste, production processes and reduce waste. These advancements can collectively promise to drive significant gains in productivity, cost savings, and reduced environmental impact across all sectors.

To achieve this improved future state, it's crucial to understand the steps needed for effective implementation. Additionally, having a partner who understands the unique opportunities and challenges in your industry is essential. Whether it is a plant, factory, warehouse or other commercial or residential facility, every operator of buildings or aerospace systems works in a distinct environment with a complex demand set of considerations that careful planning and a robust foundation of core technologies like sensors, connected software and advanced data analytics and process controllers which enable insights and provide advanced guidance for long-term success.

Autonomous operations are systems that can perform complex tasks without human intervention, using artificial intelligence, machine learning, robotics and other technologies. They are critical for the future because they can enhance efficiency, profitability, quality, safety, and innovation in various industries and domains. By leveraging autonomous operations, organizations can optimize their resources, reduce costs, improve performance, and create new value propositions for their customers and stakeholders. Autonomous operations can also help address some of the major challenges that the world faces today, such as climate change, reducing environmental impact, energy management, security, urbanization, labor shortages and demographic shifts.

This paper will describe the advantage of autonomous operations, the steps to achieve success and the attributes of a partner to get the best possible benefit.

WHY IT'S TIME TO AUTOMATE NOW

Autonomous operations can deliver significant benefits and competitive advantages to companies over the long term, aligning with broader business goals such as:

Increasing Productivity
Autonomous operations can help reduce downtime, improve quality and optimize throughput by continuously learning and adapting to changing conditions and demands.

Reducing Costs
Autonomous operations can help lower operational expenses, maintenance costs and energy consumption by facilitating actions that reduce waste, inefficiencies and errors.

Improving Environmental Performance
Autonomous operations can assist in reducing greenhouse gas emissions, water consumption and waste generation by optimizing resource utilization.

Enhancing Safety
Autonomous operations can help prevent accidents, injuries and fatalities by detecting and avoiding hazards, promoting compliance and enforcing best practices.

Improving Profitability
Autonomous operations can increase profitability by helping reduce time and labor costs, while increasing the productivity and efficiency of assets, people and processes

There are four core areas of opportunity where these technologies can deliver the greatest value for your business, customers, investors, and employees: operations, productivity, profitability and reduced environmental impact. In each of these areas, automation and AI offer numerous short- and long-term benefits. Here are a few examples:

OPERATIONS

- Help optimize end-to-end operations, by integrating and coordinating advanced process controllers, sensors, and actuators across various facilities and structures.
- Monitor the overall process outcomes, such as production, quality and efficiency, and help intelligently adjust the control parameters, such as setpoints, modes and limits, to achieve more optimal outcomes.
- Learn from historical and real-time data, and adapt to the changing conditions and demands, such as feedstock variations, market fluctuations, and customer preferences.

PRODUCTIVITY

- Monitor the health and performance of plants, buildings, or factory assets, such as equipment, machines, and instruments, in real time.
- Predict asset maintenance needs, degradation, and failure, using a combination of domain-based, physics-based, and data-driven models.
- Help prescribe the best actions to prevent, mitigate or resolve asset issues, such as preventive maintenance, repair or replacement, including spare parts ordering and management.

PROFITABILITY

- Augment and empower workforce personnel, such as operators, engineers, service associates and managers.
- Provide the workforce with prescriptive next best actions, based on domain knowledge, best practices, and operational goals.
- Enable the workforce with expert step-by-step guided support and customized training, using natural language processing, augmented reality, and generative AI.

SUSTAINABILITY

- Support customers in their journey to net-zero operations by helping to manage emissions.
- Optimize resource utilization and minimize environmental impacts by using multi-modal inputs, such as process, weather, and market data, to help optimize setpoints, schedules and modes of operations.
- Simulate process interactions and de-carbonization scenarios, to improve profitability and further reduce emissions.

THE PATH TO AUTONOMOUS OPERATIONS

Autonomous operations and the opportunities they present are incredibly compelling, but they are not achievable overnight. Successful implementation of autonomous solutions into an organization requires thoughtful planning and tactical execution.

The journey to autonomous operations is a progressive one, where companies can move from manual or semi-manual operations to fully autonomous operations in stages, progressing sequentially through each level. While virtually any industrial company can start on the path to autonomous operations, it is also important to consider that the transition to fully autonomous operations is still a rarity in today's operating environment. There are many industries – such as aerospace, defense and healthcare – where a transition to true autonomy is not possible today and may never be. However, for most industries and operating environments from buildings and warehouses to chemical plants and oil refineries, the opportunities to integrate automation and AI are nearly endless.

Unfortunately, amid the fast-growing hype that surrounds AI, it can be easy to get swept up in the latest trending autonomous solutions. To be successful over the long-term, companies must focus on building the proper foundation and infrastructure before scaling up. The reality is the organizations that struggle the most on the path toward autonomy are those that try to skip to the autonomous future without first taking the time to lay the groundwork necessary to enable it.

THE AUTONOMOUS MATURITY MODEL

To help companies understand where they are on the autonomous journey, Honeywell developed an "Autonomous Maturity Model" that provides a clear framework and set of guidelines on how to integrate AI and autonomous solutions in the most effective way. The model defines six levels of autonomy based on the maturity of operations. The autonomous maturity model provides a clear framework so that important steps are not skipped and so that companies across industries can easily identify the level to which its business can benefit from the integration of automation.

The journey to autonomous operations spans six levels – with Level 1 being the most basic and Level 6 being fully autonomous operations of the future:

LEVEL 1: MANUAL OR SEMI-MANUAL OPERATIONS.

The most basic level. A facility relies on basic controls and semi-manual operations.

- Operators are responsible for monitoring, controlling, and adjusting the processes, and the automation systems are limited to simple feedback loops and alarms.
- There is minimal digitalization and sensorization and operations are still heavily manual, requiring large workforces and numerous disconnected assets.
- Most industrial facilities ran on manual operations during the last century.

LEVEL 2: ADVANCED CONTROLS-BASED AUTOMATION

A facility is controlled and optimized using advanced process controllers, software, and sensors.

- Operators are still involved in the operations, but they can rely on the automation systems to handle routine tasks, such as setpoint changes, tuning and optimization.
- The control is still very focused at the site level and requires a lot of manual data crunching to be effective.
- This is the most common operation today within the industrial sector.

LEVEL 3: INTELLIGENT OPERATIONS ON-SITE

A facility leverages digital twins (virtual copies of physical objects), domain knowledge and AI-based predictive and prescriptive actions to enhance the operations.

- Operators can access real-time insights, recommendations and alerts from the automation systems, but they remain in control.
- Additionally, the operators can interact with the digital twins to simulate and test different scenarios.
- These operations need fewer people in the loop but are still very tied to the physical location of the plant or factory, with each site running independently.

LEVEL 4: REMOTE INTELLIGENT OPERATIONS

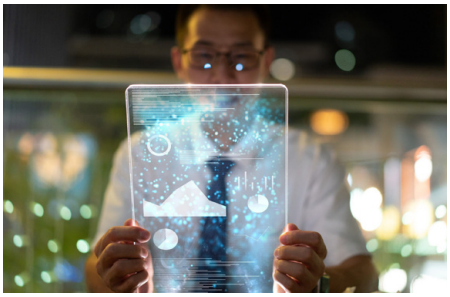
A facility expands its operations beyond the existing control rooms and enables full end-to-end process automation through distributed intelligence.

- Operators can remotely monitor, control, and optimize the operations from anywhere, using mobile devices, cloud platforms and edge computing.
- These are the high-tech operations of today.

LEVEL 5: ADAPTIVE OPERATIONS

A facility becomes a continuous learning system, with the ability to respond to unanticipated events and changes in operations.

- Automation systems can self-adjust, self-correct and self-optimize, using reinforcement learning, anomaly detection and root cause analysis.
- Advanced AI and autonomation are used with minimal human interaction.
- These are present in only the most advanced modern industrial environments today.



LEVEL 6: AUTONOMOUS OPERATIONS

This is the ultimate level, where the facility becomes a self-healing, self-optimizing auto-pilot system, that requires no human intervention for safer, continuous operations.

- Automation systems can handle many situations, including emergencies, failures, and disruptions, using fault-tolerant, resilient, and robust algorithms.
- These are true end-state operations and very few exist today.

CURRENT STATE OF OPERATIONS

Today, most industrial organizations are still in Levels 1-3, but it is the infrastructure deployed and the insights and data collected at these stages that enable a successful implementation of Levels 4-6 over the long term.

Realistically, reaching Level 6 – fully autonomous operations – is rare in some industries but not in others. In heavily regulated industries like life sciences, defense and aerospace, companies may not be able to reach Level 6 because of the crucial need to have humans involved in every step of the process. However, no matter the size or scale of a company's operations or the level you hope to progress to, the key to success in autonomous operations is the same: you must take it one step at a time, progressing level by level.

FINDING A PARTNER IN THE PATH TO AUTONOMOUS OPERATIONS

To find a true partner for your automation journey, consider the following:

- Subject-matter expertise matters: A true partner understands the unique needs and considerations of the industry you operate in and brings real, hands-on experience. For instance, the requirements to automate batch process recipe optimization in a specialty chemical plant are vastly different than those required to automate truck unloading at a warehouse's loading dock. Find a partner who knows your industry.
- Deep installed base experience is key: A true partner brings first-hand experience developing, deploying, integrating and maintaining the end-to-end technology solutions in their own operations, as well as across a deep installed base for their customers. It is crucial to find a partner who has both the domain expertise in the digital and physical aspects of the solutions.
- Find an advisor, not a vendor: A true partner acts as a trusted advisor, not a solutions provider. Look for an advisor who aggregates the right technologies and customizes them to your business and unique needs. Avoid a vendor who can only sell you the latest solution or software but can't advise on how to integrate and operate it.
- Seek to align autonomous operations and business strategy: A true partner helps you to incorporate autonomous operations in areas that will help your business to grow by improving customer satisfaction, opening new revenue opportunities and fueling business expansion avenues.
- Don't isolate automation to IT and OT: A true partner recognizes the opportunity to make autonomous operations more than just an IT/OT solution. Always remember that the long-term opportunity in automation is about more than just productivity and cost reductions.

Getting Started

- Based on Honeywell's long history of innovation in this space, as well as supporting our own plants and warehouses, we understand the journey to autonomous operations can feel overwhelming at times, but the hardest part is always getting started.

Considerations As You Move Forward

- Remember to start with the basics and follow the autonomous maturity model. It's a journey and all companies will be starting at different levels, with different visions of where they want to get to. But first, it's crucial to focus on the basic infrastructure that will enable success in the later steps – including sensors, controls, and data collection processes. Remember, it's a journey and a sequential, level-by-level process!
- Not every business can take a segment of the process to a fully autonomous solution, but along the journey there are still tangible benefits from both efficiency and productivity outcomes, resulting in economic benefits.

- Align with key stakeholders: There will be many different stakeholders with competing objectives including R&D, IT, Manufacturing, Quality and the Sourcing Team. Speak to them at the outset to determine your common goal and target level of autonomous operations.
- Don't fall for the magic bullet: There are many buzzy technology solutions available in the market and it can be easy to get caught up in the hype. Don't forget that the most advanced AI solutions will fail to move you forward on the path to autonomous operations unless you have the necessary infrastructure in place first.
- Find the right partner whose deep domain expertise and hands-on experience developing, deploying, integrating and managing autonomous solutions – for its customers and its own operations – enable them to serve as a true advisor, not just a solutions vendor.
- Understand the boundary conditions of each technology before it is implemented. For instance, the same robot cannot adapt from moving items between bins to loading and unloading trucks. Different capabilities are required to operate the same technologies in different environments and industries so always consider the boundary conditions you must operate it before getting started.
- Don't underestimate the complexity of how you would solve a problem robotically or with an autonomous control system. Consider how a problem could be solved through autonomous operations by first looking at how you could implement the early levels of the autonomous maturity model with "training wheels," as you gain the capabilities needed to advance to greater complexity.
- Incorporate training time for the team and technology in the initial days after installation. While an older system may have done a task in two weeks, keep in mind that new AI or robotic technology will require a ramp up and training period in the first few weeks. Always try to incorporate a buffer to ensure there are no productivity delays during the early days. Change management is going to be key for successful automation.
- Consistently monitor each solution and analyze the data received over the long-term to improve productivity. It can be easy to get swept up in the day-to-day tasks and forget to monitor and recalibrate solutions and products in the months following initial implementation to ensure they are achieving maximum productivity.

Summary

In summary, we recommend that companies:

- Automate simple and low-risk tasks first and increase the complexity and autonomy gradually.
- Train both the technology and the human team after installation and allocate enough time and resources for this phase.
- Monitor and analyze the performance and data of the solution over time and make adjustments and improvements as needed.
- Incorporate change management and communication to ensure a smooth transition and integration of the autonomous or robotic solution.

Automation and AI are not new to Honeywell. In fact, we have been integrating various levels of AI technology into our own operations and the offerings and solutions we bring to our customers for decades. Digitalization also underpins our entire portfolio and supports its alignment to the compelling megatrends of automation, the future of aviation and the energy transition.

We are here to help as you begin on the path toward autonomous operations.

Honeywell International

855 South Mint Street Charlotte,
NC 28202

www.honeywell.com

WPR-24-01-EN | 07/24

THE
FUTURE
IS
WHAT
WE
MAKE IT

Honeywell