# THE JOURNEY TO AUTONOMOUS

The journey from automation to autonomous looks different for everyone; the first step is to understand where you are in the journey.

Honeywell

# TABLE OF CONTENTS

# INTRODUCTION

**For the past 40 years, we have seen technology and software advancements transform the process industries, delivering more situational awareness, faster response time, and the ability to operate closer to limits—all leading to improved safety, reliability, and efficiency.**

While the benefits over the 40-year period have been substantial, a new era of automation technology is now underway that is wielding the strength of digitization to take us on a journey toward industrial autonomous operation. Industrial autonomy promises to deliver an inflection point of new benefits. This white paper describes how digital technology is enabling us to take that journey.

# WHAT IS INDUSTRIAL AUTONOMOUS OPERATION?

**Let's start by defining autonomous operation and its benefits. A common definition of autonomous operation is: operating in the absence of humans. But this simplistic definition does not get at the real story of what autonomous operation can do for us.**

Autonomous operations is about leveraging technology to improve performance. In an autonomous car, it means improving safety by leveraging the power of technology to avoid human error. With industrial autonomy, it means improving production, throughput, yield, reliability, and efficiency by making better use of process data.

## THE JOURNEY

Let's talk about the journey toward industrial autonomy, a journey along a continuum with five levels:

**Level 1:** Controlled and optimized operations

**Level 2:** Intelligent operations

**Level 3:** Remote operations

**Level 4:** Resilient operations

**Level 5:** Autonomous operations

This model has a natural sequence and evolution, but it is also recognized that most facilities will have varying capabilities at each level. For instance, there may be manual procedures for some operations, while other pieces of equipment operate largely autonomously. So, it's instructive to assess your existing capability at each level.

# LEVEL 1: CONTROLLED AND OPTIMIZED OPERATIONS

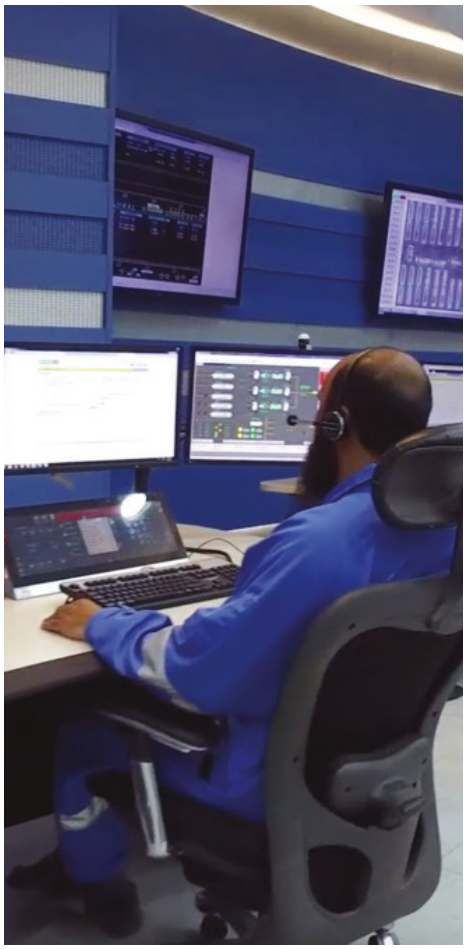
**Given the widescale adoption of control systems and advanced control software, many industrial process facilities fall into the category of controlled and optimized. But just because most are in this category doesn't mean that most excel at it.**

There are still many control loops running in manual or that are tuned incorrectly. And for those using advanced control and optimization, a large percentage of sites have models that do not reflect the current process dynamics or equipment performance. Advanced control and optimization must be viewed as a lifecycle solution, one that is continually kept up to date. First, you achieve this level, and then you work to maintain the benefits.

By leveraging newer technology and services, Honeywell adapts controls based on changing conditions and keeps a process running closer to optimal limits for longer periods of time. Our latest service offerings use remote connectivity to keep advanced process control (APC) tuned and up to date. The benefits here are clear. Excelling at the control and optimization level can mean top-tier throughput and quality for your facility.

# LEVEL 2: INTELLIGENT OPERATIONS

**The shift to intelligent operations is the essence of Industry 4.0. It's all about software analytics—collecting data, analyzing it, getting recommendations, and taking specific action. Here we see great promise in the use of digital twins to compare current process and equipment performance against the expected performance shown by the digital twin.**



The term digital twin refers to a concept that is well known in our industry—a model. And even though we understand this concept well, we typically apply a digital twin offline, for process unit design or for operator training. But using these models during operation helps us make the journey to intelligent processes and equipment.

Digital twins come in different forms:

- A true process replica using a first-principles kinetic design model
- A representative process model in the form of a dynamic operator training simulator (OTS) model that is repurposed for process operations
- A heuristic model based on your decades of knowledge

With a model-based approach to intelligent operations, you are evaluating process and equipment performance based on known or physical characteristics of your processes. You aren't just hoping for data analytics to find a needle in a haystack.

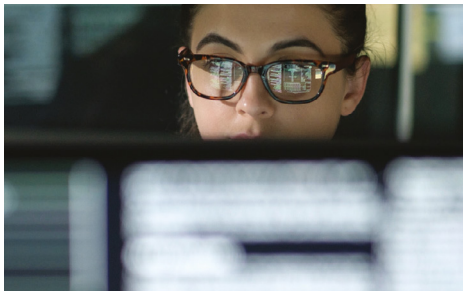
Honeywell offers a suite of digital twin capabilities to help you make the move to intelligent operations. By using a Honeywell digital twin, you leverage domain knowledge to identify areas of opportunity including noting instances where you could be at risk for unplanned capacity losses or sooner-thanplanned downtime due to equipment issues. With this depth of insight and shifting to intelligent operations, you can maximize reliability and uptime.

In fact, we are doing it already with many customers to accurately predict decoking cycles; to detect and adjust for heat exchanger fouling; to identify the root cause of reactor performance decline; and to avoid unplanned catalyst reloads.

Honeywell uses digital twins to monitor our own UOP process equipment, and we can help you with your own journey in creating a more intelligent process. Doing so will allow you to permanently capture your process knowledge and best practices in the form of digital models and achieve sustained, top-quartile reliability.

# LEVEL 3: REMOTE OPERATIONS

**With your process operations optimized and intelligent, you can be confident that you are running at peak performance; now it's time to think about how to leverage the vantage of remote operations. Honeywell divides remote operations into three phases.**



The first is Remote Project Execution. We have transitioned our project execution methodology to fully embrace remote. Where we used to have dozens of people travel to project locations, we can now fully execute a project in our cloud data center by utilizing Honeywell's unique project methodology known as Lean Execution of Automation Projects, or LEAP™. Through LEAP we can apply the best project engineers, wherever they are in the world, to the project, and they can work on the digital replica of a system as if they are sitting in front of it. With this methodology, we can go so far as to conduct a full virtual factory acceptance test, as well as to perform remote-assisted commissioning.

The second phase is Remote Service and Support. Traditionally, we would send service engineers out to a customer site in response to a problem. With our new Services offerings, we moved from reacting to a problem to proactively solving an issue before it becomes a problem. We make a cyber secure remote connection to a site and continuously monitor systems and applications, looking for looming issues. We proactively notify you of issues, and in some cases are even able to make a change remotely through a secure connection. We can do this because we have captured the knowledge of our best engineers and service technicians in a heuristic, best-practices model. We compare your actual system performance against our model to identify anomalies. Doing this is like having the world's best service technician monitoring your system 24/7.

Finally, the third category: Remote Operations. Remote operations expand operations beyond your existing control rooms. Many industries with distributed assets such as wellheads, pipelines, and offshore platforms regularly use Experion® PKS (Process Knowledge System) for remote operations. This past year, we saw remote operations more extensively employed during the COVID pandemic to maintain safety protocols within facilities. Honeywell introduced its remote access capabilities for Experion that allow for a complete operator console experience regardless of the location. It's as if you are sitting in the control room itself. Honeywell remote operations offerings can establish a consolidated center onsite in a safe area or establish a remote operations center where you can consolidate your expertise to oversee multiple plants.

With the various remote options, we see this step in the autonomous journey as a key enabler for you to achieve top-quartile performance with people efficiency.

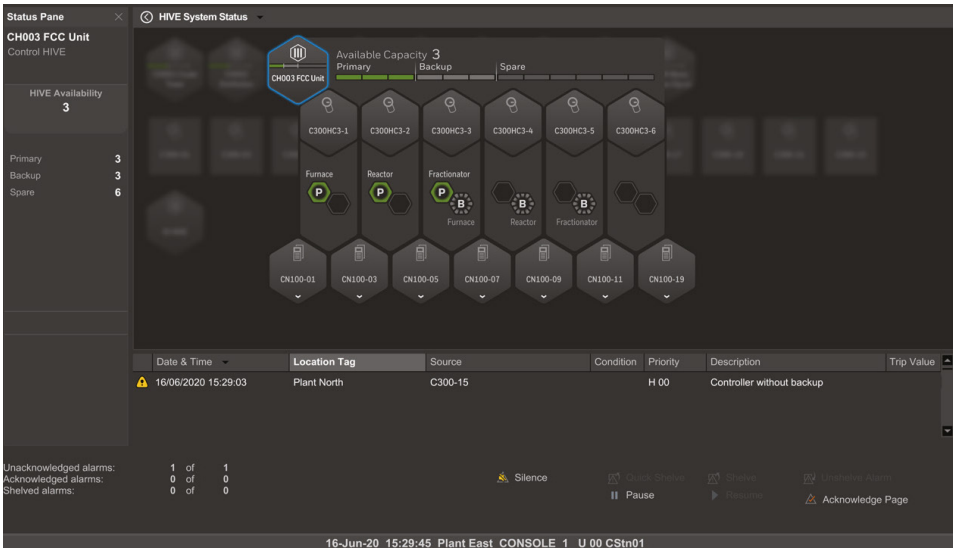
# LEVEL 4: RESILIENT OPERATIONS

> **In industrial process control, risk assessment methods identify where critical faults can occur with high consequence, and we design and implement ways to assure that a singular failure doesn't cause disruption.**

Being resilient means failures can occur, but the system or operation continues to operate normally, and recovery is automated. We know of many examples where this method occurs, e.g., in control systems built with redundant controllers. If something fails, a redundant controller takes over the compute load.

Honeywell is taking control system resiliency to a new level in our latest release of Experion® PKS Highly Integrated Virtual Environment (HIVE). The Experion PKS HIVE approach allows multiple process controllers to operate as a distributed mesh—almost like a data center of controllers. Doing so provides much simpler project engineering, because control strategies no longer need assignment to a specific physical controller; they can be deposited in a HIVE, which will automatically distribute the control to wherever there is available compute across multiple process controllers. The HIVE becomes a resilient cluster of control that can withstand multiple faults.

At the same time, resilience needs to be considered across the entire operation—assuring that operations can continue in the face of equipment failures, power outages, and weather events. Honeywell can help customers achieve resilience through a range of capabilities from establishing backup control centers to local battery storage for backup power.



# LEVEL 5: AUTONOMOUS OPERATIONS

**Industrial autonomy might seem far-fetched if you are operating a refinery or petrochemical plant, but let's consider a few examples of autonomous operation today.**

For the most part, the far upstream parts of the business are already autonomous: wellheads and pipelines are largely unmanned. Likewise for solar and wind installations. Now consider something slightly more complex and safety-critical—offshore platforms. Unmanned platforms are within our reach; in fact, they exist today. By reducing the presence of people on a platform to the few instances that are necessary, we dramatically improve human safety. What once seemed implausible is now becoming a reality.

# APPLYING A CONCEPTUAL FRAMEWORK MODEL

**For the implementation of autonomous operations, it is useful to consider a conceptual framework that can serve as a guide towards achieving those benefits as it relates to improving overall plant performance, efficiency and safety.**

The E2C conceptual framework is such a model, and depicts three key and essential domains that brings about the realization of autonomous operations:

## EDGE

First, it is necessary to gather and consolidate data from various and multiple sources, while implementing robust data communication protocols to ensure data accuracy, integrity and security.

Once this immense data is collected and integrated, it is then necessary to analyse the data to gain actionable insights in understanding the overall plants performance down to equipment level. This is achieved through data analytics tools, specialised application software, and AI/ML algorithms. Real-time dashboards and other visualization techniques can then help operators and engineers easily monitor and analyse the plant's performance and to make informed decisions and better respond to any emerging issues.

The various functions included in the Edge domain are data gathering & analytics, people and asset tracking, emissions monitoring and local control.

## CONTROL

With insights gained from data analysis established, next would be to optimise plant processes through implementing advanced process control strategies to improve process efficiency, product quality/yield and energy consumption. This is where optimal plant performance is determined and achieved.

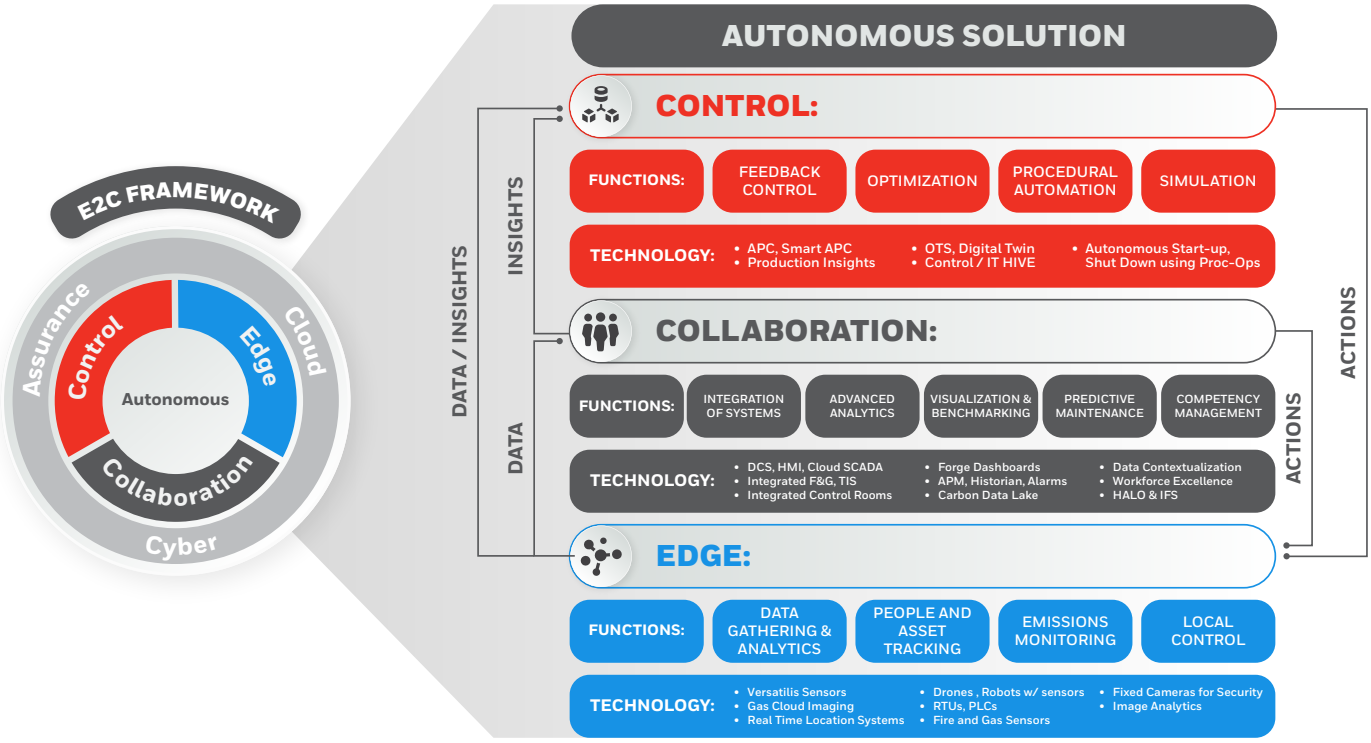
The functions the Control domain covers, includes conventional feedback control, optimization algorithms, procedural automation, and process simulation.

## COLLABORATION

Foster effective communication and co-ordination across multidisciplinary teams, including engineers, operators, data scientists and IT professionals to ensure the successful implementation of autonomous systems and continuous enhancements. The functions required would include the integration of systems, advanced analytics, visualization & benchmarking, predictive maintenance and competency management

All three domains are set against an environment where cloud capability can be leveraged as appropriate, end to end cyber security measures are in place and lifecycle assurances with supporting technologies, solutions and services for the duration of autonomous plant operations.

Within each conceptual domain are the available and leading technologies to enable each function.




While this framework provides a simplified overview of the process, it is important to remember that implementing autonomous applications in a process plant is a complex and demanding process. It involves careful planning, collaboration between multidisciplinary teams and a strong focus on safety, reliability and productivity.

# CONCLUSION

**This is an exciting time. Industrial autonomy will bring huge advances in safety, reliability, and efficiency. Let's close with four key points about this "journey to autonomous."**


First, industrial autonomy is not defined solely by fewer people. It's about how we utilize control, sensing, and knowledge to produce an inflection point in plant operation benefits. Getting to autonomous operations is itself a journey, and each step along the way will yield sizeable benefits. Ultimately, we see industrial autonomy as enabling every day to be your best day of production and enabling every person to become an expert.

Second, the journey to industrial autonomy is a digital transformation that leverages digital technologies available to us today.

Third, everyone should be on this journey toward autonomous operations. If you aren't taking this journey now, you could be left behind.

Fourth, this isn't science fiction or something entirely new. Those of us in the process and manufacturing industries have been on this journey for decades. Honeywell products, services, and software—everything from Experion® PKS HIVE to Advanced Control, to Asset Performance Monitoring, to Remote Services and Operations—are providing the means for our customers to make this journey successful.

**For more information**

To learn more about Honeywell's remote and autonomous solutions, visit process.honeywell.com or contact your Honeywell account manager.

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WP-23-05-ENG | 441DS


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