THE ROAD TO DIGITAL INDUSTRIAL OPERATORS

An operator-first approach to digital technology adoption and transformation is a more effective path to a higher value workforce

WHITE PAPER

Harbor Research

After a decade of rampant investments, we see that Industrial Internet of Things (IIoT) solutions have been both a blessing and a curse. While "IIoT 1.0" raised our awareness of the potential benefits of digital transformation, it has not developed much empathy or trust with plant operators.

Industrial plant operators are the critical linchpins that deal with the inevitable unknowns and problems required to keep plants running. Operators understand the critical production and safety performance factors better than technical support engineers, safety experts and other digital specialists. Plant operators constantly juggle diverse information inputs, often relying on intuition and first order principles to drive decisions.

Digital and IIoT technologies can help address many operational challenges but only if plant operators come to trust the outputs these systems produce. Plant operator trust is the foundational element required to drive adoption of new digital technologies.

The mPACT2WO business unit of Molex has developed unique "IIoT 2.0" solutions that offer a proven foundation for solving plant operator challenges. mPACT2WO's developments anticipate plant operators' toughest challenges—enhancing operational efficiencies, ensuring continuous compliance and achieving higher standards of safety, while minimizing subjective, manual methods.

mPACT2WO's strategy reflects the importance of three critical elements:

1. A configurable software platform that translates plant operations data into situational and contextual information that is familiar to plant operators' processes and decision methods;

2. Solutions that utilize sensor data analytics to minimize operator performance variances and provide clear "line of sight" to operator priorities; and

3. An approach that leverages "IIoT 2.0" solutions to enhance and accelerate industrial operator transformation to digital-industrial operator.

In taking this approach, we believe mPACT2WO is empowering plant operators to exploit the vast potential of leveraging sensor data and operations intelligence.

CONTENTS

TRANSFORMING INDUSTRIAL OPERATIONS

In a mere two decades, the digital transformation of every aspect of human affairs has been profound enough to make silicon-based innovations seem almost as important to our evolution as DNA itself. The undeniable and non-reversible effects are visible everywhere, including the industrial world. It can be tempting to look at this progress and believe that the impact of digital technology on industry is nearly over. In fact, it's only just begun.
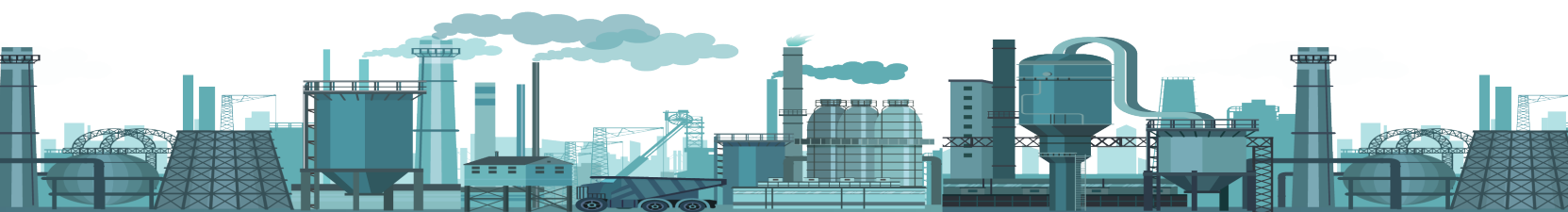
The universe of large-scale industrial process manufacturing encompasses a wide range of industries and companies that develop and manage operations in oil and gas, hydrocarbon processing, chemicals, materials, metals and more. The impact of these industries on the global economy and society cannot be understated.

Industrial operations are constantly challenged due to the complexity of the equipment, people and systems that operate and manage them. The continuing push to lower production costs, increase product quality and safer working environment, flexibility and customer service levels are constant driving forces.

Industrial players are waking to the fact that they cannot expect to compete effectively in the marketplace without aggressive investments in operations - specifically new data and digital tools to improve asset utilization, increase operations visibility and optimize production systems. This is especially true in the heavy process manufacturing arena where many companies are more concerned with risk management than innovation, and therefore less likely to adopt new technologies.

Today, traditional process industry operations and maintenance practices, as well as compliance and safety systems, are all coming under ever-increasing pressures from diverse stakeholders. To remain competitive, companies are faced with making fundamental changes in virtually all dimensions of their business and operations, including:

» Setting new goals for zero emissions and sustainability that require rapid and widespread changes in investments, policies and operating practices;

» Aggressively utilizing new digital automation and software technologies to attain higher plant performance, quality and flexibility; and

"The critical question we all need to ask is: how do we put the operator in the best position to successfully embrace new digital systems?"

VP Operations,
Specialty Chemical
Producer

» Compensating for the loss of experienced operators and process-knowledgeable personnel by investing in digital industrial operator (DIO) transformation to develop a higher value workforce.

Optimizing plants and processes to operate more efficiently requires the careful coordination of people, processes, policies and technologies. Mastering industrial digital transformation involves a subtle dance of innovation, empathy and timing. Technology innovation always moves faster than the production of real-world products. This creates a classic disconnect between the pace of technical innovation versus the time it takes to integrate new technologies into operations.

THE FAILURE OF "IIoT 1.0"

In the last ten years alone, countless billions of dollars have been invested in cloud computing technology, networking infrastructure, control systems and software to optimize production in heavy industry. Many of these investments historically focused on core processes and equipment but more recently investment has been expanding to address new compliance, safety and sustainability capabilities.

Leading industry players are recognizing that new software, systems and data analytics will be a minimum requirement to succeed. If this is the case, then why are so many companies holding back in adopting new digital technologies?

To date, existing digital and IIoT technologies have proven cumbersome and costly to adopt with many conflicting protocols and incomplete solutions. IIoT systems development has, for the most part, been limited to simple monitoring systems and data collection capabilities. Early IIoT projects, or IIoT 1.0, struggled with technical integration issues and deployment complexities.

IIoT 1.0 programs have suffered many challenges, including poorly implemented software and early hardware that didn't perform to specifications, as well as high costs and long implementation cycles. To date, IIoT 1.0 solutions have failed to meet user expectations and have not addressed the most basic operational challenges.

If you speak with plant operations personnel, you quickly discover that many IIoT 1.0 projects have focused more attention on experimenting with new digital technologies than on operator trust to drive active adoption of these systems. As a result, many companies have initiated pilots, but very few have successfully been able to scale their solutions. These shortcomings are diluting plant operators' confidence in IIoT systems and inhibiting investments.

In fact, more than 76% of digital programs have failed to meet their stated goals, according to feedback from a survey of 60 industrial C-suite leaders that Harbor Research conducted in 2021. Several industry participants we spoke

Early "IIoT 1.0" projects focused more attention on experimenting with new digital technologies and considerably less attention on operator trust to drive active adoption of these systems.

Harbor
Research

with say the number is probably closer to 90%. Anywhere in that range reflects many billions of dollars down the drain.

What often holds companies back from making new technology investments is an insidious combination of legacy systems, processes and practices. Even if we could oversimplify the path to adopting new digital plant systems as something that a company can accomplish with the help of specialists and partners, almost any path a company chooses to take will inevitably impact their operating model and business processes in unexpected ways that can lead to failures.

While many will point to organizational missteps, lack of investment or technical hurdles as the cause of such failures, we believe that many of them can be traced to a broader confusion about the relationship between plant operators and the role new digital technologies should play in their jobs. Frustrating and expensive failures can occur when companies either fail to ask this question or answer it wrong.

Based on recent survey feedback from industrial C-suite leaders, more than 76% of digital programs and investments have failed to meet their stated goals.

LET OPERATOR ADOPTION DRIVE DIGITAL OPERATIONS TRANSFORMATION (NOT TECHNOLOGY)

The operators who supervise industrial plants are the critical linchpins that deal with the inevitable unknowns and problems required to keep plants running. The front-line operators have a more acute understanding of how to resolve problems because of their unique understanding of the plant's equipment, systems and process relationships.

Process plants rely on many diverse skills and subject matter experts. At any one time, hundreds of workers may be onsite, including company personnel, contractors and third party support staff. Process control engineers monitor and optimize the efficiency of processes; maintenance staff ensures assets and equipment are repaired and maintained; environmental, health and safety (EHS) staff focus on protecting plant personnel and community; and, more recently, new technical roles are emerging to address digital systems and data science. But, at the end of day, it's the plant operators who are accountable for the coordination required to ensure the entire plant is running smoothly and efficiently.

With fewer operators, a generational shift in the workforce, and the rapidly increasing complexities of plant operations, it is becoming very challenging for plant operators to remain focused and effective. New digital technologies have the potential to provide tangible value to operators who are confronted with critical production, quality, safety and compliance decisions daily, but only if the technologies are operator-led and directly support plant operating practices.
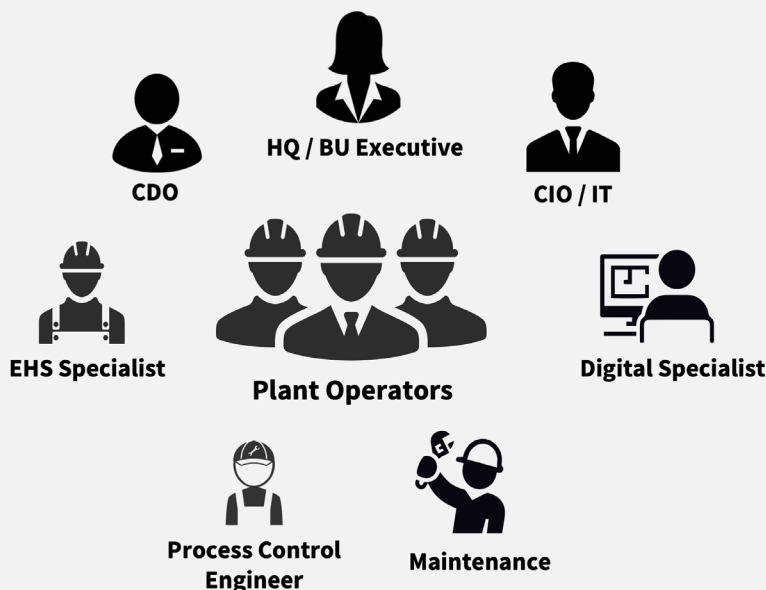
If you compare the production units of well-run plants with plants that have marginal performance, the difference is largely explained by exceptional plant operators. These are the people who understand the critical production and safety performance factors better than the technical support engineers and other plant specialists. The plant operators constantly juggle diverse information coming from both "top-down" and "bottom-up" sources, often relying on intuition and first-order princples to drive decisions.

Exhibit 1

Plant Operators Are Key Adopters of Digital Systems

Operators understand how to resolve problems because of their unique knowledge of the plant's equipment, systems and relationships.

CDO

HQ / BU Executive

CIO / IT

EHS Specialist

Plant Operators

Digital Specialist

Process Control Engineer

Maintenance

If you compare the production units of well run plants with plants that have marginal performance, the difference is largely explained by exceptional plant operators.

Digital and IIoT technologies can help address many operational challenges, but only if plant operators come to trust the outputs these systems produce. Plant operator trust is the foundational element required to drive adoption of these new technologies, particularly in highly mission-critical environments.

As the complexity of operations increases, the number and diversity of roles expands, and the volume of their interactions grows, the role of digital systems needs to become more aligned and tightly coupled to the plant operator role. The role of digital systems and the role of the plant operator need to be mutually supportive without inhibiting one or the other.

Harbor Research

Trying to coordinate and leverage the siloed role of digital technology with plant operators often creates contention. However, leading industry players are coming to see the continuously evolving relationship between plant operators and digital solutions as fertile ground for innovation. They need to be interwoven and mutually supportive. Many people believe success in either increasingly goes to those that effectively utilize the combined potential of both.

ENTER mPACT2WO and IIoT 2.0 INNOVATION

It is evident that we need to evolve from IIoT 1.0 and more effectively align digital innovation with plant operations. mPACT2WO is one such player that is thinking about IIoT solutions very differently.

mPACT2WO, a business unit within Molex (a Koch Industries subsidiary), organized a seasoned development team a couple of years ago to develop a new generation of sensing and data analytics solutions for asset, compliance and safety applications across the process industry arena. The mPACT2WO business unit is pursuing one the most overlooked industrial innovation opportunities in history: enabling the hands-on plant operators. In many ways, industrial companies have invested in just about every kind of newfangled system anyone could imagine, but they've only invested marginally in systems directly focused on the operator.

As the mPACT2WO business innovation team began to develop its plans for new solutions, it dedicated time and resources to better understanding what process industry operators need and expect from new digital systems. They focused their early investigations on the large-scale process operations of their parent company, Koch Industries. As a result, the team discovered three critical drivers for a new generation of "operator-first" systems:

» **Leverage collective intelligence:** For all its supposed sophistication, many existing IIoT system models are a direct descendent of traditional SCADA and similar monitoring systems where each device acts in a "hub and spoke" mode and does not leverage the full value of sensor and measurement data from the overall system. When diverse sensor and measurement nodes are networked and interoperate seamlessly, the data they produce allows operators to better understand system-wide behavior.

» **Automate insights and collaboration:** When telephones first came into existence, all calls were routed through switchboards and had to be connected by a live operator. It was long ago forecasted that if telephone traffic continued to grow in this way, soon everybody in the world would have to be a switchboard operator. Of course, that did not happen because automation was built into the systems to handle common tasks like connecting calls. We are quickly approaching analogous circumstances with the proliferation of smart connected sensors, instruments and equipment.

Effective deployment of new digital solutions requires software tools that can automate insights for plant operators and facilitate collaboration between critical plant personnel.

» **Enhance and extend plant operator experience:** Operators, just like everyone else on the planet, are becoming more digitally proficient through the use of smartphones, the Internet and consumer social media platforms. We are all interacting with smart devices and systems that provide better user interfaces, contextual navigation, warnings and alerts, and collaborative communications. These systems are more natural and intuitive. Applying the same user-centric design concepts to industrial systems will create a path for plant operators and personnel to value and trust the critical data originating from processes and equipment systems.

Moving from systems that create an avalanche of undecipherable data to better organized, user-centered tools that operators can trust and easily extract value from is a fundamental requirement.

Exhibit 2

IIoT "1.0" versus IIoT "2.0"

Maximizing Operator Adoption and Use

	IIoT 1.0	IIoT 2.0
FOCUS & APPROACH	• Technology first • Technology focused • Lack of trust in complex technologies	• Operator first • Operator focused • Demystify tech and data
OPERATOR EXPERIENCE	• Focused more on technology experiments • Does not address operator processes & practices	• Focused on operator priorities • Familiar, trusted situational and contextual awareness • Aligned with operators' daily processes and decision methods
OUTCOMES	Data "avalanche" versus pragmatic, familiar and trusted data and information	Operator-centric information for anomaly detection, root cause analysis and corrective actions to create an effective path to a higher value workforce

Plant operators have complained for many years they often feel they don't have the right data or reliable data to make confident decisions. Getting information on performance variances often proves to be elusive because the data are siloed and the insights are too futuristic from an operator 's perspective.

Harbor
Research

New sensor, software and data analytics technologies need to tangibly help plant operators address critical operation challenges. Moving from systems that create an avalance of undeciherable data to better organized, user-centered tools that operators can trust and easily extract value from is one the most fundamental drivers of IIoT 2.0 systems.

OPERATOR-DRIVEN IIoT APPLICATION OPPORTUNITIES

The rigid and fragmented nature of today's systems and software offerings make it extremely difficult, if not impossible, for plant operators to leverage the full potential of sensor and system analytics. The digital tools plant operators are working with to make better decisions were not designed to handle the scope of capabilities enabled by new intelligent sensors, the diversity of measurements and the massive volume of data-points generated from systems.

These challenges are diluting the ability of industrial organizations to effectively leverage new digital systems and data values. To make matters worse, the rate of operational change today already exceeds the design-develop-deploy cycle of existing systems and is expected to increase as much as 5X over the next 10 years. We are reaching a critical juncture where organizations will soon be crying out for a completely new approach - one where the system enhances and extends plant operators' knowledge and capabilities.

Operators expect evolving software tools to be functional, ubiquitous and easy to use. In practice, the first two expectations often run counter to the third. The mPACT2WO team's concept of IIOT 2.0 solutions is directly aimed at all three of these requirements. They address several new and novel solutions focused on compliance, safety and plant operations, including:

» Continuous emissions monitoring to achieve net-zero emissions by reducing VOC (volatile organic compounds) and GHG (greenhouse gas) emissions; and promote environmental stewardship by complying to ESG (environmental, social and governance).

» Analysis of performance variances for critical fixed equipment assets, including pipes, vessels and more;

» Analysis of usage intensity for mission critical rotating assets including motors, pumps and high value turbo-machinery;

» Anomaly detection and root cause analytics to enhance situational awareness for operators that can be integrated with "operator-first" principles and work processes;

"Investing in digital plant initiatives is a bad idea without also investing in support and training because not all plant operators will feel completely comfortable with new systems and technology."

Plant Manager,
Global Oil & Gas Producer

Exhibit 3
Customer Case Study

Early Emissions Detection Enables Quick Response

Leaking systems in refineries and chemical plants, such as valves, pumps, compressors and lines are a large source of volatile organic compounds (VOCs) and related emissions. Typical process facilities have hundreds of pumps, more than ten thousand valves and connectors as well as several hundred open-ended lines, sampling connections and relief valves. This creates a very large challenge for plant operators. By integrating continuous monitoring with leak detection and repair (LDAR) programs, the mPACT2WO solution provided early detection and location information to enable a faster and more effective response to emissions leaks.

Customer Goals:
» Mitigate potential leaks across the unit to reduce emissions
» Eliminate production waste due to equipment leaks
» Environmental, Social and Governance (ES&G) stewardship

Problem Areas:
» Passive monitoring - inability to prevent leaks before they happen
» Ensuring a safer working environment
» High re-monitoring cost

Results:
» Detect leaks and field investigation in about 30 minutes - from the time notification was triggered to the time the field services isolated the problem area in the field
» Detect small and large emission leaks at the source
» Enhanced digital approach to seamlessly shift existing manual operations methods, such as method21

Benefits:
» Operational efficiency
» Compliance and penalty avoidance
» Accountability & safety
» Planned and controlled shutdown vs. unplanned and costly shutdown

Harbor
Research
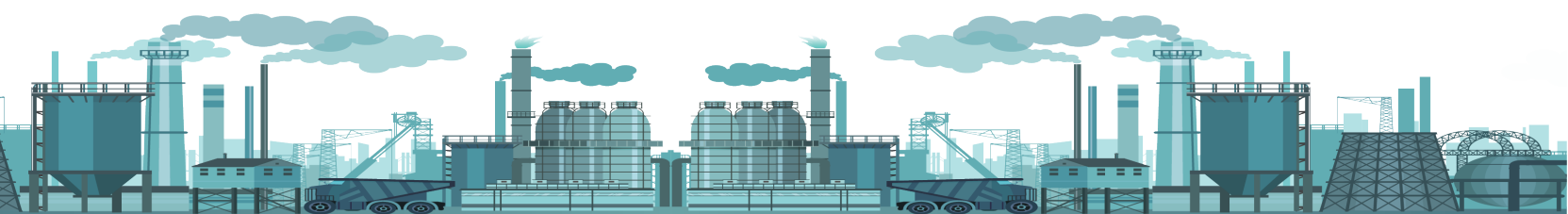
» Sensor data and analytical models that combine current and historic data to analyze the state and lifecycle of critical infrastructure to avoid over monitoring and over maintenance;

» Data and analytics that inform collaborative services between first-line plant maintenance, the equipment provider's service technicians and other third party support personnel, such as a unified equipment maintenance record that captures and leverages all of the machine's performance data and history; and

> "Most companies ignore their operators while planning digital projects -- you can put forward the best analytics system developed by highly skilled subject matter experts or data scientists but without operator engagement it will never be used."
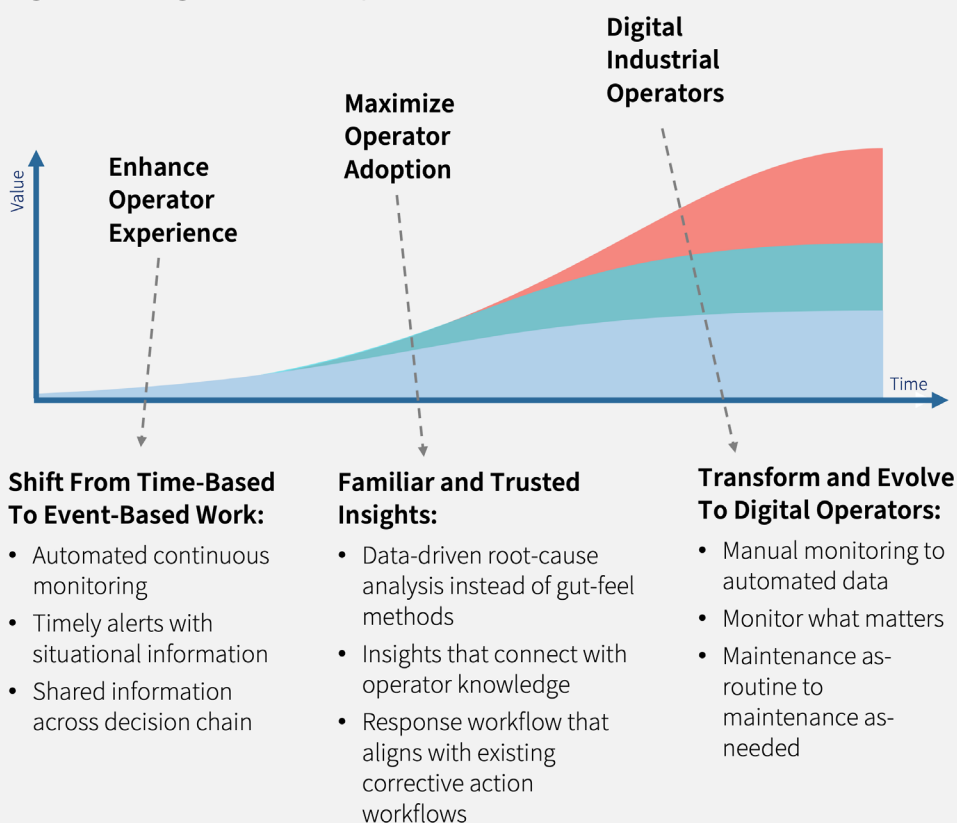>
> Director, Systems Development
>
> Diversified Chemicals Producer

Exhibit 4

The Road To Digital Industrial Operators

Operator-first approach maximizes operator adoption enabling higher value digital industrial operators (DIO)

Shift From Time-Based To Event-Based Work:

- Automated continuous monitoring
- Timely alerts with situational information
- Shared information across decision chain

Familiar and Trusted Insights:

- Data-driven root-cause analysis instead of gut-feel methods
- Insights that connect with operator knowledge
- Response workflow that aligns with existing corrective action workflows

Transform and Evolve To Digital Operators:

- Manual monitoring to automated data
- Monitor what matters
- Maintenance as-routine to maintenance as-needed

» Vastly improved levels of service and equipment availability through management and automation of an operator's service delivery chain.

Molex's mPACT2WO business is focusing on developing more intuitive operator-centric systems where new value is created from sensor-based data. This actionable data becomes integral to operators' processes and practices and enables visibility into the state of process equipment, systems and performance.

mPACT2WO's IIOT2.0 innovations set the stage for operators to make confident data-informed decisions where tangible operational efficiencies, compliance and higher standards of safety can be realized. It gives plants the ability to connect equipment systems and infrastructure into a "digital nervous system" that will smoothly interact with plant operators, process engineers, maintenance personnel and other specialists.

Exhibit 5
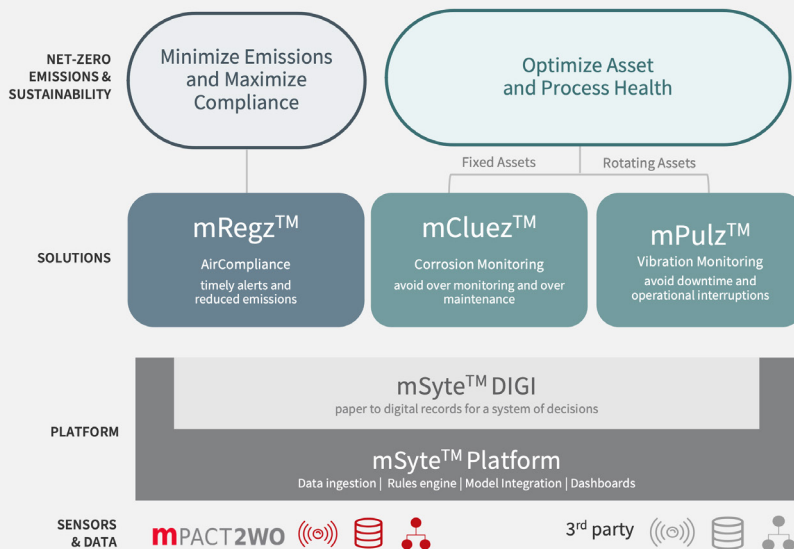
mPACT2WO's IIoT 2.0 innovations set the stage for operators to make confident data-informed decisions where tangible optimization potential is realized.

Digital industrial operations transformation will require unique knowledge of sensor technologies and a deep understanding of how data and analytics enable sensor-based systems, as well as capabilities to develop applications.

Molex's mPACT2WO business is ideally positioned to help plant operators reach their full potential by utilizing smart sensors, monitoring and data analytics to help manage plant complexity and situational chaos. mPACT2WO solutions help operators quickly and effectively gather inputs and assess abnormal situations, collaborate with others as needed and then act on the problem as smoothly and intuitively as possible.

New sensor-based systems can enhance production efficiencies, compliance and and higher standards of safety by providing event-base monitoring solutions that translate equipment data into operational insights, enable a step-function increase in digital workforce capabilities and help transform plant operators into digital industrial operators.

Harbor Research

Harbor Research

Harbor Research has over thirty years of experience working with clients on growth strategy and new business creation. At the core of Harbor's approach is a deep understanding of the core technologies, markets and business characteristics as well as the management and organizational challenges companies face adopting and developing digital and smart systems technologies. We strive to generate deep insight into how emergent technologies drive value creation and competitive advantage in our clients' businesses and the economy as a whole.

For more information visit www.harborresearch.com.