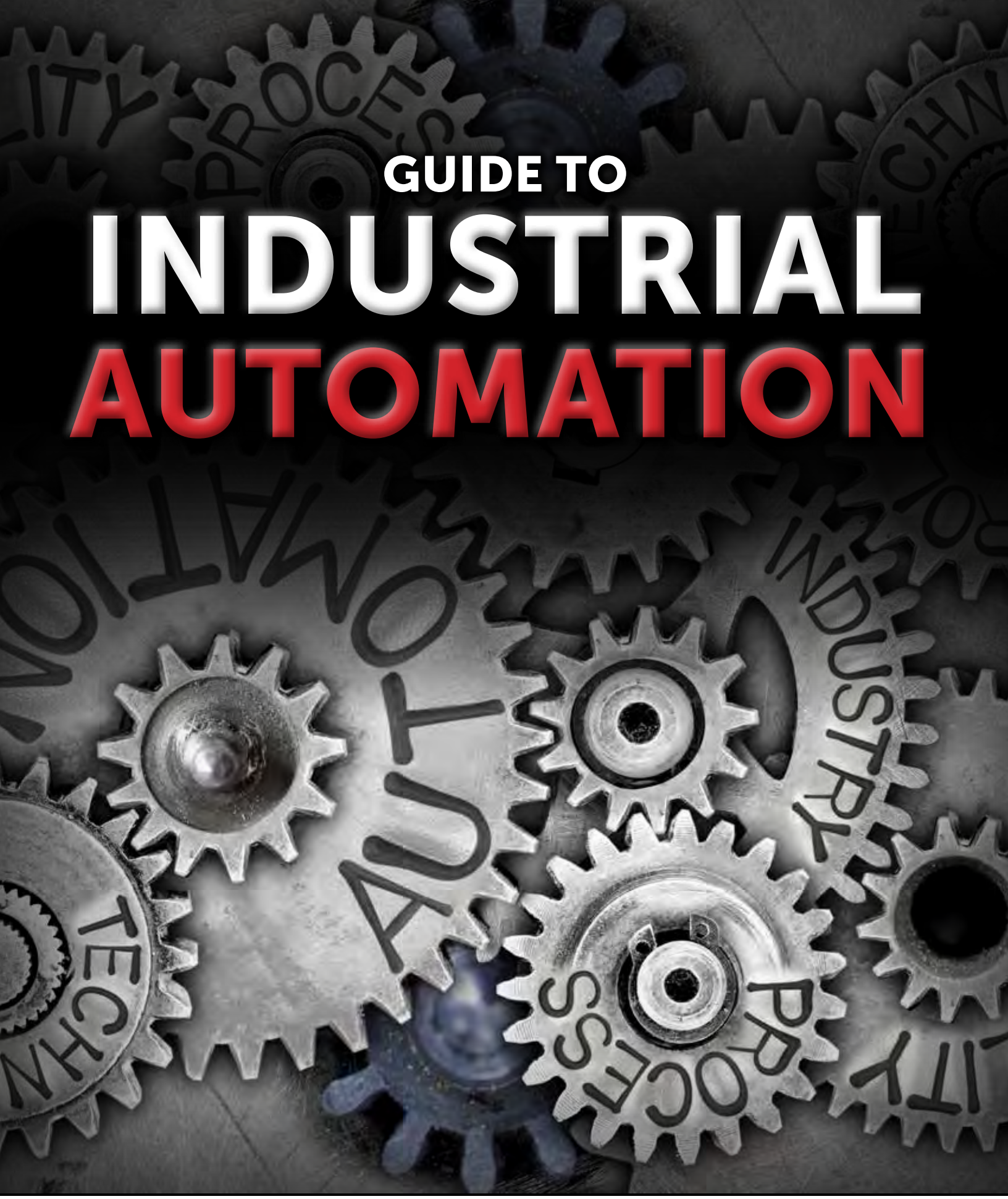
GUIDE TO INDUSTRIAL AUTOMATION



DOMINO FESTO HAMMOND MANUFACTURING Honeywell WAGO

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IPP&T's Automation Handbook offers engineers and process managers insights into the latest automation technologies and terminologies that are being used today.
This collection of articles provides a wealth of practical advice on smart manufacturing, making the right purchase, and explanations of what can best be termed as "tech speak."
You'll find expert advice and applications that work best for a number of real-life situations, and tips on how to choose the best automation system for your company's process operations.
Included in the handbook are articles on:

- Process values are continuously calculated by using P (Proportional), I (Integral) and D (Derivative), or PID. Learn how a programming tool for WAGO's performance class PFC controllers offers several proven methods of autotuning PID loops for a multitude of applications.
- How you can win the war on "error" by integrating and automating coding and marking, which can go a long way to reducing costly product recalls.
- Compressed air is the most cost-effective energy source for driving many industrial processes – but leakage often negates much of the savings. Learn how energy efficient technologies can optimize compressed air usage, saving you money.
- The enclosure is sometimes an afterthought when designing automation systems. Choosing the right electrical enclosure can make all the difference, and underestimating or delaying the selection of the appropriate enclosure can cause significant issues – but these can be avoided.
- Do you find tech confusing? Making the wrong purchase decision can cost time and money. Demystifying digital terms can avoid this, and in this article, the author dives deep into the reality on the shop floor, and what vendors and operators are envisioning for process manufacturers.

GUIDE TO
INDUSTRIAL AUTOMATION

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WINNING THE WAR ON ERROR

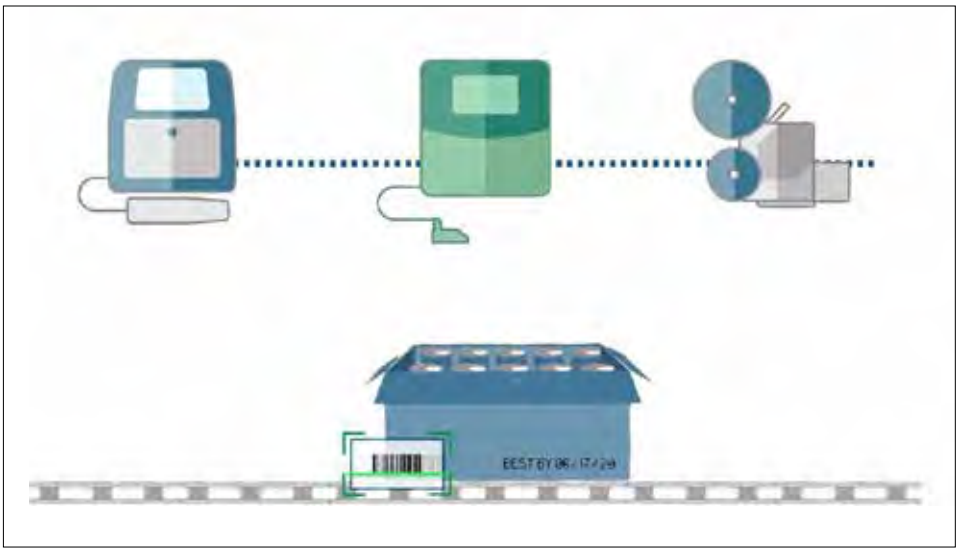
How integrated and automated coding and marking reduces costly product recalls

The more things change, the more they stay the same. Two years ago, almost half of all product recalls in the US food industry were caused by undeclared allergens or labelling errors that typically manifest themselves in inaccurate coding. Today, despite major advances in coding automation, the dial has barely shifted; in the first five months of 2019, more than a quarter (27%) of US recalls were due to inaccurate labelling or allergen declaration. The issue is not limited to North America. In the UK, suboptimal coding has contributed to a 40% rise in food recalls, with three major brands recalling products due to labelling errors in the first few days of June 2019 alone. The challenge also extends beyond food and beverages; manufacturers in many other industries – not least drugs and medical devices – continue to suffer costly product recalls due to deficiencies in their coding and labelling capabilities. In the Industry 4.0 era, these flaws are not only avoidable, they can be eradicated quickly and cost-effectively – in the process, unlocking productivity and efficiency gains that can seriously improve the bottom line. The message is simple: automated coding and marking equipment can help companies win the war on error. It's time it was integrated into supply chain operations.

Decoding the myth

Integrating coding automation into existing production lines and industrial networks has long been considered complex and expensive. As such, despite widespread use of IoT across most other aspects of the supply chain, many companies have continued to rely on manual processes and human intervention to ensure the right codes are printed on the right products, boxes and pallet labels. It's a tremendous risk. With consumers increasingly requesting more nuanced products – like organic, artisan, lactose-free or gluten-free – manufacturers are now sending a wider variety of products down a single production line, ramping up the pressure on already-streamlined resources and placing the responsibility for code validation squarely on operators' shoulders. The challenge is particularly intense at 'changeover', when – as part of a diverse range of primary tasks – operators must quickly determine the right code for incoming (and often similar-looking) products without slowing the line or halting production. It's a huge ask that's understandably prone to human error. Operators need help.

The idea that coding automation cannot be integrated into industrial networks is a myth. The fundamental principles of Industry 4.0 – collaboration and integration – are just as achievable with coding as they are with everything else. Historically, companies have typically deployed automated coding equipment as standalone solutions, separate from their other business systems. This has meant that many organisations have squandered the op-



portunity for operational efficiencies and inadvertently increased the risk of coding error. It need not be the case. The emergence of new printer encoding technologies and compatible software solutions has transformed supply chain operations. Now, with the simple application of IoT methodology, it's possible to integrate automated coding solutions into an existing network. Through a single connection – and without needing to know the industry protocols or characteristics of a printer – coding software can leverage data that exists within an ERP, SCADA or other automated system to populate a label and push it to the printer without any manual intervention.

Transformation through automation

The benefits are substantial. In progressive organisations that have successfully brought their coding capabilities into the Industry 4.0 era, labelling errors – and expensive product recalls – have been eliminated and changeover processes have become much more efficient. For example, one well-known food manufacturer – who fully automated coding through their SAP – has not only eliminated coding errors, they've significantly increased productivity by minimising reworking and removing associated downtime that typically accounted for as much as two hours each day. Similarly, a major beverage company – where gaps in coding processes had led to a $40,000 recall – has completely removed human intervention failures with the introduction of integrated automation, mitigating production risk and increasing efficiency by 100%.

In both organisations, and many more, embedding coding automation into major business systems is allowing a full, seamless communication stream and data sharing that's fuelling more efficient operations. Moreover, busy operators are being freed to focus on their main priorities – getting high quality products out the door, first time, every time.

The Domino effect

Despite the advantages of coding automation, some companies still rely on traditional manual processes. In many organisations, the common misconception that coding software isn't sophisticated enough to integrate with other systems or comply with industry protocols is an unnecessary barrier to progress. Similarly, companies often focus their attention (and investment) on large capital equipment, overlooking inefficiencies in secondary or tertiary systems. However, with businesses under significant pressure to increase OEE, there are huge efficiency gains to be made by stitching coding automation into the fabric of wider supply chain operations. Moreover, the domino effect of better compliance, greater productivity and fewer recalls naturally leads to a healthier bottom line performance.

So how can organisations realise these benefits? Fundamentally, success depends on adopting a Triple-A approach; Audit, Act and Automate. Primarily, plant managers should evaluate their existing set-up to identify major pain points. What and where are the current causes of inefficiency and downtime? Which solutions operate outside your normal automation systems and why? It's only by fully auditing your coding creation and development processes that you can identify the fundamental drivers of errors and the associated impact they have on productivity and efficiency.

Secondly, be prepared to act on what you find. Often, companies build automation into their larger business systems but fail to consider the holistic benefits of bring other solutions into the bigger picture. Sometimes, limitations with existing technologies prevent integration, stifling the advantages of interoperability. It's important to make an honest assessment of current capabilities and respond accordingly.

Finally, in the Industry 4.0 era, if you're not using automation everywhere you can, you're most likely missing a trick. There's a school of thought that 'automation is the future' – but it's a slogan that's fast-becoming out of date. Automation isn't the future, it's very much the present. As artificial intelligence technologies become mainstream, fully automating a production line is no longer ambitious, complex or expensive – it's practical, sensible and, crucially, affordable.

Ultimately, coding automation allows companies to reduce risk, save money and realise significant efficiencies within the production environment. To progress, companies must move beyond a reliance on traditional methodologies, and partner with a technology provider that – through integrated coding automation – can help them win the war on error.

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FESTO ENERGY EFFICIENCY TECHNOLOGY OPTIMIZES COMPRESSED AIR USAGE, SAVING MONEY

Compressed air is the most cost-effective energy source for driving many industrial processes – but leakage, invisible to the eye and generally inaudible to the ear except up really close, often negates much of the savings. It's constant waste, and it happens even in businesses with a strong focus on system maintenance. Estimates of compressor capacity loss run from 10-30%. It usually starts with tiny trickles around joints or in hoses, and can grow into a major problem causing unscheduled downtime.

The conventional means for monitoring air loss are reactive, like relying on pressure sensors on air preparation units to alert the operator via a signal to the PLC or DCS that the pressure has dropped below the required operational level. At that point, the system reacts and often shuts down until engineering or maintenance diagnoses and fixes the problem.

However, measuring air pressure addresses only one factor. Air flow rates and volumetric consumption have been widely ignored, yet can point to problems or problematic trends well before they are serious enough to trigger an unscheduled shutdown. Festo's intelligent MSE6-E2M energy efficiency module has changed the paradigm, enabling a proactive rather than reactive approach to air loss recognition. By continuously monitoring air flow, the -E2M serves as an early detection system for leaks, so repairs can be done when issues are small, and usually between cycles or during scheduled maintenance.

The -E2M, part of the newly expanded MSE6 series of energy efficiency modules, serves as both a pressure sensor and flow sensor, measuring the real-time air flow rate as well as the volumetric consumption over a defined period. This data can be used to reduce compressed air consumption on an on-going basis.

The MSE6-E2M energy efficiency module provides alerts if it detects pressure dropping below prescribed limits while a process is in shutoff state. It likewise measures compressed air consumption for significant anomalies that suggest leakage.

For instance, in a given manufacturing setting, the -E2M shows a specific, repeatable process is consuming 27 litres of compressed air per minute at standard atmospheric pressure. This establishes a baseline. Subsequently, it shows the same process consuming 33 litres per minute. Pressure measurement isn't going to identify the existence of a problem unless the pressure level falls below operational minimums. However, in this example, the pressure is sufficient, but the process is inefficient because it now takes 33 litres of air per minute to maintain sufficient pressure, which means the compressor is working harder, at a cost.

The -E2M also can perform leak checks downstream between cycles. The unit will pressurize the pneumatic circuit and measure pressure degradation to deter-

When the MSE6-E2M is connected to the cloud via the Festo IoT Gateway device, data from the energy efficiency module is displayed on a standardized dashboard for easy monitoring and benchmarking. Trends can be analyzed, early warnings can be issued, and incident notifications can be set up. The Dashboards can be securely accessed in a web browser from any device with internet access.

mine if air is leaking and at what rate. Furthermore, while the system is idle or shut down, the -E2M acts as a master on/off valve, preventing air loss through trickling.

The -E2M is also notable among Festo's MSE6 series for its ability to upload data to the cloud when connected to a Festo CPX IoT Gateway on a CPX electrical terminal. That enables simple traffic light indications, as well as graphic depictions of energy use, performance figures, and makes available historical data on standard predesigned dashboards. These dashboards can be securely accessed on any device with internet access.

The MSE6-E2M fits directly into existing air preparation and filtration units of both new and existing manufacturing equipment. The IoT Gateway module fits directly into valve terminals, the Festo I/O module, or a combination of both. Both products work over fieldbus, HMI, local networks, Festo cloud, and third-party clouds, and in unison to provide useful and meaningful data for optimal compressed air performance.

The MSE6-E2M can be incorporated into an existing system as a standalone unit, which is the simplest and most cost-effective approach. In this scenario, because it is not connected to the PLC or DCS, some benefits of the -E2M are not fully realized, like the ability to measure air loss between processes or the automatic air shutoff capability when the equipment is idle. But all the analytical tools are available to indicate leakage or deteriorating performance. It's a risk-free way to evaluate data collection on operational efficiencies. There are no programming or commissioning changes required at the PLC/DCS.

Alternatively – and this is certainly the preferred approach with new designs or significant upgrades of the compressed air system – the -E2M can be integrated into the PLC/DCS. In this scenario, the full benefits are available, like the measurement of pressure changes during the idle state and automatic shutdown when the system is not in production or process. These are configurable parameters, accessible from the FB or AOI, that allow customization for process requirements. The HMI can also have access to all the energy and diagnostic data for local dashboards and fault handling.

For more information on the MSE6-E2M, CLICK HERE

Read about one food company's success story with the --E2M, CLICK HERE

To download a whitepaper on the E2M in the Life Science Sector – and how it might apply in your process business, CLICK HERE

To view a video on the -E2M, CLICK HERE

Smart IoT Compressed Air Device Delivers Advanced System Diagnostic and Energy Efficiency

Saving energy is easier than ever before thanks to the MSE6-E2M. Achieve your energy efficiency and sustainability targets while optimizing process equipment performance. Intelligent assembly features include:

- Zero compressed air consumption in standby mode
- Monitors the system for leaks
- Ensures maintenance in the event of leaks
- Enables effective real-time monitoring of relevant process data

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HOW TO CHOOSE THE RIGHT ELECTRICAL ENCLOSURE

While the electrical and electronic devices required in the assembly of a control panel are the focus of your design efforts, underestimating or delaying the selection of an appropriate enclosure might cause significant issues which can be avoided with just a bit of forethought. Consider these key factors in advance and save yourself headaches.

Which Electrical Enclosure Should I Use?

A quick Google search for "electrical enclosures" returns 58 million results so it is not surprising that some specifiers may feel a bit overwhelmed at the task. For most applications, there is a perfectly acceptable solution readily available – in fact Hammond Manufacturing alone has over 6,000 standard electrical enclosures and accessories. Reaching out to an enclosure supplier for support when needed is ideal, but you will need to know some critical information to decide what's appropriate.

There are many factors that can affect the selection of an enclosure for a particular application. We will focus on 7 common considerations for Electrical Enclosures:

1. Protection Rating
2. Certifications and Approvals
3. Size
4. Access Needs
5. Cost
6. Temperature Environment
7. Corrosion Resistance.

Protection Rating

An enclosure's protection rating indicates the degree of protection that the enclosure provides for the equipment that is inside. Enclosures are rated according to their ability to prevent various levels of dirt and liquids from entering. These protection levels are commonly referred to as "Type" or "NEMA" (National Electrical Manufacturers Association) ratings.

The table on the following page outlines the "Type"/"NEMA" ratings and protection levels for Hammond Enclosures.

Certifications and Approvals

Standards organizations create rating measurements for the performance of different products. Electrical enclosures categories are defined by organizations like NEMA, CSA, UL, and IEC to identify an enclosure's ability to provide protection from dust, dripping water, hose directed water, and more.

While these standards are all intended to guide the user to make the right choice of product, there are some important differences between them.

In North America, NEMA, UL, and

Provides a degree of protection against :	Type 1	Type 3R	Type 12	Type 13	Type 4	Type 4X
Contact w/Enclosed Equipment	Yes	Yes	Yes	Yes	Yes	Yes
Falling Dirt	Yes	Yes	Yes	Yes	Yes	Yes
Falling & Lightly Splashing Water	No	Yes	Yes	Yes	Yes	Yes
Dust	No	No	Yes	Yes	Yes	Yes
Oil and Coolant	No	No	No	Yes	No	No
Sleet and Ice	No	Yes	No	No	No	No
Splashing Water and Hose-down	No	No	No	No	Yes	Yes
Corrosives	No	No	No	No	No	Yes

Note: Many enclosures carry multiple approvals.

This table outlines the "Type"/"NEMA" ratings and protection levels for Hammond Enclosures.

CSA are the most commonly recognized standards organizations. They are almost identical in their rating and testing of enclosures.

UL and CSA require that enclosures be tested in an approved lab in order to prove their performance. They regularly inspect manufacturers to ensure they use the approved materials and construct to previously tested product designs. In turn, they provide "certification labels" to be permanently attached inside the enclosures.

While NEMA ratings are a common reference, distinct from UL/CSA, that organization does not provide testing services, they leave compliance and testing to the discretion of the manufacturer, and they do not provide "certification labels" for enclosures.

In Europe, IEC ratings are the most commonly recognized standards for enclosures. IEC ratings are similar to NEMA, but the pass or fail requirements are different. IEC primarily focuses on ingress protection and does not include distinct ratings for enclosures in conditions of corrosion, rust, oil, ice, or explosive (hazardous) environments.

IEC does not provide testing, so testing and compliance is left up to the manufacturer. In Europe, TUV and VDE are two popular, testing agencies that manufacturers sometimes use to validate protection levels.

Size

Kind of basic, but consider the minimum dimensions of the enclosure needed to house all of the installed components – e.g. how deep is the deepest component? Then, confirm if there are physical size limitations in the area where the enclosure is to be installed – is the space available wide open, short and wide, tall and thin, etc.

Hammond has over 600 sizes of standard enclosures available from inventory to meet almost every size of application. While sometimes necessary, specifiers that request a custom size will likely limit their supplier options, increase costs, and lengthen lead times.

Access

The interior of an enclosure is accessed generally through a front door/cover. These can be closed with quarter turn latches, clamps, handles, or screws. The proper choice will be driven by frequency of access, security concerns, and planned device mounting on the door (e.g. handles take up more door space).

Larger enclosures can offer expanded access options with optional door on the rear or removable side panels. When security is an issue, often basic accessories additions can include padlock hasps, tamper proof screws, or key lockable hardware.

Cost

While choosing the proper protection level is key, there are some ways to save costs.

Do not over-specify the protection level. For example, a clean commercial environment generally only needs a Type 1 level of protection and specifying Type 12 industrial protection will just add cost. Similarly, specifying Type 316 stainless steel when Type 304 stainless steel is appropriate will unnecessarily raise the price.

In general, designing custom enclosures from scratch will drive costs up. Use of standard enclosures or modified standard enclosures allows manufacturers to use their existing hardware, processes and approvals to meet most of your needs.

Temperature

It is important to consider where the enclosure will be installed as the ambient temperature can definitely impact the performance of the equipment enclosed within a cabinet. You should be aware of the minimum and maximum ambient temperature along with equipment temperature tolerances.

Suitability	Acids	Alkalis	Solvents
High	316 Stainless Steel 304 Stainless Steel	316 Stainless Steel 304 Stainless Steel	316 Stainless Steel 304 Stainless Steel Fiberglass Aluminum Powder Painted Steel
Satisfactory	Fiberglass Powder Painted Steel	Fiberglass	
Limited	Aluminum	Powder Painted Steel Aluminum	

This guide is for the use of various materials in different types of corrosive environments.

In a very warm environment, it may be necessary to compensate by using a larger enclosure. This would allow more air to circulate around the components in the enclosure and provide a larger surface area on the enclosure to dissipate heat. Another option is to use some form of supplementary cooling apparatus, like cooling fans, heat exchangers, or an air conditioner, designed for this purpose.

In colder climates, heating is often needed to maintain a minimum temperature. There are numerous heating solutions available for small to large enclosures. In humid environments, heaters can also help control condensation issues by keeping enclosure temperatures above the dew point.

Corrosion Resistance

Enclosures are used in many different environments, some of which are very corrosive. Enclosure manufacturers use materials such as Stainless Steel (304 and 316L), Aluminum, Polycarbonate and Fiberglass Reinforced Polyester to help combat these environments.

The popular Type 4X standard is widely known for "corrosion resistance", but it's important to realize that achieving this approval is based solely on resistance to certain concentrations of salt. If there are other corrosive chemicals in the environment, the standard Type 4X materials can have widely different levels of performance.

In Closing

The performance of a control cabinet can be significantly impacted by poor enclosure selection. Use the considerations above to choose wisely and reach out to an enclosure expert with any concerns you have.

For more information on enclosure selection, please speak to your local Hammond Manufacturing distributor, sales representative or contact factory support here. The website **www.hammondmfg.com** is well structured and advanced search functions to find the proper enclosure you need.

About the author: Sheldon Butts is the National Sales & Marketing Manager for the Electrical Enclosure Division of Hammond Manufacturing in Canada.

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- Type 3R - Outdoor applications
- Type 12 - Industrial environments
- Type 4 - Non-corrosive, wet environments
- Type 4X - Wet, corrosive environments
- IP69K - High termperature, high pressure wash applications

Material options:

- Painted carbon steel
- 304 stainless steel
- 316 low carbon stainless steel
- Aluminum
- Polycarbonate
- Fiberglass reinforced polyester

Explore all your enclosure options at:

hammondmfg.com

DEMYSTIFYING DIGITAL TRANSFORMATION IN INDUSTRIES

By Sandeep Chandran, Honeywell

INTRODUCTION

Adding a 'tech' prefix to traditional business is an easy way to identify the disrupter in a traditional industry. We now have a new breed of entrant disrupters - FinTech, InsurTech, GovTech, PropTech, WealthTech, RegTech, EdTech, FoodTech, CleanTech, BioTech, RetailTech, MadTech, HealthTech, and the list goes on.

The common thread amongst all these disrupters is the use of digital technologies to drive innovation that will upend the traditional industry. Within manufacturing, and process industry in particular, we have a similar wave of disruption in play. Although there is no term with a 'tech' prefix to define digital transformation, we come close with Smart Manufacturing in North America, and Industry 4.0 in Europe.

This article takes a step back, and attempts to debunk some of the myths and mystery that makes this an interesting topic to write about. We'll start with a review some of the terms that are used indiscriminately, then delve into the reality on the shop floor. We'll wind down with what vendors and operators are visioning, and finally close out with some bold predictions

SMART MANUFACTURING & INDUSTRY 4.0

According to the National Institute of Standards and Technology (NIST) Smart Manufacturing are systems that are "fully-integrated, collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the factory, in the supply network, and in customer needs."

The Smart Manufacturing Leadership Coalition definition states, "Smart Manufacturing is the ability to solve existing and future problems via an open infrastructure that allows solutions to be implemented at the speed of business while creating advantaged value."

The German federal government adopted the idea in its High-Tech Strategy for 2020. Subsequently, a Working Group was formed to further advise on the implementation of Industry 4.0. "these Cyber-Physical Systems comprise smart machines, storage systems and production facilities capable of autonomously exchanging information, triggering actions and controlling each other independently. This facilitates fundamental improvements to the industrial processes involved in manufacturing, engineering, material usage and supply chain and life cycle management.

SAY IT WITH AN EXAMPLE

Regardless of the term used to categorize Digital Transformation, there are some fundamentals we need to get straight. The two commonly used terms, and often inter changeably, are Digitization, and Digital Transformation. There is a difference between them. There is Digitization and Digitalization on one hand - which is the transformation data and processes using technology, and then there is Digital Transformation on the other hand which is a business strategy of combining various digitalization initiatives together.

In the process industry we have activities that requires the use of paper and pen. Like Operator Rounds, which in a lot of locations, even today, uses a clipboard. This activity can be easily replaced with a tablet or mobile device. This is a classic

example of digitization.

Building up on our case study, there are other activities that an outside operator performs like to capture data from stranded assets. Stranded assets are those where data that is not automatically captured into a control system or historian, and requires data to be captured during a round. Digitalization in this case would be to use such data, say the decibel level of the environment around a compressor to drive some machine learning or deep learning to predict the compressor health.

DIGITAL TRANSFORMATION UTOPIA

Digital Transformation is a business strategy that combines all the ongoing Digitalization initiatives under a common framework, resulting in a step change in business outcomes.

The consumer world have made tremendous advancements over the last decade, with technology and applications, helping us to draw analogies within the industrial world. What we are experiencing in the process industry today is what has already happened in the consumer world.

Overs the last 15 years, a lot of smartphone applications have been developed to enhance personal productivity. Some of the popular applications we all use are camera, uber, spotify, expedia, yelp, airbnb. Each of these apps represent digitalization of specific function from our lives. But combining all these apps meaningfully to enhance our efficiency or happiness is an example of an individual digital transformation strategy.

In the process industry, we are just starting Digital Transformation. We have numerous solutions that address different parts of the business independently. For example: In a refinery, we have a solution with linear programming that a planner uses, we have a yield accounting solution based on statistical data reconciliation that an accountant uses, a lab technician uses a laboratory information management system system. But, meaningfully combining these digitalization solutions towards a Digital Transformation strategy is still in its infancy.

STATE OF THE INDUSTRY

There are pockets of innovation happening in the industry that make us believe organizations are actively adopting and embarking on their own digital transformation journeys. Enumerating a few facts:

1. Digital transformation are strategic initiatives, requiring support from the highest levels of the organization. In a poll Honeywell had done in the ME region, 60-70% of executives indicated they are thinking or planning to make digital transformation initiatives a core of their strategy.
2. In the recent years conversation has shifted from planning activities to actual validation of initiatives via proof of value and benefits realization. An example here is the Centralized Predictive Analytics & Diagnostics (CPAD) program, kicked-off by Abu Dhabi National Oil Company (ADNOC) in 2019. It is an enterprise-wide program on the oil value chain across the brown-field facilities.
3. There are indications that the future Oil &Gas Greenfield projects have already factored in the promise of digital transformations into their organizational design and project economics.
4. And finally, unlike the past where the cost of technology adoption were prohibitive for smaller operators to benefit, the ubiquitous availability of technology has made it possible even for smaller players to initiate their trans-

formation programs. This is a crucial factor, as this is what leads to mass adoption and eventually the transformation across the industry.

BLOCKERS TO OVERCOME

There are still factors outside of technology maturity, that are to be addressed for mass industrial transformations:

1. Data: Data policies around ownership, privacy and security are evolving rapidly and are unique to organizations, regions and countries.
2. The Human Factor: Technology alone is not going to bring about the scale of transformation we are hoping for. As with any large programs, change management, organizational design and cultural change will be required for successful adoptions. This also leads to the questions of role transformations, and the future of work for the Human Resources team.
3. Vendor Collaboration: There is growing realization that such transformation programs cannot be delivered by any single vendor. The requirement is to leverage the collective knowledge across the industry - Operators, Technology Providers, Original Equipment Manufacturers (OEM), and having all collaborating to work together, including traditional competitors.

HOW DOES THE FUTURE LOOK?

The future is autonomous. A factory or a manufacturing facility where:

1. Tasks are executed by a myriad of robots with minimal ground personnel. There is minimal manning on-site, with all specialists available remotely.
2. Personnel on the ground will be trained via AR/ AI/ VR technologies, ably supported by experts from all over the world
3. Continuous feedback on competency will enable training to be relevant and timely.
4. Connectivity and 5G makes data and information available instantaneously. Real-time what if simulation scenarios will be driven by AI/ ML/ Deep Learning algorithms, providing best case outcomes regardless of the scenarios
5. All of the above will ensure every day to be the best day of production, and every worker the best worker. In 2020, this doesn't seem too far-fetched or too distant in the future. The next five years are exciting times for our industry.

THE AUTHOR

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Sandeep is an MBA in Finance from the Booth School of Business, University of Chicago, and has a Masters and Bachelor degree in Chemical Engineering. Sandeep is based in Atlanta, GA.

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Introducing Honeywell Forge for Industrial (video). CLICK HERE:


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USING PID CONTROL FEEDBACK TO MAXIMIZE SYSTEM PERFORMANCE

In the field of control engineering, it's necessary to be able to quickly and accurately tune the process parameters of control loops. Process values are continuously calculated by using P (Proportional), I (Integral) and D (Derivative), or PID.

The goal of any process system is to maximize system performance while keeping process parameters within application limits. Control engineers rely on the time tested PID control feedback loop to tackle most control applications. This mathematical function enables engineers to tune their processes, meaning they are able to more precisely control their system's efficiency and performance. By selecting the best values for P, I and D, the control function solidifies the required characteristics of the system.

Selecting these three values comes from experience and is a bit

eXTReme 750 Series I/O

Intrinsically Safe 750 Series I/O

of an art form. It can be a tricky business to control a process loop to meet specific application expectations. Engineers must first know if their system is overdamped, critically damped or underdamped. They also need to know the process parameters of what they are trying to achieve. Should the loop be tuned primarily for speed with error, i.e, the difference between set points and actual values being a secondary concern, or should the loop be tuned without overshoot, with speed being a secondary consideration?

Many engineers follow guidelines developed in 1942 by Ziegler and Nichols to help tune their PID loops. This method of loop tuning usually results in a system with a quarter wave decay (a small amount of oscillation) which may be acceptable for some applications, but may not be optimal for others. An alternate set of guidelines developed by Chien-Hrones and Reswick is known as CHR tuning. CHR tuning offers methods for loops with either 20 percent overshoot or without overshoot for applications that cannot withstand going over the set point.

Commissioning of systems can be time consuming and sometimes frustrating; especially if the selected three values of PID do not meet expectations. Fine tuning these loops without the aid of an automated autotune application can be a cumbersome and costly trial-and-error process.

Fortunately, modern control systems offer PID loops with autotune functions built-in. These functions still require the controls engineer to understand the process and application objectives, but streamline the tuning process. An autotune function not only tests the system by monitoring the response based on a series of set point changes, which are triggered by varying conditions, such as step changes or pulse changes, but also analyzes the actual value response of the system itself. From this data the P, I and D values are automatically calculated.

Using a PLC controller with autotune features can save engineers valuable time when commissioning a system. Plus, it results in control loops that perform at high levels while meeting all pertinent application requirements. Using autotune can be very helpful in systems that have frequent system changes, like in a prototype. When the process is reconfigured, the characteristics are changed and then the PID loops may need to be re-tuned. Using autotune can make this process much faster.

e!COCKPIT software is a programming tool for WAGO's performance class PFC controllers that offers several proven methods of autotuning PID loops for a multitude of applications. Using either the principles of Ziegler and Nichols, or those of Chien-Hrones and Reswick, the WAGO autotune feature allows the user to adapt their processes based on the type of loop that is used in the application. These streamlined applications come at a time when there are fewer and fewer engineers working in the field. This software helps over-burdened engineers who may be managing multiple assignments to efficiently find time to complete and manage all their projects. See more on e!COCKPIT engineering software and try it free for 30 days here.

There are many applications where this can apply such as in the food, beverage, and pharmaceutical industries. Many products in these applications can be considered flammable and considered hazardous materials. In these applications, engineers can use intrinsically safe input and output modules to control the processes without worrying about an ignition point. Using WAGO's blue intrinsically safe modules (pictured above) with analog inputs can be combined with the autotuning PID to configure process control. Learn more about

Other applications that take place in harsh outdoor environments, such as mining or pipeline, call for controllers that can withstand extreme temperatures and vibration. WAGO's eXTReme product line has the solution: industrial controllers with an operating temperature of -40^0 C to $+70^0$ C. They are also shock resistant up to 5g with the ability to endure normal condensation. These devices are offered with analog input and outputs, and can also leverage the e!COCKPIT-based PID autotuning feature.

To learn more about our intrinsically safe and eXTReme product lines, CLICK HERE

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