Chemical Industry

Digital Transformation Guide

*Wireless*HART® Applications

EMERSON™

1. Executive Summary

Without a doubt the Chemical Industry is a key industry that affects everyone. It turns the earth's resources such as oil, gas, minerals, water, organic crops, and energy into value added products that are used to fulfil our basic needs but also provides materials to enhance our lives daily.

Although this industry has been around for centuries it continuously has to adapt to new realities and therefore it is on the forefront of many R&D endeavors.

Since this industry is the link between the resources it uses as feedstock and the consumer, it must find new ways of dealing with changes in feedstock availability and prices, decline of skilled workforce, customer expectations and behavior as well as an ever-changing regulatory environment.

Every industry can only survive if it generates enough return on the capital invested and, for the chemical industry that means first and foremost that it is able to produce in a safe, reliable, and available way. Automation of chemical processes helps meet these targets.

Automation and, in particularly, the vast amounts of measuring points used in this industry have been most used in a standard way of getting single point information on the behavior of the variable that needed to be measured and controlled. But measuring devices of today are using *Wireless*HART® and have become more intelligent. They are able to deliver way more information than the initial value that needed to be measured. This, together with the huge strides in the IT space, have led to an increased effort on digitalization, an area that many in the chemical industry are just beginning to explore.

Today's global focus on carbon footprints has increased the focus on sustainability initiatives. This is driven by both more stringent environmental regulations around emissions and decarbonization and the desire to be better stewards of the environment. Ultimately this is leading to new ideas around energy efficiency, a shift to green feedstock and chemical recycling efforts.

This handbook will give you some new ideas on what the chemical industry is doing to tackle the new parameters of the world we live in today and how *Wireless*HART® is helping to get that done.

2. Introduction

The chemical industry has been impacted by the COVID-19 pandemic, but the fundamentals remain. Efforts should be directed toward driving higher process efficiencies and enhancing cost savings across the chemical value chain with the help of digital technologies (Digital Transformation).

COVID-19 has tremendously accelerated digitalization in the chemical industry. It goes without saying that in a pandemic where a large portion of the workforce was required to work from home, digital technologies proved the argument very compellingly. Companies are finding that it is possible to produce efficiently with fewer people if you provide the right automation solution.

Digitalization has uncovered many improvement opportunities including:

- Improving data flow and analysis to speed up innovation from pilot to production
- Using the available rich and predictive data to enable real time response to adjust more quickly to market conditions by streamlining operations
- Maximizing asset performance and minimizing rework
- Streamlining the interactions between customers and suppliers

Many chemical companies now mention automation and digitalization as key strategies in their annual reports.

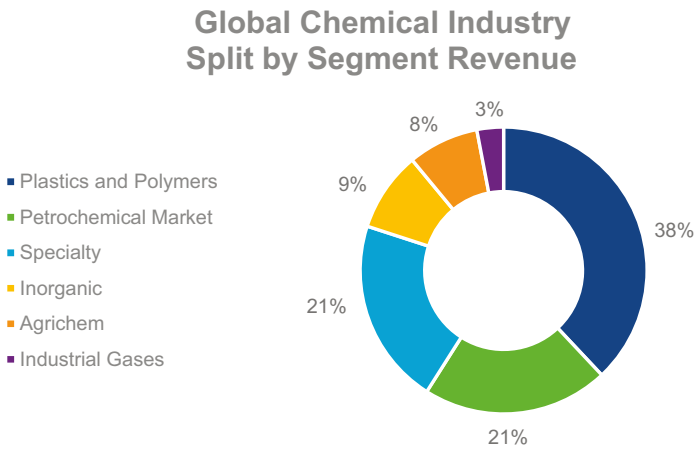
We have seen some of the large greenfield capital projects (new built) pushed out and there has been an increasing trend toward investing in capital projects in plants (extensions). These projects, along with MRO spending, will be robust and customers are looking for ways to improve Productivity, Reliability, Safety and Compliance. Wireless technologies offer a more cost-effective way for these extensions to be realized.

Chemical Industry High Level Customer Goals

- Maxime production and reduce lead-times
- Produce the highest quality products while reducing waste & rework
- Increase plant reliability and availability
- Ensure safety and compliance with regulatory requirements

3. Chemical Industry Overview

The Chemical Industry is complex and made up of a number of different segments. Over 65% of chemicals are still derived from Oil and Gas. Over 90% of all manufactured goods are touched by the chemical industry. Because of this the industry is seeing tremendous pressure from consumers to be safe, to be green and to reinvent and innovate itself.



As you can imagine each segment has its own set of unique challenges. The manufacturing process differs, the customer differs and the profitability differs. However, you can break each process down to its process units (reactors, furnaces, absorption columns, separators, etc.) and process assets (heat exchangers, pumps, compressors, tank). By doing so you can leverage industry best practices around automation and instrumentation to cost effectively optimize your operations.

Industry best practices allow the industry to attain first quartile results in critical areas of plant operations. These include reducing energy use and emissions, improving reliability, ensuring safety, and optimizing production. Between the pressure

from the consumers noted earlier and the desire to drive operational excellence the chemical industry is quickly moving towards adopting strategies around digital transformation.

The challenge is doing this cost effectively in a brownfield environment. Today's wireless solutions make that possible.

Why *Wireless*HART® in (Chemical) Industry

4. Why *Wireless*HART® in (Chemical) Industry?

While wireless technology has been around for over 100 years, the process industry has only been deploying wireless measurements on a large scale into their operations since the last 10 years.

The increased momentum around digital transformation has accelerated the deployment but also the confidence by users and use cases. The Covid-19 pandemic forced many companies to rethink their current business models and to become more efficient in operations, reduce energy consumption and increase uptime and profitability while budgets have been cut.

The deployment of wireless technologies plays a very important part in becoming adaptable to this new world. The need for reliable wireless communications in challenging process environments is critical, and *Wireless*HART® has more than 14 years of proven uses cases and references in all types of industries.

So, what is the value *Wireless*HART® can bring?

Wireless offers OPEX savings

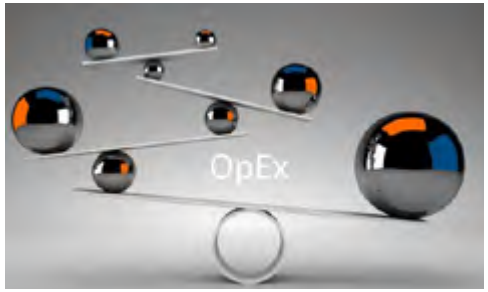
Plants face many critical business challenges ranging from production issues, such as, reliability, energy efficiency, throughput and safety, all the way up to challenges related to personnel and financial results. These challenges are not specific to wireless customers but exist at every site.

A single event, such as an unplanned shutdown, can impact several business performance metrics.

An unplanned shutdown directly reduces throughput and capacity utilization. Startups & shutdowns consume energy and increase the energy intensity of the plant.

Repairs and startup costs impact maintenance and operating expense. Higher costs and lower throughput impact return on investment, income and margin. In addition, there might be unwanted emissions and safety incidents.

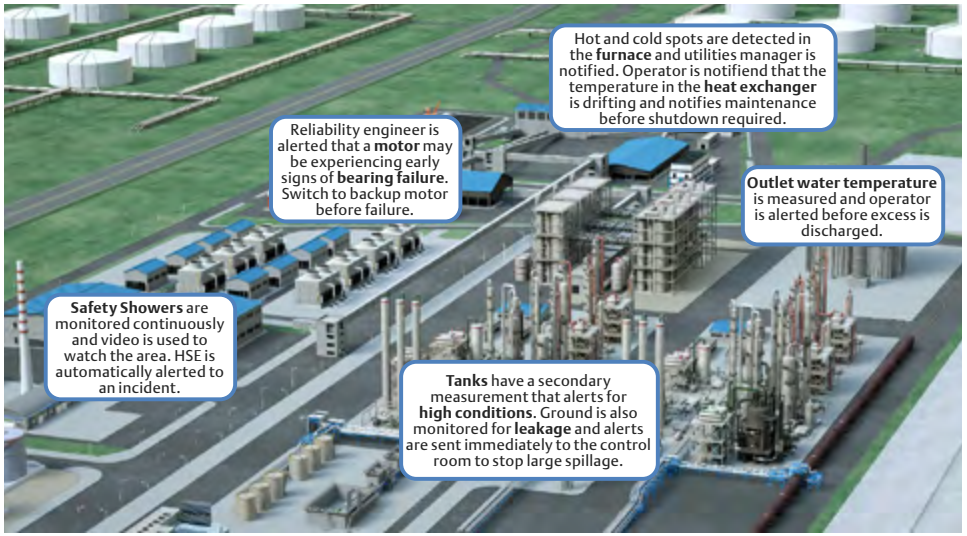
In many cases these unplanned shutdowns are unavoidable due to lack of **timely** and



actionable information. This could be because this information wasn't identified during the plant design as critical to the operation. We need to highlight that many (European) plants are also brownfield and aging. The average age is between 20–40 years and were designed from a totally different point of view.

In addition, generating this information on such aged plants might be cost prohibitive due to structural or physical constraints – or simply impossible. To overcome this lack of automated and valuable data many plants still collect this information manually (which often interferes with other tasks). Covid-19 has painfully clearly shown us that human resources are fragile andreduced personnel can create havoc in plant operations.

By **automating** the collection of data wirelessly it eliminates the manual information gathering and unlocks tremendous amounts of information which helps to reduce costly shutdowns. It may be through an early warning to a reliability engineer that a roller bearing in an essential motor is failing, a notification to the utilities manager about hot & cold spots in a furnace or a notification that the temperature in the heat exchanger is drifting.

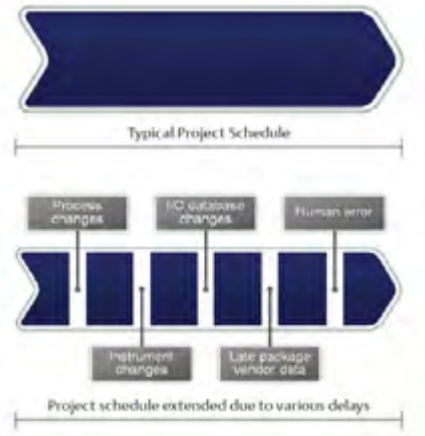


Wireless enables the right information to get to the right users when they need it. These users might be people such as reliability engineers or quality or safety engineers who may not traditionally be impacted by controls instrumentation, but they have real pains that wireless can solve.

They may need information real-time or just on demand in the control system, or in a specific application related to their job. Or this could replace information that is being logged manually – freeing up the field operators for more critical tasks. The key is that lack of information is no longer a barrier to achieving business results. Emerson provides the necessary hardware & software to help unlock the information users need.

Wireless reduces project cost, time & complexity

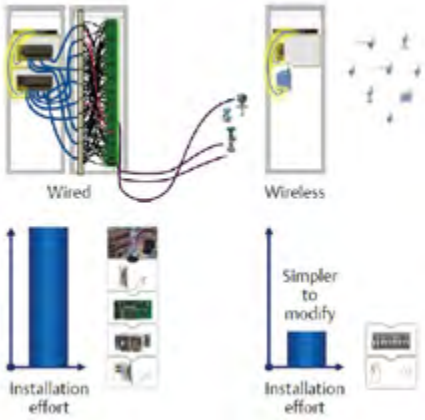
The process industry is being squeezed from many directions, and much of it is people driven. The challenges of the past such as global competition, optimizing production, regulatory compliance is still there, but the people challenge has come into focus as key for running a safe, reliable and highly productive plant.



During project execution, various contingencies often tend to cause delays and lead to slippages in plant start up date.

These contingencies are late modifications, late package vendor data, constant changes to I/O database, adding instrumentation, moving instrumentation, changing instrumentation type and human error and simple mistakes.

With wired systems, a significant amount of equipment is needed and work must be done to design and install the equipment. All this equipment such as controllers, I/O, marshalling cabinets, junction boxes and wired devices significantly add to the complexity of the project.



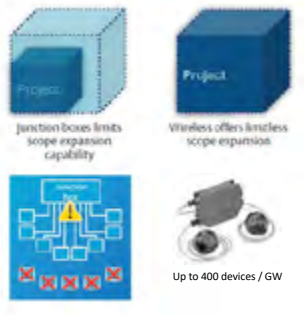
The calculations of such savings, found at the beginning of this document, were consistent time & cost savings obtained between 30–60%.

Wireless systems do not require I/O, marshalling cabinets or junction boxes. This saves a significant amount of time on design and installation, and if any changes are needed, they do not require rewiring.

Wireless makes projects scalable

As the project or expansion scope changes, it can quickly run out of capacity. Junction boxes only allow for a certain number of connections and changes to equipment can quickly use up capacity that was designed in, which in return causes problems.

The Emerson Wireless 1410S Gateway and 781S Smart Antenna allows up to 400 devices per Gateway. If additional points are needed, simply add more gateways.



Wireless is a proven technlogy

Security, reliability and co-existence

Major instrument vendors and organizations such as the HART Communication Foundation carried out customers surveys and not surprisingly each returned the same top 3 requirements:

Make It Secure

Everyone is aware of security these days and it was not surprising that this was a top requirement. Not only do we need to encrypt data to stop it being read by outsiders and gain a financial benefit but we need to authenticate the data to make sure it has not been changed since transmission.

Make it Reliable

Experience with wireless commodity product (WiFi – Bluetooth - Mobile phones) has shown some wireless applications do not provide the availability required in a process plant. We need a network that can monitor itself and repair problematic pathways automatically.

Make it resistant to Interference

Concerns that radio frequency interference between wireless solutions could affect the reliability of essential communications. An open, standards- based wireless architecture from Emerson and Cisco addresses these concerns by using (self) healing mesh network technology and other methods to provide high levels of communication reliability at both the field- and plant network levels.

Security

*Wireless*HART® security features include:

- Security is “built-in” and cannot be disabled
- Utilizes Standard AES 128-bit encryption
- Ease of use
- Only the final device can decrypt and utilize the data

*Wireless*HART® Networks have 2 main categories:

- Data Protection (Confidentiality, Integrity)
- Network Protection (Availability)

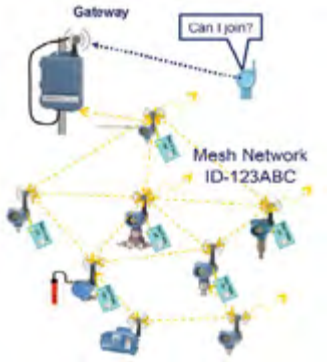
Data Protection

Authenticate Instruments

The *Wireless*HART® sensor network provides a 128-bit Join Encryption Key to keep the data sent and received during the joining process private.

The join key also serves as authentication to the security manager that the device belongs to the network. The join key is treated separately from the other keys to enhance security.

Join keys can either be unique to each device or common to a given *Wireless*HART® network.



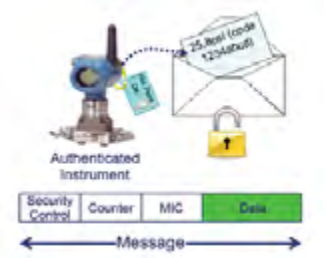
Encrypt messages

The *Wireless*HART® network provides end-to-end AES 128-bit encryption from the source to the consumer with individual session keys.

Check message integrity

The *Wireless*HART® sensor network provides message integrity checking. It checks the data sent over the wireless network has not been altered.

For each message it adds a Message Integrity Code (MIC) to each data packet. The receiving device checks the MIC to confirm the contents of the packets have not been altered. This will enable you to make sure that the message has not been altered during transmission by external agents.



Network Protection

Denial of Service

- Saturates the network with – join request data
- Join request ignored for unidentified / unauthorized devices
- The Network Manager has a list of authorized devices
- Need to be authorized device
- A counter log failed join requests – and alert site security if there is an increasing number of join failures

Replay Attack

- Keeps the network busy handling data
- Read data and repeat it onto the network
- The message is ignored since the counter at the network layer is time slot dependent
- The replay has to happen in the same time slot (10 msec)

Clone an Instrument

- Clone an authorized instrument and join the network
- This is prevented since the Gateway can rotate the join key regularly
- Clone may have correct UID and TAG but cannot know new join key

Reliability

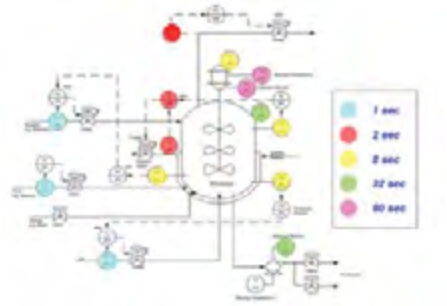
99.9% reliability is achieved by:

- Managing power thru efficient data sending and smart updates
- Build redundant paths thru MESH Network
- Management of Network thru the Gateway

Managing Power Thru Efficient Data Synchronization and Smart Updates

To achieve an efficient communications protocol each of the network instruments must have a common sense of time to avoid data collisions and synchronize transmission and receipt of data. Timely access to the network is achieved by dividing time into slots and distributing these time slots to individual instruments.

With time synchronization each instrument is aware of the sequence of channels used during the channel hopping procedure ensuring that the transmitting and receiving instruments are not only time synchronized but frequency synchronized too.



MESH Network and Redundancy

The MESH technology provides the most robust topology for a wireless network as there are multiple redundant pathways to get the data from the source to destination – reliability is one of the top concerns for process industries.

- **Self-Building MESH**: simplified commissioning, automatic features like Time Slot allocation & Path selection
- **Self-Healing MESH**: redundant pathways (no ACK from message) & more instruments = more pathways

Management of Network thru the gateway

The Network Manager in the Gateway builds and maintains the MESH network. It identifies the best paths and manages distribution of slot time access (*Wireless*HART® divides each second into 10 msec slots).

Slot access depends upon the required process value refresh rate and other access (alarm reporting – configuration changes)

*Wireless*HART® devices also report the condition of their power module so that the battery can be replaced before it is exhausted.

Co-existence

Using an unlicensed band (ISM) means that there is no need to license the radio on the plant – however you have to co-exist with others. *Wireless*HART® has several co-existence strategies.

- Channel assessment – sample a channel to make sure nobody is using it
- Send short messages (10 msec) – so less chance of collision
- Channel hop to reduce risk of collision
- Black-list a channel know to be used by others for long periods

5. Financial & Time Savings of *Wireless*HART® vs Wired

Very few people in the chemical industry have the luxury of working in a brand-new plant with state-of-the art instrumentation and technology. Most chemical plants in Europe are at least 20 or 30 years old, if not older.

It is inevitable that any attempt to improve existing facilities will require access to more information and measurement. For a traditionally wired architecture this can pose many obstacles including the lack of spare capacity, the cost and complexity of access and installation, and the pure hassle associated with implementing a relatively small change.

*Wireless*HART® removes most of these obstacles. It enables you to implement the improvements that you need without any hassle, at significantly less cost, and without making new demands on the already overloaded and aging infrastructure.

In the example below we show the real benefits between a wired and wireless execution of a (small) project. In larger projects the savings are even higher due to increased complexity of the project.

Two Scenarios considered below

- Conventional
- Wireless

We have considered a total of 96 pcs of wireless instruments and I/O while performing the savings calculation:

- Rosemount 3051SMV Pressure Transmitter – 11 pcs
- 248 temperature transmitter with RTD – 44 pcs
- Power Modules - 96 pcs
- Rosemount 2051 Differential Pressure Transmitter – 14 pcs
- Rosemount 2051 Gauge Pressure Transmitter – 27 pcs

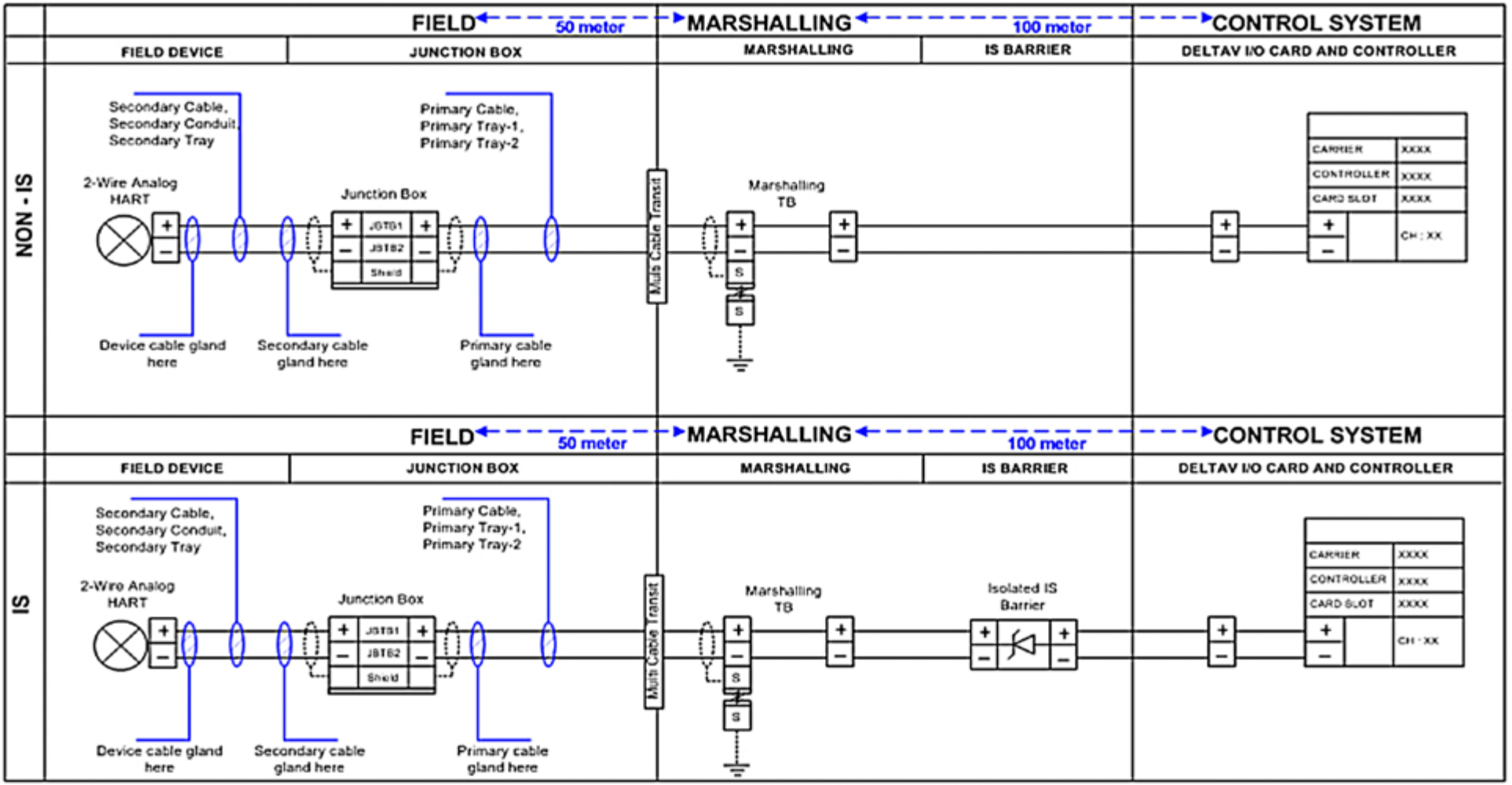
Design Input

- Baseline scenario – Conventional
- Scenario 1: Wireless
- 15 meters average Distance from Transmitter to Junction Box
- 50 meters average distance to Field Junction Box from Control Room
- Protection Concept

Labor Cost	Hourly Rate [Euro €]
Installation & Commissioning	60
Engineering & Design	90
Procurement	100
Quality	100

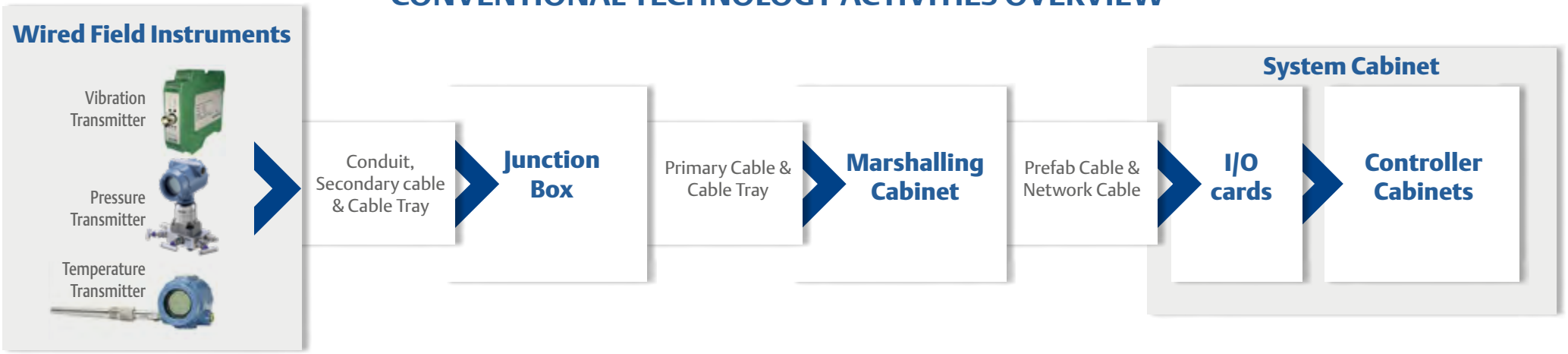
The comparison between a wired and wireless infrastructure is largely influenced by the number of materials needed. Initially the capital investment cost of wireless instruments is higher than wired devices but this is largely offset by not having all the complexity of the wiring, cable trays and I/O configurations amongst other (less) visible costs (scaffolding, excavation, mounting of cable trays, etc.)

Below example shows the components that are needed for a conventional loop (non-intrinsic and intrinsic safe). The next diagram explains all the activities that are needed to deploy the infrastructure.



Typical conventional loop

CONVENTIONAL TECHNOLOGY ACTIVITIES OVERVIEW



Device Activities	
Review process license or P&Ds and create equipment and instrument specifications for the project.	Preparation of Specifications for Instrument Stand and supports.
Prepare Instrument Index	Vessel and piping drawings; Instrument Discipline approval
Prepare instrument Specification sheet	Study of P&Ds & preparation of Instrument Index
Prepare Transmitter Loop Diagrams	Update engineering design based on HAZOP study
Interdepartmental design review	Specification/ Datasheets/ MR document development
HAZOP study	Material Inspection
2D or 3D drawing preparation for cable trays layout and cables. Instrument Location Plan. Prepare Material Tak off List for cable, cable trays, glands, lugs and conduits	Field Survey: Checking site readiness for device installation. E.g. Secondary cable and cable tray installation and availability at site along coordination with civil and Mechanical dept.
Installation of glands at secondary cable tray entry. Laying of Secondary Cable tray between Device and JB	Device installation with glands to interface with conduit/secondary cable at device end
Installation of secondary cable (Cable pulling, cable laying, cable marking, cable tracing, cable dressing)	Termination of devices to nearby Earth bus via conduit and Cable lug
Installation checks, Grounding check, Mechanical completion checks, Cable continuity grounding/ megger checks	Prepare Material Take off List for cable, cable trays, glands, lugs and conduits

Junction Box Activities	
JB (Floor mounted) civil foundation	Prepare Material Take off List for JB
Mounting of Insert plate (Ips) as per Cable tray route within infrastructure for welding of cable trays	Installation of Primary cable (Cable pulling, cable laying, cable marking, cable tracing, cable dressing)
Structural requirements for JB and related interface	JB frame installation & installation of JB
Earthing pits & JB earthing/ grounding	Junction Box Grouping, JB location Plan
Material inspection	Termination of JBs to Earth bus
Marshalling Cabinet side termination to Junction box	Device side termination to Junction box
2D or 3D drawing preparation for primary cable and cable trays	Listing of accessories required for Junction box like cable glands, canopy, bind plugs, breather and drain
Cable scheduling (for primary and secondary)	JB side gland installation; Primary cable gland
Cable block diagram	Installation checks, Grounding
Cable drum schedule	Mechanical completion checks
JB termination drawings	Lightning/surge protection
Specification/ Datasheets/ MR documents development	Cable continuity; grounding/ megger checks

Marshalling Cabinet Activities	
Marshaling Room Floor space, footprint layout/ Room layout document that includes	Installation of Cabinets/ barrier cabinets
Base frame installation, fabrication drawings for Marshalling cabinets	Termination to marshalling cabinets/ system/ relay cabinets
Multi cable transit entry	Cable tray layout from MCT to cabinets
Cabinet wiring connection diagram	Control room tray layout installation within marshalling room
Control room tray layout drawings within marshalling room	Transportation of cabinets from warehouse to location for installation
Multi cable transit entry	Installation of primary cables
Cable tray layout drawings from MCT to marshalling cabinets	Multi cable transit entry installation
Specification/ datasheets of bought out items for cabinet/ MR (Material Requisition) document development	Grounding check, Cold Loop Check
Prepare material Take off List for cable, cable trays, glands, lugs and conduits	Cable continuity; grounding/megger checks

System Cabinet Activity	
System Room Floor Space, footprint layout/ Room layout	SAT
base frame installation, fabrication drawings for System cabinets	System power on checks, Grounding check
Cabinet wiring connection diagrams	Level checks: With respect to mounting of base frame-its mechanical checks
Power calculation/ Heat dissipation calculation	Cable continuity, grounding/megger checks
System network architecture drawing	Control room tray layout installation within System room
Specification/ datasheets of bought out items for cabinet/ MR (Material Requisition) document development	Transportation of cabinets from warehouse to location for installation
Installation of Cabinets	Prefab cable and network cable installation
Termination to System cabinets	Cable tray layout from MCT to cabinets

Conventional loop activities

When we look to a *Wireless*HART® technology deployment the number of activities needed to deploy the infrastructure are a fraction of what's needed for conventional infrastructure based on traditional wiring:

WIRELESS TECHNOLOGY ACTIVITIES OVERVIEW

Device Activities	
Review process licenseor P&Ds and create equipment and instrument specifications for the project.	Material Inspection. Prepare Instrument Index
Prepare instrument Specification sheet	Field Survey: Checking site readiness for device installation. The check list includes
Prepare Transmitter Loop Diagrams	Interdependency with other department for making proper drawings
Study of P&ds & preparation of instrument index	Termination inspection and calibration
Update engineering design based on HAZOP study	Prepare material take off list for wireless instruments
Specification/ Datasheets/ MR (material Requisition) document development	Install *WirelessHART*ʂ field device, *WirelessHART*® AMS snap on study
2D or 3D drawing preparation for cable trays layout and cables. Instrument Location Plan and Secondary cable tray layout.	Specifications for Instrument stand and supports
HAZOP study	Installation checks. Grounding check.

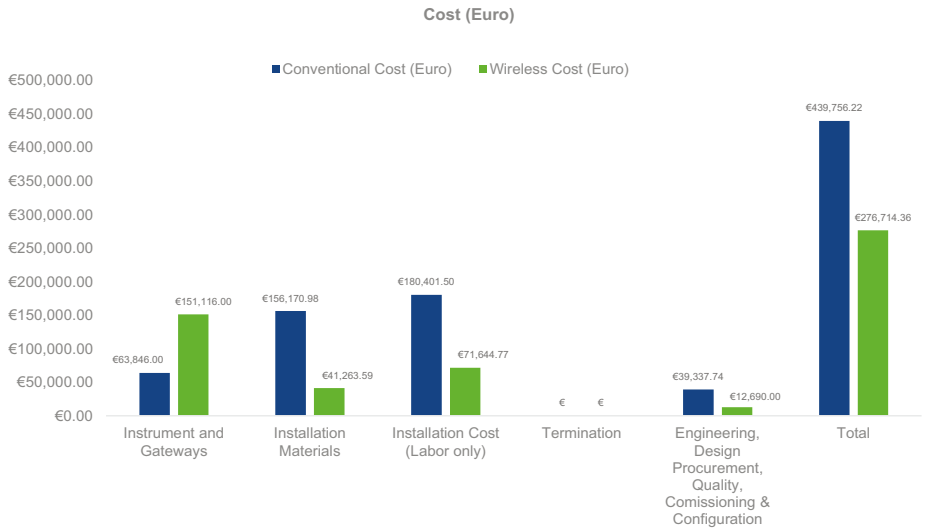
Junction Box Activities	Marshalling Cabinet Activities
X	X

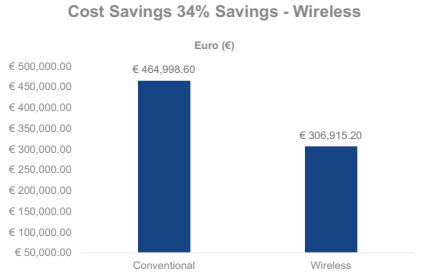
System Cabinet Activity	
WirelessHART® Gateway to System cabinet wiring connection diagrams	SAT
System network architecture drawing	*WirelessHART*® power on checks, Grounding check
WirelessHART® Gateway specifcation/datasheets	Level checks: with respect to mounting of base frame-its mechanical checks
WirelessHART® Gateway mechanical installation	Cable continuity, grounding/megger checks
	Prefab cable, antenna and network cable installation

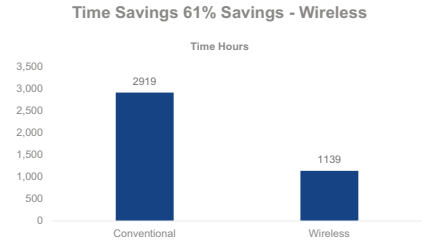
***WirelessHART*® loop activities**

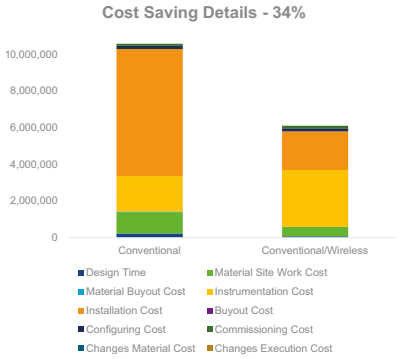
Cost using Basis of Design Tool (BODT)

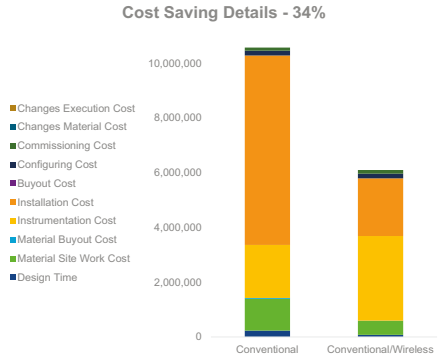
The Base of Design tool is a service Emerson offers to calculate the savings of a wired versus wireless installation. The savings is custom calculated using the exact installation parameters provided by the chemical plant ensuring an accurate and representative estimate for your facility.











There is also a breakdown of the different costs and time savings for each of the scenarios.

Regardless of whether the project is an extension or revamp, large savings can be obtained both on the investment and commissioning side. If a plant expansion is needed later, additional sensors can be deployed very easily – requiring minimal configuration.

Custom cost calculations can be provided based on exact plant configurations such as exact number of I/O, distance to junction boxes and DCS, type of multicore cable, etc.

If needed, we can provide more detailed calculations specifically for EPC's and large projects.

Examples of *Wireless*HART® in Chemical Industry

Energy Efficiency

Health, Safety, Security, Environment (HSSE)

Process Optimization

Reliability & Integrity

6. Examples of *Wireless*HART® in Chemical Industry

Every day, process manufacturers are faced with the challenge to improve operations through safety, environmental, reliability and energy initiatives, while reducing downtime, maintenance costs, integrity issues, creeping energy waste, manual tasks and personnel injuries. However, trying to meet these demands with traditional methods can be time consuming and costly.

Pervasive Sensing strategies allow you to strategically visualize operations, empowering you to solve problems before they occur.

Reliable wireless communications systems are removing the physical and economical barriers that previously made it difficult or impossible to access many types of information in chemical plants. In fact, wireless automation technology addresses many management priorities, including continuous process improvements, safety, and protection of the environment, with such dramatic ease and clear benefits that it is changing work practices throughout the industry. The technology of transmitting never-before-available information from process and equipment can be put to use now, regardless of the vintage of the plant's control system.

The all-digital *Wireless*HART® communications protocol can work with any industrial instrument application, whether for control or monitoring, just as all HART products do currently.

In this handbook some of these applications are explained in detail, for specific assets or needs do not hesitate to reach out to us. Emerson Automation Solutions has the largest and most comprehensive *Wireless*HART® portfolio available, which can cover most (if not all) requirements for chemical industry.

Energy Efficiency Cases in Chemical Industry

Energy

An important aspect of energy loss reduction is the use of automated monitoring of steam traps. Many end users have already deployed a measurement strategy to monitor the condition of steam traps – typically by manual walkdowns every 6 months.

Manual monitoring of steam traps does not provide real-time data which will limit energy savings. A steam trap could be leaking for months before it is discovered on the next walkdown. Historically failure rates on stream traps are consistently between 10–25% per year making an undetected failure likely.

The arguments to monitor steam traps online go beyond saving of energy. Many different aspects outside of energy savings are connected to steam traps which are described in the graphic on the right:

On the next page some examples can be seen on automated, real-time monitoring of steam traps. *Wireless*HART® provides a self-organizing mesh network designed for industrial environments – for steam trap monitoring we use the Rosemount 708 Acoustic Transmitter which has proven to be very successful in the chemical industry.

ROI calculations can be provided as part of the service when considering a steam trap monitoring system. Another option is to use Connected Services to remotely assess steam trap condition.

6.1. Steam Trap Monitoring at Chemical site

APPLICATION

On 14 July 2021, the European Commission adopted a set of proposals to make the EU's climate, energy, transport, and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. Achieving these emission reductions in the next decade is crucial to Europe becoming the world's first climate-neutral continent by 2050 and making the European Green Deal a reality.

For most chemical plants the consumption of energy accounts for more than 40% of their total operating cost. Steam generation is widely used in chemical plants and has a large impact on energy consumption. Malfunctioning steam traps causes not only large financial losses but contribute to unwanted CO^2 emissions and loss of energy.

Most companies will need to reduce their energy consumption to comply with the 2030 Energy & Climate framework. This customer has chosen the Wireless Acoustic Steam trap monitor to detect failing or malfunctioning steam traps and reduce their energy consumption.

CHALLENGE

The new directive requires that companies measure their energy streams and reduce their amount of energy used. This can be done with several technologies of which wireless is one. The usage of wireless technologies allows for implementing extra points for measuring these energy streams (like DP Flow for compressed air, temperature for heat exchangers, etc.) in a very easy and flexible way. This customer also had steam traps on different floors separated by concrete which makes pulling of cables expensive and difficult.

SOLUTION

Only 2 days of installation and configuration was needed to get 100 x 708 Acoustic Transmitters up and running. Immediately 11 faulty steam traps were detected and scheduled for repair and bringing ROI from day 1.

The image shows clearly the *Wireless*HART® Self-Healing Mesh network and stable wireless communications, despite several concrete floors in between.

Image courtesy: NAMUR

6.2. Steam Trap Monitoring at Fine Chemicals

ROI calculation for Steam Trap Monitoring (1086 steam traps / ROI 11.9 months)

Total Project Savings Detail

Steam Traps to be Monitored	All 1086,	High Value 1086,	Critical 23,
Average Annual Energy Loss /trap in Blow-Thru	11.865 l	11.865 l	38.615 l
Failure Identified at Midpoint between Audits	50%		
Average Energy Savings /trap	5.933 l	5.933 l	19.408 l
Annual Failure Rate	15,0%		
Annual Energy Savings	966.417 €	966.417 €	66.966 €
Annual Manual Audit Cost Savings	29.322 €	29.322 €	621 €
Total Projected Annual Savings	1.304.016 €	1.304.016 €	88.797 €

Project Return on Investment Detail

Steam Traps to be Monitored	All 1086,	High Value 1086,	Critical 23,
708 Acoustic Transmitter Cost Estimate	942 l		
1420 Gateway Cost Estimate	2.885 l		
Pervasive Insight Analytics Software	8.057 l		
Installation & Commissioning Labor Estimate	146.610 l	146.610 l	3.105 l
Total Installed & Commissioned Cost	**1.215.699 €**	**1.215.699 €**	**35.723 €**
Expected Failures /year	162,9	162,9	3,45
Average Cost to Repair or Replace	450 l		
Total Annual Cost to Repair or Replace	73.305 l	73.305 l	1.553 l
Payback Period	**11,9 months**	**11,9 months**	**4,9 months**
Annual Cash Flow without initial investment	1.230.711 l	1.230.711 l	87.244 l
5 Year Total Internal Rate of Return	98%	98%	244%
5 Year Net Present Value* @ 12% Cost of Capital	3.220.738 l	3.220.738 l	278.773 l

Environmental Impact

Steam Traps to be Monitored	All 1086,	High Value 1086,	Critical 23,
Average Annual CO_2 Emissions /trap in Blow-Thru	58,2 tons	58,2 tons	189,3 tons
Failure Identified at Midpoint between Audits	50%		
Average Emissions Reduced /trap	29,1 tons	29,1 tons	94,6 tons
Annual Failure Rate	15%		
Annual Reduction of CO_2 (85% boiler efficiency)	4743, tons	4743, tons	326, tons
Annual Reduction of CO_2 in Passenger Cars	998,5 cars	998,5 cars	68,7 cars
Annual Reduction of CO_2 in Trees Planted	11477,4 trees	11477,4 trees	790, trees
Annual Water Savings	38657000, L	38657000, L	2678000, L
Annual Water Savings in Olympic Pools	15,5 pools	15,5 pools	1,1 pools

Note the environmental savings which are in addition to the ROI. In the calculation the ETS pricing was set to 24 EUR / ton, currently it is tracking at 43 EUR/ ton.

APPLICATION

Multi-purpose plant for the production of organic intermediates and final products for Agro, Pharma and Fine Chemicals industry. Recent demands around reduction of carbon footprint and optimizing energy required them to rethink the monitoring strategy for steam traps.

CHALLENGE

This company determined that defective steam traps were causing loss of steam, inefficient heat transfer and therefore loss of energy. If failed steam traps could be identified as early as possible then this plant would decrease CO^2 emissions and optimize energy usage. Another problem was blocked steam traps which can cause water hammer and corrosion which potentially could create safety hazards.

SOLUTION

Manual steam trap monitoring rounds were already deployed but with mixed results due to the offline character (steam traps that failed still caused for max. 6 months steam loss (the time between two manual measurements campaigns). It was then decided to install a real-time wireless steam trap monitoring system to detect steam trap failures as early possible.

In the picture to the right the Rosemount 708 Acoustic transmitters can clearly be seen as it enables the customer to have real-time information over the steam trap condition using the *Wireless*HART® network.

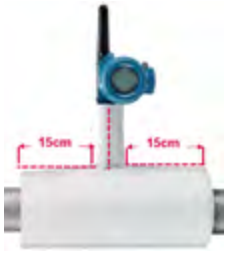
6.3. Heat Exchanger Monitoring at Chemical plant

APPLICATION

Heat exchanger temperature, monitoring at a chemical site.

CHALLENGE

Heat exchangers have the potential for clogging or reduced output, and therefore an increased energy usage. Temperature monitoring on the input and the output of the heat exchanger provides a measure of the efficiency of the exchanger. In many plants, the temperature data is collected manually and not monitored in real-time. This increases operator costs and can result in long durations where the heat exchanger is not operating at the desired efficiency which increases energy costs.



SOLUTION

To improve the operation of the heat exchanger and improve efficiency of the monitoring process, this customer installed *Wireless*HART® temperature monitoring. They selected the Rosemount X-well solution that delivers accurate process temperature data without thermowells or process penetrations. The X-well sensor is clamped to the process pipe and measures the surface temperature which is correlated to the internal process temperature. This solution simplifies measurement point specification, installation and maintenance and reduces possible leak points. Knowing the temperature real-time increases visibility to heat exchanger fouling and efficiency so corrective action can be taken immediately, thereby reducing energy consumption.

6.4. Energy Efficiency Monitoring at Chemical plant

APPLICATION

Natural gas flow to a gas metering grid.

CHALLENGE

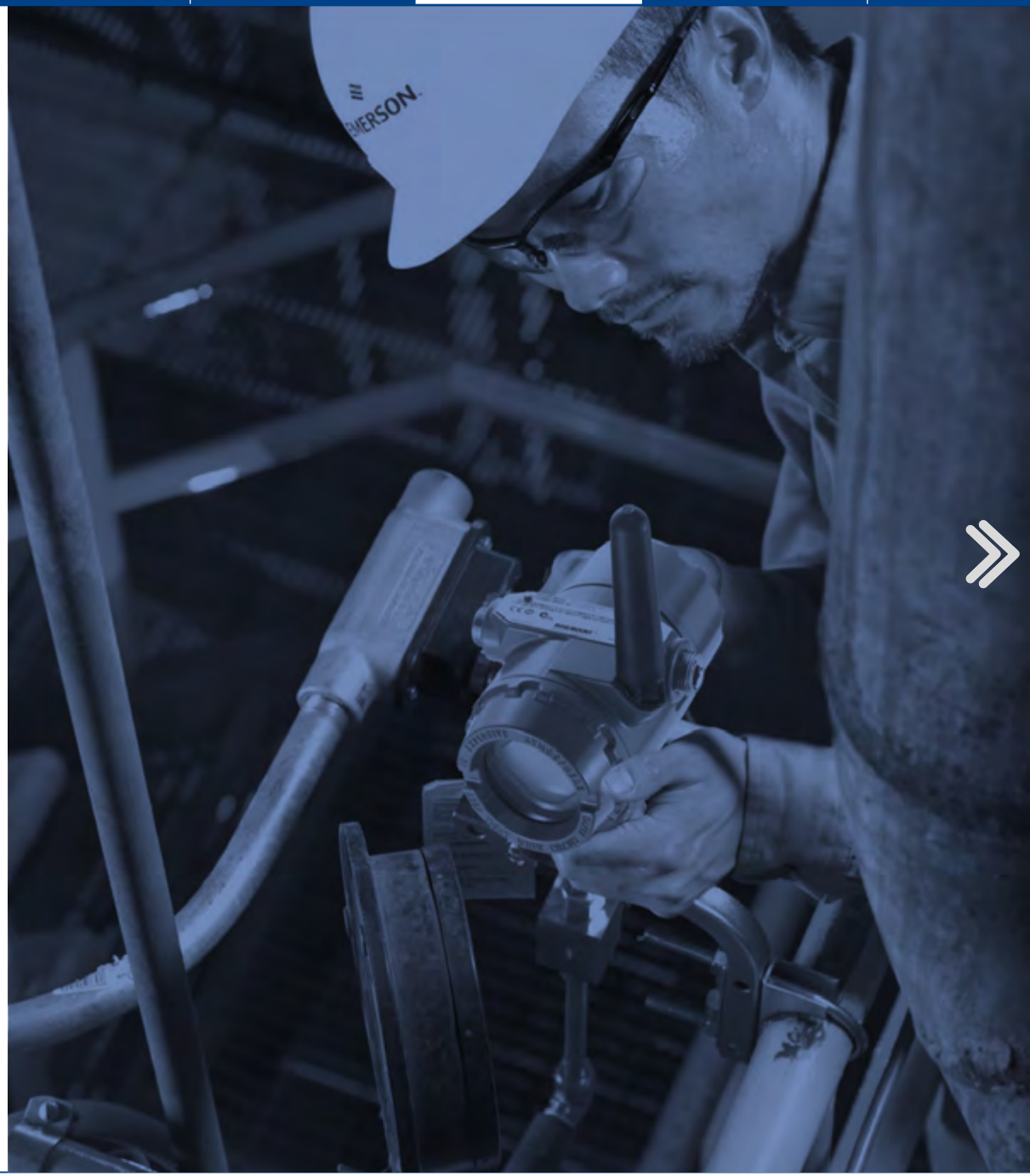
Energy efficiency is an important consideration in the process industry and reducing operating cost is imperative. Operations personnel wanted to reduce the plant's consumption of natural gas. To achieve this, gas flow to the boiler needed to be measured and temperature measurement at the gas metering grid was required.

SOLUTION

The plant installed Rosemount 3051SFC conditioning Orifice Flowmeters with *Wireless*HART® connection to measure gas flow into the boiler and heater systems. For the gas metering grid, Rosemount 648 temperature transmitters were deployed. This provided temperature measurements without the installation costs or pulling of cables.

The wireless solution brought data such as flow rate, gage pressure and process temperature to the control room which is critical to operations. The data made gas consumption visible to the process engineers enabling them to make adjustments and make the process more efficient.

With the *Wireless*HART® infrastructure in place, the plant has more flexibility to explore other measurement points.



Health, Safety, Security, Environment (HSSE) Chemical Industry

HSSE (Health, Safety, Security & Environment) application solutions help predict and prevent abnormal situations, instead of simply reacting to them. Continuously monitoring equipment, helps reduce safety and security risks, and alerts you of any issues that arise for immediate action. Protect personnel, the environment, and mechanical integrity of equipment as well as improve operational procedures and regulatory compliance.

6.5. Monitoring of Safety Showers at Acetylene Unit

APPLICATION

Safety shower monitoring

CHALLENGE

This customer had unmonitored safety showers in their acetylene unit. During and emergency it was impossible for rescue teams to know which shower was triggered reducing emergency response time. The safety showers were insulated and could not be disassembled making it difficult to install a monitoring system.

SOLUTION

16 safety showers were equipped with Rosemount 708 acoustic transmitters spread over several floors. The wireless acoustic sensors detected the safety shower activation and reported the exact location of the event reducing emergency response time. They were implemented in the existing *Wireless*HART® network and connected to the DCS system for logging and documenting.

6.6. Upgrade of Old-Style Safety Showers at Chemical Site

APPLICATION

Upgrade of older style safety showers to accommodate the request for increased personnel safety.

CHALLENGE

This customer had 65 safety showers and eyewash stations that they wanted to monitor to increase plant safety and reduce response time to a shower or eyewash station activation. The locations did not have power cables, making the addition of a wired solution cost prohibitive.

SOLUTION

A total of 65 x safety showers were upgraded with *Wireless*HART® monitoring by using a Rosemount 702 Discrete transmitter with two GO-switches. One Go-switch was attached to the eyewash station, and the other was attached to the shower. If either GO switch is triggered the corresponding alarm is immediately transferred to the control room showing if the shower or eyewash (or both) have been triggered.

6.7. PRV Monitoring at Ethylene Unit

APPLICATION

The Pressure Relief Valve (PRV)is a type of valve used to control or limit the pressure in a system or vessel which can build up by a process upset, instrument or equipment failure, or fire. The pressure is relieved by allowing the pressurized fluid to flow from an auxiliary passage out of the system. The relief valve is designed or set to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressures that exceed their design limits.

CHALLENGE

Sometimes over-pressure situations can occur putting the plant and personnel in danger. To relieve the pressure, pressure relief valves (RV's) are installed that send gases and vapors to a flare stack for burning or for atmospheric release.

PRVs are often not monitored which can lead to undetected relief events that can increase emissions, and lead to environmental fines.

SOLUTION

By installing Rosemount 708 Acoustic transmitters it is possible to detect PRV activation. Also reseating problems (like partial closing of the PRV) can be detected. The customer detected about 200 PRV lifting events over 15 months. About 20 of these proved to be problematic (blow thru, leaks or bypass found open).

6.8. Location Awareness at Chemical Site

APPLICATION

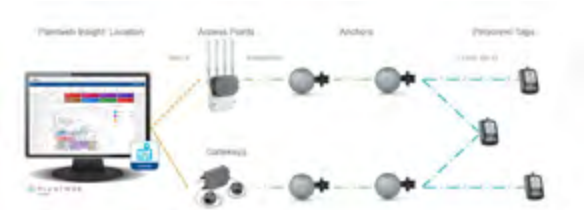
The Location Awareness system provides real-time, safety-focused monitoring of your most valued resource - your people. Enabled by *Wireless*HART® Anchors and battery-operated Personnel and Asset Tags, the Location Awareness system is less than half the investment of existing Wi-Fi location systems. The Plantweb™ Insight Location application includes geofencing, safety mustering, and safety alerts, helping you digitally transform your facility's safety.

CHALLENGE

Many location awareness systems are based on GPS or WiFi which comes at a significant implementation cost and therefore is not often installed. Very often badge systems are used to know how many employees have entered a particular area. Unfortunately, these systems do not provide location awareness during a mustering event. Some badge systems do include location and gas detection, but this often comes at a cost and reduced battery life.

SOLUTION

37 Location Anchors, 100 Personnel Tags, 3 Modular Gateways, Automated safety mustering, geofence for hazardous areas and safety alerts to quickly dispatch assistance to the station and investigate for possible injuries.



6.9. Tank Overfill Level Alarm at Bitumen Plant

APPLICATION

Aging plant without local overfill protection.

CHALLENGE

Bitumen is largely used as a construction product. It is supplied and stored as hot liquid at temperatures ranging from 150 °C to 230 °C. Care is needed for safe handling of bitumen to avoid accidents. The project manager of this bitumen plant wanted an automated solution for tank monitoring to ensure plant safety during filling as tank status was not visible to engineers on-site or at the control room.

SOLUTION

The plant installed 28 Rosemount 702 Wireless Discrete Transmitters connected to 41 third party RF capacitance switches on the bitumen tanks. This combination provided wireless high and low level alarms, saving on cost of wires and junction boxes. The signals were connected to the control room via OPC (via the Smart Wireless Gateway). The wireless solution was easy to setup, cost effective and provided the alarm automation to reduce risk of overfills. No wires or cable trays also meant reducing project cost, no scaffolding and less risk to personnel.

6.10. Storage Heating Tank Control in Chemical Plant

APPLICATION

Storage tank heating control, gas vent pipe monitoring.

CHALLENGE

Existing manual measurement and control methods were unsatisfactory for maintaining the temperature of fatty nitriles and amines in the 40 tanks where they were stored before shipment to customers. Too much steam was sometimes used to heat the materials, and several customers complained that the product was too hot. In addition, corporate guidelines and new environmental legislation required monitoring and controlling of all gas emissions.

Existing procedures for detecting potential problems required an operator to make frequent trips into the field to take “snap-shot” readings from pressure gauges on the tank farm venting conduits. This was time-consuming. Additional thermal measurements were required from within the same venting conduits to help prevent potential fires arising from high temperatures. All three applications would benefit from automated measurements or control technology but a lack of cable infrastructure, shortage of available I/O and tight budget constraints made traditional wired solutions impractical.

SOLUTION

By installing Emerson devices with *Wireless*HART® technology all these challenges were met. Four Emerson *Wireless*HART® temperature transmitters were installed to control the temperature on several tanks. For the gas venting issues 10 Rosemount *Wireless*HART® pressure transmitters were installed to replace the manual gauges and allowed for continuous readout of the pressure. Additional *Wireless*HART® temperature transmitters provided the thermal data needed to meet corporate and government legislation.

6.11. Overspill Protection at Chemical Storage Terminal

APPLICATION

Overspill protection of tanks at petrochemical storage site.

CHALLENGE

To meet the latest environmental and safety requirements, overspill protection was required on existing tanks storing solvents, petrol, and a range of chemicals. Previously there was limited instrumentation in place. The customer wanted to automate these measurements. Some tanks are over 200 meters away from the main control room and new cable infrastructure would be required – costing approx. € 100K. The storage tanks are critical to the terminal operation and needed to stay online so a short commissioning time was needed.

SOLUTION

Rosemount 3051S wireless differential pressure transmitters were installed combined with several Wireless 848T temperature sensors. By implementing a *Wireless*HART® network the customer was able to save a significant amount of engineering cost and simultaneously commission the project in a very short time frame. The flexibility of the *Wireless*HART® network also allows for future expansion like pump monitoring.

6.12. Hydrocarbon Leak Detection at Chemical Site

APPLICATION

Detection of hydrocarbon based Xylene & Benzene spills.

CHALLENGE

Leak detection on large sites can be both difficult and expensive. In this case, operators were making twice-daily inspection rounds using portable leak detectors, but new and stricter government regulations required continuous monitoring. A traditional online monitoring solution would require extensive cabling, together with the associated I/O, signal converters and installation costs.

SOLUTION

The wireless system from Emerson solved these problems by integrating sensors that detect liquid hydrocarbons with Rosemount 702 discrete transmitters to enable cost-effective liquid hydrocarbon leak detection even from remote locations with the site. The leak detection system uses Emerson's Rosemount 702 Wireless Discrete Transmitters in combination nVent liquid leak detectors. The 702 discrete transmitters communicate leak status to the 1420 *Wireless*HART® gateways.

In this particular case the customer selected the TT5000 cable to detect any leaks which might happen around the tank area.

6.13. Seal Pot Monitoring of Pumps at Chemical Site

APPLICATION

After a HAZOPS study it was determined that the seal pots needed permanent monitoring.

CHALLENGE

Previous methods were primarily based on manual walk arounds to assess the level of the seal pot fluid and record any difference in pressure levels. This would indicate seal breach problems. On many occasions, pressure or level switches were installed on the seal pots. To convert to a more automated way of measuring the customer has 3 specific requirements:

1. They needed to measure the static pressure of the nitrogen blanket. If a seal was to fail, the seal pot would try to 'fill up' the system which would manifest itself as a surge in flow and therefore a pressure drop, and a static pressure change.
2. On another type, they had to measure the liquid level in the seal pot. Any rapid change in level would indicate a failure.
3. On the third type there was gas (nitrogen) at a constant flow rate. An in-line orifice and DP pressure transmitter solution was used to detect small changes in the flow rate.

SOLUTION

By deploying Wireless DP (Differential Pressure) and Level transmitter, changes in the barrier fluid could be detected. This solution was rolled out for 102 critical pumps allowing for a reduction in operator rounds and immediate notifications in the control room.

6.14. Valve Position Monitoring at Petrochemical Site

APPLICATION

This customer uses manual valves for sampling, directing, injection, and extraction processes at a chemical production facility. Many of the valves are in hard-to-reach places that are too costly to access with wires

CHALLENGE

Monitoring was a difficult process requiring operators to travel into hazardous areas, climb up ladders, and visually check the valves' state or position. The facility uses propylene oxide and ethylene oxide for its processing operations, and exposure to either one can irritate a person's eyes, skin, or respiratory tract.

Leaks involving toxic chemicals can also result in hefty fines. Plus, the facility must pay cleanup, rework, and disposal costs per incident. Sample and drain valves, for example, are opened and purged before and after a batch. Some products may be "released" or leaked during this process. The facility needed a better, more flexible and less expensive way to monitor its isolated, manual valves

SOLUTION

For this customer the Fisher™ 4320 *Wireless*HART® communicating device was installed to monitor the valve movement throughout the range of travel and provides frequent, wireless updates about the valve's position. The wireless signals are delivered automatically, reducing the time and risks associated with visual inspections.

Adding the Fisher™ 4320 wireless position monitors enabled the customer to identify valve issues and prevent chemical leaks before they could result in fines, production delays, or clean-up costs. The Fisher™ 4320 wireless monitors can be easily integrated with existing DCS systems.

6.15. Valve Position Monitoring at Petrochemical Site

APPLICATION

Valve span monitoring.

CHALLENGE

Due to the specific shape of the valve stem, continuous valve position monitoring proved to be challenging.

SOLUTION

Emerson created a specific adapter to mount the Fisher 4320 and provide real-time information on valve position monitoring.

6.16. Monitoring of O_2 at Chemical Site

APPLICATION

Asphyxiation Risk Mitigation.

CHALLENGE

The DeltaV control system did not have any gas detection system installed thereby creating a safety risk. The plant wished to add oxygen depletion sensors to detect any risk of low oxygen levels that could result in asphyxiation.

SOLUTION

Emerson conducted a detailed site *Wireless*HART® survey and provided a report to verify the suitability of *Wireless*HART® technology to detect O_2 levels. The infrastructure included 4 x Gateways/ 16 x Repeaters/ 10 X 928 Gas Monitors, integrated to “Delta V ready “DCS. 0–25% Oxygen Volume Measurement, 0.5% Accuracy, 19.5% Default Alarm.

Process Optimization

Process application solutions increase plant efficiency by reducing costs and increasing plant throughput. A common cause of poor efficiency is process variability—often small, undetected shifts in process variables that, when added up, take a toll on overall profitability. By implementing wireless solutions, your team can extend mobility and monitoring applications to gain more process insight that provides new efficiencies, reduces operator rounds and get data from hard-to-reach process points.

6.17. TemperatureMeasurement (X-well) at Nitrogen Complex

APPLICATION

*Wireless*HART® temperature measurements with X-well technology.

CHALLENGE

This customer was looking to deploy additional temperature measurement points at his Nitrogen production unit. The customer did not want to create extra intrusions into the process piping to install thermowells.

SOLUTION

Emerson offered to let the customer test the Rosemount X-well Technology which delivers accurate process temperature data without thermowells or process penetrations.

By using a thermal conductivity algorithm and with an understanding of the conductive properties of the temperature measurement assembly and piping, this surface temperature sensor solution accurately measures internal process temperature. In addition, this solution simplifies measurement point specification, installation and maintenance and reduces possible leak points.

The picture on the top is the 648 Temperature transmitters with X-well, the picture on the bottom is the comparison between in-line thermowell (Blue trendline) and the X-well technology (Orange trendline). Both are matching almost perfectly. The X-well provided a non-intrusive, wireless, and easy to install solution that additionally does not require complex wake frequency calculations.

6.18. Pressure and Temperature Measurements Combined with Wireless Video Cameras at Air Separation Unit (ASU)

APPLICATION

ASU plant separates atmospheric air into its primary components (Oxygen and Nitrogen) using a cryogenic fractionation distillation at a very low temperature (approx. -196 °C). Due to more stringent global regulations and isolated incidents, mandatory process monitoring of the ASU units is needed.

CHALLENGE

Unavailable I/O's, lack of 4–20mA spare cables and reduced cable tray space makes it very costly to extend and deploy a monitoring strategy. The customer was also interested in adding Wireless Video Cameras to be notified of any potential process upsets.

SOLUTION

Emerson gave an update on the latest releases of its *Wireless*HART® product portfolio including the new 1410S2 *Wireless*HART® gateway and Cisco WiFi infrastructure and Emerson's Best Practice Rules on setting up and maintaining a *Wireless*HART® network. After a site visit the customer purchased several *Wireless*HART® pressure and temperature transmitters and is deploying a wireless camera network.

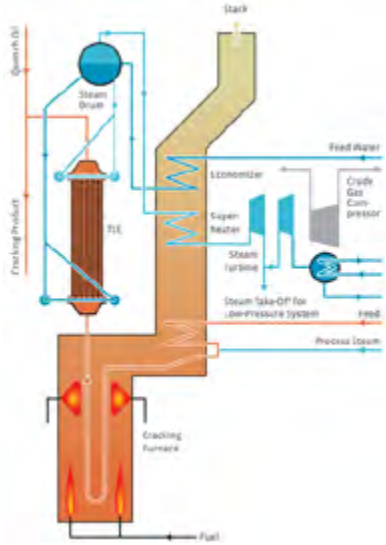
6.19. Ethylene Furnace / Cracker Coke Monitoring

APPLICATION

Monitoring ethylene furnace coking rate.

CHALLENGE

During furnace operation coke builds up inside the coils requiring de-coking. To determine when de-coking is needed this customer was manually monitoring differential pressure measurements across a venturi in the coils. The pressure was measured manually every 12 hours. Depending on the furnace this is anywhere from 32 to 176 coils. They were experiencing inconsistent results and increased HSSE risk from manual rounds. They wished to automate the measurement but a wired solution was not an option due to cost and high temperatures.



SOLUTION

*Wireless*HART® allows for fast commission at a minimal cost - the whole cracker coke monitoring was equipped with Wireless Pressure Gauges and 3051S transmitters. ROI calculations demonstrated savings up to 60% compared to traditional wired installations. In addition, they reduced non-value added labor hours, and reduced safety risk going into the high elevation, high temperature furnace area. They estimate they can eliminate one de-coke cycle per furnace per year with increased monitoring and efficiency.

6.20. CEMS Calibration Bottle Monitoring

APPLICATION

CEMS (Continuous Emissions Monitoring System) requires the usage of calibration bottles. Pressure indication is provided by traditional Bourdon gauges.

CHALLENGE

EPA requires emissions be neutralized therefore calibration gas bottles cannot go empty. Bottle pressures must be charted every 12 hours to ensure gas is available. Gauges with Bourdon tubes are prone to defects (fragile internals) which could result in reading a wrong pressure or no pressure at all.

SOLUTION

Wireless Pressure Gauges (WPG) are a good alternative and cost-effective way to monitor calibration bottles. The WPG doesn't contain any moving parts and will also send the pressure value every minute to the control room. Any overpressure event is time / date stamped for later analysis.

Also, alarms can be sent when the bottle reaches a certain (low) pressure. Readings are more accurate than manual checks. In combination with the WPG Plantweb Insight App results can be documented and monitored.

6.21. Truck Temperature Measurements

APPLICATION

Monitoring of 12 Truck Trailers when they are on site.

CHALLENGE

This customer needed to monitor the trailer tank inner temperature during loading, heating and when it was parked. Since the trailer is moved frequently to loading, heating and parking areas, it wasn't possible to monitor the temperature with a wired solution. Also, the customer was looking for a solution to determine if the trailer was on-site or off-site.

SOLUTION

The customer decided to install a *Wireless*HART® Network with repeaters located strategically around the plant to ensure full coverage. The 12 trailers were fitted with a Rosemount 648 *Wireless*HART® Transmitter and temperature sensor. With the wireless network installed, it doesn't matter where the trailer is on site. The trailer temperature is sent to the DCS every minute. The customer is able to ensure the specified inner trailer temperature of the product is within specification when the trailer leaves the site to their customer. Also, when the trailer returns on site, they can see it immediately due to the connecting transmitter. This allows them to track which trailer is on and off site.

6.22. Improved Maintenance on Flow Transmitters

APPLICATION

Upgrading installed base of Micro Motion Coriolis meters.

CHALLENGE

After a flow audit, this customer wanted to upgrade their existing installed base of Micro Motion Coriolis meters to the latest sensor and electronics designs during their next turnaround. They wanted to take advantage of the latest device diagnostics to check the health of the meters but they did not have an easy way to access the diagnostic information.

SOLUTION

To gain access to the latest device diagnostics and Smart Meter Verification, the new meters were installed with THUM adapters. The THUM™ adapters allowed the customer to gain access to all the diagnostic information via the *Wireless*HART® network. The THUM adapters were placed on every flowmeter including Rosemount Vortex meters.

6.23. Wireless Switch Provides Safe and Practical Overfill Prevention During Truck Loading

APPLICATION

Truck loading overfill prevention.

CHALLENGE

Preventing truck overfills is critical to ensuring plant safety and protecting the environment. Installing a wired level switch on a truck loading arm is challenging due to the constant motion of the loading arm to position it over the truck hatch. As a result, the cables were often damaged which resulted a safety issue as well as loading being suspended unnecessarily leading to operational delays.

SOLUTION

Rosemount 2160 Wireless Vibrating Forks for overfill prevention were installed next to the filling hose. Several units work together in one network and provide information about potential overfill situations. As the communication is fully wireless no more issues were encountered, and filling activities were no longer interrupted. The system is also easy and flexible to use.

6.24. Chemical Company Improves Raw Material Supply and Tank Utilization

APPLICATION

The existing tank level monitoring system was sometimes malfunctioning causing the fully loaded railway storage tanks to be placed out of service, resulting into fees and penalties.

CHALLENGE

The unreliable tank monitoring system reduced the capacity of the storage tanks and over-purchased materials could not be accommodated. There was also no visual display at the loading station resulting in overfill conditions or halted loading.

SOLUTION

Rosemount 3308 Wireless Guided Wave Radar were installed for storage tank levels, eliminating the reduction in capacity and overfill risk.

Reliability & Integrity Chemical Industry

Reliability application solutions help your team avoid unplanned slowdowns or shutdowns caused by previously unmonitored or manually monitored equipment. These solutions detect conditions that can lead to equipment failure, and replace manual, periodic readings with online insight into equipment health, minimizing trips to the field. Besides increased process availability and improved asset reliability, you can decrease maintenance costs while mitigating safety and environmental risks.

6.25. Non-Intrusive Wireless Corrosion Measurements

APPLICATION

Expansion / upgrading of existing corrosion monitoring installation due to an incident.

CHALLENGE

Because of a serious incident the corrosion monitoring system was no longer working and needed upgrading. Since this plant is running 24/7 a non-intrusive solution was required. Quick commissioning was key with minimal disturbance to the existing infrastructure and process systems

SOLUTION

Emerson's Rosemount permasense non-intrusive systems use unique sensor technology and wireless data delivery to continuously monitor for pipework metal loss from corrosion or erosion in the most difficult environments. As the system is based on *Wireless*HART® and is non-intrusive, rapid deployment of the system could be achieved.

95 on-line corrosion monitors were installed and connected to several *Wireless*HART® 1410S2 gateways within days – with no disturbances to any external or process system. New corrosion data was provided in less than 96 hours.

6.26. Non-Intrusive Wireless Corrosion Measurements

APPLICATION

Online, non-intrusive integrity measurements to monitor pipe wall thickness carrying hot caustic soda (+ 150 °C).

CHALLENGE

Equipment life planning is difficult without a measurement system, in challenging caustic environments. The customer wanted to have a near real-time recording of the wall thickness of Ni pipelines in a new electrolysis plant which uses caustic soda.

SOLUTION

Permasense data provided insight into the wall thickness decrease correlated to the product flowing through. Continuous wall thickness measurements allow the chemical water composition to be optimized in order to minimize or even stop corrosion resulting in improvement of planned maintenance (RBI & TA planning).

6.27. Condition Monitoring on Critical Centrifugal Pumps

APPLICATION

Vibration monitoring on centrifugal pumps.

CHALLENGE

Unclear technical problems on rotating equipment VE-Water-Plant

SOLUTION

Installation of triaxial AMS Wireless Vibration Transmitters, equipped with PeakVue technology to detect any issues around bearing or lubrication problems. The sensors are non-intrusive and allow for quick installation – data acquisition is up and running in a matter of minutes.

Providing both spectral and waveforms data combined with PeakVue data a full comprehensive picture can be formed about the condition of the rotating asset. The provided data sets are very rich and do no require the need to send a vibration specialist over in case of any problem. The embedded technology in the AMS Wireless Vibration Transmitter comes close to a portable FFT- analyzer.

7. Implementing the NAMUR Open Architecture (NOA)

Are you wondering what the best architecture is for deploying the Digital Operational Infrastructure (DOI) required for Industry 4.0 and Digital Transformation (DX)? The good news is that the NAMUR user group has defined the best practice standard for this second layer of automation known as the NAMUR Open Architecture (NOA). Many plants have already successfully implemented systems modelled on this architecture.

The member companies of the International User Association of Automation Technology in Process Industries (NAMUR) have jointly developed an open basic architecture for unlocking the potentials of Industry 4.0 called the NAMUR Open Architecture (NOA).

NAMUR recognizes there would be challenges using the DCS for the new automation of reliability, maintenance, energy efficiency, and personnel safety etc.

At their very core, DCS are not open systems, so it is not easy to get data out of a DCS. Also, new technologies are incorporated slowly or not at all, which means stand-alone parallel installation of new systems for new functions, not integrated with each other, results. There are no possibilities for quick testing of new apps on the DCS without risk to plant safety and availability.

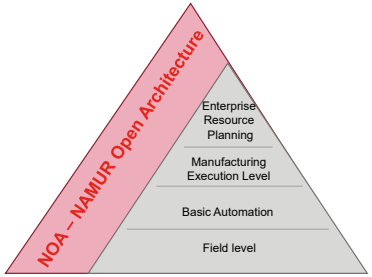


Image courtesy: NAMUR

Basically, process automation lags behind modern technology: IoT, cloud, big data, and mobile devices.

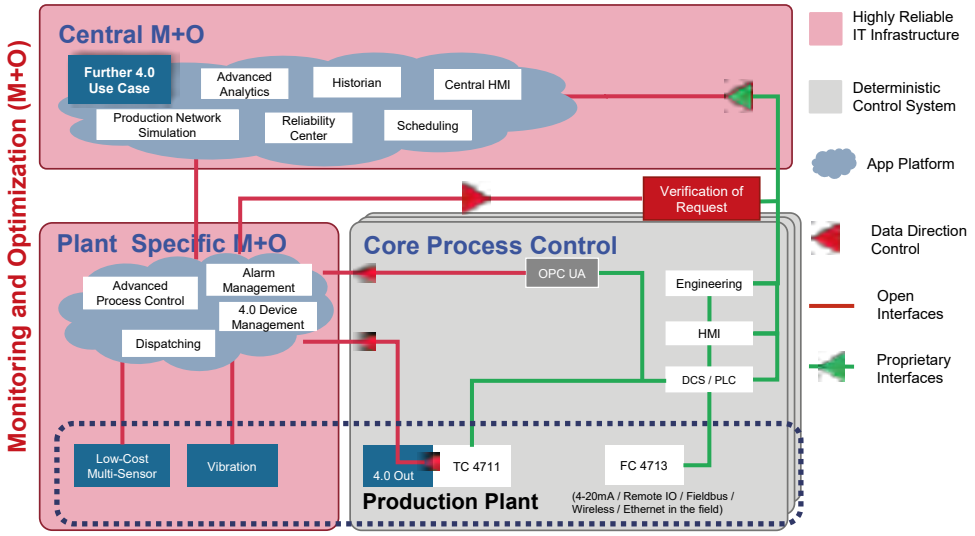
The NOA was designed to take several important factors into consideration. The existing DCS is proven and has a widely accepted architecture. These are highly available and mature systems that supports sustainable operations with long life cycles. Plants cannot risk losing these advantages.To protect the DCS, the NOA is based on a second layer of automation beside the existing plant automation, complementing the DCS, stretching from level 0 to level 3, connecting to level 4, in the Purdue / ISA95 / IEC62264 reference model.

Thus the existing DCS for Core Process Control (CPC) need not be replaced or dramatically changed. The key principle is to not touch the DCS. However, the plant automation has to be expanded with additional Digital Operational Infrastructure (DOI) for monitoring and optimization (M+O) for reliability, maintenance, energy efficiency, and personnel safety etc. beyond the P&ID.

System	Function
Distributed Control System (DCS)	Core Process Control (CPC)
Digital Operational Infrastructure (DOI)	Monitoring & Optimization (M+O)

Another interesting trend is the significant improvements of cost per sensor thanks to open and integrative approaches: digital communication technologies like wireless, fieldbus, Ethernet in the field (Advanced Physical Layer). And, non-intrusive sensors provide lower total installed cost per sensor, enabling new applications.

The NOA is designed for no compromise on plant availability and safety of existing DCS. The NOA is additive to existing automation, there is no need to replace the existing DCS. A key technology at the heart of the NOA is OPC-UA to read the data in the DCS and the field instruments from the new DOI to enable new Industry 4.0 solutions for M+O.



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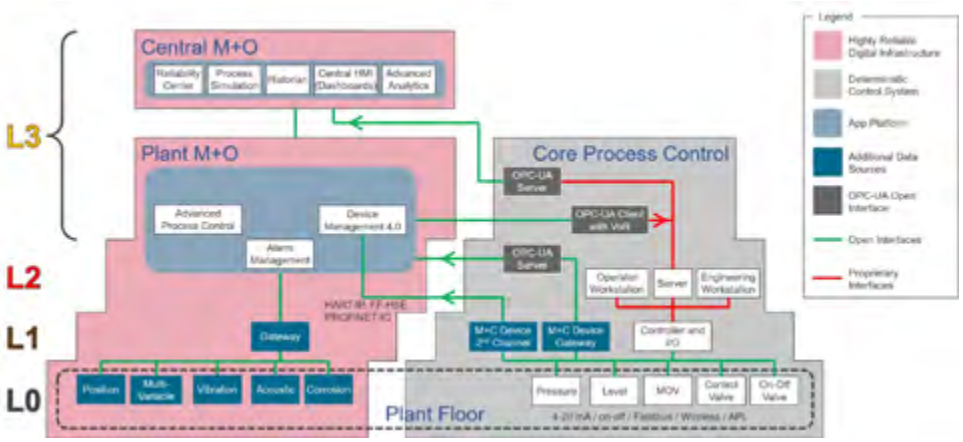
The NOA is based on existing standards like established I&C fieldbus protocols and software interfaces such as OPC-UA to enable simple integration of digital components from the field level up to the enterprise level.

This approach suits both new and existing production plants. Automation security is an integral design aspect (security by design) of the architecture.

Lastly, usability, reduction of complexity, and cost-effectiveness are the main success factors.

Plant specific M+O services are those which are directly related to the process like Advanced Process Control (APC) and alarm management.

Central M+O services are not directly related to the process, such as equipment maintenance. The related tasks can be carried out from the offices in the admin building, or from an enterprise fleet management center in another location common for multiple plants with experts supporting multiple plants.



The NOA is a very good approach for modernizing existing plants as the existing DCS is left intact. It is independent of the existing DCS, so migration to Industry 4.0 is possible regardless of the DCS in the plant.

The NOA is a good way to make sure new plants are not built the old-fashioned way with manual data collection and interpretation for maintenance, reliability, integrity, energy efficiency, and other operations beyond the DCS.

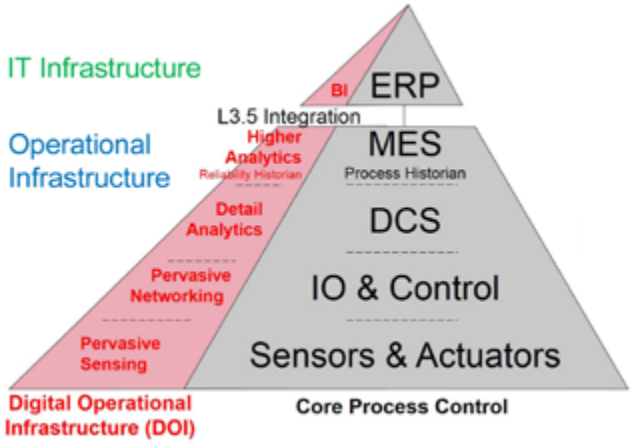
Although details of the NOA is still being worked out such as specifications for the data diodes, information model, and Verification of Request, plants can already implement the high-level concept of DOI for M+O as a second layer of automation added beside their existing automation.

In summary, the key attributes of the NOA:

- DCS remains as-is
- DOI added as 2nd layer on the side of the DCS
- Based on existing I&C standards
- Platform independent OPC-UA interface from DCS
- 2nd channel interface to auxiliary measurements and data in networked instruments
- Digitally networked add-on sensors
- Open OPC-UA application platform
- DCS reads and verifies data over OPC-UA

The Plantweb digital ecosystem is a Digital Operational Infrastructure (DOI), a second layer of automation beyond the P&ID, for digital transformation of the many manual tasks around the plant along the lines of the NAMUR Open Architecture (NOA).

This 2nd layer of automation sits side-by-side and is integrated with existing plant operational infrastructure and the global enterprise IT Infrastructure. This enables a separate security zone and defense in depth valuable to any plant. It is particularly valuable to the pharmaceutical / life science / biopharma industries where the control system and historian are GAMP validated.



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