Best Practices for Automation Technology Implementation in the Oil & Gas Industry

Automation and Industrial Internet of Things (IIoT) technology solutions provide a way to attain numerous industry goals, while also addressing market volatility, safety, and regulatory issues. Learn more with this eBook.

ADVANTECH

Enabling an Intelligent Planet

Improving Efficiency, Productivity, and the Bottom Line in Oil & Gas

For the oil and gas industry, the business environment is always changing, with the cost of crude, for example, ranging from a low of less than $20 in inflation adjusted currency to a high of $120-$160 and back again more than once over the years *(https://www.macrotrends.net/1369/crude-oil-price-history-chart)*. What has not changed is the need to maximize asset performance and return on investment. Achieving this requires getting the most out of technology for those concerned with upstream, midstream, or downstream oil and gas resources.

Automation and Industrial Internet of Things (IIoT) technology solutions provide a way to attain these goals while addressing market volatility, safety, and regulatory issues. Technology can help optimize resources by improving equipment reliability and uptime, as well as extending the effectiveness of the workforce.

The key to success is to follow best practices, which can be broken down into three steps:

- **Have the right workforce** – this category includes management and company staff, as well as a technology partner that can supply needed expertise
- **Have the right plan** – this step involves a realistic assessment of the current situation and a strategy to get to the desired destination
- **Have the right equipment** – this phase centers on the hardware, peripherals, and other gear that will support the workforce when executing the plan

Following these steps can lead to a successful technology rollout and some major competitive advantage.

Use Cases and Benefits of Predictive Maintenance and Remote Monitoring

Before getting into such aspects, though, it helps to examine what the benefits can be, thereby providing an answer to the question of: "Why implement automation technology?" The payback breaks down into a number of different areas:

- Improved maintenance
- Increased productivity by avoiding downtime
- Real-time production data, leading to data-driven solutions
- Reduced production costs
- Optimized and protected assets

The impact of these areas varies depending on which part of the oil and gas industry is being discussed. Also, the various categories have some overlap. Take, for instance, the first three, which play a role in results of a study from Kimberlite International Oilfield Research *(https://www.kimberliteresearch.com/)*. The international oil and gas market research and consulting firm found that offshore oil and gas organizations experienced a $38 million hit annually due to about 27 days of unplanned downtime. The worst performers ssaw a bottom line drag of more than $88 million as a result of even higher levels of downtime.

$34 Million

The average, annual amount saved from using a predictive, data-based approach

Operators who used a predictive, data-based approach, a Kimberlite study found, saw unplanned downtime drop by 36 percent as compared to those engaged in reactive tactics, leading to an average $34 million boost to the bottom line annually.

Part of the reason for this performance is the result of another nugget from the Kimerlite research: about three fourths of organizations surveyed were engaged in reactive or time-based maintenance. Companies that took a reactive approach waited until something broke to fix it, a tactic that maximizes unplanned downtime when it occurs. The companies following a time-based approach replaced gear on a schedule. However, according to research from the ARC Advisory Group, only 18 percent of asset failures are due to increased use or age. So, this method only somewhat reduced downtime and likely resulted in higher equipment expenditures.

Predictive maintenance, in contrast, collects data from pumps and other assets to spot impending equipment failure before it happens. Sensors and analytics, for example, can identify pumps that are on the path to failure by picking up minor changes in machine vibration characteristics, which can appear weeks or months before failure.

Operators who used a predictive, data-based approach, the Kimberlite study found, saw unplanned downtime drop by 36 percent as compared to those engaged in reactive tactics. This led to an average $34 million boost to the bottom line annually.

More use cases and a more complete discussion of the benefits of a predictive approach can be found in Advantech's eBook "Overcoming Oil & Gas Industry Challenges with Hardened IIoT Technologies."

What is clear is that the power of predictive maintenance and remote monitoring makes the implementation of automation technology well worth the investment.

The First Step: Have the Right Workforce

Best practices provide a way to achieve the greatest possible return on automation technology. However, achieving this outcome does not start with technology. Instead, success begins with people. This starts at the top of an organization. It is critical that there be executive level leadership and support—someone or a group who knows why and how this technology change is occurring . Having a high-level change champion is vital to gaining commitment from key stakeholders on their role, change benefits, and metrics to measure progress *(https://www.forbes.com/sites/hvmacarthur/2019/05/28/leading-change-management-in-the-modern-workplace/#647fa79b2d37)*.

There also must be a skilled and motivated team in place, something that executive support can help ensure. There may be expertise gaps in the workforce, particularly if an implementation plan calls for the use of unfamiliar technology. To handle such an issue, it may be necessary to enhance a workforce with education and training on anything new.

However, companies engaged in rolling out a technology do not have to go it alone, which makes both assessing and addressing a skills gap easier. This is because, in many ways, the right technology partner can be considered an extension of an organization's staff. To be truly useful in implementing a change plan, though, a technology partner must be able to help build out a full solution architecture. For deployment of automation technology, a partner should also have at its disposal a network of experts who can provide needed information and guidance.

A technology partner, for example, can help uncover expertise deficits. They can then either help correct those directly or provide information about training programs offered by others.

As can be seen, having the right staff and partner in place involves all levels of an organization. Getting personnel aligned in this manner is the first of three distinct areas of best practices.

The Second Step: The Right Implementation Plan

The second step in best practices for automation in the oil and gas industry involves the implementation plan. Such a document will be both the guiding principles and detailed roadmap that will get a firm from where it is to where it wants to go.

An important first point to consider for any plan is to **define the objectives** for a technology upgrade. This process should be done prior to starting the technology rollout. A key point to consider is the final objective—basically the answer to the questions: "What are you trying to achieve?" and "Who is the consumer of this information?"

The amount of data generated by an oil and gas installation can be enormous. A typical oil platform, for instance, can produce 2 terabytes—2,000 gigabytes—of data a day. Information arriving from a wellhead may include flow and other traditional data, as well as images from a camera and audio from a microphone. Hydrocarbon leak detection, for instance, can include recorded images and sound. Predictive maintenance, as noted earlier, can require collecting vibration and other data *(https://www.forbes.com/sites/markvenables/2019/05/31/moving-to-the-edge-is-crucial-for-oil-and-gas-companies-to-make-better-use-of-data/#335c614e59bd)*.

Simply passing along this mass of generated data to the cloud is often not practical. In an oil and gas production setting, for instance, the data may be collected at a remote location, with connectivity bottlenecks that limit how much data can be moved and raise how much it costs to transmit data. Additionally, cloud storage may be inexpensive, but it is not free, perhaps making it prohibitively costly to warehouse the data at some cloud facility.

So, **any plan must also be based on reality**. If the amount of data being generated is too large for communication and storage, then perhaps the answer is to perform as much of the analysis as possible at the edge of the network. In selecting an approach and incorporating it into a plan, keep in mind that the lifespan of the asset will be measured in decades. That is true, for instance, for a well, which produces a varying ratio of oil and gas for about 30 years *(https://www.dallasnews.com/business/energy/2019/12/24/the-permian-basin-is-getting-gassier-as-wells-age-and-oil-output-declines/)*, and for the technology that supports hydrocarbon assets.

In the case of the hardware, this reality means that virtualization may be the right solution. In virtualization, a software

Questions to Ask:

What am I trying to achieve?

Who will be using this information?

layer—called a hypervisor— runs applications, which means that the applications are separated from the hardware. This makes the applications independent of the underlying technology, an approach that makes it possible to deploy new applications easily and remotely. In effect, this technique future proofs the solution, making it feasible to use the platform for years to come.

This is part of a third aspect of the right plan: **have an assets optimization strategy**. Here, the optimization is of the IT infrastructure, the hydrocarbon field if present, and any hydrocarbon production or processing equipment.

For virtualization to be successful for some time after the hardware is deployed, for instance, it is important that the computing and communication capabilities of the platform be sufficient to handle applications today and tomorrow. A best practice, therefore, is to have a multicore processor with the target being at least a quad-core chip. This base computing platform requirement will evolve over the years and it is important to adjust the minimum requirements as needed. When doing so, always keep in mind there must be headroom in hardware capabilities to allow for future applications that may be more demanding than those currently deployed.

The right technology can make possible asset optimization of hydrocarbon fields and production of processing equipment. For instance, many oil and gas fields have legacy equipment, such as analog meters, gauges, and other standalone equipment. With remote connectivity, such devices can be effectively digitized, enabling the data they generate to be gathered and acted on. In this way, costs can be cut, and the highest value derived from every hydrocarbon molecule produced *(https://www.forbes.com/sites/gauravsharma/2019/11/17/adnoc-doubling-down-on-modernization-of-oil-and-gas-portfolio/#69cf1d1210f9)*.

This could allow, for example—following the 80:20 rule by making it possible to identify the lowest performing 20 percent of wellheads—to gather the data needed to understand why the wellheads are in that category, and then fix poor performing assets.

Technology, as noted previously, by itself is not enough. Therefore, a best practice is to **prepare for the human factor by having training available**. Any implementation plan must include time and resources for training, both for the initial deployment of a solution and as part of ongoing maintenance and analysis of that solution.

How much training is needed initially is determined by the expertise required to implement the technology and the skillset of the workforce. The latter should have been at least partially assessed as discussed earlier. However, the true size and nature of any gap in know-how cannot truly be established without having settled on a technology. There must be some flexibility built into the plan to accommodate potential changes brought about when the technology platform is settled.

It may help to break down barriers between different groups. One way to do this is to form a team from operations and IT and assign a task to that team. This best practice can lead to cross training and a better outcome as members from the separate groups bring their own strengths and knowledge to the task.

There are two final elements to having the right plan: **ensure automated processes are tested and reviewed** and **standardize how procedures are automated**. The first is important because automating processes removes the human element. Doing so helps to eliminate the chance for mistakes to be made; however, it also means there will be no one to catch any error or failure, such as might arise if incoming data is in a strange format or has unexpected values in a field.

Standardization brings uniformity to procedures in the original plan and for other procedures that might be automated in the future. This prevents changes that might otherwise arise and ensures that someone looking at how things are done at some time later will be better able to understand what is going on. This type of future proofing can help make maintenance and debugging easier. This best practice, however, has an aspect that should be understood. A standardized approach may not result in the best possible performance of an automated procedure. This fact should be kept in mind.

The Third Step: Have the Right Equipment

With the right workforce and plan in place, the third and final step is to have the right equipment. One of the most important features of any gear or technology is that it must have the right hazardous location classification. For oil and gas applications, this means it should be Class 1, Division 2, or C1D2. This classification is needed for most equipment because the gases and liquids present in hydrocarbon production and processing often present fire or explosion hazards to an extent that is not present in other situations.

Documents such as the United States National Electrical Code state, for instance, that motor fuel dispensing and bulk fuel storage locations will have extensive Class 1, Division 2 zones. Other operations, such as extraction and refining, will also have many areas that are similarly classified. Because of this reality, the technology going into such zones must involve design, construction and operational elements that keep the chance for combustion or explosion acceptably low. Thus, a technology partner should have a broad Class 1, Division 2 product portfolio.

To learn more about Advantech's Class 1, Division 2 product portfolio, visit: http://select.advantech.com/class-1-division-2-solutions/.

Featured Product Solutions

Edge Computers

To meet the needs of the industry 4.0 era, Advantech offers a complete range of embedded automation PCs capable of edge computing, bridging the gap between IT and OT. The UNO series serve as flexible IoT gateway with each series coming in three sizes: palm, small and regular. With a robust design, they include multiple expansion solutions and versatile mounting options to fulfill the needs of various industries.

UNO-430

Class 1, Division 2 Intel® Atom™ IP66 Ruggedized Outdoor Gateway for Oil & Gas

- Intel® Atom E3950 quad-core processor with 8G DDR3L memory
- LTE M.2 3042 key B, Wi-Fi M.2 2230 key A/E, GPS support
- 2 x GbE, 2 x RS-422/485 (isolated), 1 x RS-232 (console), M.2 2242 key B, TPM2.0
- IP66 water-proof design for outdoor environments
- C1D2 rated + IEC-ATEX standalone type certified PC
- -40°C ~70°C wide operating temperature design for harsh environments
- Easy maintenance with front door and cable gland design
- Bi-direction wall mount support and optional pole mount design

The UNO-430 has been specifically designed for oil and gas applications in harsh environments. The device is dust tight, and it protected against powerful water jets and heavy seas. It has easy wiring capabilities due to it's front door and cable gland design, so no special water-proof cable wiring is needed. It can be installed anywhere as it has a wall mount support and pole mount design.

UNO-1372GH

Class I, Division 2 Certified Intel® Atom™ Quad-Core Control DIN-rail PC

- UL listed for Hazardous Locations: Class I, Division 2
- Intel® Atom E3845 1.91GHz processor with 4GB DDR3L Memory
- 3 x GbE, 3 x USB, 2 x COM, 1 x VGA, 1 x HDMI, Audio, iDoor, mSATA, 2 x mPCIe, 1 x SATA, 4 x DI, 4 x DO, 1 x Power Terminal
- Spark-free design with lockable I/O kit
- Dual-power input for avoiding power downtime
- Exchangeable RTC Battery with easy access on top
- Digital I/O with isolation protection for sensing and controlling
- Diverse system I/O and supports Fieldbus Protocol by iDoor Technology as a Protocol Gateway
- 3G/GPS/GPRS/Wi-Fi Communication by iDoor Technology as a Communication Gateway
- Supports MRAM by iDoor Technology

The UNO-1372GH is designed to be safely operated in hazardous locations and are UL listed for Hazardous Locations with Class I, Division 2, groups A, B, C, D T4A certification.

Another defining characteristic of the oil and gas industry is that it may operate in remote areas and harsh environments. Equipment, therefore, must be industrial grade. Furthermore, working in remote locations means that connectivity can be a challenge. One option is to go with cellular technology. Another choice is to use LoRaWAN, which is targeted at IoT.

When deciding on a connectivity technology, a best practice is to match needs and capabilities. For instance, monitoring a pump for predictive maintenance purposes may involve collecting a limited amount of data at a high frequency, such as 10,000 samples a second. The connecting technology must have bandwidth to handle this requirement, along with the reach to deal with data collection points that may be far removed. An important point to consider is how much it costs to move and store the data if analytics are done in the cloud. It may make more sense to used edge computing to do the initial processing of the data and forward on only the processed information.

Other important technology components are embedded automation computers, panel PCs and HMIs, or human machine interfaces. These are typically found in refineries, large tank farms and similar sites that are commonly manned in person. As with other technologies, these need to carry appropriate certifications and ratings.

Featured Product Solutions

HMI and Panel PCs

The Advantech HMI series contains high-performance Touch Panel PCs, low-power industrial thin clients, web terminals for smart factory applications, and industrial monitors. Industrial monitors integrate the latest LCD and touchscreen technology to facilitate data visualization and increased productivity. Advantech's industrial Panel PC product portfolio includes customizable and all-in-one touchscreen PC series with multiple industrial touch panel sizes and rich I/O expansion to meet industrial standards. The rugged FPM series of monitors are built to withstand operation in industrial environments, extreme temperatures, and exposure to corrosive substances.

FPM-8151H

15" XGA Industrial Monitor for Hazardous Location, with 316L Stainless Steel Front Panel

- IP65-compliant front panel
- -20°C~60°C (-4°F~140°F) wide operating temperature range
- Enhanced 5-wire resistive touch panel
- Direct VGA & DVI-D video input interface
- Combo RS-232 & USB interface for touchscreen function
- Supports 24 VDC input and 100~240 VAC input (optional AC adapter)
- OSD control pad with lockable function on front panel
- Certified with UL Class 1, Division 2 for hazardous environments

The FPM-8151H is a particularly rugged and reliable 15" XGA wide-temperature industrial monitor for a variety of industry applications, such as oil and gas. It's equipped with a wide operating temperature range of -4°F~140°F) and also features enhanced five-wire resistive touch and system isolation to enhance the reliability.

TPC-125H

12" XGA TFT LED LCD Thin-Client Terminal with Intel® Atom™ Processor for Hazardous Locations

- Industrial-grade 12" XGA TFT LCD with 50K lifetime and LED backlight
- Intel® Atom™ E3845 1.91 GHz quad-core processor with 4 GB DDR3L SDRAM
- UL Class 1, Division 2 certified HMI for hazardous environments
- In-cabinet design with true-flat touchscreen with 5-wire resistive touch control and IP66-rated front panel
- Wide operating temperature -20°C~60°C/-4°F~140°F)
- Front-facing LED indicators to show operating status
- Advantech iDoor technology and SSD/HDD bay
- Compact, fanless system with aluminum alloy front bezel and chassis grounding protection
- Supports VESA mount (100 x 100 mm)
- Hazardous Location Designation Group A, B, C, D, T4

Finally, various devices are involved in getting data out of field instruments and into networks or computers for subsequent processing. The list includes data acquisition modules and industrial communication components, a category that spans Ethernet switches, serial device servers, media converters and protocol gateways.

Featured Product Solutions

Industrial Communications

With industrial-grade product design, Advantech's industrial communication products have passed the harsh tests of various vertical markets, such as IEC 61850 for substation automation and UL508 safety for industrial control equipment. In order to fulfill the networking needs for hazardous applications, Advantech offers a comprehensive line of UL-approved Class I, Division 2 Groups A, B, C, D industrial communication solutions: Industrial Ethernet Switches, Media Converters, Serial Device Servers, and Modbus Gateways.

EKI-5626CI-AE

ProView 16-Port Gigabit Industrial Switch with 2x RJ45/SFP Combo

- Total 18-Port 10/100/1000Base-T industrial Ethernet switch supporting Modbus/TCP and SNMP and -40°C~75°C extreme temperature support
- Features 16x 10/100/1000BaseT(X), and 2 x Giga (RJ45/SFP) combo ports
- Communicates with SCADA software via Modbus/TCP
- Communicates with Networking Management System via SNMP
- Port-based QoS for deterministic data transmission
- 8.4~52.8 V DC wide-range power input
- EMS level 3 protection for extreme outdoor environments
- Supports redundant 12~48V DC power input, P-Fail relay and loop detection

Data acquisition modules translate field instrument information into a digital format, if necessary. An important point to remember is that serial communications have a long reach and can function even in challenging environments but may be limited in bandwidth. A best practice, therefore, may be to arrange sampling and data rates so that they can be supported by serial communications, which may be the only technology that can be used to retrieve data.

Featured Product Solutions

Data Acquisition

Advantech's remote I/O modules—including repeaters, converters, and both RS-485-based and Ethernet-based remote data acquisition modules—provide ideal industrial automation, control, and measurement solutions for confronting harsh environments and demanding applications. What's more, with wide operating temperatures and multiple mounting methods, Advantech's ADAM series can be implemented in diverse applications, making the system always connected and reliable.

ADAM Series for Remote I/O

ADAM-4015, ADAM-4017+, ADAM-4018+, ADAM-4019+, ADAM-4051, ADAM-4056SO, ADAM-6022

- Various I/O types including RTD, analog input, thermocouple, digital input, digital output
- Interface: RS-485 and Ethernet
- Works with Modbus RTU/ASCII protocols
- Watchdog feature to recover the system
- Wiring burned-out detection function
- Isolation protection of 2000VDC to 3000VDC
- Independent channel configuration

ADAM-4510I

RS-422/485 Repeater

- Wide operating temperature of -40°C~85°C
- Automatic RS-485 data flow control
- Surge protection RS-485 data line
- Transmission speed up to 115.2 Kbps
- Networking up to 1,200 meters (4,000 feet)
- Reserved space for termination resistors
- Power and data flow indicator for troubleshooting

ADAM-4520I

Isolated RS-232 to RS-422/485 Converter

- Wide operating temperature of -40°C~85°C
- Automatic RS-485 data flow control
- 3000 VDC isolation protection
- Surge protection RS-485 data line
- Transmission speed up to 115.2 Kbps
- Networking up to 1,200 meters (4,000 feet)
- Reserved space for termination resistors
- Power and data flow indicator for troubleshooting

Featured Product Solutions

Wireless Sensing Solutions

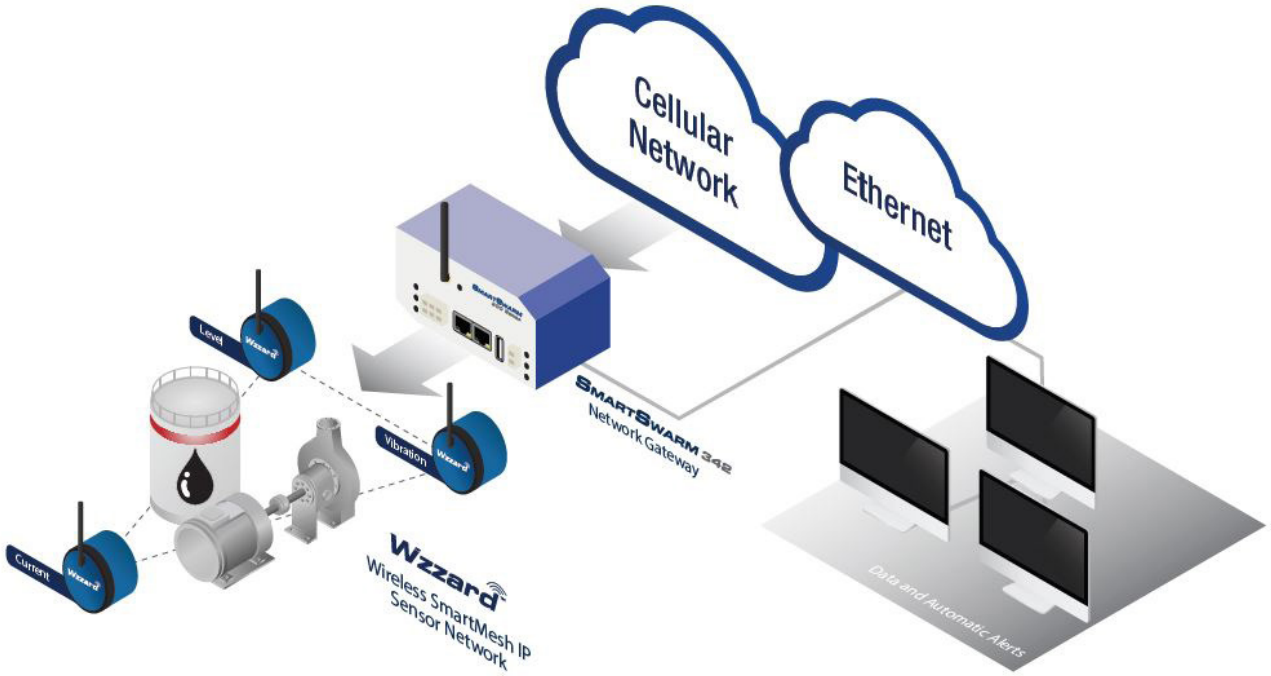
Wireless sensing technology and sensor networks deliver the data you need to manage and optimize your operations by LoRa or LoRaWAN. In the Oil & Gas industry, the pressure to increase data acquisition efficiency, reduce waste, reduce energy consumption, and maximize equipment uptimes is constant. Wzzard from Advantech makes it easy and non-intrusive to capture sensor data from existing equipment and operations, thus facilitating ongoing improvements that lower costs, increase productivity, and reduce waste.

The platform uses Wzzard mesh sensor edge nodes and a wireless 802.15.4e SmartMesh IP network to transmit sensor data to a SmartSwarm Gateway. The gateway can connect to the Internet via wired connections or cellular data networks and communicate with application platforms using the MQTT IoT protocol and JSON data formats.

Check out these Success Cases to see Wireless Sensing and LTE Technology in action:

+ Monitoring Oil & Gas Equipment in Hazardous Environments with Wireless Mesh Sensing

+ Oil Fluid Monitoring with LTE Technology



BB-WSD2C31010

Wzzard Industrial Wireless Sensor Node

- Industrial monitor node with 3 analog inputs, 1 digital input, internal temperature
- Ultra-low power 802.15.4e SmartMesh IP technology
- Communicates with SmartSwarm-342 gateway via highly scalable and reliable wireless mesh networks
- Rugged, IP67-rated, fiber-reinforced polyester PBT enclosure
- MQTT and JSON IoT protocol to application platform
- Sensor interface cable and antenna included

The Wzzard™ intelligent wireless sensor platform creates a complete, quick and easy connectivity stack between your sensors and application – on your network or the Internet.

BB-SG30000520-42

SmartSwarm 342 Gateway

- Configurable user business logic data processing and display engine
- Comprehensive data outputs via MQTT, email, SMS and a variety of other services and database connections
- Cellular or Ethernet connection to IIoT system
- Acts as LAN to WAN bridge for third-party device connection

SmartSwarm 342 gateways integrate data from diverse systems, remote devices and sensors into dashboards, analytics, and predictive maintenance programs.

The right equipment toolset will include all of the aforementioned elements. These products should come from as few suppliers as possible, and ideally they will come from a single supplier as that is likely to make support and maintenance easier. For an example of such a broad product line, consider Advantech's product portfolio.

Wrapping Up

To recap, by having the right people, plan and technology in place, oil and gas industry companies can implement a best practices-based solution to automation. The result will be a competitive advantage through lower operating costs, business streamlining, and increased safety. Predictive maintenance, for instance, will be enabled, potentially cutting downtime by more than a third. That outcome alone will result in a significant cost savings as well as a potentially substantial increase in safety. Furthermore, the data produced by automating processes can be used in business analytics, which can lead to a sizeable boost to the bottom line.

The industry as a whole has seen and continues to see a roller coaster ride in terms of product price and resulting revenue, which can make for a dizzying journey. The proper approach to automation can help smooth the ride while also increasing the payoff.

Want to Learn More?

To learn more about Advantech's Oil & Gas Solutions, please visit: http://select.advantech.com/oil-gas-solution/.

Visit us at www.advantech.com for more information on solution ready packages, industrial devices, and services.

Advantech Corporation
IIoT Group

Call Center: 1-888-576-9668
Tech Support/RMA: 1-877-451-6868
eMail: eAinfo@advantech.com
Web: www.Advantech.com/eA

Cincinnati, OH Office
11380 Reed Hartman Highway
Cincinnati,OH 45241
Toll Free Tel: 1-800-800-6889
Tel: 1-513-742-8895
Fax: 1-513-742-8892

Milpitas, CA Office
380 Fairview Way
Milpitas, CA 95035-3062 USA
Toll Free Tel: 1-800-800-6889
Tel: 1-408-519-3891
Fax: 1-408-519-3888

Ottawa, IL Office
707 East Dayton Road
Ottawa, IL 61350
Tel: 1-815-433-5100
Fax: 1-815-433-5109

ADVANTECH

Enabling an Intelligent Planet

www.advantech.com