THE ROAD TO SUCCESSFUL PLANT MODERNIZATION

Obsolescence, Regulatory, Operational & Other Key Considerations
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INTRODUCTION
Modernization & Control Improvement
This eBook is a tool for owner organizations to better understand, plan and scope modernization/reinstrumentation and control improvement projects.

The contents of this asset will look into some of the most peculiar challenges related to plant modernization, and is meant to provide support for a structured process that helps properly scope, execute, and justify reinstrumentation and control improvement projects.

While this eBook focuses on basic process control, safety systems and instrumentation for plants in the U.S., many of the concepts described are applicable to other regions served by Yokogawa.

On behalf of the entire Yokogawa crew, we hope this resource will help you improve your operations.

Enjoy!
CHAPTER 1
The Road to Successful Modernization
Modernize or Maintain?

The needs of today’s business world are very dynamic. The way we communicate, inform, collect data, analyze and report, all seem to change from decade to decade, and it is changing industries too.

The field technology has evolved from pneumatic to analog to hybrid to digital. Collecting process parameters is no longer sufficient, because more diagnostic information from smart devices is now available. This real-time data for quick and intelligent decisions has become critical to manage business risks and opportunities.

Industrial plants should prevent falling behind. After all, operating a plant with old instrumentation and an aging control system is a major challenge for plant owners today. Day after day, operators face various age related issues like inaccurate sensors, blocked impulse lines, spurious shutdowns, seized valves and failed actuators. The result: the reliability of the system is uncertain and safety of the plant is at stake.

So, why not modernize the system instead of maintaining an aging plant? A couple of questions come to mind:

- Is the cost of maintaining the old system worth spending?
- How many more years can the existing system last? Can the capability and productivity of the old system be improved?
- Is it safe to operate?
- How much will it cost to migrate the system?
- What are the benefits and value added features of the new system?
- What is the downtime and will it disrupt operation and maintenance?
- How will regulations influence your operations in the future?

All these are practical issues in plant operation and need to be assessed thoroughly to calculate the return of investment (ROI) of the plant’s system and instruments.
Modernization Projects

The normal reinstrumentation and modernization projects are thought of as infrastructure projects like bridges or roads: the tendency is to just scope the DCS and not look at other risks or other issues connected to the DCS that may also be obsolete.

Many companies see a reinstrumentation project as a purely defensive tactic: the main objective is overcoming the failings of the older system or instruments and keeping the unit or plant exactly as it has been. Such a ‘like-for-like’ approach can be very successful if the only desired outcome is recreating the status quo on new hardware, and many projects are designed precisely along those lines. The problem with this approach is a major lost opportunity.

Nowadays, new instruments and control systems are able to support extensive improvements to help the plant run better and more efficiently.

In this eBook we holistically approach the concept of plant modernization in terms of reinstrumentation.

Such a project is a major undertaking and can only be successful if addressed methodically and with careful planning. In the end, the risks of an unsuccessful project are serious. Costs can spiral out of control, and production can be disrupted. Even after it is installed, poorly configured systems or instruments can have trouble controlling the process.

On the other hand, when planned well, a reinstrumentation project, even a large-scale system migration, can move from phase to phase on time and within budget, resulting in significant operational improvements.
CHAPTER 2
Drivers for Modernization
Challenges that Can Drive Modernization

Most manufacturing plants follow a very practical belief: if something works, leave it alone. After all, plant operators are not rewarded for having the latest technology, but for making quality products in the largest possible quantities. If, for example, the old PLC running a chemical injection skid does its job, it will be left to continue until the plant requires change or it quits working properly.

Those attitudes apply to both field instruments, analyzers, DCS, and SIS platforms. But for DCS platforms, it is remarkable that many of them designed and installed in the 1970s and 1980s proved to have outstanding longevity, operating reliably for decades in unrelenting service. Yes, some specific components may have failed along the way and parts needed replacement, but these control systems worked well day in and day out.

Unfortunately, a lot of these systems finally are showing their age. In many cases, much of the equipment needs to be upgraded at a minimum, or perhaps undergo a full migration to a completely new DCS, potentially involving a move to a new supplier.

But what in the end drives plant modernization? We identified three major challenges that can drive plant modernization projects:

- **2.1 OBSOLESCENCE**
  - DCS | SIS | Operator Stations
  - Field Instrumentation

- **2.2 SAFETY, INDUSTRY REGULATIONS & COMPLIANCE**
  - SIS Regulations
  - Environmental Compliance Monitoring

- **2.3 OPERATIONAL EXCELLENCE**
  - Risk of the Aging Workforce
  - Advanced Process Control
  - Cyber Security
The actual numbers may vary slightly from study to study, but the consensus opinion suggests the majority of process plants running today depend on a DCS more than 20 years old. In most situations, the aging infrastructure extends beyond just the DCS and affects all manner of ancillary systems, creating a larger manufacturing environment populated with a museum of outdated hardware and operating systems. Every situation is different, but when IT professionals look at what is running in their plants, most of them are astonished and even horrified by the outdated, often unreliable and insecure equipment.

AUTOMATION SYSTEM COMPONENTS LIFECYCLE

The average lifecycle of most components of a process automation system is longer than 15 years. In many cases, systems are maintained by replacing individual components.

Old control system platforms and instrumentation increase the risk of failure and production interruptions, and lack many of the capabilities of newer systems for improving plant performance.
INSTALLED BASE OF OBSOLETE INFRASTRUCTURE

In today’s world, the reality is that there is an enormous installed base of obsolete infrastructure. ARC Advisory Group research estimated that in 2011 there was approximately $65 billion dollars’ worth of it. Many automation systems still in use today were engineered back in the ‘70s or ‘80s and have continued to run well beyond their expected lifespans.

Operating a plant with an old instrumentation and aging control system creates several potential problems for operators and production. Day after day, the staff eventually will start facing various age related issues. From inaccurate sensors, to spurious shutdowns. At the same time, most control systems are not properly documented and/or up to date, including P&IDs, control narratives, strategies, spares, control system utilization, etc.

Simply put: the reliability of the system is uncertain and safety of the plant is at stake.

TECHNOLOGY CHANGE

But there’s more to it- the rate of technology change is also occurring at a faster rate than before. Sustainable technology becomes iterative and must be refreshed more frequently. It is one of the main explanations why most system migrations are due to obsolescence.
There is increased emphasis on health, safety, and environment in today’s industrial environments. Unfortunately, accidents continue to occur in many manufacturing facilities even after the installation of safety systems and other precautions that were initially considered adequate.

Operational safety still depends primarily on operators. At the same time, many operators are faced with paralyzing information and alarm floods when confronted with an abnormal situation. In such a case, it can be difficult to sort through all the noise to get to the right data and make a good decision in a crisis.

Several major incidents in the past few years were caused in part by plant personnel not following proper operating procedures while under pressure.

After all, operators and maintenance personnel are human. It is human nature to interpret the same written procedure slightly differently and perform them a little differently too, especially under pressure. This variance can lead to degraded, inconsistent performance, abnormal situations, and even worse, a catastrophe.

**INADEQUATE OR INCORRECT PROCEDURES**

Industrial sites are at risk, especially during abnormal operation states. Thus, many safety incidents occur during infrequent, transitional, or abnormal situations. A potentially dangerous (and abnormal) situation might occur when an infrequent operation has to take place, but key individuals are not available, leaving inexperienced operators to follow inadequate or incorrect procedures. Something can get out of control and quickly lead to undesirable outcomes such as equipment damage, environmental release, injuries and/or fatalities.
INDUSTRY REGULATIONS & STANDARDS

The instrumentation and controls intended for handling process risks play a vital role in ensuring plant safety. In September 2004, the European Committee for Electro technical Standardization and the American National Standards Institute (ANSI) adopted a new standard related to SIS systems. This standard, called IEC 61511, EN IEC 61511 or ANSI/ISA 84.00.01-2004 Parts 1-3 (IEC 61511 Mod), now becomes the primary driving force behind the work processes that should be followed to design and manage SISs. It applies to any new or expanded process unit and to the upgrade of an existing SIS.

Industry regulations have been changing to be more stringent globally. The Edition 2 of IEC 61511 (2016) is in a Redline release and has not yet been approved and released but expected to be released later in 2016 or early 2017. This requires the application of the best available technology as well as separate Basic Process Control Systems from the Safety Instrument System but may allow grandfather clause for existing systems. However, in certain parts of the world such as Singapore and Australia, safety systems are being upgraded as part of their evolving standards. A Process Hazard Analysis and Hazard and Operability Study (HAZOP) should be part of every Front End Engineering Design (FEED) to evaluate the existing safety systems and mitigate the risks. Existing Layer of Protection Analysis (LOPA) should be reviewed to assure that it is current. This may cause inclusion of safety system upgrades into the scope of Modernization Projects.

Average Dollar Loss per Major Incident by Cause in Millions of Dollars

<table>
<thead>
<tr>
<th>Cause</th>
<th>Dollar Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Failure</td>
<td>$100M</td>
</tr>
<tr>
<td>Operational Error</td>
<td>$75M</td>
</tr>
<tr>
<td>Unknown</td>
<td>$50M</td>
</tr>
<tr>
<td>Natural Hazard</td>
<td>$25M</td>
</tr>
<tr>
<td>Design Error</td>
<td>0</td>
</tr>
<tr>
<td>Sabotage/Arson</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: J&H & McLenna, Inc

![Warning]

Even when regulations don’t require any precautions, during determining the scope of a reinstrumentation project, careful thought needs to be given to how a possible accident could affect the owner company, for example in terms of workforce safety, equipment damage, and loss of reputation.
For many plant owners, obsolescence alone cannot justify executing a large capital upgrade project, and enhanced functionality and system performance to improve operational excellence are major criteria impacting funding decisions.

(Source: ARC 2011)

Enhanced functionality is the concept of a plant or factory’s capability to implement the latest technologies and innovations to deal with a wide range of challenges in a certain industry related to technology. To be able to properly deal with these challenges in the future, new technologies or innovations might be necessary. If the installed base of instrumentation and systems can’t implement these, an upgrade or even a complete replacement of instrumentation or systems could be required. In such a case, these ‘platforms for the future’ could trigger plant modernization.
Are you concerned about senior operators retiring? Given the demographic problems with aging workers and hard-to-find replacements, this type of dependence is becoming ever more perilous.

Finding experienced personnel is already a big challenge for the process industries. Recently, an executive at a major refining company stated in an interview they had lost 2,500 years of experience when 100 operators retired at one site, each with an average of 25 years of experience. As further evidence, a team at a major chemical company analyzed their plant demographics and found one of their largest plants would lose 75 percent of its operating staff due to retirement. Another major refiner has to fly its experienced people to various sites all over the USA to augment the existing workforce during start-ups, and another has to contract back retired workers to do unit start-ups because they do not have enough people left on site that know how to do these procedures.

The Exodus of workers is reducing companies’ ability to sustain Operational Excellence.
2.3.2 | ADVANCED PROCESS CONTROL

In recent years, increasing global competition and environmental and other regulatory requirements have spurred manufacturers and other industrial organizations to shift their focus from production to more agile and sustainable operations.

By now, virtually every industrial process in the world is under automatic control, so the logical next step is Advanced Process Control (APC). APC has already been implemented in many facilities, albeit with varying degrees of success. But when APC works, the results can be nothing short of spectacular. (source: www.controlglobal.com)

Today’s more user-friendly advanced control and real-time optimization tools are playing an increasingly important role to maintain profitable operations and be competitive.

Advanced systems provide many advantages for the process units, such as:

► improved process yields,
► increased throughput,
► reduced energy consumption
► improved process stability.

These operational improvements can trigger plant modernization and are often used as a way to justify the large costs.

Multi-Variable Control (MVC) is the key component of an APC system, that enables optimum process stabilization, resulting in increased productivity. MVC achieves this by predictive control using process dynamic models, which is proving to increase throughput, save energy, and reduce quality giveaway.

Typical APC Implementation Schedule

![Typical APC Implementation Schedule Diagram]
**APC RETURN ON INVESTMENT (BENEFITS/YEAR)**

**PETROCHEMICALS**
- **Ethylene**
  - 2-4% increase in production

- **VCM**
  - 3-5% increased capacity / 1-4% yield improvement

- **Aromatics (50KBPD)**
  - 3.4M-5.3M US$

**CHEMICALS**
- **Ammonia**
  - 2-4% increased capacity / 2-5% less energy/ton

- **Polyolefin**
  - 2-5% increase production / up to 30% faster grade transition

**OIL & GAS INDUSTRIAL UTILITIES**
- **Upstream**
  - 1-5% increase in production

- **Cogeneration/Power systems**
  - 2-5% decrease in operating costs

**PULPING**
- **Bleaching**
  - 10-20% reduction in chemical usage

- **Thermo Mechanical Pulping**
  - $1M-$2M
2.3.3 | CYBER SECURITY

As industrial plants evolve, the industry is moving towards the “connected enterprise” being able to read information from smart devices, i.e. tablets, smartphones. By using these information system technologies, control systems have been enjoying the merits owing to connection to information systems but, at the same time, have become exposed to the security risks inherent to information systems.

Examples of online identity theft and intellectual property violations are not hard to find. With WikiLeaks, NSA scandal, and the hack of Apple’s Cloud fresh in mind, it’s becoming evident that cyber security is a serious threat that can ruin reputations and can lead to loss of production or unsafe situations.

The biggest and most urgent question most plant owners are concerned about regarding cyber security is therefore how to protect their network from these hackers and malware infections.

Typical life cycle information from Microsoft

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Release Date</th>
<th>End of Mainstream Support</th>
<th>End of Extended Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows XP</td>
<td>April 14, 2009</td>
<td>April 8, 2014</td>
<td></td>
</tr>
<tr>
<td>Windows Vista</td>
<td>April 10, 2010</td>
<td>April 11, 2017</td>
<td></td>
</tr>
<tr>
<td>Windows 7</td>
<td>January 13, 2015</td>
<td>January 14, 2020</td>
<td></td>
</tr>
<tr>
<td>Windows 8</td>
<td>January 9, 2018</td>
<td>January 10, 2023</td>
<td></td>
</tr>
<tr>
<td>Windows 10</td>
<td>October 13, 2020</td>
<td>October 14, 2025</td>
<td>N/A</td>
</tr>
</tbody>
</table>

ACTUAL DAMAGE CAUSED BY ATTACKS

Security problems have been actually arising in control systems. For example, malware originally targeting information systems has damaged control systems, resulting in several plant shutdowns. In July 2010, a new threat related to process control systems was discovered. This new threat is referred to as Stuxnet, which is a sophisticated malware, targeting Siemens PLC systems. Before the appearance of Stuxnet, process control systems had not been recognized as a potential target for malware developers. However, the appearance of this new generation malware shattered such an optimistic view. After Stuxnet, many other process control malware emerged.
VULNERABLE EQUIPMENT

The continuous evolution of the control system enabled organizations to protect the investment in equipment and control strategies over long periods of time. However, interfacing decades-old controllers with current technology also makes this equipment indirectly vulnerable to attack.

All these systems have one common denominator: they experience gaps in support. This makes them more vulnerable than contemporary systems.

HOW DOES THIS AFFECT SECURITY?

Remaining secure requires the installation of a continuous flow of new security patches, which contain software fixes for vulnerabilities.

Vendors of operating systems have a limited support window for security fixes; once the product is no longer sold, the support is generally limited to a three-to-five-year period. After this period, no more security patches will become available, resulting in a rapid degradation of the product’s security.

Software that protects the process control system, such as anti-virus and whitelisting applications, also has support limitations pertaining to legacy platforms. Therefore legacy systems can suffer from the unavailability of security patches as well as the unavailability of security protection software.
PREVENTING SYSTEMS FROM BECOMING LEGACY SYSTEMS INVOLVES SEVERAL ASPECTS:

► Performing periodic system refreshes to maintain a system’s serviceability
► Maintaining security patches to keep the system up-to-date with the latest vulnerability fixes
► Maintaining documentation so you can know your system and document the assets, network traffic flows and security controls
► Processes and procedures to help fight the cyber security attacks. Is there a recovery plan?

OVER THE YEARS, THERE ARE SEVERAL DETECTION AND ATTACKS REPORTED IN THE PROCESS CONTROL NETWORK.

Well-known Process Control Network Infection/Detection

- **2009**
  - **Night Dragon**
    - Remote Access Trojan
    - Distributed through spearphising

- **2010**
  - **Stuxnet**
    - Intercept and Changes
    - Data targeting
    - Siemens’s PLC System

- **2011**
  - **Duqu**
    - Cyberespionage
    - Equipped with modules for SCADA attacks

- **2012**
  - **Flame**
    - Cyberespionage
    - Intended to steal sensitive operational data

- **2014**
  - **Dragonfly**
    - Cyberespionage
    - Targeting energy sector

- **2016**
  - **BlackEnergy**
    - Backdoor for cyberespionage and crime ware toolkit
    - Targeting energy sector
4 TYPICAL CYBER SECURITY PROBLEMS FOR CONTROL SYSTEMS:

**Contamination of vulnerability risks due to shift to open architecture**
Control systems incorporate the vulnerability inherent to information systems. Remaining secure requires the installation of a continuous flow of new security patches, which contain software fixes for vulnerabilities. Vendors of operating systems have a limited support window for security fixes; once the product is no longer sold, the support is generally limited to a three-to-five-year period. After this period, no more security patches will become available, resulting in a rapid degradation of the product’s security. Software that protects the process control system, such as anti-virus and whitelisting applications, also has support limitations pertaining to legacy platforms.

**Obsolescence of security measures due to long-term operation**
Control systems are operated for 10 to 20 years, while attacking techniques become more sophisticated year by year. As a result, the security measures installed at the beginning of the operation may be insufficient to prevent the attacks.

**Restricted introduction of security functions due to availability prioritized operation**
Because system availability is highly prioritized in the operation of control systems, new security measures cannot be easily introduced to them. Moreover, the measures themselves may disturb the system operation and thus there is a case where its introduction is postponed until confirmation that there are no problems.

**There are increasing regulatory mandates and guidelines issued by the US Government**
As well as guidelines and best practices for securing plant control systems from advisory groups such as the ISA SP99 committee, NIST (Process Control Security Requirements Forum-PCSRF), NERC, etc.
CHAPTER 3
Successful Modernization
Successful Modernization

How to achieve successful plant modernization, and how to properly prepare for such a project?

Thinking about it, many questions may come up. One of the main questions to begin with is what’s reusable and what’s not, and how to maximize the efficiency of the existing infrastructure. Overall, it is important to challenge conventional thought processes in each phase, and check the costs of maintaining old field instruments versus installing a new one.

6 STEPS TO SUCCESSFUL MODERNIZATION

1. Owner to conduct a preliminary field survey.
2. Owner to develop preliminary systems architecture drawing including field instruments, wiring, analyzers, etc.
3. Owner to engage MAC with preliminary scope.
4. MAC to conduct an extensive site or field surveys on existing control systems and instrumentation.
5. MAC to produce and overall systems & product architecture diagram, and then, piece by piece review the items by unit and category for obsolescence or improved infrastructure keeping in mind the overall project premises.
6. MAC to produce the Final Project Scope and execute the project with no trips or incidents.
A preliminary fields survey is usually conducted before getting a possible automation vendor involved. The information of this initial survey is necessary to come up with a bid for automation vendors. Besides that, it is a significant step for mapping the system architecture.

**FIELD SURVEY CHECKLIST**

- Field instruments including the control valve positioners, transmitters, manifolds (and other field devices) - would new smart instrumentation be less expensive and provide more information for the future (predictive maintenance) than the existing?
- Instrumentation process connections and piping taps – is the replacement of existing manifolds and tubing required?
- Safety shutdown systems – do they meet the upcoming regulations?
- Analyzers – are they obsolete? Do they meet the emissions monitoring regulatory requirements?
- Bypasses on valves – are they there and will the bypasses hold? What infrastructure is there for later cutovers?
- Field cabling – assess the field cabling for UV and damage from the elements. This is a central decision and could change the overall new systems architecture. How much room is there in the cable trays for additional cabling if required?
- Control room equipment – how will the control room change with the new operator consoles? Will new lighting be required and how will the change occur?
- Rack room equipment – is there space for the new equipment in the existing rack room? How will this be staged during the conversion?
- At one of the preliminary steps, evaluate existing documentation and accuracy to better identify scope/risk of the project. Review with operations accuracy of loop diagrams, instrument specifications sheets, building infrastructure drawings, field plot diagrams, wiring diagrams, electrical diagrams, and etc.
- Existing alarm panels – will they be needed with the new system? What is the philosophy for hardwired alarms?
- Existing sub system interfaces/protocols – how will these interface to the new system?
- 3rd Party PLCs – will some of these PLCs also be obsolete? Is there anyone at the plant who can maintain these? Should the functionality be incorporated into the new DCS system?
- UPS sizing – are they sized to support the new system?
- Building grounding drawings – how will the new system be grounded?
- Interfaces to plant/corporate IT Systems – what interfaces are required to existing plant and corporate IT systems such as email, maintenance. Is the new system designed to be cyber secure?
- Organization of process IO from equipment. How is it currently organized and how could it be improved? Are specific IOs going across multiple controllers?
3.2 IMPLEMENTATION BEST PRACTICES AND RECOMMENDATIONS | MAC

The MAC (Main Automation Contractor) is the logical choice for implementing the reinstrumentation projects with the right highly specialized skillsets to implement these types of projects. Using this approach reduces risks of trips or shutdowns during cutover, the right team working on the scope definition and development and timely delivery of projects.

The MAC is the automation partner capable of handling solutions and services from the FEED stage, through “detailed design” and on through construction to startup/operation (Handover).

TO EXECUTE THE PROJECTS EFFECTIVELY, IT IS IMPORTANT TO IMPLEMENT THE FOLLOWING CONCEPTS:

- Quality assurance and control at all stages
- Selecting the skilled resources for the right job onsite and offsite
- Manage stakeholders between all the project team members (operations, project and site teams, subcontractors)
- Total Project Management of all the parts of the reinstrumentation project, including management of any subcontractors (i.e. construction, panel shops, remote enclosures, etc.)
- Standardization across multiple units/plants using toolkits to streamline delivery
- Complete system integration including communication with third party devices
- Use of technology to develop and maintain re-instrumentation information for construction, testing, cutover, and maintenance
- Cutover planning and detailed/accurate procedures to assure no trips or incidents
- Cost effective project execution

Early project involvement to help develop the scope and to subsequently develop the solutions as a solution partner.
Just like a preliminary field survey, a preliminary system architecture needs to be developed first. This is an evergreen document showing the scope as it develops during FEED.

Accurate drawings are tough to find for loops and schematics but some are stashed in various personal files of maintenance technicians. They are key to finding out what changes have been made to assure that the new control system provides the same functionality as the old control system.

By collaborating, the customer and manufacturer ensure that the P&IDs, instrumentation, and control schemes are fully understood to implement it accurately in the DCS and the SIS. An example of this are the Hazop’s and LOPA analysis.

Any opportunities and risks should be identified during site survey and FEED studies. Improve control strategies for improved reliability and tighter control.

Safety Instrumented Systems have historically been blended in with process control where safety and process logic co-exist in the same processor (DCS or PLC). The time has come where the segregation of safety systems is a requirement per the IEC 61511, where safety systems should be dedicated to safety critical assets only. During upfront site survey activities, this will be a key component to identify safety and process segregation and obsolescence of existing systems performing safety function.
3.4 PROJECT SCOPE DETERMINATION

Reinstrumentation projects are marathons rather than sprints. The reinstrumentation team must maintain a vision of where they want to be when the project is finished and, ultimately, what constitutes project success. Identifying what are the drivers on reinstrumentation and priorities of upgrades across the asset will help plan and scope the reinstrumentation project.

**Important key success factor:** Proper scope identification - explore all opportunities and do a proper risk analysis. On the right is model that can help you identify the big pieces.

Plant reinstrumentation projects are notorious for scope changes. For project success, there must be a well-established scope change procedure so that changes can be dealt with in an orderly fashion yet with as little negative monetary or schedule impact to the project as possible. Examples of such changes would be sudden failure of an existing piece of equipment, an unplanned outage that must be taken advantage of or, conversely, a delay in the shutdown of some area of the plant.
3.4.1 | SYSTEM IO (HARD/SOFT IO)

Safety and process IO can use smart configurable IO (Network IO – NIO) in the field using fiber optic cabling to eliminate traditional homerun multi-conductor instrument cables which are not cost effective and labor intensive.

► Traditional control systems had dedicated IO card types, and now with NIO (Network I/O), there is only one IO module type that covers all the IO type signals for both the DCS and SIS.

► N-IO simplifies the process of wiring field devices, construction, materials, cabling, and labor. The technology also allows for late IO changes which uses software to bind the changes rather than costly construction wiring changes.

► Modernization projects implementing field solutions should consider using field panels or junction type box solution.

► Significant reduction in the number of IO terminations compared to the conventional wiring methods. This solution eliminates the need for marshalling cabinets and complicated cross wiring solutions.
<table>
<thead>
<tr>
<th>TOP 8 N-IO BENEFITS:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>Save resources on wiring</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>It supports multiple signal types on a per-channel basis</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>Once a transmitter is replaced and all hardware tasks are finished, the necessary application change can be done centrally. All data and documents are consistent at any time.</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>Spare hardware channels are 100% available at any time without delay or physical adjustment</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>Application functions can be assigned to any available hardware channel at any time during flexible binding, enabling more independence in application engineering and reducing project risk. No rewiring or exchange of signals is required.</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>I/O cabinets can be ordered, shipped and wired as a standard item, since they require no project specific engineering (except size and layout), marshalling cabinets or field terminations.</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td>Changes in any section (hardware, software) do not affect the other due to Flexible binding. Flexible binding of the hardware layer to the software layer is achieved to seamlessly transition to project completion without gaps in the schedule, as much of the hardware loop validation is accomplished during System-Independent Loop Commissioning.</td>
</tr>
<tr>
<td><strong>8</strong></td>
<td>Marshalling cabinets are eliminated along with most termination points. The number of wiring terminations from each device to the control system is reduced from 20 or even more, to perhaps 5.</td>
</tr>
</tbody>
</table>
3.4.2 | RE-USE OF EXISTING INFRASTRUCTURE

In the case where the existing infrastructure is reused such as field homerun cables to IO rack rooms / control rooms, existing DCS/SIS could be replaced with new systems and marshalling cabinets. Yokogawa has migration toolkits to convert existing marshalling IO over to Yokogawa DCS or SIS. Existing rack rooms need to be checked for size to fit in the new cabinets and ensure UPS size is adequate.

OLD WIRING

Field devices and their supporting wiring are often sources of unhappy surprises. When old wiring is disturbed in the installation process, insulation can break and terminations may disconnect. While these types of problems are often easy to fix, they can take a lot time to troubleshoot, and the remedy may involve pulling more cable. Poorly functioning instrumentation also jumps out at this point, and dealing with an erratic pressure transmitter can cause a commissioning effort to stall or interrupt a unit restart.

<table>
<thead>
<tr>
<th>Typical Lifecycles of Different Automation Components (in Years)</th>
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<tbody>
<tr>
<td><strong>WIRING</strong></td>
</tr>
<tr>
<td><strong>IO PANELS</strong></td>
</tr>
<tr>
<td><strong>CONTROLLERS</strong></td>
</tr>
<tr>
<td><strong>WORKSTATIONS</strong></td>
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<tr>
<td><strong>MONITORS</strong></td>
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</table>
THE OBSOLESCENCE DILEMMA

“Users should factor in the lack of a deterministic character of end of life when considering key plant performance variables like safety, environmental, and asset utilization. It is what the industry calls the "obsolescence dilemma." (Source: Managing Obsolete Technologies: Strategies and Practices, ARC 2011)

According to ARC, a key factor complicating the obsolescence dilemma is that a typical automation system consists of many different components, each having very different expectations of service. For example, the displays used in older DCSs get a lot of use (and abuse), causing their life to be shorter than, for instance, copper field wiring.

At the same time, many plant owners realize that obsolescence alone cannot justify a large capital project. Enhanced functionality and system performance are major criteria and impact funding decisions.

But at many plant’s a clear strategy to deal with obsolescence is lacking. Instead, many plan on executing obsolescence projects during normal turnaround and shutdown periods for manufacturing assets.
THE OBSOLESCENCE DILEMMA

According to ARC, failure rate data for automation systems is not precise and supporting information can only get you in the range of actual failure rate experiences. Failure of electronic components is perhaps even harder to predict, particularly when viewed as replaceable parts in a system. In many cases, installation standards have a tremendous role in the longevity of assets. Equipment rack room standards, heating, cooling, and humidification cycles, combined with the presence or absence of corrosive materials, impact the life of electronic components. But even under extreme circumstances, many of these factors have not caused the demise of many older generation automation systems. (Source: Managing Obsolete Technologies: Strategies and Practices, ARC 2011)

In many plants users keep track of failures, but the failure analysis is not sufficiently done to help predict end of life accurately. By observing the theoretical “bathtub curve” (see figure on the right) chart of NASA, the question arises whether the bathtub curve actually exists. After all, for many automations systems, the time along the x-axis ends up in a range of between 15-50 years.

Automation engineering specialists across the manufacturing industries deal every day with the preciseness and deterministic repeatability of process control in a plant. However, the lack of preciseness for determining asset end of life leaves make decisions around this important area difficult. (Source: ARC 2011)

**Figure.** The ‘bathtub curve’ hazard function (blue, upper solid line) is a combination of a decreasing hazard of early failure (red dotted line) and an increasing hazard of wear-out failure (yellow dotted line), plus some constant hazard of random failure (green, lower solid line). This curve is widely used in reliability engineering and it describes a particular form of the hazard function.
3.4.3 | SYSTEM & SECURITY REQUIREMENTS

An effective, end-to-end cyber security approach delivers many advantages for plant owners, including increased business agility and risk awareness, lower cost of operations, and reduced downtime.

INTRODUCING SECURITY MEASURES

Overall system architecture and IT security requirements come into play. During the design of the new process control system, a plant owner needs to look at upgrading higher level systems that site above the process control systems and perform a risk analysis on cyber security threats/vulnerability.

Furthermore, the effects of introduced security measures gradually become less effective because security threats including new types of cyber-attacks increase. Therefore, continuous maintenance of security measures is required to maintain their effectiveness.

Figure. On the right Yokogawa’s support for the security activities of customers over the entire product lifecycle is represented, from product development, implementation of security measures during system integration to security management during operation. Owing to these activities considering the product lifecycle, customers can lower the security threat to an acceptable level at all times without incurring excessive costs.
OPERATION AND MAINTENANCE

In the operation phase, maintenance to keep the security measures effective is required – an approach that strives to implement and maintain security controls and processes that will help ensure a higher availability metric which will avoid project downtime, product deferment or loss, etc. *(Figure on the right)*

< It should be noted that this approach allows a centralized security view and point of control across the entire installed base. A Secured Remote Solution tunnels all activities allowing customer to maintain insight in the activities performed by third parties in their estate and the vendors to internal customer policies or regulatory compliance.

< It is recommended to implement a solution that consists of the delivery of OS patches and anti-virus pattern files for control systems and the provision of real time and proactive monitoring of solution delivery, as well as a help desk operation to manage this solution.

< Supplier-certified Windows security patches and virus signature files should be distributed at each plant via customer’s existing global network. If that’s the case, the real time and proactive monitoring capabilities enable the centralized management of plant security.

*Implementation & Management Services by Yokogawa and Cisco*

*Schematic overview of SecurePlant solution by Yokogawa*
### 3.4.4 | ADVANCED PROCESS CONTROL

**WHY IS APC IMPORTANT?**

Advanced Process Control (APC) is a proven control and optimization technology delivering measurable and sustainable improvements in production yield, coupled with the added value of energy savings. It is widely known in the industry that by stabilizing the process you can then maximize profit, but as the plant operation complexity increased requiring frequent feedstock/rate and product grade changes, we are reaching limits of human capacity whilst total numbers of operators are being reduced but they are expected to handle over 300 control loops.

APC is typically comprised of **MPC (Model Predictive Control)** or soft sensors (inferential property estimation) enabling more advanced stability and control by utilizing the multivariate analysis and estimated product properties in real-time (such as RON, RVP, Density, etc.)

**Multi-Variable Control (MVC)** is the key component of an APC system, that enables optimum process stabilization, resulting in increased productivity. MVC achieves this by predictive control using process dynamic models, which is proven to increase throughput, save energy, and reduce quality giveaway. As the MVC control strategies vary, our experienced APC engineers work closely with experts on the side of our customers to ensure successful and seamless implementation.
APC IMPLEMENTATION

Estimating production quality in real-time is essential in controlling product quality in MPC. Therefore, soft sensor (inferred property) modeling by historical process data and commissioning are conducted prior to, or in parallel, with the MPC design.

Step response testing is required to get dynamic response data for MPC modeling. After MPC modeling based on the dynamic response data and configuration based on the control strategy MPC simulation with static parameters are completed, tuning is then executed to confirm MPC behaviors. With tuning MPC dynamic parameters and soft sensor calibration parameters, commissioning is executed, and implementation is complete.

A stable base layer control is the first step towards achieving stability in your overall operation. Since MPC systems generally manipulate the set points of the targeted PID controller, it is important to tune PID parameters and introduce enhanced regulatory control prior to implementing MPC system.

Implementing soft sensor and MPC is the next step. Improving potential benefits, with reduced cost and efforts comparing with the final step of optimization (Ex. 2). Using prioritized constraints, MPC realizes optimization of control variables and economic formulas for both steady-state and static optimization objectives.

The last step - but certainly not the least - is implementing the first principle model-based real-time process optimization. Great efforts are required not only for defining rigorous static process models and setting data reconciliation, but for maintaining these models as well.

Note: Post audit is important. Measuring the control performance and controllability of key variables, with prior result being compared to results after APC introduction, will give a clearer understanding of the improvements and its benefits.
3.4.5 | OPERATOR EFFECTIVENESS

Research has shown that the largest reason for unscheduled downtime is operational or human error, which accounts for approximately 42% of the unscheduled shutdowns in the process industries. Luckily, with the adoption of new technologies (technologies for the future) there are ways to assist operators in making the right decisions at times of increased stress such as during the initial stages of operation or during abnormal conditions.

In this eBook the term operational effectiveness is divided into three pillars:

- Control Room Design
- Modular Procedural Automation
- Human Machine Interface
- Operator Training System
- Alarm Management

Together, the above four components or developments influence operator effectiveness.
CONTROL ROOM DESIGN

CONTROL ROOM UPGRADE

An appropriately designed control room will make people feel relaxed and secure. As a result, operators and managers can fully concentrate on plant operations and stability. Additionally, improvements in data integrity and data availability accelerate communication between units to optimize the total operation.

Biggest challenge with control rooms often is to create synergy and flow in control rooms. Human-centered design prioritizes safety, health, and comfort. All aspects of the work environment must be taken into consideration when designing control rooms. These aspects include operator comfort, ergonomics, safety, ease of communication, functionality, automation of systems, and business policy. Streamlining these aspects and creating a synergy through the layout and design of the control room is the key to achieving streamlined and safe operations.

CENTRAL CONTROL ROOM PHILOSOPHY

Move to a central control room philosophy to increase operator efficiencies and breadth of operator control, improve communications. Automate your procedures to help mitigate the risks of the aging workforce by automation of specific tasks in a project that typically requires manual intervention from operators.

Depending on the facility, once you have provided information such as the site plan, existing control room drawings, control room photos, and system configuration, an automation vendor will work with your team to develop a proposal containing the draft design, including conceptual designs, material selection and layout planning. If you are considering a grass-roots project, control room consolidation, or control system migration - then now is the time to visualize how the control room will be designed.
MODULAR PROCEDURAL AUTOMATION (MPA)

MPA is not new, nor is it some theoretical concept. It is all about automating specific tasks in a process that typically requires a lot of manual intervention from operators to avoid the problems that can originate in manual intervention.

INDUSTRIAL PROCEDURES

Many procedures in industrial plants are not documented properly. Most plants depend on the knowledge of those few skilled operators who know how procedures are to be performed, sometimes in accordance with documented instructions (assuming they exist), and sometimes following the “right way” in spite of what the instructions say. By relying on the knowledge of those skilled operators, plants may run into trouble when operators retire, a serious issue because of the aging workforce. Their retirements can create a skill gap. At the same time, because procedures aren’t documented properly, different operators may practice procedures differently.

Part of automating such procedures is determining the best practices and incorporating those approaches, so they will be followed consistently. MPA is a clear path to operational excellence in the process industries. It is like having your best operators all day, every day.

FREE YOKOGAWA eBook!

MODULAR PROCEDURAL AUTOMATION EBOOK

Download this eBook and learn how enhance production and safety through modular procedural automation.
OPERATOR TRAINING SYSTEM

Facing the challenge of many plant operators retiring - especially those who are familiar with efficient and safe operations - the early training of rookie operators and successful knowledge transfer from more experienced operators has become an important issue. The challenge is to prevent that inexperienced operators will not result in inefficient operations, and potential disasters.

Safe and efficient operations must be continuous; refreshing the skills of experienced operators is also necessary - increasing process knowledge and confidence prevents to the occurrence of a disaster, improves productivity, and efficiency.

SEEING INSTEAD OF READING

Humans are visual creatures who learn more by seeing how something works than by just reading about it. Further learning improvements result by actually performing the tasks at hand. Simulation training is vital for preventing incidents and accidents. It also improves process control, resulting in higher throughput and quality with less downtime. Maintenance is reduced because equipment is operated closer to specifications.

In addition to immediate costs, operator errors and subsequent incidences can result in fines or even jail time for plant managers in some industries. These occurrences can be minimized or eliminated with the right training plan and equipment, of which off-line process simulation is a key component.
## Benefits of Operator Simulation

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
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<tbody>
<tr>
<td>Provides the least expensive operator training method</td>
<td>The introduction of PC-based simulation into the process control industry made simulation training affordable. The PC hardware is inexpensive, and graphical programming methods created for the Windows operating system now enable plant personnel, instead of IT experts, to program and configure the simulator. Operators can now be trained on-site in smaller time blocks, instead of being sent to training classes at distant locations.</td>
</tr>
<tr>
<td>Improves quality of operator response and subsequent actions</td>
<td>The process simulator can create scenarios that depict actual unit operation problems. Common and unique events can be recreated so that the operators’ responses can be seen and recorded. Senior operators’ responses can be used to establish best practices for less experienced personnel. Once best practices are established, the training system can be used to measure improvement.</td>
</tr>
<tr>
<td>Improves operator response time to process upsets and incidents</td>
<td>A process simulator can be set up to quickly change process operating conditions. Snapshots of the process running in specific conditions can be taken for instruction. Perhaps one operator needs to practice changing product grades on a static state process, but another needs to work on unit startup. PC-based simulation allows easy implementation of these scenarios.</td>
</tr>
<tr>
<td>Offers the fastest practical operator training method, particularly for inexperienced personnel.</td>
<td>With fewer experienced operators available to train new operators, simulation training can provide invaluable instruction to fill the training gap. Simulators can be sped up or slowed down. For a process with a large amount of dead time, the simulator can be sped up to compensate for the delay. For training of inexperienced operators, actual process conditions can be slowed to build confidence, and then gradually sped up.</td>
</tr>
<tr>
<td>Helps meet regulatory requirements</td>
<td>In general, the higher the potential environmental and safety impact, the more oversight involved from government agencies, with corresponding increases in required training. Process simulation training provides the extensive instruction and detailed training records required to meet regulatory standards.</td>
</tr>
<tr>
<td>Can be a mitigating factor in an incident does occur</td>
<td>In addition to direct costs, operator errors and subsequent incidences can result in fines or even jail time for the plant managers in some industries. If an accident does occur, simulation training programs and related records can be a mitigating factor to show the plant took precautions and performed due diligence.</td>
</tr>
<tr>
<td>Often leads to process improvements including increased uptime, more throughput and higher quality</td>
<td>Taking training a step further, observation of operator actions can be used to better the actual process control programs and the HMI screen designs. This can further enhance operator actions, reducing the possibility of incidences and improving general plant operation and output quality.</td>
</tr>
</tbody>
</table>
Safe and efficient operations rely on operations staff being able to quickly identify potential process deviations before the situation reaches an unsafe or undesirable production condition.

Based on the experience and research at Yokogawa, we have identified that the root cause of this is not just in operator training, but it revolves around having an operations environment that is aligned with the operator mental model and work processes.

In order to improve plant safety and operators’ productivity, further modernization of existing HMIs in process control systems based on ergonomics and knowledge engineering becomes a global trend in recent years, that helps operators’ quick decision-making.

Yokogawa clearly understands customers’ challenges and has developed significant expertise in operations HMI development. Based on this existing expertise, Yokogawa has developed a standardized method for development of site specific HMI design guidelines and a collection of template graphic objects and standards that we are now offering globally.

Better situational awareness helps operators to more quickly recognize and act on abnormal events, which can be safety, quality, or equipment related. Better designs reduce operator distractions so that the operator can focus more time on control of the product quality and throughput. Improved contextualization of information also results in faster and better informed decision-making.

Advanced Operating Graphics (AOG) is a consulting service provided by Yokogawa to redesign PCS graphics based on human factors engineering and operations engineering. It is this combination production operations and human factors that ensures that the resulting design brings together the physical production process with the way operators visualize this in their mind.
ISA101 Global Standard: Established in 2006 to develop a standard, recommended practice and technical report regarding HMI design, implementation, operation and management of IA application.

The ISA101 HMI committee was formed to establish standards, recommended practices, and technical reports relating to Human-Machine Interfaces (HMIs) in manufacturing and processing applications. The forthcoming standard and accompanying technical reports are intended to help users understand the basic concepts as a way to more readily accept the style of HMI that the standard recommends. It is aimed at those responsible for designing, implementing, using, or managing HMI applications.

The standard defines the terminology and models to develop an HMI and the work processes recommended to effectively maintain it throughout its lifecycle.

Read more: ISA101 HMI Standard Nears Completion

HUMAN MACHINE INTERFACE BENEFITS

- Time shortening of monitoring cycle
- Time shortening of malfunction detection
- Prevention of mistaken judgment or maloperation
- Reduction of operators’ eyestrain or workload
- Inheritance of operation skills

CHALLENGES REGARDING HMI MANAGEMENT

- No standardized methodology for HMI management causes a problem of plant safety and working efficiency.
- A lack of consideration to ergonomic design causes a problem of longer monitoring period, later abnormality detection, false recognition, false judgment, eye strain, or higher operator workload.
- A lack of consideration to knowledge engineering has a bad influence to inheritance of operation knowledge.
- A lack of HMI specialists in end users makes them difficult to improve HMI performance by themselves.
ALARM MANAGEMENT

Plant operators are often faced with a high number of alarms and abnormal situations. They are therefore unable to respond quickly enough to prevent safety related incidents, environmental issues, shutdowns and equipment damage. In addition, a poorly applied alarm management philosophy may result in excessive alarms that can cause operators to routinely ignore these alarms due to the information overload.

ALARM OVERLOAD

Alarm overload is partially a result of formerly independent systems that are integrated for more effective operation by fewer operators, each operator then has to monitor an increasingly wider area and consequently deal with more alarms. Without rigorous alarm rationalization efforts, alarm flooding becomes a serious problem and increases the risk of safety and environmental incidents.

STANDARDS

There are a number of alarm management standards and guidelines such as ISA-18.2-2009, IEC 62682 and EEMUA 191 that help customers rationalize their alarm systems, but practical tools that can be implemented are still in short supply.

ALARM MANAGEMENT BENEFITS

- Identifying nuisance alarms
- Sequence of events aids decision making
- Integrated management of change and rationalization process
- Tighter control of approval workflows
- Enterprise deployment and access
- No more unaudited setpoint changes
- Suppressed and disabled alarms are reported
- Automated notification to relevant stakeholders
- Overall reduction in alarms, workload, operator uncertainty, operator errors, operator response time
- Supports a structured approach to alarm management through
- Provides a mechanism for change control
- Enhances operator response through

OVERALL REDUCTION IN:

- alarms, workload, operator uncertainty, operator errors, operator response time
Chapter 3 | Successful Modernization

3.5 | Different Scenarios: Upgrades, Migrations, and Replacements

The challenge of a plant modernization project compared to a brown- or green-field project is that the sequence of construction must be very tightly controlled. In most cases a reinstumentation project must work within a limited shutdown window. Unlike a grassroots project where you have more flexibility, the reinstumentation project also has to deal with construction in a running plant with all the hazards and limitations that this entails. We shall now discuss the different scenarios of modernization.

After conducting a proper field survey, creating the system and product architecture diagrams, and after the project scope has been defined, it is equally important to think about the different scenarios in which modernization can be executed. In a simplified form, there are three main categories to consider:

1. **Step-by-Step DCS and/or SIS Upgrade**
2. **Migration (Control System, SIS)**
3. **Field Instrument Replacement**
For most companies, the thought of doing a rip-and-replace with a complete gutting of the existing DCS is mind-boggling. Since what we think of as a DCS is really a conglomeration of smaller systems connected to a central processing core, parts of the sub-system structure can likely be left in place. For example, most migration projects reuse existing field wiring for the most part. The question is where to draw the line. What parts should be kept, and what parts need to go. Here are some possible scenarios.

**UPDATE (maintain)**

Improve existing software to a newer revision designed for error correction and/or minor functional improvements. It is called patch management.

**UPGRADE**

Improve existing software and firmware to a newer version with enhanced functionality.

**MIGRATE**

Replace component (e.g. I/O cards / HMI) with a functionally similar component from current supplier.

**REPLACE**

Remove current system entirely (or partially) and fit new system. Continuity with current supplier is not necessarily implied.
Step-by-step upgrade means the component base upgrade unlike full system upgrade. For example, HMI is upgraded one by one without stopping controllers. Another example is to replace one controller which controls a particular area without stopping other controllers. The large benefit of step-by-step upgrade is to minimize the loss of production time and to mitigate the risk of total production stop. Upgrade schedule can be decided based on the customer’s production/maintenance schedule and budget.

The key technology to achieve above is the capability that the existing hardware and new hardware coexist in a system, and work together. CENTUM VP HIS can access the existing CENTUM controllers with similar operation manner to controller of CENTUM VP.

Also the components of CENTUM VP and those of the previous CENTUM series can be in the same system. So the HMIs of the existing previous CENTUM systems can be replaced with CENTUM VP HIS with leaving the existing controllers, and also the controllers can be replaced with CENTUM VP controller one by one.
Yokogawa developed a comprehensive system migration strategy that addresses competitor systems. Yokogawa’s consultative “value-added migration process” is a multiphase approach. In addition to system migration solution, it also consists of a feasibility study and site survey that analyzes the gap between targeted and actual results, identifies bottlenecks, proposes practical countermeasures, and estimates the resulting improvement in profit by using Yokogawa systems and solutions. Yokogawa specialists are involved in all phases of this process.

Yokogawa has developed the necessary migration solutions to enable many legacy controllers and process interface units to be replaced by CENTUM VP I/O and controllers, utilizing special marshalling panels and adapter cables that connect to the existing terminal panels of the legacy system.

Yokogawa has experience in more than 400 third-party system migration projects including Honeywell, ABB, Emerson, Invensys, Siemens, and Yamatake, and can also serve as the main contractor, providing a turnkey legacy system migration solution. Yokogawa can effectively handle both hot and cold cutovers.

Yokogawa also developed various database conversion tools which can convert software engineering information of third-party system to CENTUM VP engineering database. Based on Yokogawa’s project experience, up to 20% of engineering cost can be saved by utilizing conversion tools.
SCENARIO 3: FIELD INSTRUMENT REPLACEMENT

Field instruments (transmitters and actuators) represent a substantial share of investment costs in automation. Today’s digital smart process automation systems and the connect field instruments can do far more than what legacy systems or products are capable of, and this should be taken advantage of as we modernize our plants. As already pointed out, time must be invested upfront in the planning and design of a plant modernization to review the control schemes, revise and improve them, decide on how to best to implement and advance control techniques to employ, and deploy the latest technologies that are being invested on.

TRULY EMBEDDED AUTOMATION

If you are planning a modernization project, you should consider the amount of truly embedded automation you are implementing in the new system from the perspective of the process automation system and your instrumentation assets, including:

- process field transmitter,
- I/Ps on control valves, I/Ps positioners, and analyzers.

It is possible for users to combine simple devices such as level switches with more advanced fieldbus devices to create a more effective control solution. In fact, this practical approach is the basis of what many in the industry are calling the digital transformation of the process industry.

CHALLENGES FOR THE PLANT USERS

Upgrades to the device description files often cause major challenges for the plant users:

1. An un-repairable device is replaced, so that a mixed version landscape can develop over time. Has it been ensured that a new driver version supports both new and older device versions?

2. Does the new driver/device description still fit the engineering system, the control system in use or the Asset Management System? Is compatibility guaranteed?

3. Who ensures that the driver will also still work in future versions of the control system?

4. What are the upgrade possibilities if the user does not wish to use the new functions of the new software driver/device description?
INTELLIGENT FIELD INSTRUMENTS AND ANALYZERS | PREDICTIVE MAINTENANCE

Intelligent field instruments and process analyzers accumulate diverse field information including process values and diagnostic results. This data needs to be sent to upper systems such as Distributed Control Systems (DCS) via digital communications such as FOUNDATION Fieldbus and analyzer buses, or hybrid communications such as HART and Brain, and visualized to enable the customer to utilize them for plant operations and (predictive) maintenance.

Intelligent self-diagnosis functions of analyzers have been enhanced to ensure the reliability of measurements and minimize maintenance. These self-diagnosis functions include not only simple failure diagnosis but also those that transmit preventive and predictive maintenance information. Because the deterioration diagnosis, replacement prediction of sensors, etc. are influenced by their installation environment, operating information from the field is indispensable to improve the accuracy of prediction.

SOME TOPICS TO CONSIDER ARE:

- What field communications technologies are to be used? Analog 4-20 mA? If so, is HART capabilities required? Foundation Fieldbus, especially if it is a pneumatic replacement (yes, there are those still out there ...)
- Do you retain your field marshalling or use modern electronics marshaling?
- Can wireless play role? From field measurement to plant wireless enabling mobile worker, asset tracking etc.?
- Process historian upgrade
- Alarm management and rationalization
- Predictive diagnostics and plant asset management
- Improve process safety features
SUMMARY
Recommendations
New projects are becoming increasingly geared towards modernizing their processing plants. There are very few green-field plants (a new plant built on virgin ground) or brown-field plants (a new plant project within an existing facility that usually requires some demolition or remediation.) Instead, modernization projects tend to lean towards a mixture of new work with modifications to existing facilities. The challenge is to keep production downtime to an absolute minimum.

A modernization or reinstrumentation project of any size is a daunting task. The project goal is to add years to the lifetime of the facility, while minimizing production stoppages, and to ensure that safety, health and environmental issues are all addressed. Timing and scope are constant challenges. Generally a change in scope on a reinstrumentation project impacts the schedule to an extent not experienced on a green-field project.

If reinstrumentation becomes necessary – whether due to technological, economical or operational reasons, the key of such a projects must be an objective look at the condition of the existing plant. The findings must be documented and organized in such a way that they cannot be refuted and can be readily accessed by the project team and others throughout the project.
OTHER PUBLICATIONS

MODULAR PROCEDURAL AUTOMATION
Download this eBook and learn how Procedural Automation can make your operations safer and more efficient.

AGILE PROJECT EXECUTION EBOOK
Download this eBook and learn how to decrease industrial automation project times.

COMBUSTION & FIRED HEATERS
Download this eBook and learn about an innovative analytical approach to improving safe & efficient fired heater operations.
THANKS FOR READING THIS EBOOK!

Are you interested in a free consultation about plant reinstrumentation or control improvements? Find out how Yokogawa can help you with your upcoming project. Sign up for a free consultation!

CLICK HERE For a Free Consultation

THE ROAD TO SUCCESSFUL PLANT MODERNIZATION
Obsolescence, Regulatory, Operational, and Other Key Considerations

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ABOUT YOKOGAWA

Yokogawa’s global network of 88 companies spans 56 countries. Founded in 1915, the US$3.5 billion conducts cutting-edge research and innovation. Yokogawa is engaged in the industrial automation and control (IA), test and measurement, other business segments.

The IA segment plays a vital role in a wide range of industries including oil, chemicals, natural gas, power, iron and steel, pulp and paper, pharmaceuticals, and food.