ARC WHITE PAPER

By ARC Advisory Group

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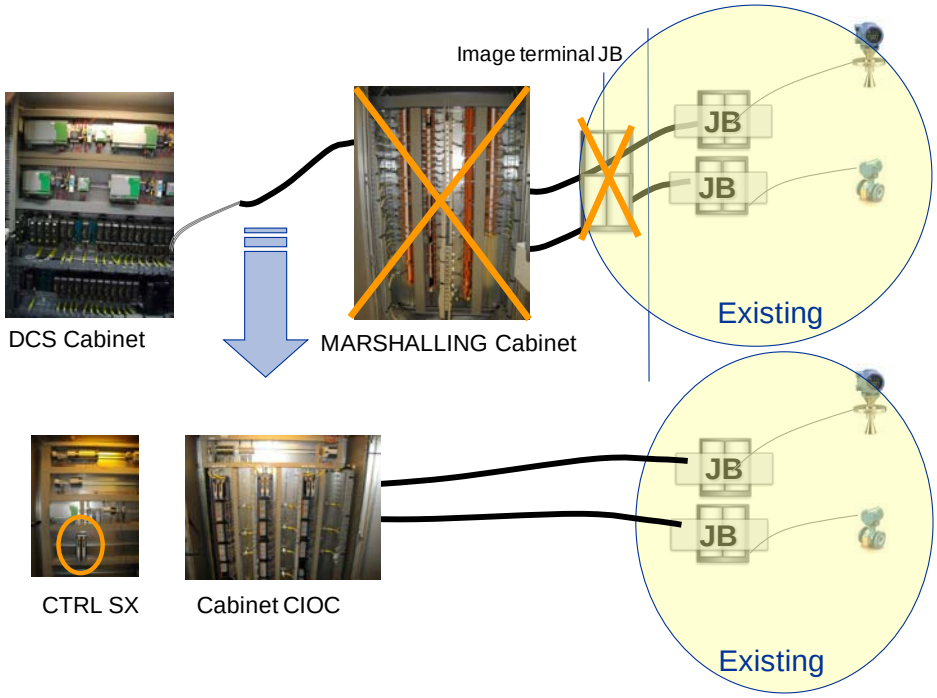
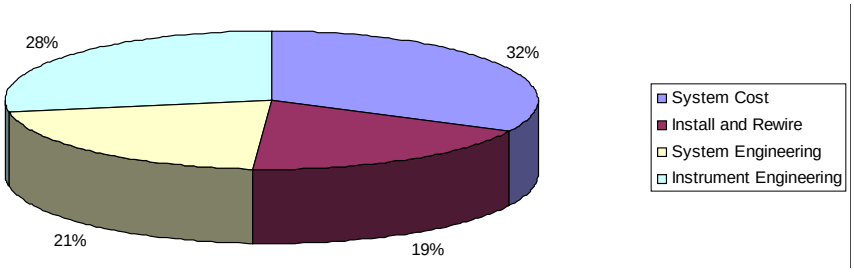
Solvay's Migration Path to DeltaV Version 11



DeltaV Version 11 Eliminates a Huge Portion of Wiring and Related Infrastructure that adds no Value



The Cost of the System Itself Typically Represents only a Third of the Installed Cost

Executive Summary

One of the biggest challenges facing end users today is the management of their installed base of process automation systems. Meanwhile, the state of DCS hardware has not changed in any significant way in the past 20 years. End users do not want to replace their installed base of systems with functional replacements that are almost an exact copy of the old system in terms of functionality and architecture.

Solvay is one company that has selected DeltaV Version 11 and CHARMs as a solution for both its pilot plant operations and critical control processes.

Project justification today is extraordinarily difficult, and any system being replaced is going to have to provide a superior business value proposition, which means lower installed cost, lower lifecycle cost, and increased agility and ability to take advantage of rapidly emerging business opportunities. End users are also under increased pressure to reduce downtime, both planned and unplanned. Control system migration usually requires the control system and the process to be shut down, and is typically conducted during scheduled maintenance turnarounds. If you are working on a new project, you must reduce cost and make sure the plant starts up on time with a minimal amount of fuss.

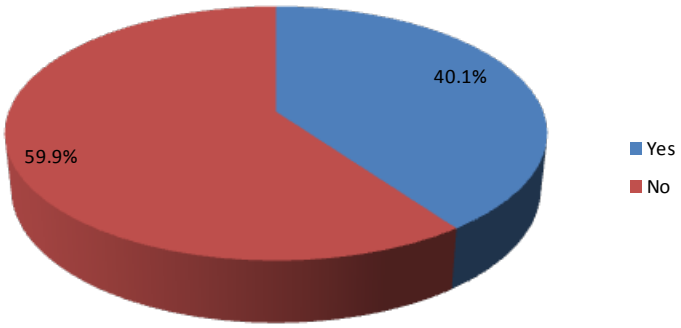
With its DeltaV Version 11 process automation system, Emerson Process Management has taken some big steps to address these project and lifecycle related issues. With a completely redesigned hardware architecture using the guiding principles of Human Centered Design, Emerson has morphed conventional DCS I/O into a completely modular format for each individual channel that features Characterization Modules (CHARMs), which can be configured for any point in a location independent manner. DeltaV Version 11 eliminates the need for terminal blocks and much of the additional wiring and cabinet space associated with conventional DCSs. This also reduces the labor cost of installing all that wiring and termination. Time to startup is also improved due to the reduced hardware content and workload.

Solvay Chemical is a world leader in the specialty polymers market as well as the world's largest supplier of key chemicals like hydrogen peroxide and soda ash. Solvay is one company that has selected DeltaV Version 11 and CHARMs as a solution for both its pilot plant operations and critical control processes. Currently, the company has already deployed one DeltaV Version 11 system at a pilot plant in its largest facility in Tavaux, France, with

another one planned to control the Tavaux plant's IXOL production process.

Project Pressures Increase Across the Plant Lifecycle

When it comes to doing any automation related project, end users are under more pressure than they have been at any point in history. The global recession, increased regulatory pressures, reduction in experienced personnel, concern for sustainability, and a drive to Operational Excellence (OpX) are all placing end users under more pressure to get projects done quickly, with minimal downtime, with the fastest time to startup and operational readiness. While the process automation market has always been averse to capital spending, the situation is even more constrained now, requiring an even stronger value proposition and justification for projects than in the past. Justification becomes even harder when many of these systems continue to operate reliably. A recent ARC survey on process automation lifecycle management shows that end of life for a system is not enough by itself to justify its replacement. Most plants use their systems well beyond the end of life date announced by the supplier.



Is Obsolescence of the Control System Sufficient Justification for a Control System Upgrade Project, Even if the System Continues to Operate Reliably?

The Migration Mess

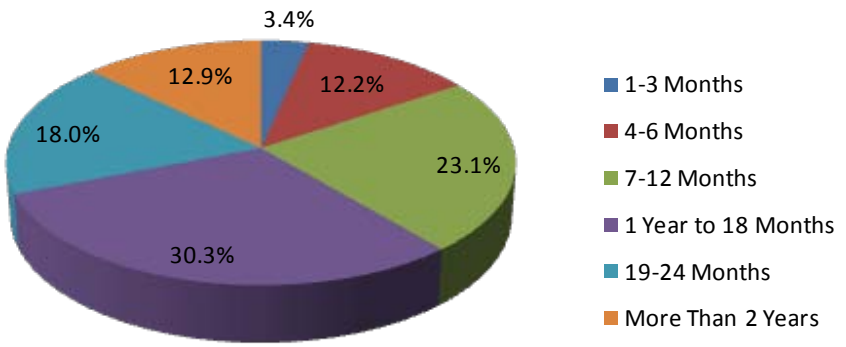
Modernizing the installed base of process automation systems is a huge challenge. ARC's research on the installed base of process automation systems worldwide shows that over $65 billion of process automation systems are approaching or have reached the end of their useful life. The installed base of systems 20 years or older is $53 billion. The dynamics of the market for control system migration have changed. The recession has significantly curbed capital spending in the process automation end user business. While this market has always been averse to capital spending, the situation

is even more constrained now, requiring an even stronger value proposition and justification for migration projects than in the past.

New Projects: Bigger, Better, Faster

Accurately forecasting project costs for the process industries is becoming increasingly difficult. Even in the wake of the current economic crisis, capital costs continue to soar, particularly in the process industries. Booming capital expenditure in developing economies, such as China and India, has given way to an environment of uncertainty and unpredictability due to the global economic meltdown. Companies must work harder than ever to reduce risk and provide some level of predictability for the capital projects that are still underway.

The trend toward larger mega projects — into the tens of billions of dollars — brings a completely new level of complexity. There are also the issues of operational costs, lifecycle costs, and plant performance. For the end user, the project is only the beginning. How many plants do you know that started up on time and running at full capacity? Many plants today are taking too long to commission. Decisions made in the early stages of the project have an impact throughout the plant lifecycle. The cost of the system itself typically accounts for only a third of the total installed cost. The installation and rewiring costs can reach close to 20 percent of the installed cost. System and instrument engineering can account for half the installed cost.



A Recent ARC Survey Shows that Modernization Projects can Typically Take a Year to Eighteen Months to Complete

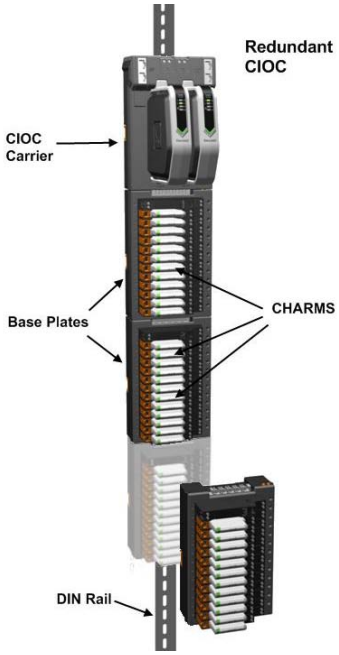
DeltaV Version 11: Rethinking the DCS

Whether you are doing a modernization or grassroots project, projects cost remain much higher than just a few years ago. Change orders continue to be a costly problem, and EPCs and design engineers always wait until the

last possible moment to hand over the system design. This means that a lot of redesign is typically necessary in an automation project, and this redesign often must be done in the field. The design of conventional I/O does not have the flexibility to accept design changes late in the project. The ability to be less specific in the engineering and design phase can save a lot of money, allowing the user to design up to 90 percent accuracy and then make final decisions and design changes at startup. The system should also be built around Human Centered Design principles, so it works the way that people work. This is the overall concept behind Emerson's DeltaV Version 11.

I/O on Demand

A lot of wiring in place today in process plants probably doesn't need to be. The potential for reducing this wiring, I/O, and other hardware components and the labor costs associated with it is tremendous. Emerson has addressed this issue with its "I/O on Demand" concept, released along with Version 11 of the DeltaV process automation system at the Emerson Global Users Exchange 2009. The I/O on Demand concept offers a wide range of I/O options to address any user requirement, from wireless devices to fieldbus systems, electronic marshalling, field-mounted I/O, and conventional I/O.



Emerson Electronic Marshalling

ARC's key recommendation for users undergoing control system migration projects is to avoid doing a "functional replacement," that is, swapping the old technology for the exact same functionality in the new system. Any new technology solution should provide more functionality and a better value proposition. This is just as true for I/O as it is for the entire DCS. In fact, it is becoming next to impossible for end users to justify automation upgrade projects on a functional replacement of I/O.

I/O Options in DeltaV Version 11

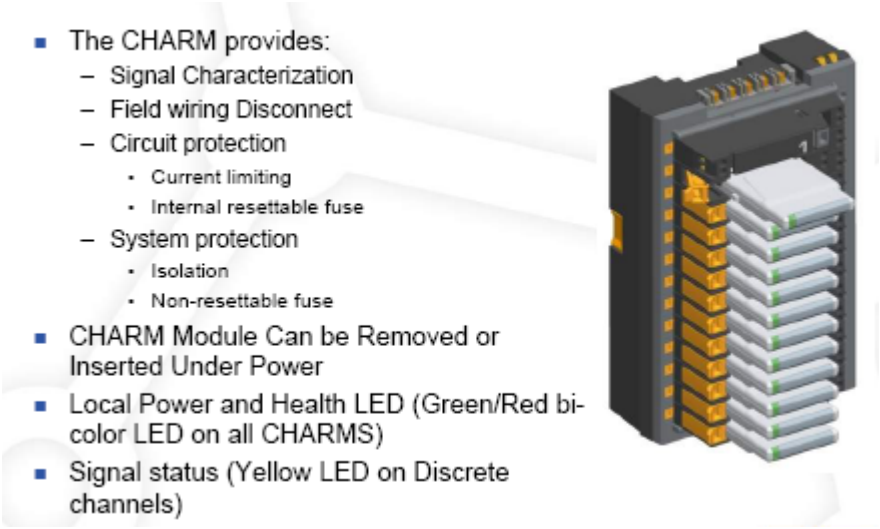
I/O options for the new DeltaV automation system Version 11 include DeltaV S-Series I/O, Electronic Marshalling techniques, Foundation Fieldbus,

and Wireless HART I/O. In addition, Emerson still supports original DeltaV M Series I/O.

Electronic Marshalling

The DeltaV system's new Electronic Marshalling concept, according to Emerson, has the potential to eliminate thousands of hours of landing I/O. Instead, users add I/O as they need it, one point at a time. This is done with CHARacterization Modules, or CHARMs, which turn the idea of conventional I/O on its head.

Instead of conventional wiring landing at a terminal block, wired to I/O modules, which are then wired to controllers – the wiring is connected directly to a DeltaV electronic marshalling rack. CHARM modules are attached onto this continuous rail. CHARMs can then be characterized however you want them to be and plugged into the rack. Location on the rack is unimportant. In an I/O on Demand system, field wiring can be landed to terminal blocks in any order. The installer snaps in the appropriate CHARM module at each I/O point; the CHARM module then electronically marshals the I/O to the proper controller via an Ethernet backbone. There is no need for users to wire I/O to a specific controller or I/O cards. Later changes can be accommodated by landing the new I/O and plugging in a new CHARM module.



Emerson Delta V Version 11 CHARMs Provide a Completely Modular Approach to I/O

The uniqueness this solution is that you can put any type of point on the CHARM, and plug it in anywhere in the CHARM module. This also makes it possible for any point in the system to talk to any controller in the system. The CHARM is essentially "free formatting" for the card. This frees users from having to rewire, significantly reducing the overall level of wiring required for a control system. According to Emerson, this can result in a 50 percent reduction in controller cabinets, a 40 percent reduction in cabinet footprint, and a 90 percent reduction in intra-cabinet wiring.

In ARC's view, the significant cost associated with traditional marshalling methods can limit the changes possible in the engineering and design of the system. The new I/O on Demand capability of Emerson's DeltaV S-series allows users to add or change I/O types whenever they make project design changes, no matter where the I/O is located. This reduces project costs and, even more importantly, reduces time to startup.

Solvay's Critical Approach to DeltaV Version 11

Of course, talking about the benefits of a system is one thing and actually seeing results proven in the field is another. Solvay chemical is one of Emerson Process Management's largest customers, and one of the first to install the DeltaV Version 11 system.

Tavaux is Solvay's Largest Plant and one of the Largest Chemical Plants in France

Solvay is an international chemistry group with headquarters in Brussels, Belgium. The Group employs more than 19,000 people in 50 countries. In 2009, its consolidated sales reached 8.5 billion Euros. Solvay's two primary businesses are chemicals and plastics. The company is the world's largest manufacturer of chemicals such as hydrogen peroxide and soda ash, and is among the world leaders in the market for specialty polymers.

Tavaux: Solvay's Largest Facility

Established in 1930, the Tavaux plant, in the Franche-Comté region of eastern France, is the largest chemical production site in the Solvay group, producing 1.2 million tons per year of multiple products. Tavaux also has its own research and development facility. The Tavaux plant makes both chemicals and plastics. Chemicals are synthesized from salt extracted from the groundwater, which is put through an electrolysis process to create chemicals such as chlorine, hydrogen, and sodium hypochloride. These chemicals are also used as feedstock for plastics produced at the plant, including PVC and the specialty plastics PVDC and PVDF. Ethylene is

provided through a long distance pipeline operated by Total. The plant produces 300,000 tonnes of PVC annually in addition to 55,000 tonnes of PVDC. PVDC is used for applications such as pharmaceutical packaging, providing a barrier to gases and flavors.

Solvay Relationship with Emerson

Like many end users, several years ago Solvay Tavaux found itself with a large and diverse installed base from multiple suppliers. The company had conventional DCSs, PLCs, relay-based systems, pneumatic systems, and more. In 2005, the Tavaux plant decided to limit its number of DCS suppliers to two. Emerson became one of those strategic suppliers after they evaluated the DeltaV process automation system.

After forming its relationship with Emerson, Solvay Tavaux embarked on an ambitious migration program. Many of their systems had reached the end of their useful life, and since 2005 the company has modernized approximately 15,000 I/O points in its plant out of a total of 45,000 I/O on site. There are some expansion projects going on in parallel, and the plant still plans to modernize another 10,000 I/O in the near future. Around 5,000 will be modernized this year, while the rest will be modernized over the next three years. Tavaux now has 18 DeltaV systems installed at the site in addition to two Provox systems. Tavaux is also a big user of Emerson's AMS plant asset management application, intelligent HART devices, and DeltaV SIS safety systems.

The Beta Test

Solvay became aware of DeltaV Version 11 in 2009 and wished to conduct a beta test of the system with an eye toward using it in future modernization projects. The company received a test system for this project in March of 2010. Solvay then tested Emerson and third party field devices with the system, including HART, 4-20 mA analog, and digital inputs and outputs, pulse inputs from Micro Motion Coriolis meters, and 24VDC outputs to a solenoid valve. The test program involved two people from Solvay, including a DeltaV systems expert and an instrumentation engineer. Technical coordination was done with Emerson's Austin-based research and development experts. Solvay also verified compatibility of DeltaV Version 11 with installed DeltaV SIS safety systems.

The test program was completed in just nine days, and the focus was kept on understanding the installation processes, which allowed Solvay to develop best practices for project execution using CHARMs I/O. With the test successfully completed, Solvay Tavaux was confident that the new I/O system would be compatible with the existing field devices (including devices from third party suppliers) and with their wiring requirements. The beta test also validated that it would be possible to reduce the number of system cabinets needed for future projects significantly. Solvay also liked the labeling feature of the system, which identifies each signal/channel with a text that fits over the terminals of the CHARM module. Based on the test results, Solvay Tavaux produced an internal document outlining the best practices for CHARM I/O installation and wiring.

The DeltaV Version 11 Beta System Undergoing Testing at Solvay

Deploying DeltaV Version 11 in the Pilot Lab

After a successful beta test, Solvay Tavaux decided it was time to take the next step and deploy a DeltaV Version 11 system in their plant. The location for the first system would be a pilot plant. The previous system used was an old Texas Instruments PLC-based system with a third party HMI.

The DeltaV Version 11 system was delivered in June of 2010. Space was a concern for the system, with the system cabinet occupying a hallway outside of the lab. The system consists of one controller with 200 CHARMs I/O. Solvay preferred to do their own software engineering for this project, which they did in June and July. The commissioning and qualification work was done in August. As of mid-September, the unit has been fully ready to operate.

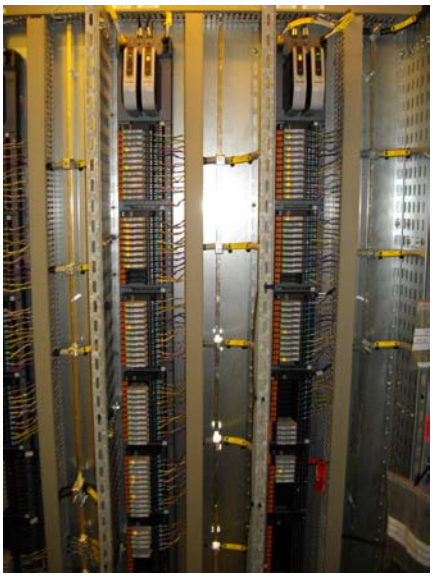
Significant Space Reductions and Flexibility

Solvay personnel noted that the DeltaV Version 11 system takes up half as much room as a "classical" DCS with the associated wiring. Twice as many cabinets would have been needed for a convention system, which would

have been difficult given the space constraints. Solvay was able to eliminate the marshalling cabinet and the associated wiring and design entirely, as well as the terminal junction box. Solvay also noted that the CHARMs architecture made it easier to add controllers and processing power because they are totally separate from the I/O. As you can also see in the photo, there are many open slots that are currently not being used but provide for later expansion to the system.

Simplifying Management of Change and Reducing Change Orders

Another key benefit reported by Solvay Tavaux with the DeltaV Version 11 system and CHARMs is greatly simplified management of change. Solvay reports that it is easier to define what hardware is required for the system, and the overall design is simplified. This allowed Solvay to define the hardware required more accurately and made it easier to assign additional signals where they were needed. In past project, Solvay noted that there was always 5 percent extra that always had to be added because of change orders, wrong estimations, and other problems. With CHARMs, the definition of the I/O was the same throughout the project.



DeltaV Version 11 System Installed at the Plastics Lab

Faster Time to Startup, Reduced Turnaround Time

Another key benefit noted by Solvay in its deployment of DeltaV Version 11 is reduced engineering effort. Solvay still does all of its own engineering in house, so reducing this effort is tantamount to reducing cost for the company. The reduced engineering effort also means fast startup time and reduced downtime. This will become increasingly important as Solvay continues to focus on fast turnarounds for its planned migration projects. Currently, planned shutdown times for migration projects are only two weeks, which requires a lot of up front planning and precise execution.

Plans for DeltaV Version 11 in Critical Production Applications

With successful implementation of the lab system, Solvay is planning to deploy DeltaV Version 11 in its critical production processes. One of the first applications is the Tavaux plant's IXOL production process. IXOL is a rigid polyurethane foam that is also flame retardant and is used in construction applications. The current system controlling the process is an old Hartmann and Braun Contronic system with around 1,300 I/O, including the safety instrumented system. The unit is scheduled for startup in March of 2011.

DeltaV Version 11 Controller Cabinet Shows Dramatically Reduced Hardware Footprint

Space Savings are Paramount for Upgrade Projects

Space savings and decreased turnaround time associated with CHARMs and electronic marshalling technology are major reasons for choosing DeltaV Version 11 for this project. Technical rooms are already cramped places, and the new system must be installed in parallel with the old system until the old system can be decommissioned. DeltaV Version 11 and the CHARMs architecture takes up significantly less space. CHARMs can also be mounted in field junction boxes to further save on space. Aside from these concerns, however, there are several other factors that had a major influence on Solvay's decision.

HART and AMS integration

With the total number of devices at the plant increasing to 15,000, with over 20 percent of these being complex instruments, Solvay views AMS plant asset management suite of applications as a valuable tool. It has a large installed base of HART devices and intelligent valve positioners, and they find AMS to be particularly useful for installation and commissioning applications, both for instruments in basic process control applications and safety instrumented systems.

Emerson's AMS Suite enabled Solvay to create a complete database of device information in less than one day. It has also enabled the number of sophisticated and powerful instruments and valves being managed on site

to be increased significantly without increasing staffing levels. Maintenance staff now use AMS Suite to manage the calibration of devices, and document and trend the calibration information.

Solvay is also using Emerson's AMS ValveLink application to AMS Device Manager to monitor control valves fitted with Fisher FIELDVUE DVC6000 digital valve controllers, which enable a partial stroke test to be performed every month without shutting the plant down or bypassing the valve. Partial stroke testing enables higher reliability of the valve and reduces manpower required for full testing. This procedure already successfully detected an anomaly on a valve that is critical for the unit, allowing them to fix the issue before there was a plant upset.

I/O on Ethernet is an Advantage

Solvay sees value in adopting standard networks such as Ethernet. The fact that CHARMs I/O sits directly on an Ethernet backbone was viewed by Solvay as an advantage. The Ethernet architecture combined with the modular CHARMs approach allows Solvay the flexibility to assign an I/O point to the controller they want, so they can make optimum use of controller processing resources. In the past, the company has had to add controllers to accommodate for this lack of flexibility found in earlier generation systems.

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ARC concurs with this assessment. Ethernet's increasingly compelling value proposition in the areas of technological commonality, vertical integration, and global ubiquity is one of the most significant changes in automation. Ethernet can greatly enhance the data gathering from the plant floor. This becomes especially useful if the data is effectively evaluated using applications such as plant asset management (PAM). In the past, the benefits of physical layer commonality were often overwhelmed by Ethernet's lack of real-time performance and determinism, use of a non bus-based architecture, higher incremental costs, and overall complexity when used in machine control and other device network applications, but these shortcomings have since been overcome.

Avoiding Unplanned Downtime, Achieving Higher Availability

Unplanned downtime is one of the primary enemies of the process industries. A single unplanned downtime incident can wipe out the profitability of an entire plant for the year. The average impact of unplanned downtime accounts for roughly five percent of all production in the process industries.

Solvay sees advantages related to avoiding unplanned downtime. Sometimes, the indirect costs involved with avoiding shutdowns or reducing turnaround times are more important than direct and measurable cost reductions in hardware. In the case of Solvay, they are trying to drive their downtime related to migration projects down to two weeks. After two weeks, they can start losing money. The first week of the project is usually dedicated to the wiring and related tasks, with the second week dedicated to FAT and SAT.

Benefits:
No need for data mapping
Single set of engineering tools
Significant reduction in integration efforts
Lower life-cycle cost
Challenges:
Putting hardware and software barriers between safety and control systems
Ensuring proper access protections
Ensuring visual differentiation between control and safety environments

Benefits and Challenges: Integration of Safety and Control Systems

Solvay Tavaux also feels that DeltaV Version 11 provides better availability because if something does go wrong with a CHARM module, only the module itself is affected. In a conventional I/O module with multiple channels, the entire module can be affected and it can cause a process upset.

Integrated Safety is Important

Solvay Tavaux is a big user of DeltaV SIS systems and is understandably a big proponent of integrated control and safety systems. The company has a mandate to improve its safety culture and become compliant with the IEC 61511 and 61508 standards. There are also multiple layers of safety regulations and directives to adhere to. In Europe, there are local safety regulations such as the Seveso II Directive. Named after a disastrous release of Dioxin at a chemical plant in Sevezo, Italy in 1976, the Seveso II Directive applies to thousands of industrial establishments where dangerous substances are present in quantities exceeding the thresholds in the directive. The company also has its own internal rules governing process safety.

As part of the IEC 61511 standard, Solvay Tavaux now conducts HAZOP analysis in their plant to determine the SIL requirements for their safety instrumented systems. All relay based safety systems are being replaced

with modern process safety systems that are based on IEC 61508 certified technology. DeltaV SIS is one of the approved safety systems that is installed throughout the plant. The common visualization tools, intelligent SIS device diagnostic data, and common networking technology of DeltaV SIS and DeltaV Version 11 provide an integrated engineering, maintenance and operation environment with separate control and safety hardware. This functionality enables Solvay to address their regulatory requirements more effectively.

Having a separate, non-integrated safety system increases lifecycle costs, particularly in the areas of spare parts, support, training, maintenance, and service. The interfaces between the two systems are engineering-intensive and expensive to maintain and synchronize. Using an integrated control and safety system like DeltaV and DeltaV SIS eliminates the complexity associated with mapping of data between separate systems and maintaining the interfaces between two separate control and safety platforms. Other financial benefits include reduced hardware, configuration, training, and inventory costs. The burden of servicing and supporting disparate systems is also reduced.

Conclusions and Recommendations

Solvay's experience with DeltaV Version 11 shows that it is real, it is installed in the field, and it works. The real cost benefits, of course, will be realized during full production applications. Solvay expects to reduce unplanned downtime through DeltaV Version 11, both in terms of reduced project execution time and higher reliability control. The company also expects some significant space savings.

Today, I/O accounts for almost 30 percent of all DCS hardware sales. The installed cost is even greater. I/O on demand represents an opportunity to reduce these costs.

The system also enhances and complements other initiatives at the plant, such as integrated control and safety instrumented systems, plant asset management systems, and intelligent devices. Since they do their own engineering, it is important to Solvay that their team be able to adapt quickly to the new technology offered in DeltaV Version 11, and the company reports that plant personnel have picked up very quickly on the concepts of CHARMs and electronic marshalling.

While I/O on demand, particularly electronic marshalling, offers considerable advantages for new projects due to the ability to save on wiring and cabinet space, ARC also believes DeltaV Version 11 offers a migration path for legacy systems that provides users with the option to avoid a functional replacement of their existing I/O. DeltaV Version 11 collapses the hardware architecture of the DCS in the same way that functional layers in the DCS have collapsed to include production management applications and ERP system integration.

Solvay is a company that likes to evaluate new technologies and is willing to be an early adopter if they feel there is a business value proposition associated with it. Its close strategic relationship with Emerson and its willingness to be a beta tester for DeltaV Version 11 meant that it was able to realize the benefits of the system all that much faster. The beta test combined with the experience of deploying DeltaV Version 11 in the pilot lab allowed Solvay to develop a good set of best practices for system wiring and engineering to be used in future projects. ARC believes that having a close strategic partnership with your key automation suppliers is key to realizing the economic benefits of process automation and to guide future product development.

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Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/Research/IndustryTerms/

API Application Program Interface
B2B Business-to-Business
BPM Business Process Management
CAGR Compound Annual Growth Rate
CAS Collaborative Automation System
CHARM Characterization Module
CPG Consumer Packaged Goods
CPM Collaborative Production Management
CRM Customer Relationship Management
DCS Distributed Control System
DOM Design, Operate, Maintain
EAM Enterprise Asset Management
ERP Enterprise Resource Planning
HAZOP: Hazard and Operability Study
HMI Human Machine Interface
IEC International Electrotechnical Commission
ISA International Society of Automation
MPA Modular Procedural Automation
OpX Operational Excellence
OEE Operational Equipment Effectiveness
OLE Object Linking & Embedding
OPC OLE for Process Control
PAM Plant Asset Management
PLC Programmable Logic Controller
ROA Return on Assets
RPM Real-time Performance Management
SIS Safety Instrumented System
SHE Safety, Health and Environment

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