ARC WHITE PAPER

By ARC Advisory Group

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Emerson's Flexible Approach to Control System Migration

Company	Platform	DeltaV Connect	Serial Interface	OPC Interface	I/O Bus Interface	FlexConnect
ABB	INFI/NET 90	√	√	√	X	√
ABB	MOD 300	C	√	√	√	√
Emerson	PROVOX	√	√	√	√	√
Emerson	RS3	√	√	√	√	√
Honeywell	TDC2000	X	√	√	X	√
Honeywell	TDC2000/3000	√	√	√	X	√
Invensys	I/A	C	√	√	X	C
GSE	D3	X	√	?	√	√
Siemens	APACS	√	√	√	X	√
Siemens	QUADLOG	√	√	√	X	C
Yokogawa	Centum CS 3000	?	√	√	X	C
Yokogawa	Centum XL	?	√	√	X	√
Yokogawa	Micro XL	?	√	√	X	√

√ = Solution Implemented, Tested, Prototyped or Commercially Available
C = Conceptual Review/Design
X = Solutions are Limited
? = Not Yet Evaluated

Emerson Migration Options Roadmap for Their Own & Competitor Systems

Emerson Strives to Reduce Modernization Cost and Risk

Executive Overview

The issue of control system migration is becoming more important than ever. Several years ago, ARC estimated the size of the installed base of systems that were reaching the end of their useful life was around $65 billion, but that number is surely larger now as end users continue to squeeze every last ounce of performance out of their installed automation assets.

Many choices emerge when evaluating specific methodologies for a control system migration, not the least of which is deciding between the latest offering from your existing supplier, or switching to a new supplier. For many end users, migration represents a significant enough step change to warrant a complete review of all the supplier offerings in the marketplace. ARC advocates that you take the same approach to control system migration that you would to overall control system selection, all in the context of a six-sigma style continuous improvement process.

Emerson's flexible approach allows end users to evolve the components of their legacy systems that will have the greatest impact on their manufacturing operations, while preserving the components that have not yet outlived their useful life.

One thing end users should take into account when evaluating a supplier for a migration project is their ability to provide you with a solution that minimizes downtime and risk, while providing you with a tangible business value proposition that will have a real economic impact on your business. ARC believes that Emerson Process Management has developed a well-reasoned approach to migration both for their own and competitors' systems that allows for a step-by-step transition to their DeltaV system and PlantWeb architecture.

Emerson's flexible approach allows end users to evolve the components of their legacy systems that will have the greatest impact on their manufacturing operations, while preserving the components that have not yet outlived their useful life. The company augments this approach with automated tools and a range of services targeted at reducing or even eliminating altogether the downtime required to complete a migration project. This paper outlines Emerson's offerings for control system migration from their own and competitor systems in context with ARC's vision and recommended best practices for migration.

End Users Are Facing a Migration Crunch

Migration, evolution, modernization, whatever term you use to describe it, making the transition to a modern DCS is fraught with challenges for end users, from the increasingly difficult task of justifying the automation purchase, selecting a supplier, implementing the solution, to providing a roadmap for the future. Most of the end users ARC deals with list migration as one of the key issues they are facing today. We estimate that there are $65 billion worth of installed process automation systems in the world today that are nearing the end of their useful life-cycle, which in many cases can exceed 25 years. Many – as much as $12 billion worth -- are some of the original DCSs first installed in the late 1970s. Some date back to the pneumatic or analog age.

Total Installed Base of Systems Reaching the End of their Useful Life: $65 Billion

Total Installed Base of Systems Older than 20 Years: $53 Billion

Average Impact of Unscheduled Downtime: $20B or almost 5 percent of production in the process industries

Every day we read about how the aging infrastructures of developed industrialized nations are showing need of replacement. From corrosion in the Alaska pipeline to failures in the power transmission grid, the industrialized world and many parts of the developing world are relying on an installed base of assets that need to be replaced. In the first half of 2007, for example, a third of US oil refineries were shut due to a record number of breakdowns, power failures, fires, and other incidents.

Process automation end users are a conservative lot, however, and are reluctant to dispose of an asset that has outlived its usefulness. Return on assets, in fact, is often viewed as more important than metrics such as life-cycle costs. Eventually, however, the infrastructure must be replaced. This presents end users with a completely new set of challenges as they strive to justify the investment for migration, embark on the task of selecting a supplier and a system offering, and decide how to execute the installation, startup, and ongoing support and roadmap for the new system.

Migration Requires a Compelling Business Case

Justifying capital spending on automation is becoming more and more difficult as end users increasingly focus on getting the most out of their installed assets. Any automation project today requires a compelling business case.

ARC has categorized several scenarios where migration is required. Of course, the case for migration is most urgent when the old system reaches the point where an impending plant shutdown or incident is a real possibility. The system may be so old that replacement parts and support are unavailable or are extremely limited and cost prohibitive. The old system may not support many of the available new technologies that provide real economic advantages, such as plant asset management (PAM) applications, fieldbus, advanced production management applications, and Ethernet-based control networks.

When does it Make Sense to Migrate?

- Impending threat of unscheduled downtime/incident.
- No longer cost effective to support old system/system, system dead-ended or phased out, no spare parts availability.
- Old system cannot support new information technology that provides economic advantage.
- New or emerging business opportunity impossible without new system.
- Old system is inflexible and cannot react to rapid shifts in customer demand.
- Old system lacks visibility that could prevent abnormal situations, equipment breakdown, disruptions in supply chain, etc.
- Old system does not have the capacity or is not cost effective to expand.

Even worse, the old system can be burdened with a high volume of custom code and custom point–to-point integration that make long term support cost prohibitive, as companies struggle with shrinking labor resources and a lack of qualified personnel. The veteran who had a good understanding of all the custom code that was in place, probably because he/she wrote it, will retire and be replaced by a worker who knows only open technologies and standards.

Of even greater importance is the opportunity cost associated with supporting an outdated system. This is the cost of a business opportunity that was missed because your system was not advanced, flexible, or functional enough to take advantage of a swiftly emerging or fleeting opportunity. Having an old or outdated system installed can actually result in direct losses if the end user lacks the visibility into plant operations that enables abnormal situation prevention and avoidance of supply chain disruptions. An inflexible system hinders your ability to react quickly to shifts in market demand.

What to Look for in a Migration Partner

In 2003, ARC developed a list of key criteria for selecting control system migration partners. Ultimately, only you can decide if a supplier's system will satisfy your needs. Some of the key requirements we outlined included the preservation of plant physical as well as intellectual assets and knowledge. Not all parts of a legacy control system need to be replaced, and the

real challenge for the supplier is flexibility to offer solutions that allow the end user to preserve the assets worth keeping. Over time, you have embedded intellectual knowledge in these systems through control configurations, integration with information management, historical data collection, advanced process control and optimization, and other applications, to ensure that your process automation system performed the fundamental control job it was purchased to do. More importantly, however, end users should ensure that the new system offers a compelling value proposition over the old system. The new system should offer at least the same level of functionality as the old system, and should preserve the intellectual capital invested in the old system to the degree that it makes sense to do so. However, if the new system does not offer a compelling business value proposition that is superior to that of the old system, then it should not be considered. The value proposition of the new system is embodied in the economic impact of a combination of not only hardware and software system technologies, but also value-added services offered by the system supplier. A key element of the value proposition is minimizing or even eliminating the downtime required to complete the modernization project.

ARC Supplier Recommendations for Easing End User Migration Projects

New system should:

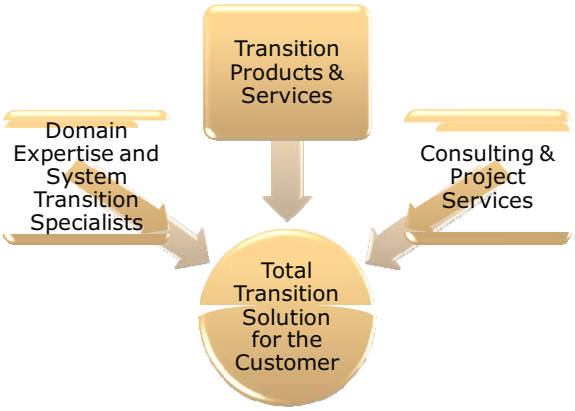
- Offer compelling value proposition and path to operational excellence
- Minimize wiring
- Preserve hardware investment
- Preserve graphics and assist with or perform graphics conversion
- Preserve control strategies and assist with or perform control strategy conversion
- Minimize/eliminate downtime
- Minimize training costs for new system

Emerson's Approach to Control System Migration

ARC believes that Emerson has developed an effective migration strategy not only for its existing PROVOX® and RS3™ customers, but one that also offers an effective migration strategy from some of their competitor's control systems. Emerson has developed a flexible approach to the migration of their own and competitor legacy systems that is based on common technology and provides a phased approach to their DeltaV system and PlantWeb® vision.

A Multi-Faceted Approach to Delivering Migration Solutions

Emerson has a three-tiered approach to delivering migration solutions that starts with its domain expertise and high level consulting capabilities. The company has considerable domain expertise when it comes to migrating its installed base of RS3 and PROVOX systems and Emerson has made significant investments in building deep domain expertise in competitor systems. The company has hired several high-level migration consultants, most with 20-30 years experience in Bailey Infi 90, Honeywell TDC 2000 and TDC 3000, and other competitor systems. These high-level consultants work closely with the customers to develop migration strategies based on unique requirements.



Emerson Migration Solutions Delivery

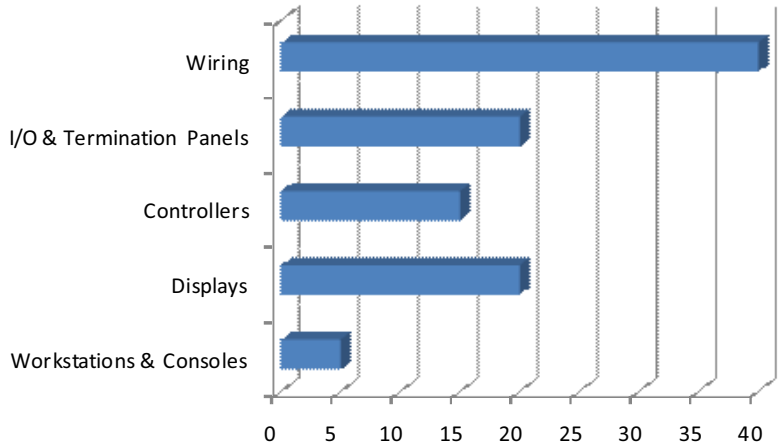
Once the requirements are determined, the transition or migration products and services come into play. These include a range of solutions designed to migrate the user's system one component level at a time, from the wiring and I/O to controllers, HMI, and other applications that can be applied in a flexible fashion and work seamlessly with the legacy system. The execution of the project is then conducted by Emerson service people as well as Emerson Local Business Partners (LBPs). The LBPs in many cases act more like systems integrators or engineering firms and bring a lot of expertise to the table. Emerson augments this execution capability with long-term system plans, field audits, and a broad scope of after sales services.

All of this is done with an eye toward maximizing the end user's existing investment, reducing overall transition costs as much as possible, eliminating downtime during transition, and leveraging the technology available in the DeltaV system and PlantWeb architecture. This includes Emerson's considerable capabilities in plant asset management (PAM), fieldbus, advanced control capabilities, and expertise in batch control.

Standard Migration Products Adapt to Specific Requirements

Most end users will not pursue a wholesale "rip and replace" migration strategy. While this technique works to totally remove the old hardware, in-

cluding the field wiring, and allows you to start with new equipment, this process is often too time consuming and impractical. At the hardware level, chances are that the considerable legacy systems to field devices wiring is still operational and could continue to function for years to come. Why replace the wiring if you have no intention of upgrading the instrumentation? This is a point of considerable savings when migrating to a new system. It is also a possible point of high risk, because once you rip out your existing wiring infrastructure there is no going back. In ARC's view, a competent supplier will have a strategy to mitigate the risk while balancing the cost. Emerson is one such supplier.



Average PAS Component Lifecycle in Years

End users also have to look at the lifecycle of their system based on different tiers of longevity. Wiring, for example, typically has a lifecycle of 30 years or even longer. I/O and termination panels can last up to 20 years, while controllers typically have a shorter lifecycle of around 15 years, while workstations and consoles typically last around five years.

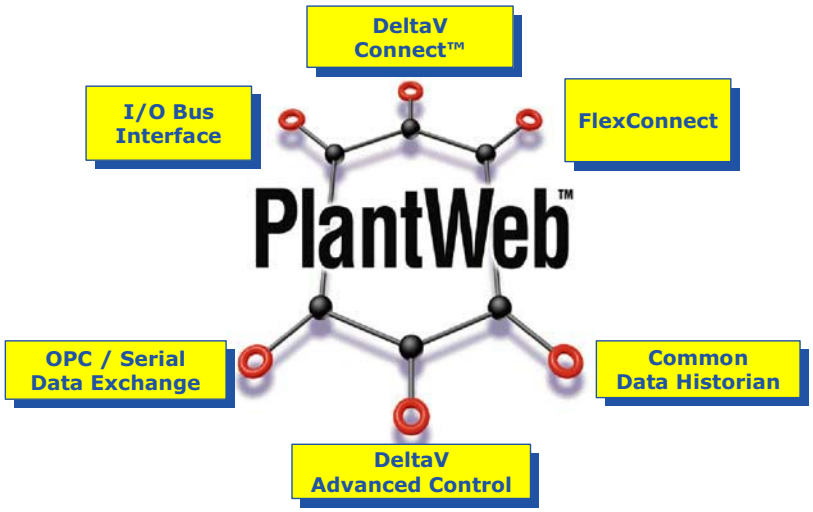
Emerson has five primary methods of transition from their own legacy systems as well as competitor legacy systems that allow for a flexible migration path. Each method targets a layer of the system from the field wiring and I/O through the controller layer, and finally the workstation, data historian, and advanced application domains. This allows end users a phased approach that will preserve the assets that are still functional.

DeltaV Connect resides at the application workstation layer, and allows end users to add DeltaV workstations to existing control networks of competitors' systems. Likewise, DeltaV Operate allows users of Emerson systems to add DeltaV workstations. These solutions preserve the end user's investment in legacy controllers, I/O, and wiring.

FlexConnect is a method of connecting multi-conductor cables to the existing termination panels and auto-marshalling the signals to DeltaV I/O. The existing I/O signals can be controlled and monitored by the DeltaV system through a pre-engineered marshalling solution. FlexConnect is available for

a wide range of systems, including Emerson's own RS3 and PROVOX systems, as well as systems from ABB, Honeywell, Invensys, Siemens, and Yokogawa. FlexConnect can reduce downtime by up to 75 percent versus rewiring. Documentation costs are also reduced because the end user does not have to change loop sheets.

Emerson also offers **I/O Bus Interfaces** that allow end users to connect directly to legacy I/O subsystems. These are available for several competitor systems as well as Emerson PROVOX and RS3 systems. The DeltaV **Serial, Virtual Interface Module, Profibus DP or DeviceNet Interfaces** provide the connection between the DeltaV system and I/O devices. Using these interfaces, plant operators have access to the legacy control system data via DeltaV operator consoles.



PlantWeb Migration Options Target Every Major Facet of the Process Automation System

Emerson's migration services include database conversion and graphics conversion or complete redesign of displays. Simulation tools expedite checkout and reduce the learning curve for operator training.

Emerson offers several options for **OPC Connectivity** as well. The DeltaV system offers OPC Mirror, which connects OPC servers on multiple control systems and enables bi-directional data flow from one system to another. These connections can be between OPC servers of the DeltaV system and other systems, including PROVOX or third-party servers or between different third-party OPC servers, or any other OPC server combination necessary. Up to 50 OPC servers may be connected through OPC Mirror. The DeltaV system also offers a separate OPC interface that can connect to legacy workstations.

Leveraging Capabilities of the DeltaV System for Migration

Migration to the DeltaV system in a flexible fashion allows end users to take immediate advantage of some of the benefits the system has to offer. The DeltaV system offers a series of advanced control options such as DeltaV

Predict multivariable control software to the DeltaV Continuous Historian. The DeltaV system offers a Common Data Historian, and Emerson's migration consultants will work to determine if they have enough components to put the Common Data Historian on the existing system.

The DeltaV system's HART pass through functionality allows end users to take advantage of the dormant intelligence in the considerable installed base of HART-compatible field instrumentation that resides in plants around the world. Emerson is also one of the strongest proponents and supporters of fieldbus technology. ARC believes fieldbus presents both significant installed and operational cost benefits. Migration to the DeltaV system can provide end users with full fieldbus functionality and connectivity not only with the control system itself, but also to the AMS plant asset management application. This allows the user to take full advantage of diagnostic data from FOUNDATION® Fieldbus, HART-compatible field instruments and intelligent control valves. Migrating in a flexible fashion to take advantage of the cost benefits that can be provided by fieldbus and HART is an excellent way to reap high rewards in a short amount of time.

ARC estimates that on average it costs about $1,200 to generate a page of graphics. Any competent migration partner should provide a solution for conversion of graphic displays in an automated or semi-automated fashion.

According to Emerson, conversion to Emerson's PlantWeb digital plant architecture enables a manufacturer to achieve up to 30 percent capital and engineering savings, and 2 percent gains in operating efficiency, including up to a 40 percent improvement in maintenance efficiencies.

Graphics and Control Strategy Conversion Capabilities

Migration of application functionality is just as critically important as migration of hardware components like I/O and controllers. Whether your current system is only doing basic control or is part of a hierarchy of control and optimized execution, you need to be assured that you can have at least the same level of control functions you now have. ARC advises end users that any prospective supplier should provide a path to adapt the existing control strategy to the new system. The supplier should have conversion software that can read the old configuration and automatically or semi-automatically convert it to your new control system's control language. If not, then you should have them explain how they intend to do this conversion. Most importantly, the supplier must ensure that the conversion has no control flaws before startup.

Graphics represent another key investment. If you add up all the time you have put into engineering and refining your current graphic displays, you will realize that these displays represent highly valuable knowledge. ARC estimates that on average it costs about $1,200 to generate a page of graphics. Any competent migration partner should provide a solution for conversion of graphic displays in an automated or semi-automated fashion.

As part of its migration portfolio, Emerson offers conversion services for point databases, graphic displays and control strategies to reduce migration risks. For graphics conversion, an Emerson Process Management team works with the end user's process and graphics personnel to develop and produce a graphics standard that takes advantage of the new display technology and matches plant operating procedures and philosophies. Using this standard, a graphics library is developed using elements from the DeltaV standard libraries. The existing graphics are translated into DeltaV format per the end user's operator interface standards.

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The graphics conversion requirements may vary with every end user project. Some end users want their new graphics to look the same as the old ones, while some prefer to take advantage of the capabilities of the new system. Emerson's considerable investment in automated graphics conversion capabilities allows end users this kind of flexibility, and saves considerably on commissioning costs and checkout times.

Emerson Migration Service Offerings

The ability to provide a comprehensive array of services is becoming more crucial than ever for automation suppliers. The primary contributor to the growth in services over the next several years is the continuing shortfall of skilled labor among end users. End users face a shrinking resource base of qualified employees, and workers face an ever-increasing range of responsibilities across the plant. The issue of migration is no exception. Any supplier prepared to offer a sound migration strategy must be prepared to offer a full suite of services to go along with their solution, from consulting services to front-end engineering and design to project implementation and after sales service. Emerson offers a full set of migration and new installation project services from front-end engineering and design to specifically

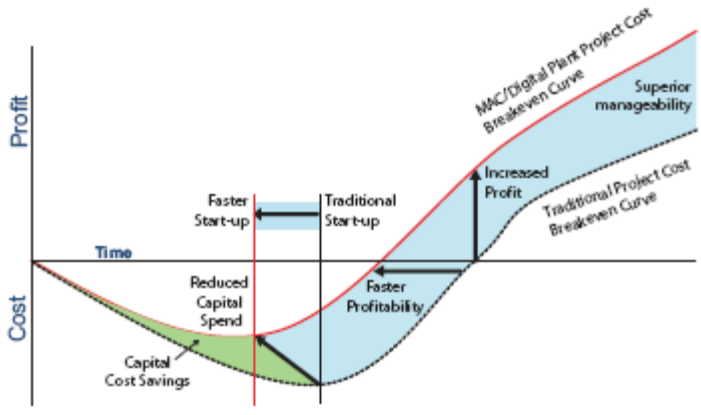
tailored services that satisfy the specific needs of hot cutovers and maintenance turnarounds.

Consulting Services Set the Stage

Emerson has a full set of consulting services that can be deployed prior to modernization projects. Consulting services range from project justification and definition to planning. Many consulting projects begin with a review that establishes what the client's business goals are, including elements such as increased availability, improved quality, and increased safety. Based on these objectives, Emerson can conduct a site assessment that defines key performance criteria, such as process constraints and limitations and equipment or operational limitations. The site assessment feeds a process automation feasibility study, which is then used to develop process automation modernization plan.

Front End Engineering and Design Services -- Reaping the Benefits of Upfront Planning

Emerson provides services specifically dedicated to process end user requirements in front end engineering and design (FEED). FEED addresses a specific need for end users to drive advanced automation planning into the initial stages of a project. In many cases, particularly when end users are installing advanced technologies such as fieldbus or plant asset management applications, the initial project stages receive inadequate attention and planning. To derive the true business benefit of a new technology, proper planning must take place, and whether it is on a new grassroots plant, an expansion, or a migration/modernization project, this should be done at the FEED stage.

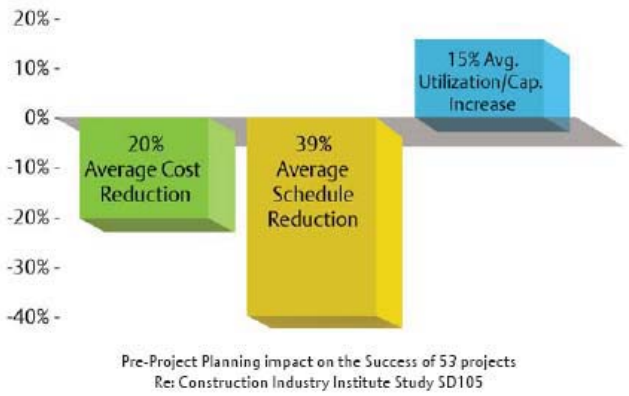


Emerson's Total Solution Value Proposition Includes Faster Startup Times, Faster Profitability, and Increased Overall Profit

Emerson's FEED business consists of high-level consulting engineers with many years of experience in automation in specific vertical industry segments. These consultant/engineers apply a methodology that addresses technology, human, and work process concerns. Emerson's FEED work process is built upon the recommended best practices of authorities such as Construction Industry Institute (CII),

Project Management Institute (PMI), and Independent Project Analysis (IPA) methodologies. The company's project management program is consistent with these guidelines for project implementation.

Probably one of the most important things Emerson does with its FEED business is to narrow down the cost and the business value benefit estimate within plus or minus ten percent. The estimate includes a detailed functional scope of the engineering and design, detailed project execution plan, and a detailed procurement plan. This results in a well-defined scope for the rest of the project, which provides a more accurate estimate, lower contingency, and lower overall project costs.



Construction Institute Study on Pre Project Planning Found Significant Cost Reductions

The FEED definition often includes the required economic justification in both investment requirements and the expected process and business-related returns. An ROI calculation can be determined as part of a FEED study to ensure that the project clears the required financial hurdles. As part of this effort, Emerson coordinates activities among all parties with a stake in project to make sure everyone's business and technology objectives are in alignment with overall business objectives.

The effort and upfront cost of the FEED can deliver major economic benefits, because this is work that would otherwise be done in the first 10-25% of detailed engineering. The resulting "blue print" is further refined during the detailed design phase of the project. Projects with a thorough FEED study are more likely to be completed on time. Early identification of potential problem areas and/or necessary changes allow for early resolution with less impact to the project.

Migration projects are often done during maintenance turnarounds, and have a very short time to execution and a narrow project window. In ARC's view, users must take the utmost care to plan up front and make sure that everything happens on time and within budget, or, even better, ahead of time and under budget. A good FEED study is a key element in achieving this.

Hot Cutover Services – Migration with Zero Downtime

Particular attention needs to be given to the impact that downtime has on profitability and business performance, with downtime driven as close to zero as possible. Currently available migration approaches can significantly shorten the shutdown window, reducing turn around duration to less than two days, even down to hours in some cases. The money saved by driving downtime as close as possible to zero is significant whether it is during a scheduled maintenance outage or, even more so, during an outage planned specifically for the purpose of a control system switchover. If you are an end user then you know that many things can happen during a startup that can result in delays, from loop tuning to construction errors.

The ideal situation of course is to have a hot cutover of the control system; the new system takes over seamlessly where the old system left off, with no need for process interruptions. This is particularly a concern in the continuous process industries where any interruption in the process results in lost money and potentially lost opportunities. Hot cutover is especially attractive if you are moving from a very old legacy system based on pneumatic technology.

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Emerson has conducted numerous hot cutover projects in multiple industries. The company has consolidated their expertise in this area and has a dedicated service offering built solely around hot cutover capabilities. The company starts with a detailed audit of the existing instrumentation, assists in selection of hardware, installation, and commissioning. The hot cutover team makes heavy use of Emerson's AMS Intelligent Device Manager for efficient commissioning of the instrumentation during hot cutover. AMS Device Manager digitally communicates and builds a database of equipment and information, including configuration and calibration test definitions with remote device status checking.

Emerson's hot cutover teams begin the cutover process with "easy" loops such as indication-only measurements, which enable the team to adapt to and navigate within the new digital automation system in a low-risk environment. Strategically approaching the project one-loop-at-a-time makes hot cutovers more manageable than commissioning an entire unit after a

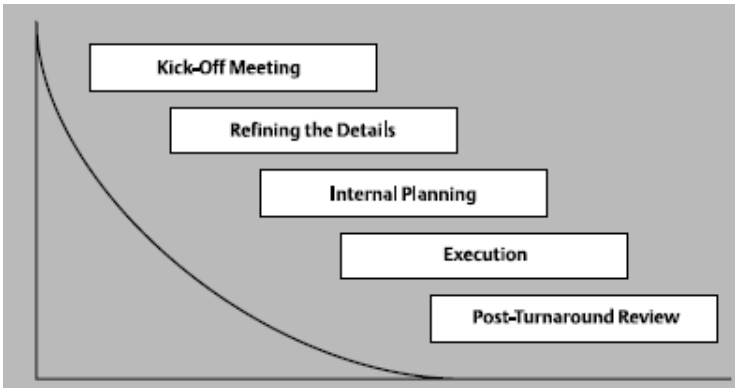
shutdown or turnaround. Minimized shutdown/turnaround periods for critical instruments and safety system changeovers also mean reduced cost.

Each piece of instrumentation has a special cutover procedure, and Emerson is continually building best practices into these procedures based on the experience gained from each project. AMS Device Manager is used by the team to help coordinate hot cutover projects and reduce project risk. AMS allows quick confirmation that device configurations match specifications, quick instrument configuration, and faster implementation time. AMS is also used to verify correct device connection and ranging and appropriate device construction materials. Finally, AMS ensures that devices function as an entire system through checking interlocks, stroking valves, and verifying alarm points on field devices.

Emerson employs a communication plan that ensures safe coordination during hot cutover work. Personnel follow daily communication procedures with the end user team so that all plant personnel and project team members are aware of the work being performed. Procedures are established to ensure that all equipment is properly isolated and purged prior to cut over, thus reducing risk of safety, health and environmental incidents.

Turnaround Services – Turning Routine into Opportunity

Hot cutover does not make sense for all applications. Migration during scheduled turnarounds is a common practice. To address end user needs during turnaround projects, Emerson offers Turnaround services that, in addition to identifying the needs of instrumentation and maintenance during standard turnarounds, can implement phased migration projects. Emerson identifies assets affected by the turnaround, defines critical success factors, creates a General Customer Specification document, plans a detailed work schedule, conducts a post project review, and more.



Emerson Turnaround Services Follow a Specific Work Process

Asset Reliability Service engineers hold a kickoff meeting to identify the assets affected by the turnaround and determine what service they need. The team defines critical success factors for the turnaround, which may include

safety and quality requirements, documentation, and reporting. This leads to the creation of the General Customer Specification document, which will be used throughout the turnaround to ensure delivery as specified. Then, a detailed work schedule is planned, followed by a post project review, grading the results based on the General Customer Specification document.

Emerson Migration Solutions for PROVOX and RS3

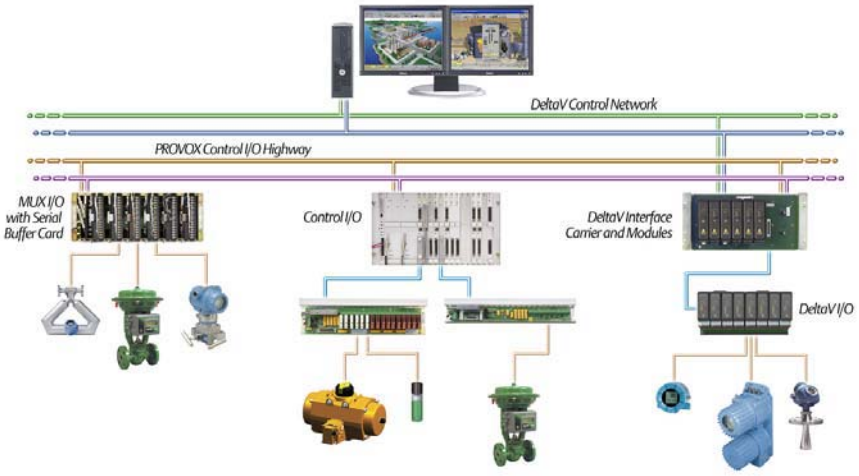
Emerson's primary goal with its migration program was initially to target its own installed base of systems, specifically PROVOX and RS3. In fact, many of the tools that resulted as a development of the DeltaV transition solutions from PROVOX and RS3 were also modified and applied to competitor systems such as Bailey Net 90 and Infi 90 and Honeywell TDC 2000 and TDC 3000 systems.

Flexible Transition Solutions for PROVOX

The PROVOX system migration path incorporates the same flexible approach as all Emerson transition solutions, with a DeltaV Interface for PROVOX I/O, DeltaV Operate HMI for PROVOX, FlexConnect for PROVOX, and database and display transition services.

DeltaV Interface for PROVOX I/O

DeltaV Interface for PROVOX I/O uses the PROVOX serial communication bus interface to Control and MUX I/O with the standard DeltaV MD+ controller and power supply on the new PROVOX I/O Carrier and interface module. This solution allows the end user to preserve their PROVOX I/O while taking advantage of the functionality of DeltaV control architecture. The DeltaV Interface

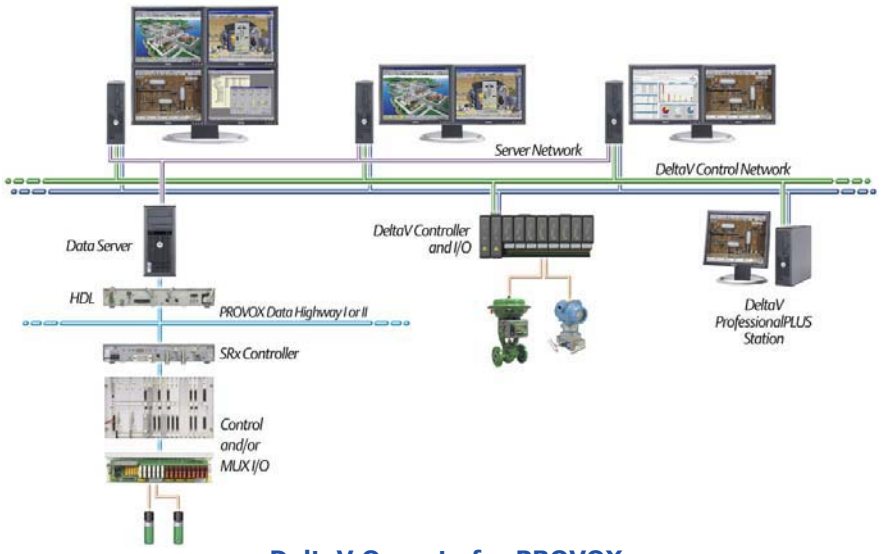


DeltaV Interface for PROVOX I/O

for PROVOX I/O can be used with both Control I/O and MUX I/O. Support for the PROVOX I/O is integrated into DeltaV Explorer, Diagnostics, and Control Studio applications.

DeltaV Operate for PROVOX

DeltaV Operate for PROVOX displays operating information from the PROVOX Operator Console Data Server to client workstations running DeltaV Operating HMI. DeltaV Operate for PROVOX also supports PROVOX Plant Management Areas (PMA), Plant Process Areas (PPA), Alarm Management, and all the existing PROVOX point types. DeltaV Operate for PROVOX is completely compatible with existing PROVOX system configurations and requires no database reconfiguration. Display migration services are also available from Emerson.



DeltaV Operate for PROVOX

FlexConnect for PROVOX

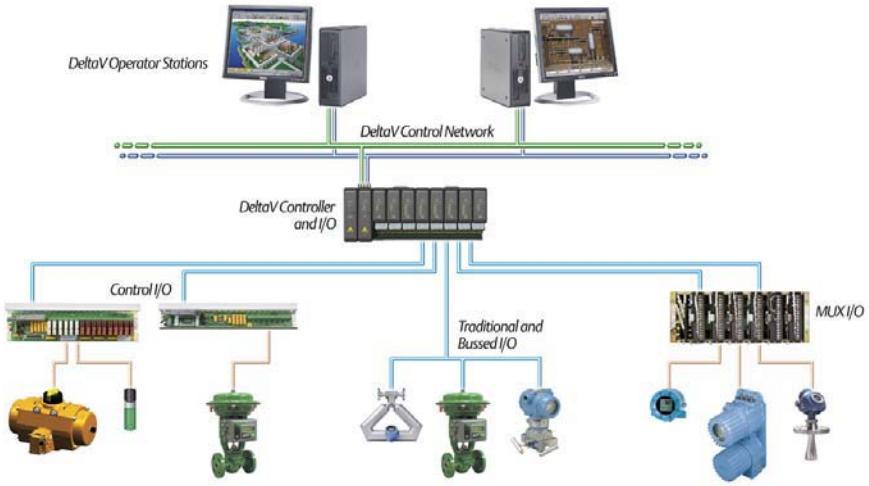
FlexConnect connects a multi conductor cable, and in some applications, an interface card, to existing terminations in the PROVOX system and automarshals the signals to DeltaV I/O. The advantage of FlexConnect is that it does not disturb any of the existing field wiring, so the risk is reduced as is time to startup. FlexConnect for PROVOX is compatible with PROVOX MUX regulatory controller card files, MUX I/O and Control I/O.

PROVOX Applications Server

PROVOX Applications Server (PAS) serves as an integration platform for PROVOX. This Windows-based server application allows PROVOX users to integrate process application software for laboratory analysis, historical data, resource planning, statistical control and other functions. PAS software is OPC-compliant and is backward-compatible with Emerson's Computer Highway Interface Package (CHIP) Application Programming Interface (API).

PROVOX to DeltaV Database and Graphics Conversion Services

Emerson offers a full scope of graphics and database migration services for PROVOX to the DeltaV system. Emerson has converted over 15,000 PROVOX displays and almost 100 PROVOX controllers to date. The end user provides a copy of the PROVOX database to Emerson who then reviews the existing systems information and provides a migration scope of work to the end user. The scope typically includes what was found in the end user's system and the DeltaV structures required to replicate PROVOX control and graphics implementations. The deliverables from the migration service are the requisite DeltaV database and graphics files. These files can then be imported/copied directly into the DeltaV system for checkout and use onsite.



FlexConnect for PROVOX

Graphics migration services provide the end user with the opportunity to select an automated migration process or the design process. In cases where the end user wishes to maintain the look of the existing PROVOX graphics in the DeltaV environment, an automated process replicates the look of the graphics in the DeltaV format. For those end users wishing to take full advantage of the graphic capabilities present within the DeltaV system or to re-design their existing graphics, the design service enables them to specify exactly how the DeltaV displays should look and act.

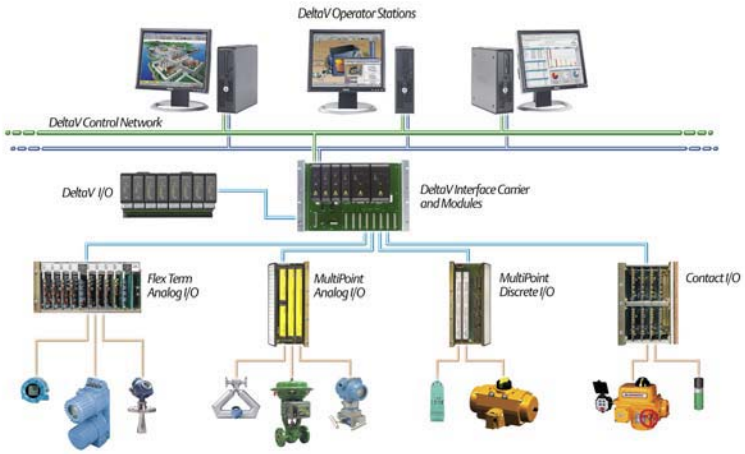
Database or control strategy migration service provides the end user with the ability either to replicate the existing PROVOX control strategy within the DeltaV system or to take the opportunity to leverage the additional/enhanced control functionality within the DeltaV system through redesign. Either process yields a complete control strategy implementation within the DeltaV system that can be imported directly for onsite checkout and commissioning.

Flexible Transition Solutions for RS3

The RS3 system migration path incorporates the same flexible approach as all Emerson transition solutions, with a DeltaV Interface for RS3 I/O, DeltaV Operate HMI for RS3, FlexConnect for RS3, and database and display transition services.

DeltaV Interface for RS3 I/O

As with PROVOX, Emerson offers a DeltaV Interface for RS3 I/O. The DeltaV solution supports the serial I/O communication capacity of the RS3 ControlFile and may be used with both RS3 FlexTerm and MultiPoint I/O subsystems. I/O support is also integrated into the DeltaV Explorer, Diagnostic, and Control Studio applications.



DeltaV Interface for RS3

DeltaV Operate for RS3

DeltaV Operate for RS3 allows users to place DeltaV Operator Stations on existing RS3 systems. Standard DeltaV Operate software and DeltaV Operate for RS3 software run on one DeltaV Operator Station, which then has access to RS3 points through the RS3 Network Interface (RNI). Up to three DeltaV Operate for RS3 stations may access one RNI. Data exchange between DeltaV Operate for RS3 station and the RS3 system is bidirectional, allowing operators to both read and write data. DeltaV Operate for RS3 also supports RS3 Alarm and Event journals. DeltaV Operate for RS3 is also compatible with ABC Batch. With dual or quad monitors, end users can view ABC batch steps on one monitor without losing view of the process, which is displayed on the other monitor.

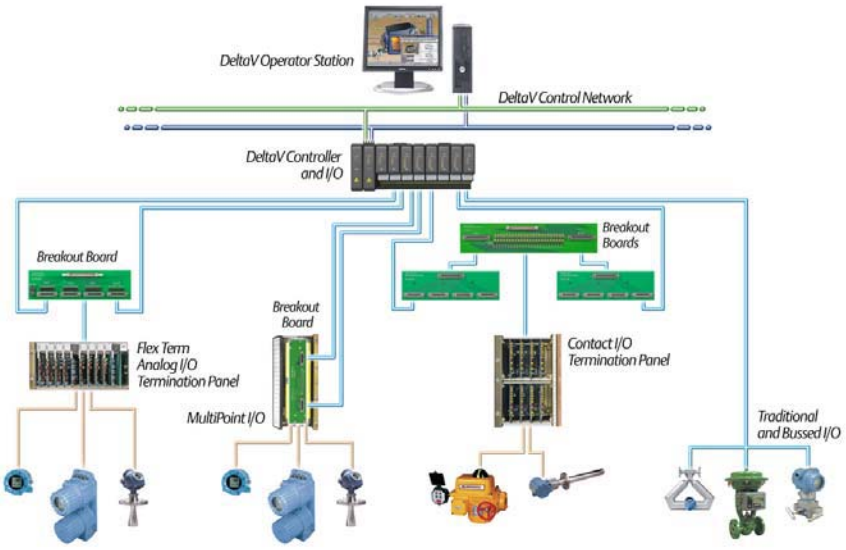
FlexConnect for RS3

FlexConnect solutions for RS3 allow end users to save on wiring costs and can be directly connected to DeltaV I/O cards. FlexConnect solutions are available for just about every type of RS3 I/O (FlexTerm and Multi-Point), and the cable to DeltaV termination block assemblies can be built and tested at the factory and are shipped as pre-built assemblies.

RS3 to DeltaV Database and Graphics Conversion Services

Emerson offers a full scope of graphics and database migration services for RS3 to the DeltaV system. Emerson has converted over 4,500 RS3 displays and over 100 ControlFiles to date. The end user provides a copy of the RS3 database to Emerson who then reviews the existing systems information and provides a migration scope of work to the end user. The scope typically includes what was found in the end user's system and the DeltaV structures required to replicate RS3 control and graphics implementations. The deliverables from the migration service are the requisite DeltaV database and graphics files. These files may then be imported/copied directly into the DeltaV system for checkout and use onsite.

Graphics migration services provide the end user with the opportunity to select an automated migration process or the design process. In cases where the end user wishes to maintain the look of the existing RS3 graphics in the DeltaV environment, an automated process replicates the look of the graphics in the DeltaV format. For those end users wishing to take full advantage of the graphic capabilities of the DeltaV system or to re-design graphics in order to put new standards into effect, the design service enables them to specify exactly how the DeltaV displays should look and act.



FlexConnect for RS3

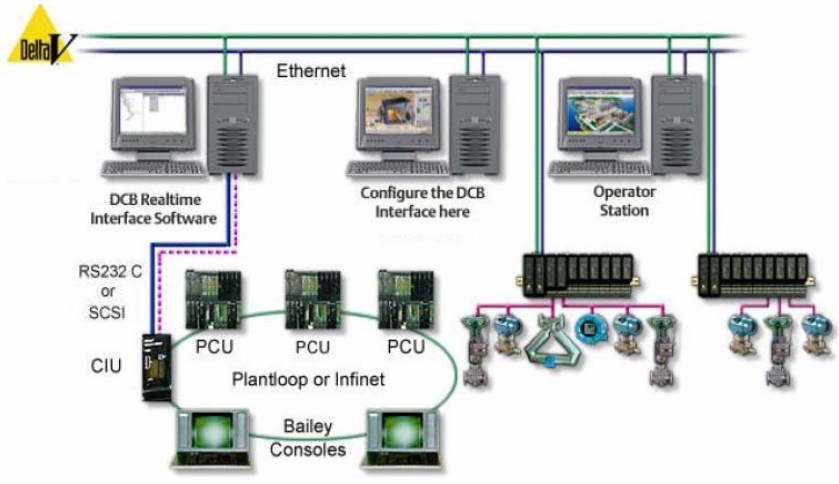
The database or control strategy migration service provides the end user the ability to replicate the RS3 control strategy in a DeltaV system or to leverage the additional/enhanced control functionality inherent in the DeltaV system through re-design. Either process yields a complete DeltaV control strategy implementation that can be directly imported for onsite checkout and commissioning.

Emerson Migration Solutions for Bailey® Systems

Emerson realizes the opportunities presented by the legacy installed base of their competitors' systems and has developed a comprehensive plan to target these systems. While Emerson offers a wide range of solutions for many of its competitors' systems, for the purposes of this report we will focus on the two most popular targets – the Bailey Infi 90 and Net 90 systems and Honeywell TDC 2000 and TDC 3000 systems. For both product families, Emerson takes the same standard approach as it does with its own systems, offering a phased migration path that starts at the HMI layer, moving progressively down to the controller, I/O and field wiring structures.

DeltaV Connect™ Solution for Bailey Systems

The most basic migration from Bailey systems to the DeltaV system starts with DeltaV Connect Solution for Bailey Systems, which allows Bailey users to migrate to DeltaV Operator Stations and expand to an entire DeltaV system in conjunction with their existing Bailey system. This DeltaV interface connects directly to the Bailey Computer Interface Unit (CIU), and requires no downtime, since no system configuration changes are required. An existing Bailey console can be removed and the DeltaV Connect solution can use its CIU connection to immediately begin reading Bailey data, recording alarms, history and updating new DeltaV displays. An alternative to removing a console is to connect the DeltaV Connect solution to any available CIU on the network or to the CIU for the Bailey engineering workstation. The engineering workstation can connect thru the DeltaV interface workstation, allowing the two applications to share a CIU. Users can also connect this interface to both CIU ports, enabling them to increase the throughput. The DeltaV Connect solution can be simplex or redundant, in which case two



DeltaV Connect for Bailey Plugs Right Into the Bailey CIU

workstations connect to two individual CIUs. The interface driver running on the DeltaV workstation gives the user access to all the data on the Bailey network.

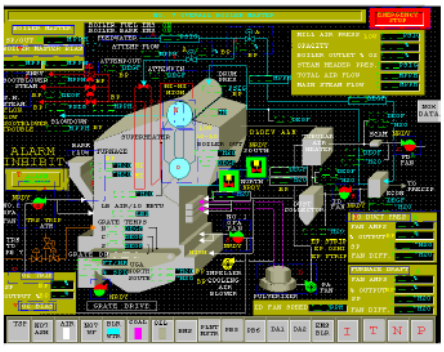
The DeltaV Connect solution also makes the Bailey function block data accessible on DeltaV workstations. From Bailey-oriented DeltaV faceplates and detail displays, operators can change modes, adjust setpoints and modify tuning parameters in Bailey controllers.

FlexConnect for Bailey

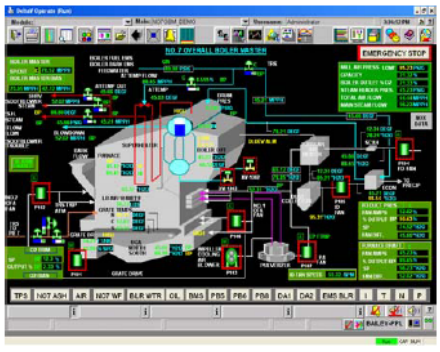
Emerson also offers FlexConnect for Bailey legacy systems. FlexConnect is available for most legacy Bailey termination panels. One key advantage provided by FlexConnect for Bailey is that it provides HART connectivity so end users can take advantage of the dormant diagnostic data and information that is present in their large installed base of HART devices.

Bailey Database and Graphics Conversion Services

Emerson offers automated conversion of Bailey graphics and has converted over 3,500 displays to date. Emerson's range of database conversion services for Bailey systems includes a Comprehensive Service that provides 100 percent functionally equivalent displays for the DeltaV system that have the same look and feel as Bailey displays. The end user sends copies of the Bailey graphics files and console tag database files to Emerson, who then runs them through the automated conversion process, performs any touchup work that is required, performs testing, and sends them back to the end user ready for deployment in the DeltaV system. Emerson has invested heavily in this automated conversion tool and has already converted thou-



Bailey display (before)



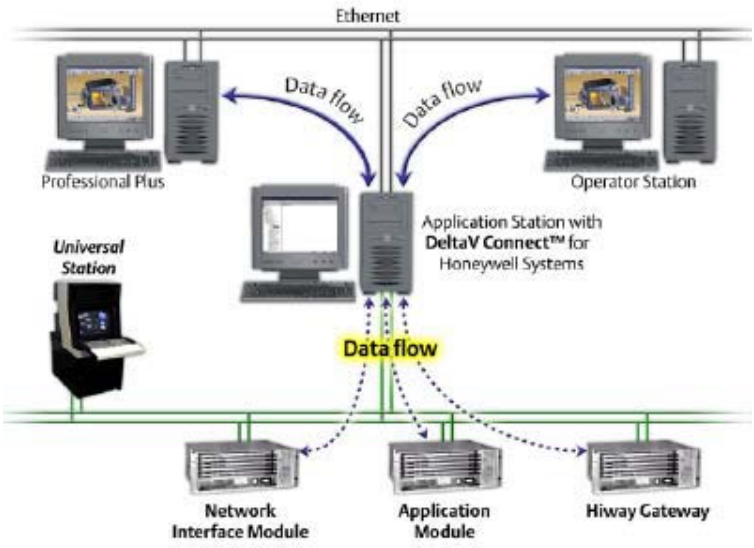
DeltaV display (after)

Bailey Graphic Converted to DeltaV Using the Automated Conversion Utility

sands of Bailey graphics files. The use of the automated tool significantly reduces overall transition costs and can reduce training costs during the transition to the DeltaV system.

Emerson Migration Solutions for Honeywell Systems

As Emerson has built a considerable installed base of DeltaV systems in industries such as refining, oil and gas, and pulp and paper, it is no surprise that Emerson is targeting Honeywell legacy systems. Emerson has developed a comprehensive migration and transition offering from TDC 2000 and TDC 3000 to the DeltaV system. Primary migration and transition options for Honeywell systems include OPC Interface, Serial Interface, the DeltaV Connect™ Solution for Honeywell® Systems and FlexConnect for Honeywell. Emerson also offers database and graphics conversion capabilities for Honeywell systems.



The DeltaV Connect Solution for Honeywell Systems Sends and Receives DeltaV and Honeywell LCN Data

OPC and Serial Interface for Honeywell

Emerson offers its OPC Interface and Serial Interface for Honeywell systems for existing Data Hiway Bridge, Data Hiway Port, Process Manager I/O serial interface, PLC gateway, EPLC gateway, PHD OPC server and TPN OPC servers respectively. Using these interfaces it is possible to connect legacy Honeywell systems with DeltaV systems and have them talking to each other in as little as thirty minutes. Emerson's OPC Mirror application also allows for server-to-server connectivity with Honeywell OPC servers.

DeltaV Connect Solution for Honeywell Systems

The DeltaV Connect solution provides operator station functionality similar to the Honeywell LCN-based consoles such as the Universal Station or Global User Station, while Honeywell controllers and I/O continue to run the process. The Honeywell system's analog and discrete I/O, process control loops, and online tuning parameters are seamlessly viewed and operated from the DeltaV operator interface. This integrated DeltaV and Honeywell operator interface provides a basis for a low-risk migration. Emerson has the ability connect to release 5xx or 6xx of the Honeywell LCN, and does not require users to upgrade their LCN R5xx to the LCN current release in order to use DeltaV Connect. No configuration is needed on the Honeywell side to implement DeltaV Connect for Honeywell and no shutdown of the LCN is required.

DeltaV Connect Solution for Honeywell Systems also features a utility-based service that converts Honeywell EB files into DeltaV Connect solution modules. The initial alarm trip values/priorities are set from EB file values at the time of conversion, which means that the alarm priorities are now owned by the DeltaV system and can be changed on DeltaV Connect detail displays.

Alarms are identified directly from the LCN and do not required additional data scanning. Alarm acknowledgement is independent on the two systems. During the transition phase, while both the Honeywell LCN and DeltaV operator workstations are actively annunciating alarms, a Honeywell station must continue acknowledging alarms until all operator workstations have migrated to DeltaV Operator Stations.

FlexConnect for Honeywell

Emerson's FlexConnect solution is available for Honeywell systems. As with FlexConnect for Bailey systems, the Honeywell offering allows end users to get HART connectivity within a minimal turnaround period. FlexConnect is available for most TDC 2000 and TDC 3000 I/O.

Faceplates and Detail Displays

Emerson offers pre-engineered Honeywell-looking faceplates for the DeltaV system as well as pre-engineered detail information windows. This allows

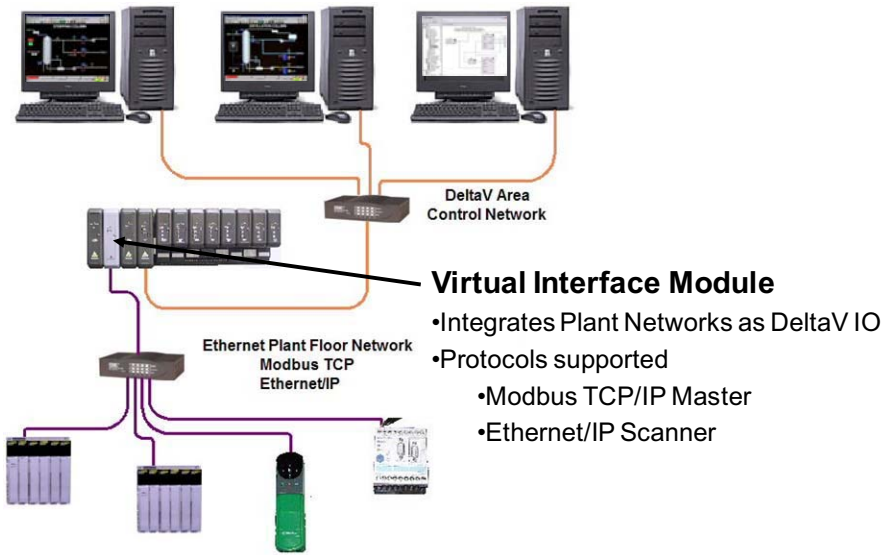
end users to use familiar interfaces they feel comfortable with while allowing them to take advantage of the functionality available in the DeltaV system.

Honeywell Database Conversion Services

Honeywell database conversion services are available from Emerson for the TDC 2000 and TDC 3000 control databases. Currently TDC databases are converted to spreadsheet or database format and then imported to the DeltaV database via a bulk edit tool. This includes all control loops and monitoring points. For Control Language (CL) programs, the functionality of the code is manually converted to DeltaV blocks. Display conversion is currently done manually, but Emerson is currently developing conversion utilities for providing an automated solution.

Emerson Migration Solutions for PLCs

Emerson applies its same flexible and adaptable migration philosophy to third party PLC offerings. In addition to serial and OPC connectivity, there are additional integration capabilities. These capabilities are the Virtual Interface I/O Module (VIM) Network Gateway and the PLC I/O System Interface.



DeltaV PLC Virtual I/O Interface Module

DeltaV Virtual I/O Module (VIM) Network Gateway provides a native DeltaV I/O Interface to open plant Ethernet networks and devices that use the Modbus TCP/IP or Ethernet/IP protocol. DeltaV Controllers can read and write signals from plant floor devices that use these Ethernet networks such as PLCs, Motor Control Centers and Weigh Scales. The VIM provides for both faster communication rates and larger data exchange than a serial card. The VIMNet Explorer utility provides the setup of the Virtual I/O Module and the plant Ethernet network.

The DeltaV PLC I/O System Interface is a combination of hardware and software that allows DeltaV to use existing PLC I/O systems such as GE Genius Bus, Modicon S908 Remote I/O, and Allen-Bradley 1771 Remote I/O.

DeltaV PLC I/O Interface includes an industrial interface hardware module, Programmable Interface Firmware, and configuration programs. Control Modules in the controllers assign the signals from PLC I/O networks the same as DeltaV standard I/O. The DeltaV PLC I/O Interface connects to the DeltaV system through the Virtual Interface Module. Communication between the PLC I/O Interface and the Virtual Interface Module Network Gateway is via Modbus TCP/IP.

Product	I/O Bus I/F
AllenBradley 1771 Remote I/O	✓
AllenBradley 1794 FlexIO	✓
AllenBradley 1756 Contrologix I/O	✓
GE Fanuc Genius I/O	✓
Modicon Quantum S908	✓
Modicon 800 Series I/O	✓
Siemens (TI500, TI505)	✓
Siemens S7	?

✓ Solution implemented, tested, prototyped, or commercially available

? Not yet evaluated

I/O Bus Interface Is Available for Most Suppliers' PLCs

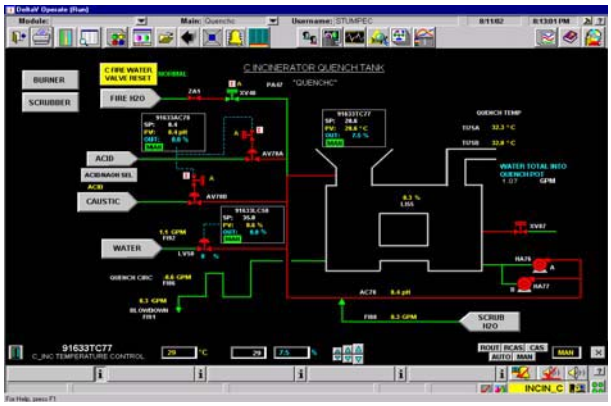
The PLC I/O Interface also functions as a Remote I/O Master/Scanner. It handles all block-transfer of data and I/O data movement between the DeltaV system and the Remote I/O bus, allowing the DeltaV system to use Remote I/O data like DeltaV I/O. It supports network diagnostic functions, for example, for Allen Bradley 1771 Remote I/O. DeltaV PLC I/O Interface module also handles 200 Series, 800 Series and Quantum I/O. It handles all data transfer functions between the DeltaV system and the Modicon Remote I/O, allowing the DeltaV system to control Remote I/O and read device diagnostic information. It performs the housekeeping tasks of initialization and fault management for up to 32 Remote I/O drops. Each DeltaV PLC I/O Interface module supports up to 32 Modicon remote I/O drops configured in the DeltaV Explorer as two ports of 16 devices.

Emerson Migration Successes

Emerson has conducted hundreds of migration projects to date for its own as well as competitor systems, ranging from the DeltaV system and Flex-Connect installations to large hot cutover projects where the entire control system is replaced. Perhaps the most widely publicized migration project for Emerson was the hot cutover of the Shell Deer Park refinery from an old pneumatic system to a DeltaV system incorporating fieldbus instrumentation in 2005. The Deer Park project was the first hot cutover conducted for fieldbus in a critical process application. The system features approximately 1,100 fieldbus devices. Since this was the first known fieldbus hot cutover of its kind, Emerson had to develop new procedures, particularly for hot cutover of control valves and instrumentation. The project was completed with no unscheduled downtime and the plant achieved a 1 percent increase in utilization. Even if three to four days of unplanned downtime a year are prevented as a result of this $32 million project, the investment will have more than paid for itself during the first year of operation.

BASF Hannibal Migration from Honeywell TDC System

Another recent migration success for Emerson occurred at the BASF site in Hannibal, Missouri. The site was an exclusive Honeywell user, with 8 LCNs in 9 operating units and over 18,000 I/O, for mostly batch applications. According to BASF, maintenance and upkeep of the legacy Honeywell infrastructure became too much of a burden. BASF also wanted to remove itself as far as possible from any non value-added engineering and maintenance functions. More importantly, the company wanted to make a full transition to fieldbus technology. Specifically, they wanted to increase the instrument count on the new system without having to invest more money in the marshaling infrastructure. Profibus was also installed to decrease discrete I/O cost by as much as 85 percent. Key elements of the project from a systems perspective included TDC point conversions, graphics conversions, control logic (CL) conversions, and wiring concerns.



New DeltaV Graphic Has Identical Layout Including BASF Custom Faceplate that Mimics Change Zone

The result was that FlexConnect enabled 8-hour conversions from the rip-out of Multi-Function Controllers (MFCs) to startup of the unit. This was particularly critical for two MFCs that support environmental controls. A total savings of $500,000 was realized using Flex Connect and Profibus alone, and an estimated $100,000 in savings is expected to be generated from an upcoming expansion project using both Foundation Fieldbus and DeviceNet. Operators easily adapted quickly to the new DeltaV system, and maintenance has benefitted greatly from the diagnostics capabilities of Foundation Fieldbus, AMS, and the DeltaV system.

Emerson Migration Strengths and Challenges

In ARC's view, Emerson has developed a strong migration and transition path for both its own systems and many of its competitors. Emerson's focus on migration project services is a key strength. By tailoring specific service offerings to meet the demands of hot cutovers, maintenance turnarounds, and particularly the consulting and FEED stages of projects, Emerson demonstrates capabilities far beyond the standard products and applications offerings. Engaging in early stages of projects creates more business opportunities for Emerson, and more importantly creates more opportunities for the end user to take advantage of the business value provided by Emerson's offerings.

Emerson Migration/Transition Program Key Strengths

- Services offering targeting consulting, FEED, hot cutover, maintenance turnarounds, etc.
- Phased, flexible migration approach
- Expertise outside of the basic process control system (instrumentation, valves, advanced control, simulation)

Emerson Migration/Transition Program Key Challenges

- Expanding solutions to cover more competitor systems
- Filling gaps in current competitor offerings
- Sticking to development schedule

A phased, flexible approach to migration is a necessary ingredient for success for any process automation supplier. Emerson's ability to address each phase of the control system, from the workstation and application layer with DeltaV Connect and OPC Interface, down to the I/O level with FlexConnect, provides the company with the flexibility to replace only those assets that make sense to replace while providing the end user with the advanced functionality required from the new system. Emerson's considerable investment in conversion tools for graphics and control strategies is another key advantage.

One key advantage that Emerson has, which many of its competitors do not, is its expertise in field instrumentation, control valves, fieldbus implementation, and wireless implementation. This is especially crucial in hot cutover projects such as Shell Deer Park, where not only the system, but also the instruments and valves were being changed over. Emerson must remain on task and continue to develop its solutions for competitor systems into the future. The company has an ambitious development schedule and must live up to the commitments it has made to its customers. Emerson continues to evaluate the technical feasibility and business case for other migration solutions and utility based services for various systems. Emerson also realizes that its competitors are in turn going after their installed base of systems, and they must remain vigilant in the face of this competition going forward.

Analyst: Larry O'Brien

Editor: Dick Hill

Acronym Reference: For a complete list of industry acronyms, refer to our web page at **www.arcweb.com/C13/IndustryTerms/**

APS	Advanced Planning & Scheduling
B2B	Business-to-Business
BPM	Business Process Management
CAGR	Compound Annual Growth Rate
CAS	Collaborative Automation System
CII	Construction Industry Institute
CNC	Computer Numeric Control
CPG	Consumer Packaged Goods
CPAS	Collaborative Process Automation System
CPM	Collaborative Production Management
DCS	Distributed Control System
EAI	Enterprise Application Integration
EAM	Enterprise Asset Management
FEED	Front End Engineering & Design
HART	Highway Addressable Remote Transducer
HMI	Human Machine Interface
IPA	Independent Project Analysis
LBP	Local Business Partner
OEE	Operational Equipment Effectiveness
OLE	Object Linking & Embedding
OPC	OLE for Process Control
PAM	Plant Asset Management
PLC	Programmable Logic Controller
PMI	Project Management Institute
ROA	Return on Assets
ROI	Return on Investment
RPM	Real-time Performance Management

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