Upgrading process control systems – what you need to know

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Among the greatest challenges facing operators of process plants today are the need to improve plant efficiency, reduce downtime and improve safety. But as plant control systems age, many components can begin to reach the end of their useful life and can become maintenance liabilities - and the increasing difficulty in finding spare parts and qualified expertise in the older technology can lead to increased downtime and increasing costs.

The overall performance of control systems can also have a significant impact on the plant's bottom line. The emerging technologies of recent years offer opportunities for further improving plant efficiency, performance, safety and business integration. But taking advantage of these new technologies will, in many cases, mean upgrading the existing DCS infrastructure - and for plant managers, there needs to be sufficient grounds to go to the trouble and cost of replacing a working DCS.

Existing plant infrastructure will already have been optimised as best as can be to efficiently manage the core processes of the plant, so further improvements through a DCS upgrade need to be justified based on futureproofing the plant against the future costs of obsolescence.

So what is your organisation missing out on by continuing to support an outdated control system? Improvements in process performance, operator effectiveness, safety and maintenance can all be limited by staying with an outdated DCS, but a well-planned and executed migration to the latest technology provides opportunities for improvement in all these areas, and can well justify the investment.

Glenn Johnson
Editor – *What's New in Process Technology*

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Glenn Johnson

Control system performance can have a significant impact on a plant's bottom line, and recent years have seen the emergence of new technologies that can greatly assist in further improving plant efficiency, performance, safety and business integration. But taking advantage of these new technologies will, in many cases, mean upgrading the existing DCS infrastructure.

Legacy distributed control systems (DCSs) often cannot meet present-day objectives of providing business information sharing, improved asset management and maintenance, lower energy consumption and better product quality, so many plant operators are considering migrating to a new DCS. However, before this can take place, there needs to be a financial and economic justification for doing so. The justification needs to compare the total cost of operation with the existing DCS, with the costs and benefits of a more modern system.

For plant managers, there needs to be sufficient grounds to go to the trouble and cost of replacing a working DCS.

Maintenance and the availability of spare parts are always significant considerations in a migration decision - components may be reaching the end of their useful life or failing excessively, and it may be becoming difficult or expensive to find replacement parts. It can also become more difficult over time to find personnel qualified to troubleshoot and repair older equipment and systems, especially as existing plant workers reach retirement age.

Excessive failure rates, difficulty in finding spare parts and lack of qualified expertise can all add up to increased downtime - a significant problem for any process plant.

Then there is the performance of the older DCS - it may not be living up to the requirements of today's standards of quality and energy efficiency. Newer systems allow more processes to be automated, enabling tighter control of existing processes and introducing new control capabilities that improve asset management, compliance and energy monitoring, as well as health and safety.

Most plants will have specific main motivations for migrating or replacing a DCS. Generally the motivations will include:

- Obsolescence - the high cost of maintaining older equipment
- End-of-life - the cost of replacing older equipment due to corrosion or age
- Futureproofing - locking in vendor support for a longer period

- Upgrading or replacing - modernising equipment for better performance or new capabilities
- Capacity - current systems are nearing their load capacity
- Improved UI - improving operator performance through better tools, alarm management and reporting
- Cost reduction - improving performance and lowering footprint
- New features - improved alarm management, operator effectiveness and asset management
- Multivendor support - being able to use 'best-of-breed' equipment that may not be possible with older proprietary systems
- Process data at the business level - improving decision-making and creating business agility
- Security - providing better integrated capabilities while reducing security risk

Migrating a DCS is going to represent significant cost to the business, so any plan to replace a system must provide an improved business value proposition - lower installed cost, lower life cycle cost and the ability to take advantage of new opportunities for improvement.

Risk and reward

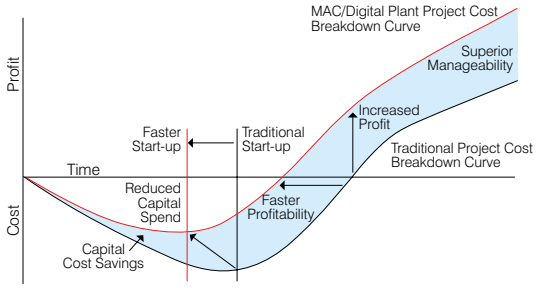
The risk of failure grows exponentially as equipment ages - and the DCS is no exception. Compound this with the reduction in the availability of support, spares and expertise over time, and leaving a legacy DCS in place for too long may become a risk too great.

One question that needs to be asked is: what am I missing out on by continuing to support an outdated control system? Improvements in process performance, operator effectiveness, downtime and maintenance can all be limited by staying with an outdated DCS, but a well-planned and -executed migration to the latest technology provides opportunities for improvement in all these areas.

Modern DCS technology also supports the latest in networking and wireless systems, expanding the reach of the control system into areas that could not be accessed by the legacy system. Essential asset monitoring (EAM), energy conservation measures (ECM) and health, safety and environment (HS&E) capabilities can now all be integrated and supported with a modern DCS.

Have a vision

The fact is a new DCS will offer new opportunities, so the justification for a migration will be helped along if you have a vision of where the plant could be if those new opportunities can be taken



advantage of. Take stock of the capabilities of the current system and determine where its weaknesses and inefficiencies are, then compare that with the improvements available to existing processes that might be possible by upgrading.

Then consider the additional opportunities that newer technology presents. Can the current system be expanded at low cost through wireless technologies, enabling new forms of monitoring such as EAM, ECM and HS&E? Can the current system effectively integrate with business systems to provide the information the business needs to make informed decisions?

It helps to have a vision of where the plant control system might be in the next few years and the benefits a migration will provide to your organisation.

Explain your vision

The initial step is to get buy-in from the plant management that will approve the project. The opportunity to improve process performance, plant reliability, maintenance, energy consumption and HS&E by modernising should be explained to the plant management, maintenance manager, reliability engineer, HS&E officer and project/turnaround manager. Investment in a new DCS can be justified on the basis of improved efficiencies and reduced downtime, as well as the potential for lower maintenance cost, lower energy consumption and improved HS&E, through the new technical opportunities presented by newer technology.

Migration strategy

A well-planned and -implemented DCS migration should enable your organisation to migrate the legacy platform at your own pace, allowing new equipment and software to be easily integrated with the old system. A structured approach will allow the system to be migrated subsystem-by-subsystem, minimising downtime and impact on day-to-day operations, and minimising those elements of the migration that will require downtime.

FEED is the key

The key to a successful migration involves effective front end engineering design (FEED), driving

the bulk of the migration planning into the initial stages of the project. To derive the true business benefit of a new technology, proper planning must take place. As well as proposing a design and migration strategy, the FEED should be able to provide a relatively accurate estimate of business benefit and costs (within 10%), including a detailed functional scope, a detailed project execution plan and a detailed procurement plan. Having a well-defined scope will provide a more accurate estimate, lower contingency and lower overall project costs.

The FEED can also include the required economic justification, including the expected process and business returns on investment.

The effort and upfront cost of the FEED can deliver major financial benefits because it is work that would otherwise be done in the first 10-25% of the project and helps reduce the risk of problems later on in the project, by providing early identification of problem areas and changes that need to be made to resolve them.

Zero downtime migration

Because of its cost to the business, downtime should be reduced to as close to zero as possible.

The money saved by keeping downtime as low as possible is significant, whether it is during a scheduled maintenance outage or during an outage specifically planned for DCS cutover, but of course the ideal situation is to achieve a hot cutover, in which the new system seamlessly takes over from the old system with no need for process interruptions.

Hot cutover, however, does need careful planning and sequencing. For example, simple loops such as indication-only measurements can be cut over first, enabling the team to adapt to the new system in a low-risk environment. Migrating one loop at a time makes hot cutovers more manageable than commissioning an entire unit after a shutdown or turnaround, and minimising shutdown periods for critical instruments and safety systems reduces costs.

Effective communication is also important, so that all personnel are aware of work being performed, and so that safe procedures are followed at all times.

Hot cutover does not make sense in all situations, and migration during scheduled turnarounds is more common in practice.

Preserving valuable assets

It should be remembered that not all parts of a legacy DCS need to be replaced, and so, when assessing suppliers, find one with the flexibility to offer solutions that allow you to preserve assets worth keeping. The embedded knowledge in these systems, accrued over the system lifetime, have ensured that your system has performed the fundamental job it was purchased to do. Any new system to be implemented must offer a compelling value proposition over the old system. It should also preserve the intellectual capital of the old system to the degree that it makes sense to do so.

Use an experienced partner

Key to the success of a DCS migration is not just the choice of system, but in partnering with an organisation with experience and understanding of the complete migration process, and that can demonstrate effective, proven migration strategies. As end-user organisations are facing an ever-reducing experience base in-house, and an increasing range of responsibilities, it is important that the partner organisation is able to provide a complete array of services to assist the migration process.

Your chosen partner should be able to provide a full suite of services, from consulting services and FEED, to project implementation, after-sales service and training. Look for a supplier with strong experience, not only in its DCS product, but also in field instrumentation, control valves, fieldbus, networking and wireless implementation. ■

Minimising risk in a system migration project

8 steps to success

Andrew Kennard, Emerson Process Management*

All control system projects include the same basic components: scope definition, hardware build, software implementation, test, commission. But system migration projects have a very different risk profile to greenfield projects, which means the project management of the two types is quite different.

In one of its recent white papers, ARC reported:[1] "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."

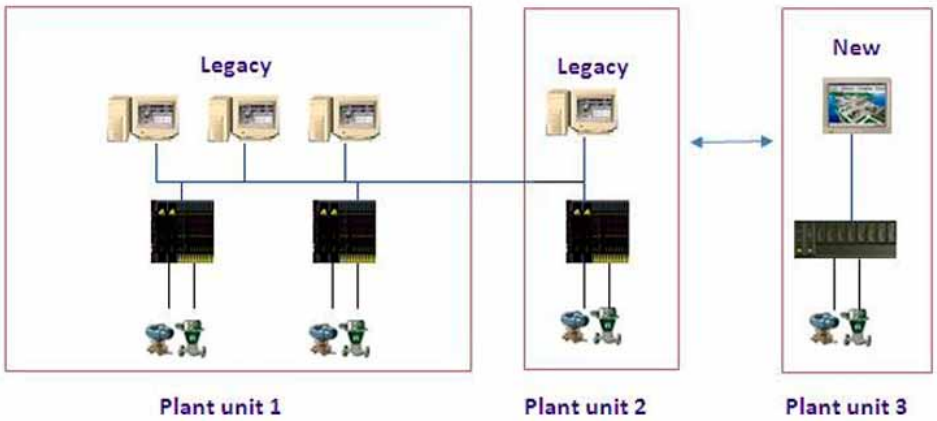
This represents a major challenge for plant owners; how to maintain their competitive advantage with ageing equipment. The challenge is exaggerated due to the fact that the skill set required to build their control system is different to that required to upgrade or migrate it.

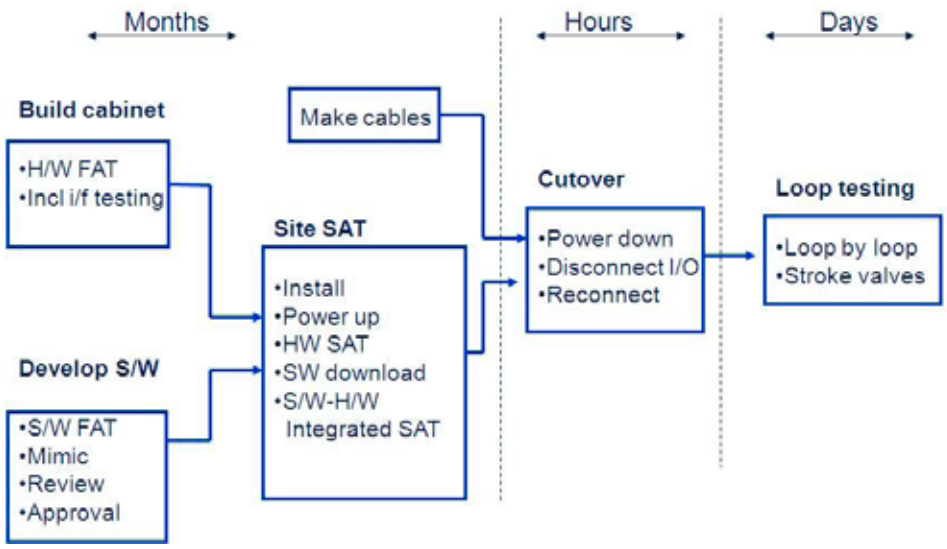
There is an attitude that migration projects only have downsides. Many companies think "today my plant is running and the best I can hope for is that it continues to run after the migration". While this may be a little pessimistic, it highlights the key issue around migration jobs - risk!

So what are the differences between migration and greenfield projects?

First - the good news

There are some aspects of migration that make them easier than greenfield projects. Firstly, with years of experience you know how your process works. You are familiar with the control strategy required and are aware of the important control functions. Secondly, your workforce is experienced, unlike the new staff you are likely to have on a greenfield start-up. In addition, your migration project is likely





to be the key task of the shutdown. Although the work may involve other process improvements, you may be less dependent on civil and mechanical schedules than on a new plant. Finally, you can often gradually execute the migration one step at a time. This can not only help spread cashflow, it can also reduce risk.

Now the bad news

How can you be sure the cutover will be complete in the shutdown window (or even cutover hot)? How can you be sure the control strategy will be as good (or preferably better) as it was in the legacy system? How can you be sure operators will be comfortable with the new system? How can you be sure there are no hidden traps and ensure costs will be controlled?

Below are some suggestions on how to minimise these risks.

Have a good plan

Firstly, to protect the schedule, you must have good plan. Not just a Gantt chart, but a full list of activities and regular progress meetings with your supplier. Clearly identify the risk areas up front and have a plan to mitigate any risks. For example, if you are unsure about the quality of your documentation, discuss the implications for schedule and cost. It may be worth extending or delaying to ensure drawings are accurate. Clearly identify what activities can be performed during the shutdown and what can be completed in advance. Even the shortest shutdowns can usually be accommodated with detailed planning.

Have a clear specification

Secondly, to protect the project budget, have a clear specification. Resist the temptation to simply take the existing configuration as the specification document. It can be used as the basis for writing a functional design specification (FDS) but a clear scope is required. Remember, during testing you will need to sign off on the functionality - the safest way is to test against a complete FDS.

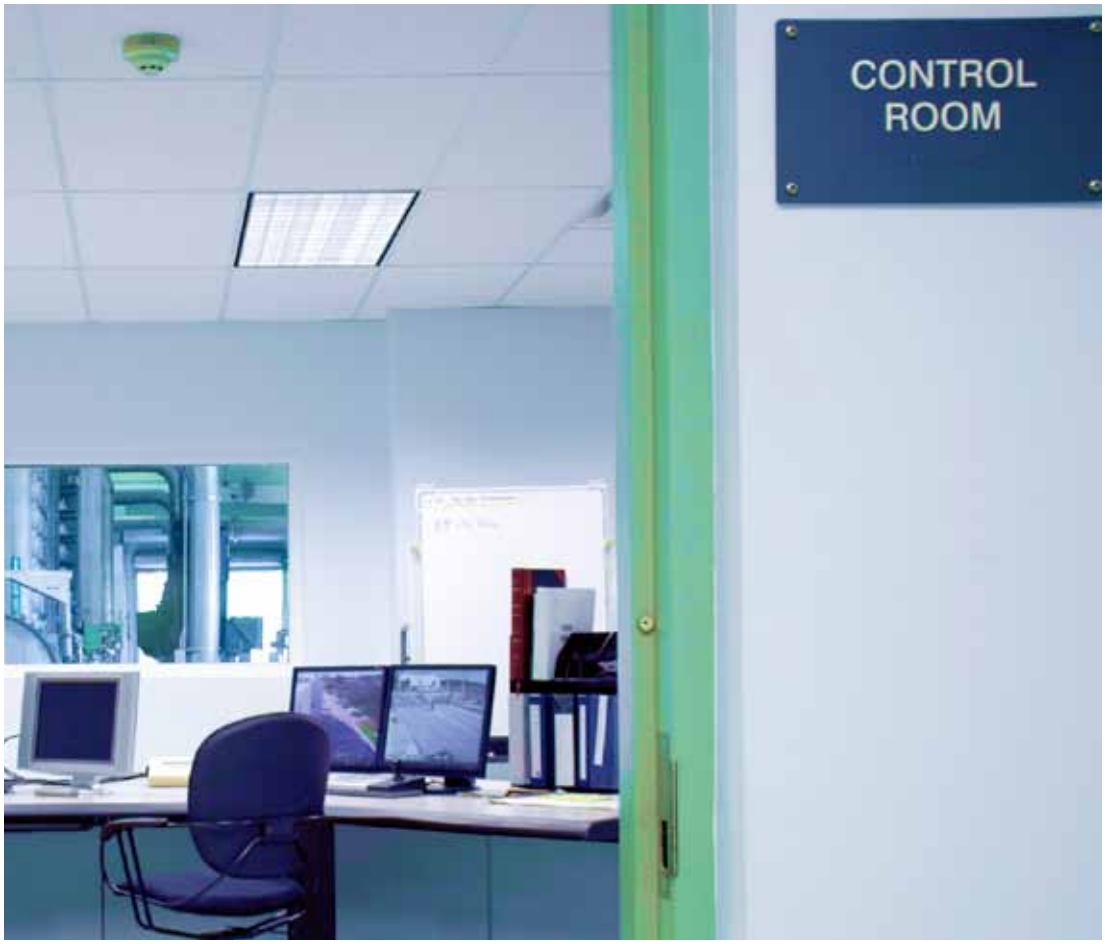
Allow time from your 'day job'

Also, as a plant engineer, don't underestimate the input you will be required to give to the project. Delays in clarifying or supplying missing data will likely have significant impact on the schedule and budget. The new system vendor will make their best efforts to interpret the requirements, but be prepared to dedicate time to the project. Don't plan on doing your current 'day job' full time during the project.

Stage the project over separable portions

If at all possible, you should try to stage the project over a number of smaller separable portions. Starting with a less complicated portion of the project can reduce risk by teaching lessons about the new system and your migration strategy. It can give the opportunity to re-evaluate your approach. One option is a 'vertical migration' split, where a standalone portion of your process (for example, the water treatment plant) is fully migrated as the first stage. A vertical migration has advantages on plants where shutdown time is limited. Consideration needs to be given to any control interaction required between the legacy systems and the new systems.

'Horizontal migration' splits are also sometimes employed, where initially only a single control layer (for example, all workstations) is migrated. Some vendors have solutions allowing various different levels of the legacy system to remain and communicate with new system. Solutions retaining the terminations to eliminate rewiring are the most common. Staged migrations, however, inevitably cost more than a single-step migration; this extra cost needs to be weighed up against any reduced risk they can deliver.



Don't try to keep old strategies

Avoid trying to make the new control system look and act exactly like the old one 'to make it easy for the operators'. You will be putting a 20-year-old strategy into a modern system and inevitably be missing out on many new developments in control system technology. Even worse, the extra effort required to make the new system look like the old one will likely add complexity and risk for the operators. Talk to your vendor and ask for their help in the best way to implement your specification into their control system.

Involve the operators

The best way to get the operators to accept the new system is to involve operators in the project. If practical, get them trained on the new system well before the changeover, so they know what they will be working with. Ask for their help in designing the screen layout, operator interface, graphic displays etc.

Take the opportunity for process improvement

Take the opportunity to improve your plant; try and get some upside beyond simply avoiding obsolescence. Perhaps you can implement a new control algorithm to improve the efficiency of a process unit, perhaps improve plant availability and reduce maintenance costs by taking advantage of the 'smarts' inside modern field devices. Or at least try and position your plant for the future by planning to take advantage of new technologies like wireless field devices, remote access, bus technologies etc.

Be prepared for some things to go wrong

Finally, be prepared to accept some things may go wrong. Even with the best planning there are usually some surprises in migration jobs. Experience has shown that the owner-supplier relationship is the best indicator of how well these issues get resolved. Find a vendor you feel comfortable with and that you can think you can develop a good relationship with. If you don't have an existing relationship with a vendor, ask for references. Look for specific system migration project experience.

References:

1. ARC Advisory Group, ***Emerson's Flexible Approach to Control System Migration***, Jan 2008, ***www.arcweb.com***.

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Taking advantage of newer process control system technologies

Paul Maric

Operators of large production plants rely on the smooth operation of manual and automated process control systems to deliver results and maintain plant uptime. Modern technology and the constant need to further automate and centralise processes has resulted in legacy systems becoming outdated and, in some cases, obsolete.

It's clear that businesses want to achieve operating efficiency, but sometimes don't see the value or need to upgrade process control systems. What new technologies are available on the market? Can older systems be upgraded without a complete overhaul? And what will your business achieve with an upgrade?

New technologies available when upgrading

The days of dealing with unintelligent controls that use vulnerable cabling are gone. Modern process control systems can incorporate over a million I/O points with intelligent control and high-speed fibre backbones to bring real-time plant control, monitoring and trending.

Wiring savings

In years gone by, hazardous areas such as those in chemical plants presented costly obstacles to the deployment of process control systems. Expensive cable protection and costly wall penetrations once limited control cabling in these high-risk areas. Leaps in technology now allow controllers to send their signals wirelessly to an access point outside of the hazardous area with no penetrations or cable protection required.

The cost of mixing old with new

Older process control systems are often costly to service due to the lack of spare parts and a diminishing number of subject matter experts. The natural progression from this expensive situation is an upgrade to a control system that incorporated better supported, up-to-date technology.

The upfront cost of completely upgrading legacy process control systems can be daunting, so a common alternative is to implement newer systems in some areas to coexist with older systems.

Ironically, this type of site set-up can often end up costing more in maintenance, problem solving and lengthy downtime when things go wrong.

Focus on user-friendliness

Advances in software technology now make the management of process control systems user-friendly. Once the initial set-up of a software package takes place, users are able to intelligently scale their process controls using 'drag and drop' functionality. Users can also monitor specific controls in real time, troubleshoot faulty plant without leaving the workstation and process batch jobs on the fly.

Servicing cost savings

Graphical user interface design is as easy as using in-built graphics or can be as detailed as custom-designed backgrounds and icons for easy discrimination. The do-it-yourself approach gives site operators ultimate control over their system, reducing the cost of servicing and call-outs when new equipment is added or removed.

Control of the site's critical plant can be managed from a single workstation on site or remotely using wireless links and wide area networks (WANs). Remote management of process control systems could immediately reduce servicing and callout fees because a technician can maintain or evaluate a piece of plant or machinery from an off-site office.

Detailed security

A more detailed security regimen can also be integrated within modern process control systems. User interfaces can be set up to allow only a certain amount of plant control or programming per user depending on their privileges. This level of control, also complemented with extensive logging and monitoring, not only maintains integrity, but allows for flexibility.

Portability reducing costs

Sites requiring portability and decentralised monitoring can take advantage of smartphones and tablets to manage the process control systems on site. High-resolution graphics can be teamed with ultrafast 802.11n wireless connectivity to securely monitor plant and process controls in real time.

This technological feat is a godsend for sites where plant and equipment may be hundreds of metres apart during servicing and inspections. Technicians can use a tablet or laptop to interrogate equipment, view logs and fix problems while physically at the piece of plant, as opposed to constantly moving between the plant and central control system.

Are these technologies only available when upgrading the entire system or can they be added into an existing system?

Some organisations become discouraged when they realise the amount of work and planning required when upgrading an entire process control system. Most organisations try to run as close to optimal

efficiency as they can, meaning that extended downtime - even to optimise efficiency - further affects business.

Progressive control system upgrades

There are processes in place for upgrading entire systems in organisations where systems can't be switched off at the same time for an overhaul. Staged upgrades allow the old process control system to operate in unison with the new process control system for the duration of an upgrade, meaning business can still take advantage of new process control systems.

Where an entire system makeover can't be achieved due to costs or timing limitations, newer process control systems can be integrated and operate over a proprietary system protocol along with the legacy system. While this type of solution often causes bottlenecks and increases maintenance costs, it is an alternative measure for organisations upgrading in progressive steps.

During the upgrade phase, sites can operate process controls via two systems simultaneously to allow for redundancy and familiarity. Operators can be trained on the new system, while still processing and performing critical functions on the old system. Once the new system is ready, the old system can be phased out and removed.

Whole system upgrade benefits

Ideally, process control systems should be upgraded as a whole to immediately see cost savings and operational advantages.

Aside from long-term cost savings, organisations will spend less money on training and mitigate risk by overhauling systems in one sitting, as opposed to progressively over time.

Each organisation is different and requires a customised plan for achieving success during an upgrade. It's well worth investing in a specialist consultant that is able to accurately estimate transition timing and determine the best way to move forward. An entire system upgrade shouldn't be attempted without due thought, consideration and consultation.

Partial upgrade vs replacement

Investing in future reliability

Don't be surprised if you see the cost of maintaining and servicing your older process control system continuously rising. Also, don't be surprised if you find the number of technicians specialising in your particular process control system decreasing. As legacy systems become older, they're costlier to maintain and support exponentially diminishes. As time goes by, these problems will grow exponentially, so the implementation of an up-to-date control system will be an investment in the future reliability of the plant.

Production and productivity benefits

Upgrading the technology behind your organisation's critical process control system is a logical step forward to reducing operating costs and eliminating the risk associated with aged hardware and outdated software. Cost savings can immediately be seen in areas where limited process reporting and forecasting, or inaccurate controls, can hold up production.

Intuitive graphical user interfaces, faster system response, higher quality reporting and ultimate scalability are just the start of advantages seen when upgrading older process control systems. These advances free up the time of operators, returning productivity to your business.

While the upgrade process can be costly and time consuming at face value, the end result is a more productive workplace, a decentralised control system and fewer maintenance requirements. Upgrading really is a logical step forward. ■

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