Life Is On | Schneider Electric

Business modernization strategies for plant and operations managers

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Introduction

A plant manager who had called us in to discuss a consulting engagement made it very clear that he wasn't looking for just an upgrade of his automation system; he wanted help with his business. Both his business and the economy had changed dramatically since his last automation implementation and he wanted to be sure that his plant was well-equipped for whatever was to come. His request illustrates the difference between upgrading and what we call holistic modernization. Upgrading simply refreshes existing technology, but may or may not provide additional business value. Holistic modernization goes far beyond upgrading by identifying and implementing new sources of automation-enabled, sustainable business value.

Holistic modernization — first and foremost — is strategic modernization. One strategy might be to capture the low-hanging fruit and use those gains to fund subsequent improvements. Another might be driven by the need to mitigate the greatest operational risk generated by obsolete systems and prioritize around that. But any strategy must be pursued in the context of the company's overall business strategy. Holistic modernization is also systematic modernization. It lays out the tactical roadmap for effective execution, leveraging, for example, economies of scale and scheduled outages. This systematic approach simplifies project management, improves communications, and provides better change control.

And holistic modernization is cost-effective modernization. In addition to boosting revenue through improved execution of business strategy, it can reduce overall modernization costs by up to 10 percent over haphazard piecemeal approaches. It enables more accurate quantification of benefits and by strategic use of OPEX can potentially reduce CAPEX. Cost control has been especially high on the minds of process manufactures in recent years, as global economic events have forced everyone to learn to do more with less. But as signs of economic improvement emerge, more and more companies are talking about growth and revenue enhancement strategies and planning to invest in the plant modernization that may be necessary to execute them.

The Pivotal role of plant and operations management

Plant and operations managers are uniquely positioned in the enterprise to view operations holistically and to implement the cross-functional collaboration that is necessary to reap its benefits. Plant managers are acutely sensitive to the impact of production on the business; they are under constant pressure to synch plant capacity with demand. For example, if there is enough demand to operate at 100 percent capacity but they run safely only at 80 percent, they may be looking for modernization that might optimize production or minimize risks. In contrast, if the plant can operate at full capacity but demand warrants only 80 percent, they may be looking in the direction of real-time information systems that might help sell excess capacity on the spot market.

Where the plant managers focus on what to produce; operations managers focus on how. Production scheduling, manufacturing execution, supervisory control, and cross-company collaboration are among their chief concerns. They know too well that obsolete, unconnected system operation can cost money and time, and threatens profits. They see, for example, how inefficiencies resulting when outdated information systems require entering the same data multiple times or when the unnecessary duplication of manual effort produces errors.

And both plant and operations managers are aware that their workforce is aging along with their technology and that any modernization approach must be conducted with that in mind. This affects not only the need for modern solutions for capturing and sharing knowledge, but points also to the need for technology that can improve training and shorten time to proficiency for new workers. And retaining talented workers may also require accommodating their need for interfaces as clean and responsive as the video game and iPhone interfaces on which they have been raised.

Plant and operations managers no doubt appreciate the value of holistic modernization, but amid the press of business and limitations on resources, an if-it-ain't-broke-don't-fix-it strategy takes over. Piecemeal upgrades become the norm as spares become impossible to find and performance begins to degrade. By that time, however, the sense of urgency is heightened and there is little time or incentive to begin looking for new sources of business value. In another white paper, **Controlling obsolescence — Overcoming common barriers to modernization**,[1] we described four barriers that impede holistic plant modernization and presented the basics of a structured approach to removing them. In this paper, we provide plant and operations managers a closer look at implementation of a planned modernization strategy and its benefits at the production, operations, and business levels.

Where to start

Holistic modernization begins with an assessment of your operations in the context of a clearly articulated business strategy. The strategy must define acceptable tradeoffs based on each company's unique market opportunity. In a market where margins are high and product demand is strong, such as upstream oil production, for example, the focus might be on getting oil out of the ground at almost any cost. Alternatively, in refining, where margins are small, profitability strategies are more likely to focus driving costs out of the process.

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[1] Schneider Electric White Paper: **Controlling obsolescence — Overcoming common barriers to modernization**, July 2012

In addition to improving cost efficiency, energy efficiency, throughput, and utilization, factors at play in strategic decisions might include reliability, yield, and downtime. And with the speed of business today, there is more need to manage such tradeoffs in real time. Raw material and energy costs in some cases are changing by the minute. A holistic modernization approach is based on articulating what the plant needs to accomplish from a business sense and then laying out a manageable execution plan to get there. Schneider Electric has built a holistic modernization practice around helping accomplish this. Its current focus is on the following technology areas, which we see as driving many modernization interventions:

- Control system modernization, which helps companies in achieving the business benefits of modern process control technology
- Safety life cycle solutions, which assess safety risks and implement the modern mitigation strategies and technologies
- Turbomachinery control system retrofits, which can defer expensive replacement indefinitely
- Cybersecurity protection, which integrates policy with threat prevention, detection, and removal
- Enterprise and productivity software applications, which enable application integration, collaboration, simulation and modeling, preventive maintenance, energy management, and many other operational improvements

Control system modernization

ARC Advisory Group estimates that, globally, distributed control systems (DCSs) valued at more than $65 billion are nearing the end of their useful life. ARC defines “end of life” by two factors: First, the systems can no longer be maintained. Second, the systems cannot meet modern manufacturing requirements, such as optimizing asset utilization or business system integration.[2]

Unless they have a planned life cycle agreement with a vendor, however, many companies delay modernization efforts to save costs, avoid downtime, or because they just don’t see the value in making a change. This may save in the short run, but could end up resulting in missed opportunities to improve plant operations, safety, and competitive position.

[2] http://arcweb.arcweb.com/featured-reports/The-Control-System-Migration-Survival-Manual.pdf

A modernization effort by a pulp and paper company repurposing its mill to serve a new niche market, for example, revealed that poor energy usage by its aged steam system was a major cost sink. Redesigning its steam utility systems at multiple levels involved modifying control valves turbines and boilers to accommodate their business need to be efficient at lower production. They knew how to be efficient at 100 percent capacity but not at 20 percent. Much more than a like-for-like upgrade, this involved reviewing process design, engineering, and maintenance issues, all in light of new technologies and solutions, and helping find cost cutting opportunities and efficiencies that could not have been done with the existing automation system. The company was well-equipped to implement its business strategy with newfound agility.

As another example, a holistic modernization assessment for a large power company revealed that replacing aging I/O modules would deliver significant benefits by enabling it to take advantage of the diagnostic data that its HART-based field devices were capturing. This alone might almost justify the cost of the new control system, but the assessment revealed other significant opportunities as well. The modern functionality of the system would enable rearchitecting of the control strategy to integrate advanced process control that would reduce NOx and CO emissions while at the same time improving heat rate, reliability, and operator effectiveness.

These are just a few of examples of benefits that can be gained from implementing a modern control system in the context of a holistic plan. Other benefits might include greater reliability through mesh networking, greater flexibility through universal I/O, lower hardware costs through virtual workstations; easier integration with asset management or other enterprise applications through standards-based control software and engineering tools; and friendlier, smarter user interfaces.

Safety life cycle solutions

Process changes or changes in the regulatory environment that occur after a safety system is installed and configured can be overlooked, putting both people and operations at risk. ISA S84.01 standard for application of safety and instrumented systems, and the related IEC 61511 "Functional safety: Safety Instrumented Systems for the Process Industry Sector," set specific design and performance requirements across the safety life cycle. They cover control elements, sensors, logic solvers, power supplies, wiring, communications interfaces, and even the people that operate them.

A safety life cycle assessment, for example, might include a review of all operations in the context of the existing regulations to which a plant might be subject. This includes a PHA HAZOP review, to identify potential hazards; LOPA (Layers of Protection Analysis) and SIL (safety integrity level) assessments to define risk, as well as an ISA S84 and IEC 61511 compliance audit.

One company was struggling to develop a program to ensure ISA S84 compliance to the performance-based standards. A safety life cycle assessment revealed that while the company did have a process in place for identifying process safety risks, it didn't really understand how to utilize that data to assess the risk quantitatively. The solution included mapping out a clear program based on ISA S84 safety life cycle. It included an assessment of the company's current risk compared with its defined tolerable risks and strategy to reduce risk to a tolerable level. The complete program combined training and services and the result is comfort that comes from having a clear map that will make the plant safe through compliance with standards. The company is now not only installing systems that reduce the level of process risk, it is also tracking the performance of existing systems and is prepared to improve them throughout the life cycle of the safety systems.

Another company, this one in the petroleum industry, found field devices connected to its control system via programmable logic controllers (PLCs) and that the PLCs were performing a safety function by using an intrinsically safe barrier as a multiplexer to connect a single device to two systems. Most standards recommend against this and it is contrary to industry best practices. The company chose to pull the I/O from everything associated with safety interlocks and put that into a modern triple modular redundant (TMR) safety system, which segregates the control and safety functions. The result was a compliant, safer system with substantially lower risk profiles.

Ideally, the safety life cycle assessment would be conducted prior to implementation of a safety instrumented system. This would then guide the specification of the system to be sure that it matched the risk profile of the company and the standards requirements of whichever authority has jurisdiction over the plant, being a government agency, insurer, or the plant itself.

Plant and operations managers know too well that responding to a single safety breach can cost a company millions, if not billions, of dollars, and, as such, most have accepted related expenses as a cost of doing business. But we have found that a life cycle approach to plant safety can actually improve performance. This is because lack of information about real plant risks tends to dictate caution in plant operations, but if LOPA and SIL analysis, for example, can provide a clearer assessment of risk, it is likely to extract more performance from a plant without putting workers at risk.

Protecting cyber assets

Like plant safety, return on cybersecurity is difficult to measure because it is not easy to determine how many problems were thwarted by vigilant practices. Attacks are real and increasing, however, and good practice dictates fortification.

For companies in the U.S. power industry, cybersecurity protection is more than just good practice, it is the law. North American Electric Reliability Council (NERC) regulations require companies to identify and protect cyber assets located in potential electronic security perimeters. The Department of Homeland Security focused on utilities first because they were most critical to the industrial infrastructure, but it appears to be only a matter of time before NERC critical infrastructure protection type requirements are applied to other industries. Regardless of whether it is the law or good practice, however, most of our clients are increasingly acknowledging the need for cyber protection and are now looking for the most cost-effective way to secure their operations beyond control system vendor equipment.

Cybersecurity protection plays into holistic modernization at both the consulting and technology levels. At the consulting level, a cybersecurity risk analysis is a key component of a modernization assessment. Just as a PHA analysis would seek to uncover potential safety hazards, a cybersecurity assessment identifies points of vulnerability and ways to create an electronic security perimeter that protects cyber assets. A thorough assessment addresses cybersecurity vulnerabilities at the site, system, policy, procedure, compliance, and risk levels. Such an assessment is most effective when conducted by experts who understand cybersecurity, IT, and distributed control technologies in the context of an enterprise strategy that encompasses manufacturing and business systems.

At the technology level, modern automation systems are more cybersecure. As awareness of potential threats grows, the market increasingly expects cybersecurity protection to be built in to all new generations of products. Microsoft®, McAfee®, Wurldtech®, and other cybersecurity leaders are working with control system vendors to create a unified front to provide cybersecurity protection at the core system application level. Schneider Electric control systems, for example, are designed to enable safe integration into Microsoft Active Directory so that each employee has a unique user name and one password, which can be managed securely by the IT department. Our workstations no longer have unused programs, services, and ports, and users have the ability to create strong passwords.

A more modern control system can also simplify and reduce the cost of regulatory compliance without jeopardizing performance. A new DCS that Schneider Electric installed for a U.S. power industry client helped the client comply with NERC standards. Not only did it help the client meet a pressing deadline, it also increased its engineering functionality and safety performance by approximately 50 percent, giving the company the ability to add new displays, implement logic changes, and install new parameter interlocks for better handling and management of alarms.

Holistic modernization must provide the cybersecurity context for all infrastructure improvements. Any new technology or network has the potential of opening up new windows of vulnerability and requires the creation of a new security profile for the network. Holistic modernization addresses this initially with the definition of policies and procedures for system upgrades by initial and routine audits similar to LOPA studies that might be conducted for safety.

Rejuvenating turbomachinery

Much of the installed turbomachinery was built outside of the U.S. and parts are becoming harder to find and more expensive as equipment ages. Likewise, the number of people who are familiar with the subtleties of operating and maintaining this equipment is decreasing. Although the older systems that are still using analog-based controls present the greatest risk, some of the digital upgrades of the 1990s still have analog inputs and outputs that are definitely due for an update.

A wide range of technical assessments is necessary to determine which retrofits are needed and which are even possible. This includes performance, surge control, governor control, and capacity studies. It includes assessment of protection systems, steam balance instrumentation, and human-machine interfaces. It could also involve analysis of various simulation reports. Such studies and analysis reveal retrofit opportunities that would be all but undetectable otherwise.

Turbines, for example, must be tested at speeds much higher than those that would be used in normal operation and those that still use mechanical overrides often fail during these tests. Repair requires complete shutdown and restart. Replacing the mechanical system with an electronic override, however, enables online testing, which can model performance at high speeds without danger of failure.

As another example, turbines in cogeneration plants can lose power due to service interruptions from the cogeneration system itself from the public utility. A modernization assessment at one plant found vulnerability in the turbine control system that had been installed in the 1960s. Retrofitting the turbine governor, the excitation system, and generator protection system with a TMR control system architecture eliminated any single point of failure and enabled continuous operation.

In addition to manual over speed, mechanical safety system, and total controls upgrades, other modernization efforts might include retrofitting an aging turbine with a new HMI to make it easier for users to interact with the system or utilization of high fidelity simulators to train operators, optimize control strategy, or check out logic and system tuning in a low-risk setting. Simulators can also reduce the time to proficiency for operators, which can help fill the skills gap that is growing as the turbomachinery experts themselves age out of the workforce.

Image 1

Before modernization

Image 2

After modernization

A platform for holistic modernization

The distributed control, safety, turbomachinery, and cybersecurity interventions discussed above can yield significant business value in and of themselves, but tight integration with each other and other enterprise applications can lead to new heights of business optimization. Much like availability of the common iPhone or Android mobile phone development platforms has fueled the creation of a new generation of applications; a convergence of standards in industrial automation has contributed to the creation of a new generation of advanced industrial technology that enables companies to extract greater value from existing assets.

Schneider Electric, for example, has built a robust industrial integration platform based on a service oriented architectures approach that extends Microsoft .NET capabilities to handle the real-time objects that are vital in critical industrial processes. Adding industrial strength capability to this open technology platform simplifies integration of legacy, third-party, and a comprehensive portfolio of control, safety, asset management, collaboration, business process management, and other applications that Schneider Electric has created for optimal operation on its platform. Following are examples of the applications that make the process plant of the future available — and affordable — today:

- Server virtualization, which allows the user to consolidate many PCs and servers into a high-availability virtual host server, reducing heat load, weight, and power consumption, as well as reducing total cost of ownership associated with maintaining many computers.

- Workflow automation software, which, for example, might store and enforce a sequence of proven procedures by which a plant worker might respond to an alarmed incident, notifying all affected parties of status and progress in real time.

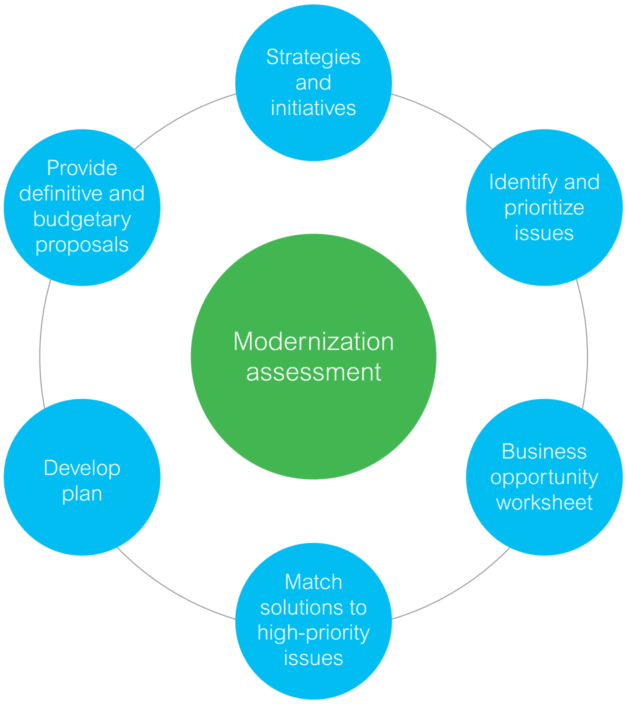
- Real-time energy management systems, in which profitability based on consumption in energy-intensive operations is monitored in real time, in the context of dynamic energy markets.

- Real-time online modeling, in which, for example, every bit of raw material that comes into a process is tracked, measured, and compared to output with analysis of variance pointing to process variances.

- 3-D virtual-reality simulation systems, in which, for example, workers can train on handling hazardous situations in a realistic virtual situation much like a pilot trains with a flight simulator.

- Controlled combustion, where advanced process control software monitors the firing of boilers and other equipment, and adjusts in real time to minimize excess O_2, CO, and NOx emissions.

The opportunity to create a fully business-optimized company has never been greater. The challenge is that realizing the potential requires unprecedented cross-company and cross-functional communication. Plant managers are pivotal to the process because they face business, operational, and production challenges daily and are perhaps more sensitive to the impact of the tradeoffs than anyone else in the company. Operations managers, likewise, are the people best qualified to implement the cross-functional policies, procedures, and automated tools that can manage the delicate balance of resources necessary for success in a dynamic environment. And automation suppliers can play a key role by not pushing technology for technology's sake but by working closely with clients to be sure that the technology that they offer actually delivers business value.



Help is available

Schneider Electric has designed its holistic modernization program to help companies manage the myriad of strategic, technical, and financial decisions that must be made to mitigate the effects of obsolescence. We provide an objective perspective on what needs to be done based on experience with standards, best practices, and industry expertise. We break the inertia that is often the greatest barrier to the benefits that modern plant can deliver.

Tailored to your site, we begin with an assessment of your strategies, initiatives, and site-specific issues. We meet with key stakeholders to understand objectives and priorities. We help create a vision of where you would like the plant to be into the future and guide you in setting the priorities for what needs to be done to get you there. And we work with you on a long-term plan that helps you avoid both technological and business obsolescence.

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