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Reducing risk in large-scale process automation projects

Making the most of main automation contractor relationships

by Harald Konermann

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Introduction

Process plant owners and operators are increasingly discovering that assigning responsibility for the entire automation scope of a major capital project to a single vendor can have tremendous cost and performance benefits. Instead of being one of multiple automation vendors whose work must be coordinated and integrated, the single vendor takes responsibility for the full scope of the process automation system, from initial Front End Engineering and Design (FEED) and planning, through commissioning and lifetime support. This might include the engineering design; delivery and procurement of control, safety, and package control; machine monitoring systems; and sometimes field instrumentation.

Designating one vendor as the main automation contractor (MAC) can reduce implementation costs by as much as 30 percent, reduce long-term maintenance costs significantly, and contribute to the long-term successful operation of the business. Realizing these benefits requires close attention to the following critical success factors:

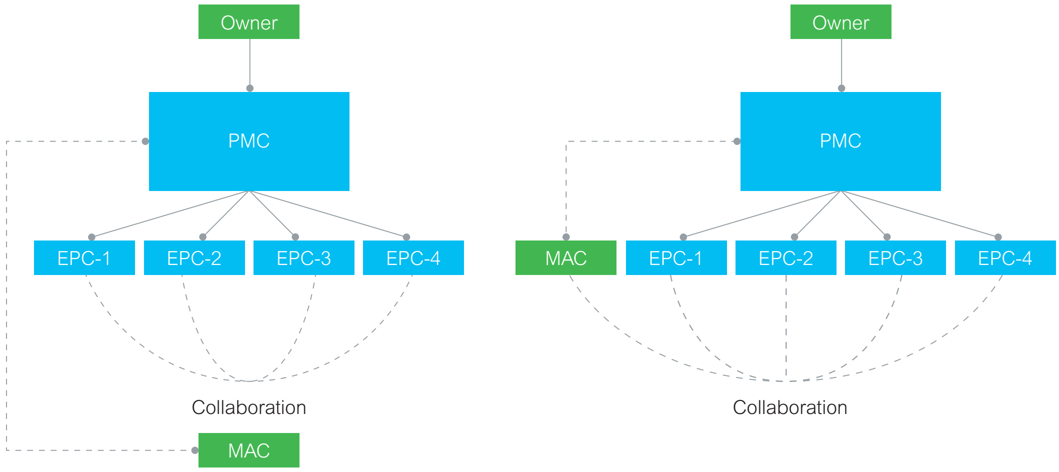
- Clear delineation of roles and responsibilities of all participants
- Early involvement in the process
- Robust project execution strategy
- Consistent project management methodologies and automated tools supported by a strong governance process
- Reliable, broad, and tightly integrated technology portfolio
- Unwavering vendor commitment to add value and garner trust

The more completely the project addresses these factors the greater the success of the implementation and ongoing, beneficial operation of the process automation system.

Clear delineation of roles and responsibilities of all participants

Structuring the relationship between the owner, engineering, procurement, and construction (EPC) firms, and MAC so that each party is assuming risk commensurate with their domain expertise is the first step in managing risk. In a typical MAC relationship for new construction, process plant management will appoint a project management contractor (PMC) who coordinates the activities of EPCs in providing the baseline engineering and construction of the plant. The MAC contracts either with the plant owner, the PMC, or an EPC to provide all automation systems and related implementation services.

Figure 1



In one of the world's largest grassroots refinery projects, for example, Schneider Electric Process Automation contracted with both the owner and the PMC to deliver the full scope of automation. The plant was designed to produce 400k B/d, which required distributed control of 120k hardwired conventional I/O points and 250k serial I/O, supporting both the distributed control system (DCS) and safety instrumented system (SIS). In addition, the automation system included supervisory control and data acquisition, off-site systems, asset management, and an operator training simulator (OTS). Schneider Electric provided all project management, cost/schedule control, FEED, procurement, interfaces, systems integration instrumentation services, commissioning, training, and operations support. The PMC was also an EPC on the project and Schneider Electric participated with them in aligning the automation elements in projects of 11 other EPCs, which were selected from 30 possible candidates. The contracting model was so effective that when Schneider Electric won a follow-on project to design and implement an integrated refinery information system for its entire refinery, the customer immediately choose the same contractual arrangement.

While MAC relationship models are becoming increasingly common in Oil & Gas industries, they apply to any industry in which putting a large process operation online quickly is beneficial. The largest coal-fired power station in North America, for example, contracted with Schneider Electric to implement all automation systems necessary to control eight 500 MW units, each requiring 4,000 I/O points.

Automating the power plant included engineering and installation of all automation controlling field devices, burners, turbines, feed pumps, soot blowing, combustion, exciters, and vibration monitoring. It included construction engineering and materials procurement and engineering of hardwired discrete motor and valve controls. It also included procurement and installation of instrumentation, including transmitters, signal conditioning, and intelligent valve positioners. On the information and communications end of the project, Schneider Electric had full responsibility for designing and implementing all data acquisition, archiving, and integration with plant information system as well as design and procurement of custom alarm monitoring displays and hardware selectors panels.

The time from project start to commissioning of the first unit was approximately nine months, a time frame that would have been impossible if the owner had to contract separately with and manage the more than seven different automation vendors that would have been used on a contract of this scope.

Both of the above examples involved new construction, but a large upgrade project often has scope comparable to a new installation and the potential to reduce risk through a MAC relationship. Through a single contract with a liquefied natural gas plant in the Middle East, for example, Schneider Electric coordinated a project involving three major upgrades. One upgrade involved 10 onshore DCS in 10 different locations; another involved a single DCS distributed across five locations; and the last part involved migration of five SISs in four onshore locations and one offshore. Each involved simultaneous changeover in five or fewer days. The stated delivery window on the project was 14 days and each day of lost production would have cost the company $15 million in lost revenue. The client had built in a three-day contingency for the project to extend beyond the stated delivery window, but, because of the tight synchronization, contingency was not needed, avoiding $45 million of lost production.

Early involvement in design

Once the plant owner establishes the scope of the project and the contractual relationships that determine who takes responsibility for each component of the implementation has been set, the next stage in the automation project is the FEED study. Traditionally, EPCs created the FEED study, often with little if any involvement from the automation suppliers. They would then select and bring in the automation suppliers to execute the design. Of late, however, a key component of the MAC relationship is early involvement in the FEED.

Changes required later in the project life cycle can add significant costs and delays. Early involvement by the MAC experts who will be installing and eventually maintaining the system can significantly reduce the need for later changes partially because transition between specification and configuration will be more efficient.

Recognizing the importance of early involvement, for example, the owner and PMC of the refinery mentioned above brought Schneider Electric in early to work with them in creating the automation FEED study. Schneider Electric then coordinated its implementation with 11 EPCs located around the world.

Robust project execution strategy

Once the design is complete, successful implementation requires compliant and consistent execution across geographies, cultures, and stakeholders. The project execution strategy lays out the structure and management of the entire project and its strength affects the effectiveness with which the project teams react to changes, communicate, and transfer technology. It is also the basis for consistent design, sharing of experience, optimal loading, and facilitated testing.

Schneider Electric accomplished all of the above for one client using a multitiered execution strategy. Leading the project was a project management team, which included a project director, QA/QC manager, and senior project manager, who were supported by other key functions, such as project planning, project administration, supply chain management, and material management. Reporting to the project management team was a technical core team headed by an engineering manager and composed of lead engineers, systems architects, and subject matter experts for each of the key disciplines, such as OTS, off-site systems, asset, alarm management, and turbomachinery controls.

To optimize collaboration and communication with the EPCs on this project, Schneider Electric assigned dedicated resources for each EPC. The team included a control engineer responsible for liaison with that particular EPC, a QA/QC coordinator, and a project manager, all in strict coordination with the correspondent MAC core team members.

While the project execution strategies will differ based on scope, physical location, number of EPCs, and other variables, the common element in all is clear and efficient delegation of responsibility for each activity.

Consistent project management methodologies and automated tools supported by a strong governance process

While a robust resource deployment strategy is fundamental, the benefits of consolidating responsibility for project execution will be realized in its tactical implementation. Unanticipated circumstances, scope changes, design inefficiencies, poor communications, and inconsistencies in material and equipment selection are among the many factors that can push a project beyond its planned startup date.

Consolidating responsibility in the hands of a single vendor enables enforcement of standards and the use of integrated engineering tools across all automation parties. Structured and systematic use of risk management practices in cooperation with the client enables early identification of possible issues and the creation of mitigation plans, which ensure both quality and on-time delivery.

Schneider Electric, for example, enforces its project execution strategy via a formal stage gate process and thorough work breakdown schedule. The stage gate model ensures that all activities are completed and reviewed before exit. As illustrated in Figure 2, all work is broken down into a discrete series of stages, which, in many instances, will run in parallel across different parts of the overall project.

Figure 2

Stage gate work breakdown schematic

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No stage is exited, though, until the project manager and lead engineer sign off that all tasks are completed in a formal governance and review cadence, such as illustrated in Figure 3.

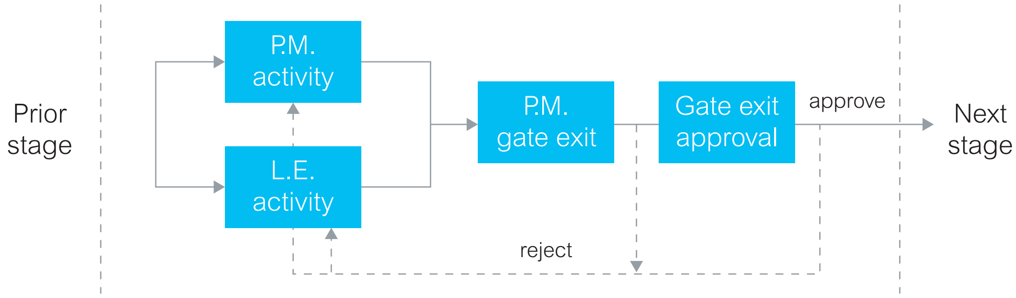

Figure 3

Stage exit review gate

Who is responsible for what is made clear by the MAC structure. Guiding respective managers in assuring high-quality performance in each stage are a wide range of standard practices, models, and templates. These include compliance with global open standards, such as the project management best practices fostered by the Project Management Institute (PMI). In addition to meeting PMI standards, Schneider Electric bases its implementations on standards cultivated over many years of handling large-scale automation projects. Figures 4 and 5 summarize the quality and safety measures that must be achieved before the project can advance to the next stage.

Figure 4

Quality measures required for a project to move to the following stage

Stage	
Initiate and set up	• Required knowledge and skills are identified and made available during the project life cycle. • A solid plan to execute and commission the project is in place. Risk management is defined. • Scope is clearly defined into an agreed project specification. • Measurable project quality attributes are identified.
Design	• Detailed engineering and project implementation meet specification requirements. Company or project best practices and engineering procedures are applied. • System operates with consistent outputs and operator interfaces, according to agreed factory acceptance test procedures.
Integrate and deliver	• Equipment and system are integrated with consistent outputs, according to agreed installation and operational protocols.
Install and commission	• Integrated equipment and system operate with consistent outputs, according to agreed performance protocols.
Close	• Equipment and system continue to perform to specification over an agreed period and meet the actual process requirements according to agreed performance protocols.

Figure 5

Safety measures required for a project to move to the following stage

Stage	
Initiate and set up	• Involved project managers have proven in field expertise and training to perform over the project scope. • Project milestones are designed to accommodate flexibility. Check points are identified to analyze and solve project deviations. • Project engineers and lead engineers are identified, assigned, trained, and certified. Cybersecurity conditions and alarm management are specified.
Design	• Company or project best practices and engineering procedures are applied. • Equipment and systems operate as specified. Electrical, mechanical, and process control norms are satisfied.
Integrate and deliver	• Commissioning engineers are identified, trained, and certified.
Install and commission	• Integrated equipment and systems operate according to agreed specification limits. • All alarm conditions are tested according to alarm test protocols. • All end-user personnel are properly trained and certified.
Close	• Equipment and system continue to perform to specification over an agreed period. • Maintenance, backup, and recovery procedures are in place. • Periodic training procedures and change management procedures are in place.

Enforcing such standards across an entire project is key to time and cost savings. Efficiencies come in through standardizing procurement practices, engineering practices, and interfaces. Other efficiencies come from streamlining program management and still others from contingency planning.

Increasingly, automated tools help enforce standards. Flexible, Lean EXecution (FLEX), (Figure 6) for example, is the automation project execution program from Schneider Electric Process Automation that enforces common workflow and processes via a centralized, controlled template library and rule sets. Its distributed architecture provides concurrent access to geographically distributed users, enforcing application security controls access to different work packages. This helps coordinate operations, simplifies import of P&ID information from design tools like Intergraph SmartPlant, enables viewing and configuration of all control system I/O, supports simulation of the DCS and safety system prior to start up, and maintains a simulation environment that supports design verification and operator training.

Reliable, broad, and tightly integrated technology portfolio

Technology choices made during implementation reduce risk not only during the implementation but throughout the entire operating life cycle. Operating, installation, and integration features are all factors in risk reduction. The following are characteristics of automation technology that contribute:

- Control systems — Distributed control, safety, turbomachinery, and other critical control systems are at the heart of any large automation installation. Risk factors include reliability, security, potential obsolescence, features that facilitate implementation, and ease of integration with complementary technology.
- Scalability — Scalable systems enable expansion of automation technology as businesses grow and change. The company may not need a massive number of I/O points initially, but when and if it does, it may face system replacement or risky add-on strategies if the installed system has grown beyond its capacity.
- Reliability — Reliability relates to designed capacity, but it is also a function of architecture. The control systems should, for example, have fault tolerance and redundancy built in at every level. Safety systems should have a 100 percent track record of not failing on demand.
- Cybersecurity — Security protection can be added at any stage, but the later in the process, the greater the cost. Vulnerability protection should be built into the hardware. Standards set by recognized standards bodies, such as Wurldtech and NERC, should be met.
- Obsolescence — Some automation systems come with the risk that they will eventually become obsolete. To avoid this, for example, Schneider Electric has designed its control system architecture to accommodate the most modern hardware and software advances.
- Implementation-friendly architecture — Control systems that support virtualization can significantly shorten time to compliance. In traditional DCS architecture, physical servers networked with large workstations access the control layer. In a virtualized architecture, however, hosted virtual servers replace physical servers and more economical thin clients replace the large workstations. (Figure 6.) This reduces the cost of owning and operating physical services and expensive workstations, and speeds system deployment as well.

Figure 6

FLEX is based on a number of components providing the methodology (in grey) and the technology (in blue) to deliver a MAC project on time, with the lowest installed cost, and lowest risk consistently around the world

Turnkey automation systems, for example, can take 18 months to complete depending on their size and complexity. By performing the engineering configuration of the control logic on virtual systems instead of physical system hardware, and implementing an automation project leveraging the FLEX program, the delivery time frame can be significantly accelerated.

- Ease of integration of third-party equipment — Typically, the more automation technologies manufactured by the same vendor, the lower the risk of implementation because the integration of the technology will be more compatible and the vendor will have had more experience in integrating their own systems. In addition to increasing long-term reliability, this reduces the cost and the time required for any custom coding that might be necessary cross platform interfaces.

- Systems designed around open architectures take the integration capability one step further. The engineering software built into the Schneider Electric control platform, for example, is built on an industrially hardened version of Microsoft® .NET software, which makes it easier to integrate with legacy and third-party software. One refinery that has implemented this platform uses it not only to integrate Schneider Electric products, but third-party solutions as well, which is especially critical when working with multiple EPCs or in connecting new systems to existing systems.

- Simulation and advanced process control software — Seamless integration of control systems and simulation, optimization, training, and advanced model predictive control can contribute to risk reduction on many levels. Simulating the control environment in advance can reduce time to commission and helps validate designs independent of hardware. Model predictive advanced process control improves process profitability by enhancing quality, increasing throughput, and reducing energy usage. Online multiunit modeling enables online optimization applications to help users obtain peak financial performance from their operating units and the supply chain. Integrating this with OTS software means that operators can begin training on the new system earlier and be ready to hit the ground running on plant start up.

- Operations management software — As the scope of automation expands beyond the plant floor to include real-time operations and business performance management, the ability of the MAC to deliver additional applications that are compatible with the production systems also contributes to risk reduction. Applications include enterprise asset management, workflow automation, enterprise manufacturing intelligence, mobile workforce management, energy management, and much else.

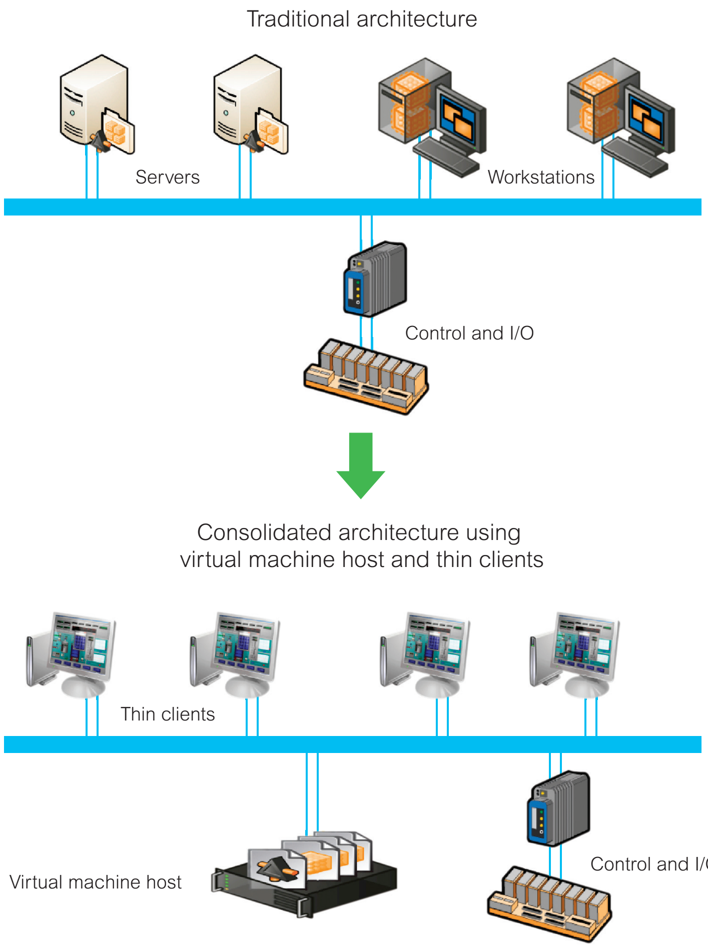

Figure 7

A virtualized control architecture accelerates commissioning and helps identify configuration issues early

Unwavering vendor commitment to add value and garner trust

Applying proven practices and technology enables maximum control over risk, but after all the features and benefits are evaluated, the success of the project depends on the people that are implementing it. When we ask clients why they selected Schneider Electric for new or continuing projects, for example, their answers frequently relate as much to personal qualities, such as the maturity, integrity, and reliability of our people, as they do to our project management and engineering depth.

Given that the quality of your automation system and its installation will determine, in a large part, how much value you can extract from your assets, the selection of a MAC could be one of the most important business decisions your company will ever make. Taking the time to look closely at the processes, products, and people that will be involved could pay off in reduced risk, lower cost of installation and ownership, and assured long-term successful operation of your company.

About the author

(Harald Konermann) Vice President Global Delivery & Vice President EMEA