Life Is On | Schneider Electric

Eight Strategies to drive Enterprise Profitability through Unified Power Management and Process Automation

Oil & Gas and Petrochemical Industry Segment

Executive summary

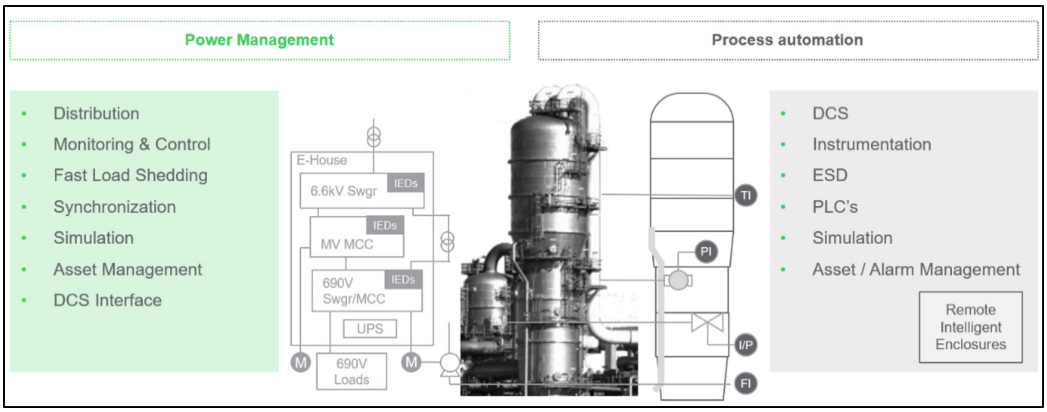
Recently we've seen several major Oil, Gas, and Petrochemical engineering and operating companies begin to consolidate their automation and electrical personnel, mostly from an organizational efficiency perspective. With the convergence of technology development and the constant pressure to reduce total expenditures and carbon footprint, we now have an opportunity to rethink the synergies between power management and process automation on a much broader scale. This paper sets out eight approaches to capitalize on this integration between power and automation.

Introduction

For many practical reasons, electrical power management and process automation have traditionally been designed and operated independently throughout the lifecycle of a plant. Pressure to reduce CAPEX and OPEX costs is driving an initiative to integrate process automation and power management. Strong evidence indicates that integrating electrical management and process automation throughout the lifecycle of a plant offers dramatic benefits. Eight strategies are outlined, including examples from the EcoStruxure™ Power and Process approach offered by Schneider Electric and AVEVA.

Figure 1

Separate plant power and process infrastructure in a typical refinery.

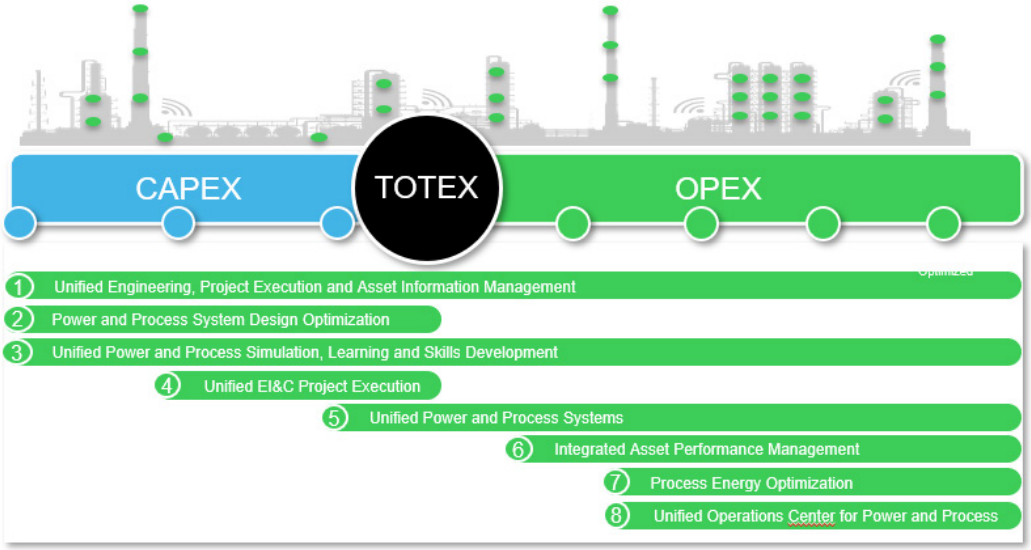


By implementing these strategies, enterprises are empowering the workforce and can realize the following benefits:

- Maximized Capital and Project Efficiency: the unification of the process model and plant model lifecycles into a digital environment enables process innovation and mitigates capital project investment risk, reducing overall project capital costs by up to 15%.
- Improved Asset Reliability and Performance: Help customers to increase longevity and performance of asset, while ensuring a safe, secure and reliable environment for the workforce, enabling up to 15% unplanned downtime reduction.
- Increased Process Energy Optimization: Design for lower energy usage and sustainable operations using less energy and reducing carbon footprint by up to 7-12%. By operating at lowest cost of energy, enable cost reduction of 2-5%.
- Maximized Profitability across the Value Chain: Maximize yield, through-put and efficiency using a single 360º view of plant operations. Enable cross-functional decision making across the entire supply chain, from trading to planning/ scheduling, and operations to product distribution, resulting in up to 3% points in profitability improvement.

Figure 2

Eight strategies are depicted at key points in a plant's lifecycle.



Digital transformation allows power and automation integration to offer a comprehensive view of asset performance management; total energy management, and the entire value chain. The integration strategy impacts the lifecycle of the plant, from initial conceptual design, to construction and commissioning, to ongoing operations, and throughout the maintenance phase.

This paper describes integrating the two domains, and the five principal attributes of each strategy:

- The "*Connection*" between these two domains
- The gaps or "*Challenges*" that exist in the absence of integration
- An explanation of their relationship and how they can be integrated
- An outline of the "*Solution*" that brings the two domains together
- The business value or "*Benefits*" that are realized through an integrated approach

Strategy 1: Unified Engineering, Project Execution, and Asset Information Management

Connection: The unified integration of asset information includes the power and process engineering asset data of the plant.

Challenge: Traditionally, asset models of the plant were developed during the design phase but were not maintained through its lifecycle. EPCs (Engineering, Procurement, and Construction companies) worked with comprehensive data for the plant, but the development of asset models created during design often weren't updated during construction. This resulted in gaps in understanding the plant asset, less effective operator training, and reduced engineering efficiency. Disconnects can exist between process and discipline engineering, while design iteration loops between these groups at key milestones were unsynchronized. Separate personnel, databases, and work methodology contributed to mistakes, rework, delays, and cost overruns. In a worst-case scenario, such errors resulted in under-sized equipment being discovered during start up, or over-sized equipment that generated higher OPEX costs.

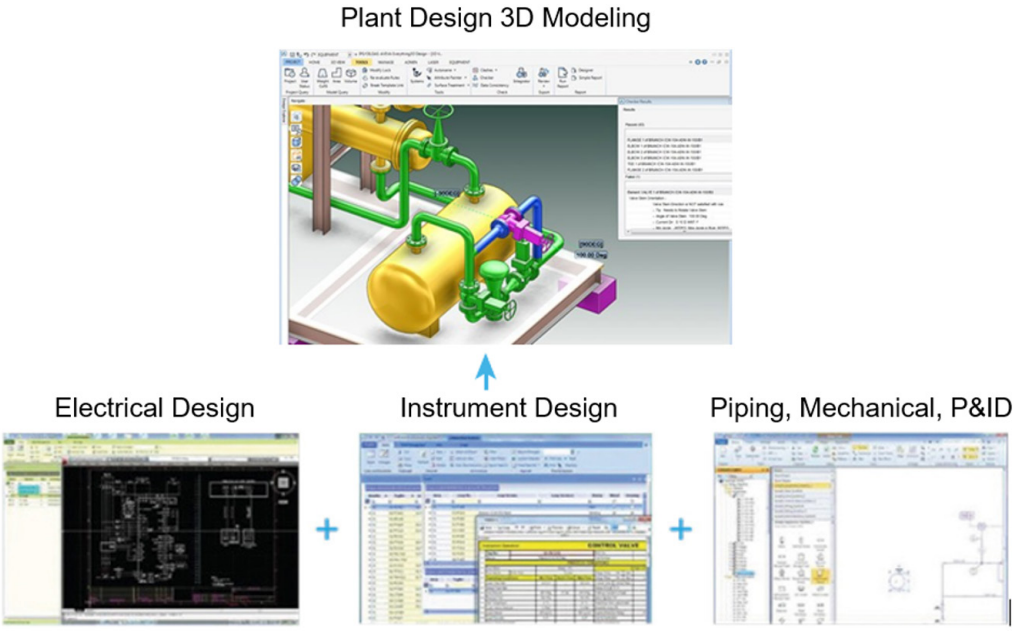
Description: Unified Engineering provides end-to-end integration of conceptual, FEED (Front End Engineering Design), and detailed design into an environment that handles all process simulation and engineering (1D, 2D and 3D) from one single data hub with bi-directional information flow.

This provides customizable, multi-discipline 3D design tools to aid in the construction of process plants. It also creates an asset digital twin of the plant – a three-dimensional model of the physical plant equipment that can be utilized throughout the plant's life cycle for design, training, maintenance, expansion, and more. The digital twin matures through stages of FEED studies, detailed design, construction, and ongoing operations. This includes asset information for industrial manufacturing processes, power systems, and equipment.

Using the example of a variable speed drive, traditional specifications might include dimensions, heat loss, instruction manuals, and terminations. The digital twin includes this information and a 3D model of the drive along with details like standard configurations and a consistent asset performance management framework. In addition, the digital twin of this equipment item can enhance simulation capabilities as described in Strategy 3, such as embedding function blocks for process simulations, power utilization data for electrical system simulation, and more.

Figure 3

Customizable 3D design tools enhance the construction of plant processes.



Solution: The digital twin incorporates the entire plant, including process and electrical distribution equipment, to unify the engineering data across the entire lifecycle. This also serves as a foundation that can provide augmented, virtual, and mixed reality experiences for the users. Embodied in the digital twin, the Unified Engineering solution is built on a single database that is maintained in real-time. Changes in attributes of assets propagate automatically, reducing human error and improving efficiency. This foundational technology supports a seamless evolution into a Unified Simulation Platform described later in this paper for Strategy 3.

Benefits: Unifying the engineering and asset information has profound and sustainable benefits, particularly at the intersection of power management and process automation. Project delivery time is shortened, engineering efficiency is enhanced, and construction costs are reduced. Managing changes, multi-discipline collaboration, and project document

creation (e.g., piping and instrument diagrams, process flow diagrams, load lists, dimensional layouts) can be automated to reduce design errors, improve workflow efficiencies, and generate new insights to reduce capital expenditures for instrumentation, control, and electrical systems, and to ensure performance to project schedules.

Strategy 2: Power and Process System Design Optimization

Connection: There's a strong interdependence between electrical power systems management and process automation due to plant power requirements being largely determined by the requirements and operating parameters of process equipment.

Challenge: Uncertainties in process electrical demand encourage power system over-design, increasing construction and operating costs.

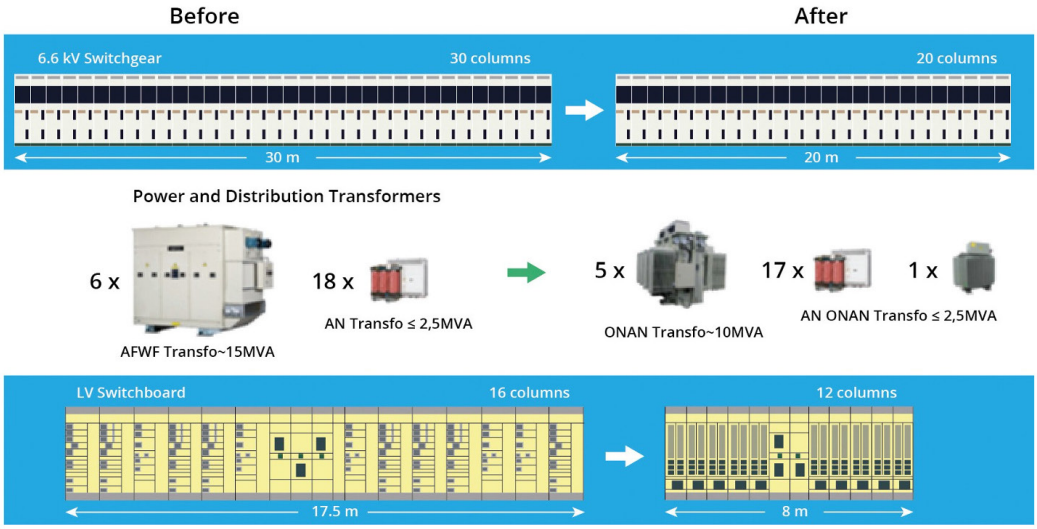
Description: Optimizing power and automation system design aligns equipment with expected power demands, including start-ups, shut-downs, abnormal situations, and fast load shedding scenarios. It also supports synergies between the electrical distribution and process automation systems. This is accomplished through early engagement with Schneider Electric energy management and automation experts, along with the use of electrical and process simulation modelling tools from AVEVA.

Solution: Power generation and distribution equipment can be a substantial part of a project's cost. Power generation equipment and facilities can cost four to five times that of electrical distribution equipment, and therefore optimizing it is critical to the project's financial performance. For example, gas turbines and motor-generator sets are often integrated in a large facility to minimize their footprint, but the space requirements for power generation and electrical distribution equipment can be reduced, which is important where space is at a premium, such as within a prefabricated modular power building (E-House), on an offshore platform, or on an FPSO facility. Likewise, where an E-House is used, the control equipment for both power and process automation may be co-located, further optimizing the overall design.

Early engagement between the EPC firm and the facility owner/operator maximizes the benefits by affecting the scope and size of the power system. By modelling the process and associated power requirements, trade off decisions such as generating power to lower utility costs and shedding loads can be analysed. In turn, these options impact the size and layout of equipment, such as transformers, switchgear, bus bars, etc. Elements within the power system model that are impacted by optimization project include transformers, induction motors, generators and breakers with built-in protection logic.

Figure 4

Optimizing low and medium voltage architecture aligns equipment and feeder capacities.



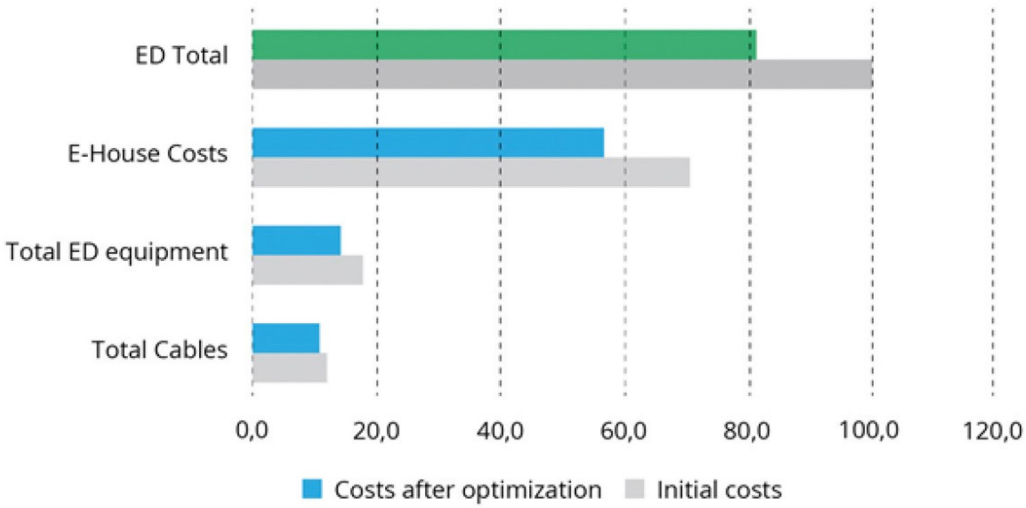
Benefits: Matching power consumption with more efficient power systems can reduce CAPEX, OPEX, emissions, and maintenance costs. Benefits include:

- Reduced CAPEX by up to 20% of electrical and automation infrastructure
- Faster project design, start-up, and commissioning
- Reduced emissions and OPEX through more efficient operations

By applying an integrated power and process architecture early in the plant lifecycle, the power system requirement and footprint for an E-House that will meet process power demands safely and cost-effectively can be determined. Figure 5 compares the initial cost and sustainability of the electrical infrastructure for a typical offshore project before and after optimization, showing a significant cost reduction in four major areas, including reduced wiring, labor, and testing.

Figure 5

Typical cost savings of 20% by optimizing offshore platform electrical infrastructure.



Strategy 3: Unified Power and Process Simulation, Learning and Skills Development

Connection: Unified Simulation builds on the asset digital twin in Strategy 1, and predicts power, process, and business performance. This provides a continuously current behavioural model that is applied throughout the lifecycle of the plant. The digital backbone is a crucial component to unify the simulation platform. The 3D model combined with a Unified Simulation then becomes a "living" digital twin, possessing both physical asset and performance characteristics.

Challenge: Typically, design changes place automation and power design on the critical path because process simulations are not integrated with the 3D asset models and include only chemical and physical processes, not electrical system responses. Unified Simulation includes both process and power to embody the design of the plant and to simulate responses to changes in process conditions, feedstock, and business directives. Integrating the three principal domains that have historically been distinct creates new value:

- 3D designs of the asset
- Fundamental physics and chemistry of the process
- Performance of electrical system infrastructure

Description: Unified Simulation is used for engineering, commissioning, staff training, asset condition monitoring, and real-time optimization. The "living" digital twin possesses reliable predictive capabilities over a wide range of design and operating parameters. The Unified Simulation is concurrently upgraded via the asset model without having to recreate the simulations. This behavioural twin becomes a vital digital asset and essential tool during the life of the facility.

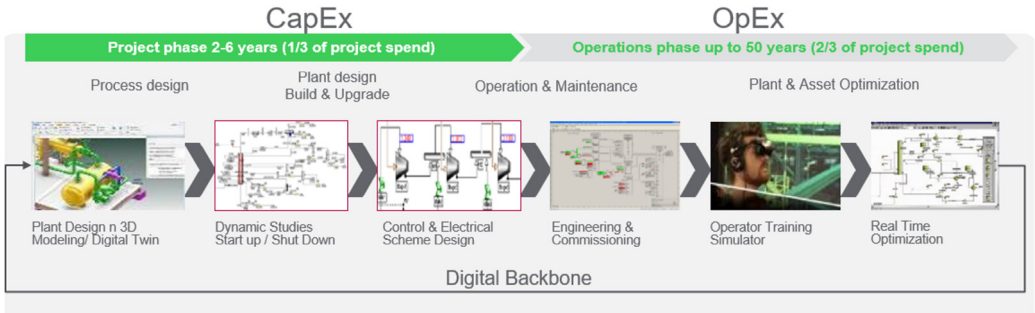
Solution: Unified Simulation enables virtual studies of process start up and shutdown, control scheme design, controls checkout, operator training, asset performance monitoring, and real-time optimization. The behavioural twin can be integrated with the 3D models described in Strategy 1 to animate the 3D digital twin with the physics and chemistry of each process. The behavioural simulation starts in the conceptual design phase to provide a macro view of the design options. As the simulation develops in the FEED stage, the model expands to include standard general asset intelligence for the plant with an auto-generated common engineering database that includes power and process equipment. During the detailed design phase, the simulation platform uses the engineering database to streamline work, while enabling continuous testing of the power and process design. Engineering design becomes more agile as changes to the model are tested. Start-up takes advantage of the digital twin to deploy operator training without the need to rebuild models for a separate operator training simulator — saving both time and money. The digital twin can evolve to reflect the same power system and process control logic as in the corresponding plant systems.

Benefits: The model created during the design phase is leveraged during plant start-up and operates as a unified platform, eliminating the need to rebuild models. It is possible to train operators, evaluate unit performance against the model, monitor asset operation, and provide real-time optimization. Together, this increases energy and process efficiency to improve business performance. As depicted in figure 6, the

digital twin delivers value throughout the lifecycle of the plant, reducing CAPEX during the project phase and OPEX during operations. Process reliability, energy efficiency, and sustainability increase while risk is reduced using model-based decision making.

Figure 6

Unified simulation reduces CAPEX and OPEX across the lifecycle of a plant asset.



Strategy 4: Unified Electrical, Instrumentation, and Controls Project Execution

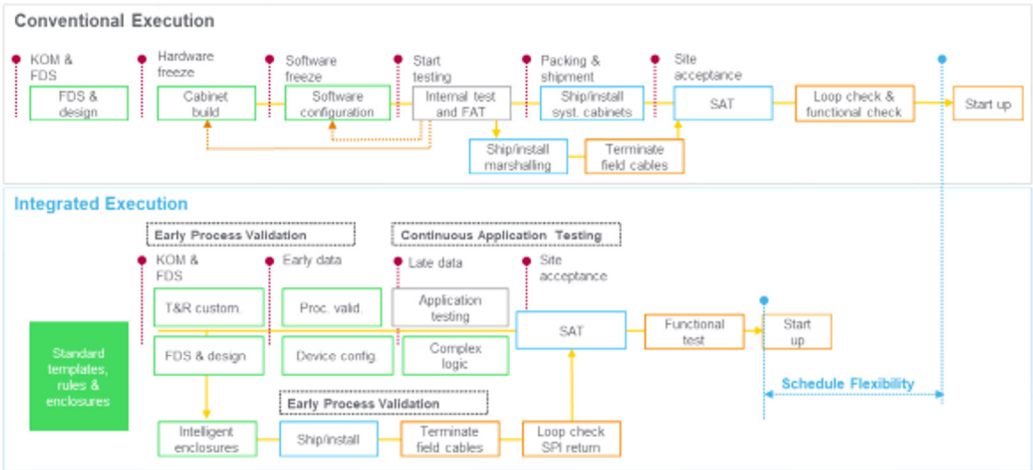
Connection: The role of Main Automation Contractor and Main Electrical Contractor emerged in the early 2000s to deliver complex solutions on-time and on-budget for capital project execution.

Challenge: These two disciplines have historically been managed separately, as were the methods that guided their design and construction work. This introduced added expense, time and risk to project completion.

Description: The Main Automation and Electrical Partner (MAEP) would be responsible for unifying both process automation, electrical distribution, and energy management control systems. The MAEP works closely with the EPC firm around a broader design scope for the project, thereby enabling better coordination and integration of systems and reducing risk, especially during plant commissioning. This new approach simplifies the process from early design to project management for the EPC and owner.

Figure 7

Integrated project execution methodology and supporting technology by Schneider Electric typically reduces related CAPEX and schedule up to 30%, in addition to trimming OPEX.



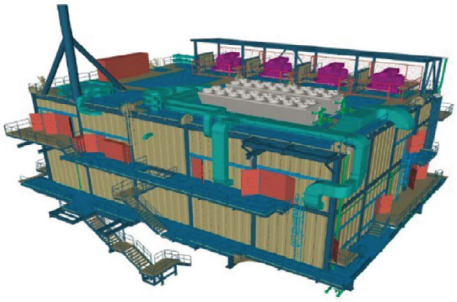
Solution: Integrated automation and electrical systems, including E-House, can be designed and constructed at the MAEP facilities. This enables optimized overall sizing and completion of integrated testing prior to shipment to the site. Additionally, the Flexible Lean Execution Services (FLEX) approach efficiently delivers projects from design to construction. FLEX includes the ability to continuously test the system during the design and configuration stages through virtualization in a cloud environment. The combination of methodology and technology has the potential to

substantially reduce changes and minimize risk to the critical path, reducing time to operations. The MAEP leverages the technologies and methodologies described in this paper to build on the power of the digital twin to plan, design, and optimize the process and electrical infrastructure for an entire facility.

Benefits: As a result of implementing the methods described in this paper, the MAEP assumes and mitigates those sources of risk that would otherwise be borne by the EPC and owner. Having the planning, design, and commissioning overseen by a single project management office, under the responsibility of the MAEP, serves to reduce surprises during the project execution. Uncertainties are reduced as process conditions, process automation systems, and the supporting power distribution facilities are aligned and optimized by the MAEP using the tools and methods described herein. The full MAEP approach is a key element in achieving the overall CAPEX reduction of 20% and improves scheduling by up to 25%.

Figure 8

Example E-House containing integrated power and process automation systems. It is also referred to as a local equipment room, power control room, or remote instrument enclosure.



Strategy 5: Unified Power and Process Systems

Connection: The control of plant processes and the management of associated electrical systems are required functions for any processing facility. These two systems interact with each other, and proper alignment of these systems is required for safe, reliable, and optimal performance.

Challenge: With separate DCS (Distributed Control System) and EMCS (Electrical Management and Control System), engineers and process operators have less visibility into the status of the electrical systems and their impact on process units. For example, the process operator may attempt to start a section of the process and be unaware of a condition that may compromise the electrical distribution network. Two separate systems can create unnecessary redundancy in the control and monitoring infrastructure, leading to greater complexity in the form of multiple databases, additional engineering tools, separate operator stations, hardwiring, and network components. Separate systems also make it difficult to diagnose process disruptions caused by electrical systems.

Problems presented by separate power and process systems include:

- Redundant engineering and extended commissioning
- Lack of incident and event traceability
- Increased infrastructure costs and delayed deployment
- Needless complexity from multiple system interfaces
- Confused maintenance priorities
- Limited flexibility to reconfigure as the plant scales up

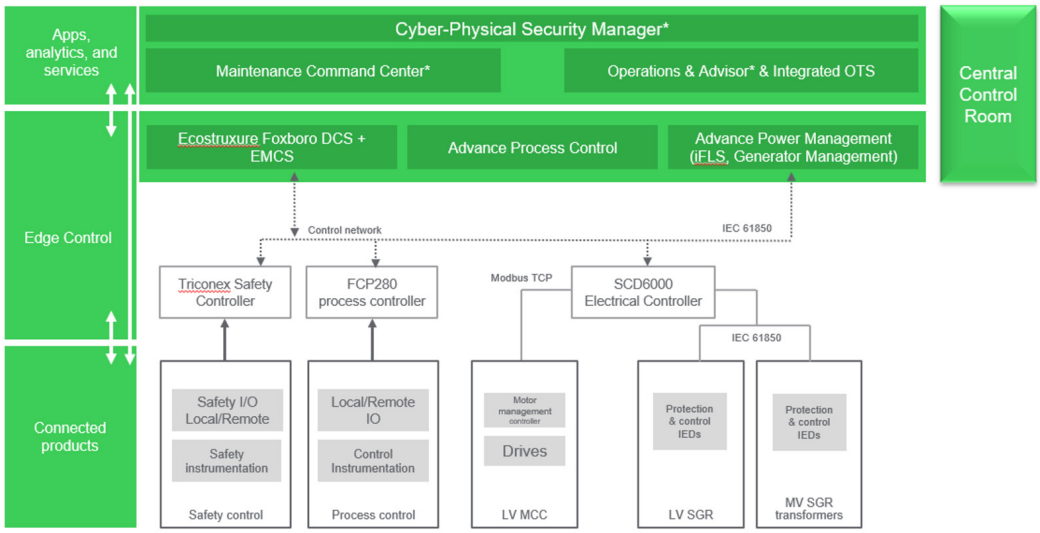
Description: A single platform rationalizes the different subsystems and EMCS system functionality, while addressing the specific needs of the process operator and electrical operations and maintenance personnel.

Solution: Integrating power and process systems combines the capabilities of the DCS, Safety Instrumented System (SIS), and the EMCS in a single control architecture. Schneider Electric is one of the few control system suppliers that can deliver an integrated control platform spanning both power and process. To avoid power disruptions, an integrated system provides the control room operators with full electrical system visibility, alerting operators of conditions that may compromise the electrical distribution network before a process is started. It also identifies how the intelligent Fast Load Shedding (iFLS) Electrical Management Control System will impact a process. A real-time view of electrical system status allows process operators to avoid actions that might unnecessarily stress or trip electrical systems. In addition, the system facilitates the analysis of faults, trips, and shutdowns through a common database with sequence of events analysis.

Benefits: Reducing cabinet space and cabling is a welcome benefit for many installations, particularly facilities with space constraints like brownfield retrofits, offshore platforms and FPSO facilities. Redundant field control stations, gateways, and servers can also be rationalized. Testing, commissioning and troubleshooting duration is likewise reduced, while improvements in operations and maintenance efficiency can be realized by understanding the interaction between process and electrical systems, boosting uptime and reducing cost.

Figure 9

Example DCS, SIS, and EMCS integration based on the Schneider Electric EcoStruxure architecture



Strategy 6: Integrated Asset Performance Management

Connection: Effective asset management applies to all plant assets, including processing equipment, rotating equipment, electrical systems, and control and instrumentation systems. All these assets are inter-dependent, and a holistic view of their status and performance is required for improvements in the overall facility.

Challenge: Process operators are increasingly expected to optimize plant performance and improve return on capital employed while ensuring safety and reliability. It is difficult to link or identify root causes between seemingly disconnected events that can impact the performance of common assets or systems. For instance, an operator may implement

process changes that overstress rotating or electrical equipment, causing unplanned downtime and increased maintenance costs. Or frequent failures may be caused by control loop instability issues that cause unnecessary equipment wear. Without an integrated asset performance management system, it is more difficult to analyse and eliminate the root cause of the equipment issues.

Description: Asset Management is about diagnostic monitoring and maintenance of plant assets including electrical supply/distribution, process equipment, turbomachinery, and the automation infrastructure that monitors and controls these assets. Asset performance management collects data about how equipment is performing and provides the tools and applications that enable the best use of assets to safely achieve operational goals at minimum cost.

Complementing traditional asset management applications, IIoT enables the use of real-time condition-based monitoring, performance monitoring, predictive diagnostics, alarming, and reporting. It also enhances prescriptive upkeep, moving beyond predictive analytics to actually prescribe recommended next steps for maintenance. Analytics and machine learning applications, as referenced in figure 10, can take advantage of the large body of asset data in the cloud. A remote service bureau, like the EcoStruxure Power and Process service, can apply these tools to increase equipment and plant reliability and make prescriptive recommendations for maintenance.

Solution: An integrated asset performance management system encompassing both power and process data to provide an asset-centric view of operations, enabling engineering and maintenance teams to collaborate and analyse issues that involve multiple equipment classes. The system streamlines and removes friction points from Maintenance and Operations work processes.

Advanced cloud-based analytics and digital services enhance these traditional functions in a way that creates new insights in the cause-and-effect relationships between equipment conditions and failure modes. Data is integrated within a single platform where it can be leveraged by data analytics and machine learning technologies to distil important relationships that would otherwise be overlooked. Cloud-based condition monitoring and predictive analytics can include insight from equipment across multiple systems, disciplines and across all asset classes, including a combination of planned and predictive maintenance actions based on the asset risk model.

Operational safety management digitizes the execution of inspection, maintenance and modification work to improve the safety of plant operations and compliance with relevant safety regulations. This includes functions such as automating the manual permit processes and automating maintenance work flow.

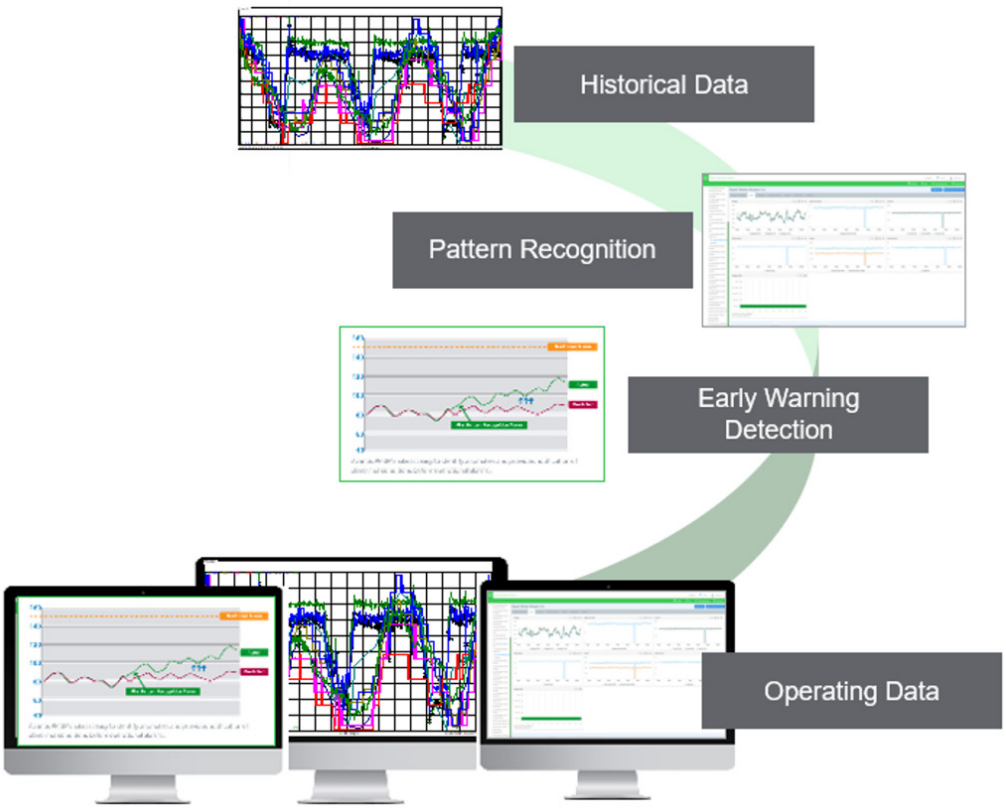
Benefits: According to the ARC Advisory Group, “The global process industry loses about $20 billion annually, or five percent of annual production due to unscheduled downtime and poor quality. ARC estimates that almost 80 percent of these losses are preventable, and 40 percent are primarily the result of operator error.”

This analysis is a good indicator of the potential savings and operational improvements from an integrated asset performance management solution and is easily supported by broad sources of value, including:

- Increased production uptime and return on assets
- Extended equipment life and availability
- Streamlined procurement processes
- Increased labour productivity

Figure 10

Example of predictive analytics applied to critical equipment architecture



Strategy 7: Process Energy Optimization

Connection: Energy consumption at major industrial facilities include electrical, gas, fuel oil, and steam power, whose expense is second only to raw materials. There's also an impact on carbon footprint and overall sustainability. Effective management of the interactions between process and energy usage is essential to master both sustainability and financial performance.

Challenge: Operational decisions are often based on periodic views of feedstocks, energy costs, maintenance requirements, and environmental events, meaning real time opportunities for improving energy usage are regularly missed. In addition, operators seldom understand the impact their process decisions have on the cost of energy or overall sustainability.

For example, EON found that 2 out of 3 managers typically don't know how their business buys energy. Deloitte found that 53% of companies lack an energy vision that aligns with their corporate vision. Operators must address these gaps to effectively reduce energy costs and overall carbon footprint.

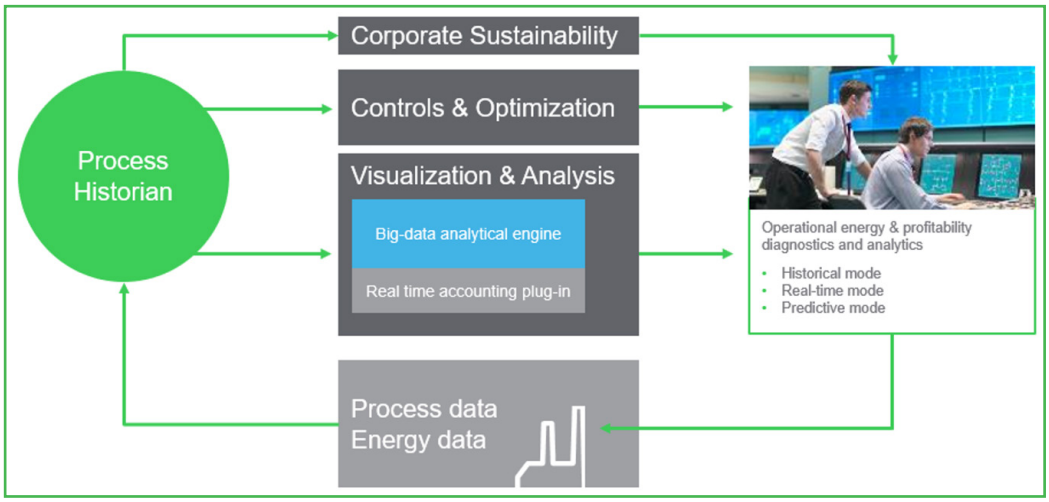
Description: The physics and design of a process dictates the relationships between production and the use of power sources. Energy optimization manages the trade-offs between these energy types throughout the process to minimize both overall costs and the plant's carbon footprint. It also incorporates the effective contracting and usage of sustainable energy sources and reports on sustainability metrics.

Solution: With improved profitability and sustainability as the overarching objectives, the effective energy optimization solution is built on three technologies (figure 11):

- A Big Data analytical engine that incorporates historical process and energy data, then applies analytics to gain insight into the process.
- A digital twin to predict the optimum mix of electricity, fuel, and steam usage that minimizes cost per unit of production within sustainability objectives. It includes the efficiencies of major equipment, such as steam turbines, and prescribes the order in which turbines should let down steam, for instance. This approach enables plant-wide optimization of energy that is unachievable through conventional control methods.
- Real-time accounting capability uses process and energy data to measure the financial and sustainability performance of an industrial operation in real time. It incorporates data from the equipment level of a plant, up through the process, plant area, plant site, and enterprise level. The results are presented in dashboards so operators and executives alike can see how their policies and operating decisions can boost profitability and sustainability.

Figure 11

Process energy optimization processes real-time and historical data from advanced process control and real-time optimization, then uses big data analytics to provide real-time guidance on plant profitability.



Electrical power sources are critical, especially for energy-intensive processes. As discussed in Strategy 2, this consultative solution evaluates facility power sources, starting in the design phase. For a brownfield plant, the assessment evaluates power from the grid versus local power generation, including the use of sustainable supplies, when available..

Figure 12

Holistic view of strategies, data and resources needed to reduce consumption, drive innovation and maximize savings

Benefits: Operators have access to real-time energy economics and sustainability metrics, instilling accountability in operations. Optimized energy management can increase process efficiency by reducing energy used per unit of output, thereby reducing overall carbon footprint. The trade-off between energy sources is optimized and stakeholders throughout the organization are provided timely information on the cost of energy and the impact on profits due to changes in operating conditions. Reliability and profitability increase as processes and equipment are optimized for energy consumption in line with sustainability objectives.

Energy savings of 7% to 12% are typical for mid- to large-scale plants, along with a further 2% to 5% reduction of energy purchases through effective contract analysis and execution. Energy-as-a-Service can also be evaluated and implemented to address needed improvements in electrical infrastructure resilience, sustainability, and CAPEX minimization.

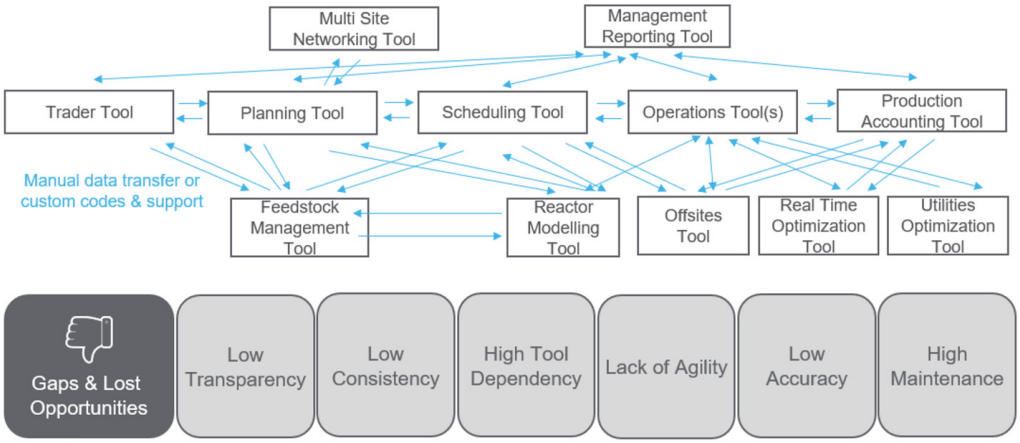
Strategy 8: Unified Operations Center for Power and Process

Connection: Whether the overall value chain is focused on a single plant, several plants at a common site, or multiple sites, maximizing economic value is central to the financial strength of a company. Knowledge of the prevailing market conditions and opportunities, plus the current operating status and capabilities of the facilities' power and process equipment is crucial to optimization.

Challenge: Although hydrocarbon value chains often have many software tools, they are rarely integrated in a way that minimizes delays, mismatches or allows running hundreds of scenarios per day instead of only a few. In addition, existing software is inaccurate because crude/feedstock characteristics and refineries and petrochemical facilities frequently exhibit highly non-linear behavior. Coupled with market volatility, it is virtually impossible for plant operators to intuitively know which feedstocks to use, which products to make, or the optimal operating conditions that will produce maximum economic benefits within reliability and safety constraints. As figure 13 depicts, the traditional approach to value chain optimization involves a variety of different tools, databases, and manual data transfers, plus the occasional use of custom-developed applications.

Figure 13

Workflows associated with poorly integrated value chain optimization tools.



This traditional approach to value chain optimization results in significant performance gaps and lost profit improvement opportunities. “Closing the loop” also becomes hard, as timely interpretation of actual results versus plan is challenging. As a result, updates to the operating schedule and operating modes are often slow to be implemented, which can result in growing deviations between optimal and actual performance. In addition, yield information required for the business model is not captured consistently, and does not represent actual process capabilities.

Optimizing the value chain is only possible if the enterprises’ facilities are operating safely and reliably. Integrated power and process management is a cornerstone of safe and reliable plant operations, and a key enabler for the enterprise to optimize its value chain.

Description: Value chain optimization unites real time asset information, the predictive digital twin, and current market conditions to derive optimal business and operating decisions. This includes decisions such as feedstock selection, product production rates, and required operating conditions. This breaks down the silos between planner, scheduler and operations, resulting in agile responses to market opportunities, which is especially critical in volatile markets.

Solution: Enabling enterprise collaboration and agility to maximize profitability across the value chain requires a unified and accurate application environment and architecture that supports streamlined, automated workflows to facilitate the best business and operating decisions, as illustrated in figure 14.

Figure 14

End-to-end value chain optimization solution

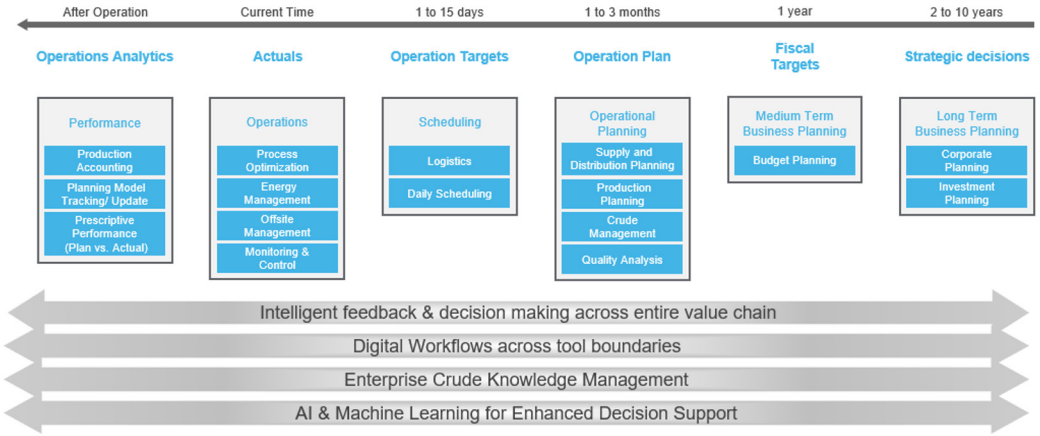
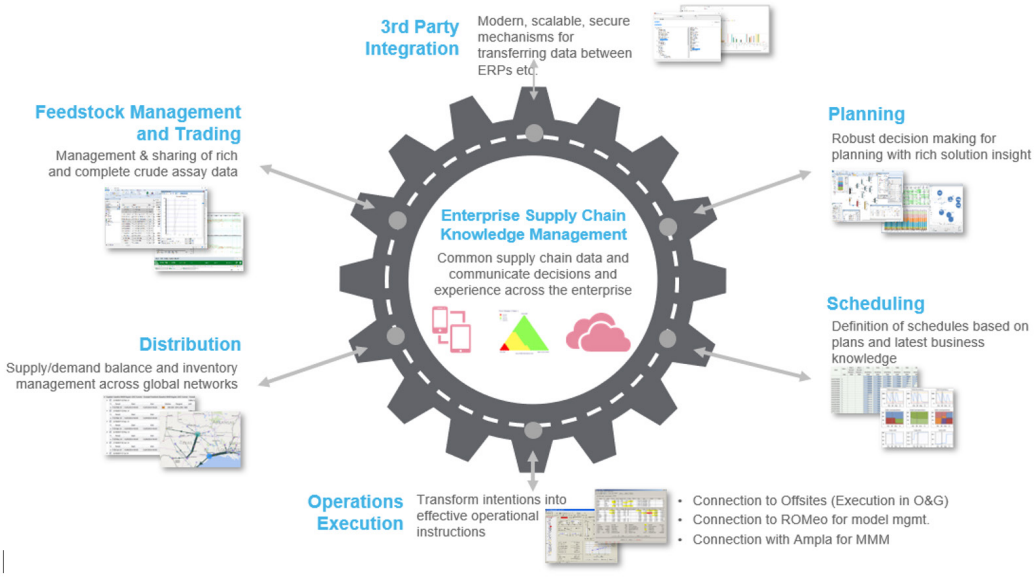


Figure 15

Unified supply chain optimization solution



Another crucial component is enterprise visualization and optimization. Assembling a comprehensive view of asset performance (e.g., energy efficiency and power consumption versus plant operating conditions) requires integration of electrical and process data. Such visualization supports early identification of possible equipment problems and/or performance, and an ability to assess the economic consequences of such faults on the overall value chain.

Example

Unified Operations Centre providing visualization, collaboration, and business decision support for an enterprise value chain.

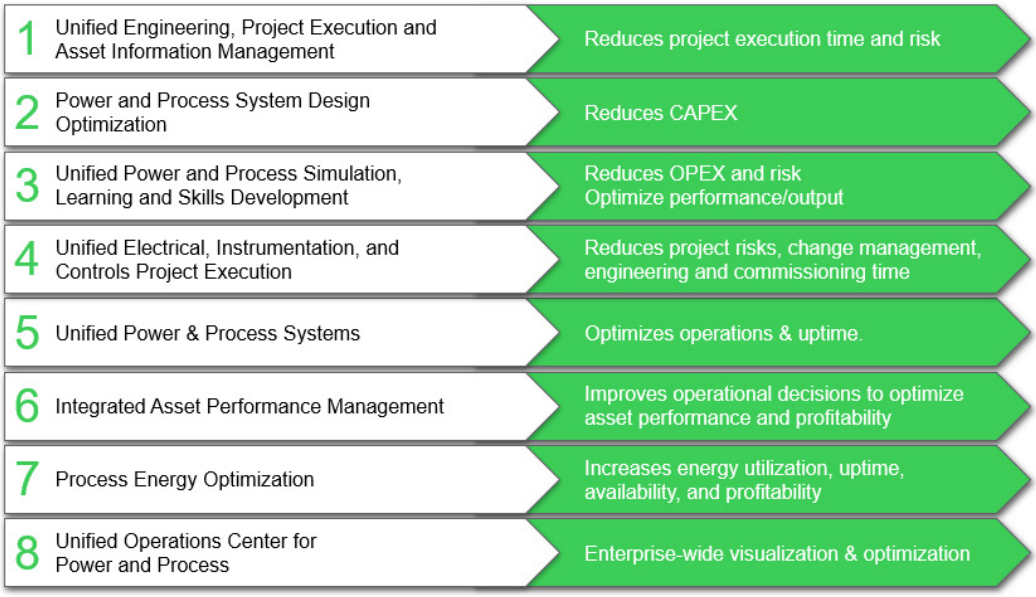
Benefits: A unified value chain optimization solution implemented in a contemporary IT/OT architecture has been shown to deliver significant benefits by facilitating quick and accurate decisions regarding feedstock selection, setting of operating targets for the enterprise's process plants, and development of medium-term and long-term business plans. For example, a large, integrated oil and gas company in the Middle East is achieving monthly benefits of $60 million to $100 million through deployment of a unified value chain optimization system. The results of the system's calculations are presented to decision makers using a state-of-the-art graphical command and control centre. Another international oil and gas company replaced a series of legacy, non-integrated value chain optimization tools with a unified system that reduced decision times from ~ 7 hours to a little over 3 minutes, resulting in an incremental benefit of $0.70 per barrel of crude oil processed. The EcoStruxure Power and Process architecture provides the required asset and process information, enables the value chain optimization decisions, and enacts these decisions at the operating level to capture the potential value improvements.

Conclusion

This paper presents a vision of convergence between what have historically been separate or loosely integrated domains: electrical power management and process control. Uniting the two reduces complexity and the number of system components, while streamlining project execution. It also provides a common platform for collaboration between those responsible for process and power through the operation's lifecycle. As shown in figure 17, CAPEX and OPEX are reduced throughout the lifecycle of the asset when all eight strategies are used together.

Figure 16

Sources of value for each strategy with an integrated Power and Process approach



All eight strategies are achieved through a combination of different technologies and engineering disciplines; however, the most significant single hurdle in realizing the vision of digital transformation is not technical, but organizational and cultural. It is as much about organization and business process changes as about technology. The technologies comprising the eight strategies can be expected to catalyze organizational and process changes to join the historically separate disciplines of power management and process automation to realize the vision set out in this paper. Business leadership and ongoing sponsorship will direct the journey toward digital transformation and the requisite organizational and cultural changes to achieve this vision, based on measured, sustainable value for shareholders, employees, and communities. Digital transformation should be a well-thought-out roadmap that is realized progressively through the application of fit-for-purpose technologies applied through a systematic project methodology, and all cast in a cohesive framework. This paper has described a vision for a dramatic step-change in the process enterprise, one that can serve as a guide for Digital Transformation and maximizing the value of an enterprise.

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