Life Is On | Schneider Electric

A Strategic Guide to Digital Transformation Chemical Manufacturing Industry

Develop agile business models with higher margins, improve regulatory compliance, streamline process innovation, capture and retain workforce knowledge, and enable a zero-accident culture focused on operational excellence.

by Matt Newton, Senior Technical Marketing Manager,
Asset Performance, Schneider Electric

Executive summary

This whitepaper discusses:

- Understanding the key challenges and opportunities facing chemical manufacturers today.
- Learning how digital transformation empowers chemical manufacturers to deliver increased value across asset and operations lifecycles.
- Developing your strategy for implementing digital transformation.

Introduction

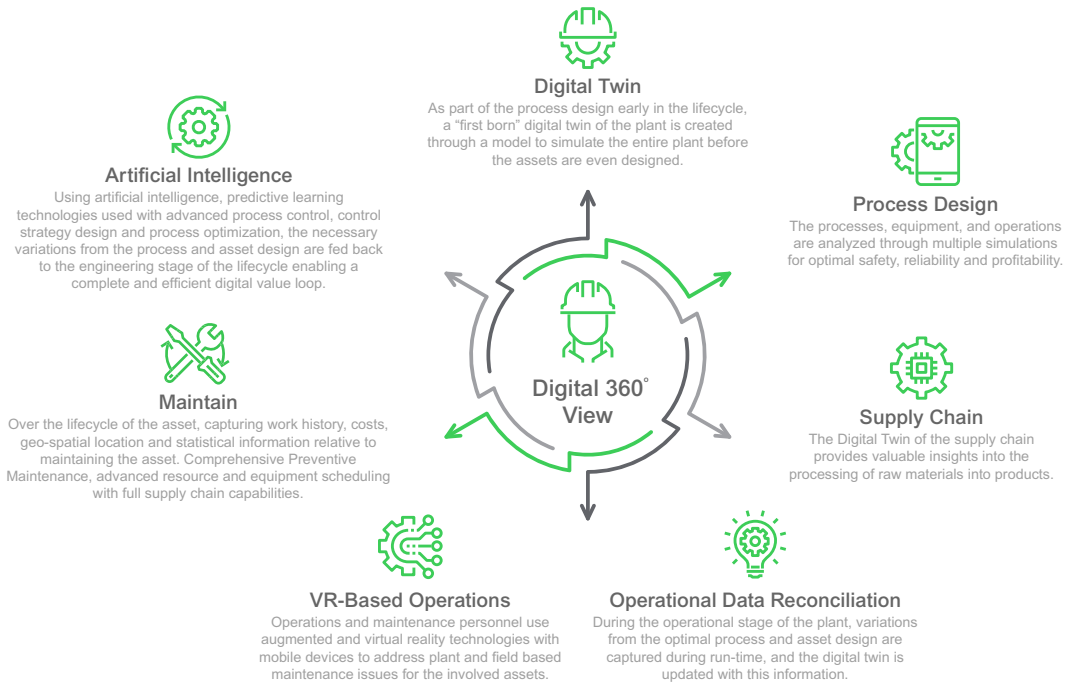
Chemical manufacturers are faced with increasing pressures across multiple dimensions of their enterprise. Heightened regulatory compliance requirements, while put in place for good reasons, create new and complex pressures manufacturers have never faced before. At the same time, the industry strives to improve knowledge creation and retention as its workforce undergoes a generational transition exposing potential risk to business continuity. And the commoditization of once differentiated chemicals makes continual process design, innovation and optimization increasingly important. While at the same time manufacturers are challenged to increase margins and drive as much cost out of production processes and enterprise operations as possible.

Coupled with these challenges is the uncertainty caused by digital technology's increasing disruption of the chemical manufacturing industry. Pivotal technologies like cloud computing, the industrial Internet of things, digital twins, and augmented and virtual reality are precursors of the next industrial revolution. How can chemical manufacturers cut through the hype and noise surrounding these digital technologies and ensure they make the right technology investments?

Digital Transformation is the key to chemical manufacturers to driving new and better customer experiences while maximizing value creation across asset and operations lifecycles to improve profitability, maximize return on capital and improve their overall competitive edge.

The Digital Twin

A digital twin is a complete 360 degree digital representation of a physical asset; like a pump, motor, turbine, even an entire industrial process or plant. Digital twins enable full lifecycle management of physical assets, starting with the design of the asset or process itself and continuing throughout its operational life. As the operational life continues, a digital copy is updated in real time. By creating digital twins data generated by the asset or process during its design and operational life is collected, visualized and analyzed to maximize return on capital and increase enterprise profitability.



Process Optimization

In today's economic environment, capital budgets and overhead are constantly being cut. Companies are faced with rising manufacturing costs, global competition, and soaring energy costs. To meet these challenges, companies are forced to optimize manufacturing operations and make performance improvements to positively affect their bottom line.

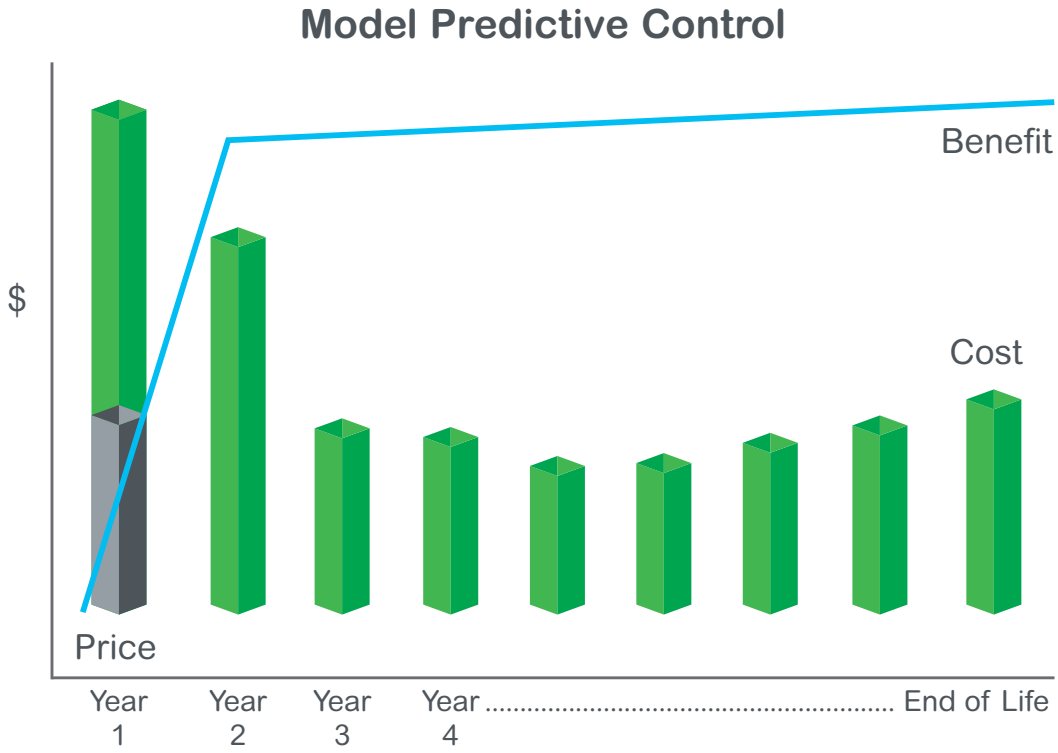
Feedstock prices shift dramatically over very short periods of time. This forces manufacturers to stay on constant alert with economic conditions and forecasts. Energy costs are also increasing, forcing manufacturers to identify new opportunities for optimizing and reducing energy costs across all facets of process design, implementation and production.

Digital Transformation offers new toolsets that enable chemical manufacturers to increase their competitive levels in their market and industry. These digital toolsets help to improve yield of valuable product while reducing energy consumption and increasing throughput. Using digital technology, manufacturers can create a complete digital twin of their processes and assets allowing them to evaluate what-if scenarios in batch processing and manufacturing.

Through digital transformation operators can mash up real-time process data with current economic conditions giving operators the ability to make informed decisions at an expedited rate. Information sharing increases while stakeholders increase their ability to visualize results and key performance indicator data across process and overall plant production. Online process optimization and reporting offers a large potential impact on process yield, energy usage and throughput optimization.

Maximize Operational Excellence

Advanced Process Control is comprehensive, advanced process control software that improves process profitability by enhancing quality, increasing throughput, and reducing energy usage. It uses modern, state-of-the art technology to provide automatic control systems that are capable of releasing process potential. Predictive control helps process operations realize their full potential by moving the process closer to active constraints — resulting in reduced process variability and increased profits.



Cloud-based Process Design

Cloud computing offers several opportunities to reduce costs in process design. By leveraging the almost infinite processing power and storage available through cloud-based architecture, process design can accelerate while also reducing capital investment costs for process modeling and training. Chemical manufactures can spin up cloud based servers and computing resources as needed. This also accelerates the flow of information throughout chemical manufacturing process design. Through a cloud based architecture for process design information accessibility is increased, availability is enhanced and total cost of ownership (TCO) is significantly reduced.

As process design moves to the cloud chemical manufacturers can continuously improve their production process through revamp and process improvement. They can also digitally connect process and control strategy design to accelerate startup after plant turnaround and quickly debug control application design. Through a cloud-based architecture offering an open model writing environment, chemical manufactures can extend simulation benefits to areas not well covered today. Like many reactors, polymers and specialties. Process innovation becomes seamless through collaboration by separating the content from the product allowing the content, such as simulation models, to be managed easily with file history logs in a central repository.

Efficiency is significantly increased using cloud-based architecture as chemical manufacturers can adapt to changing needs. This enables chemical manufacturers to scale up or down the computing power required with varying numbers of virtual machines or instances to facilitate simulation templates for engineering test or training scenarios. Secure user access control allows administrators to add, delete or edit users and privileges as needed. IT overhead is simplified to a pure on-demand cloud-based architecture where machines are accessed via a secure URL, and new versions of process designs are available as soon as they're released. Chemical manufacturers can also adapt the plant to changing legislative and market requirements faster through a cloud-based architecture. As process design information is digitally stored in the cloud it becomes easier to mashup this information with other sources of data and drive the chemical manufacturing enterprise towards a completely digital planning and operations model.

Accelerate Engineering Excellence

Simulation Platform supports the entire engineering lifecycle; from representation of actual P&ID, mapping each equipment object to a detailed engineering database; to building/ testing the dynamic stimulation early in the process design; to optimizing the process and control design, comparing capital versus operating costs; to the continuous improvement of operations, as the simulation model becomes a plant's Digital Twin.



Digital Planning and Operations

Integrated chemical production networks are highly complex and difficult to visualize for planning and operations. While at the same time, increasing volatility of supply and demand in feedstock enables opportunities for margin improvement in chemical manufacturing. Through digital transformation business units that have historically been disconnected silos can connect in real time to create a unified supply chain model that maximizes profitability by taking advantage of data mashups between real-time economic and market data sources and current plant and production status data.

In a unified supply chain model planning and operations are fused together across the digital value chain. A complete 360-degree view of the digital value chain emerges allowing all aspects of the enterprise to be visualized, analyzed and optimized. Inputs to the enterprise such as feedstock and raw materials are analyzed in real-time against planning, operations, scheduling and distribution. Full plant models are managed simultaneously within a supply and distribution network. Fast optimization, combined with user-configurable visualizations and reporting, allows the impact of uncertainties and data changes to be evaluated and understood in real-time. Feasible and robust schedules emerge that lead to business decisions that are simpler to understand and explain across the entire enterprise.

Reconciliation and back casting allows businesses to understand how and why deviations from plans occurred, enabling increased planning efficiency while making it easier to generate feasible and robust schedules that shrink the gap between planned and actual operations. The amount and accuracy of production information increases substantially, equipping users with tools and insights to go beyond basic data, OEE and lean manufacturing principles to discover the real metrics that are driving performance, availability and quality throughout all levels of supply chain management, planning and operations.

Metrics generated by newly tapped digital data sources enable users to gain immediate insight into economic decisions across a range of scenarios. Direct integration of operational data and reconciliation environments enables rapid and continual updating of production schedules. Powerful modeling tools and drill down analytics allow users to discover bottlenecks, and understand how to design more efficient operational workflows.

Through digital transformation chemical manufacturers can explore opportunities, reduce operational risk and shrink the gap between plan and actual results. Product value streams can be maximized within the chemical value chain through a site wide planning model. Optimal feedstocks can be selected based on real-time economic data and for feed flex crackers to maximize margin. And maintenance costs can be reduced through optimized part inventory and the combination of multiple logistics facilities into a single envelope. Digital transformation also offers opportunities to improve workforce training, productivity, safety and regulatory compliance.

Promote Supply Chain Excellence

BP implements industrial software from Schneider Electric with advanced modeling to optimize supply chain management from source materials and feedstock to planning, scheduling, operations and distribution. Information is easily shared between users and business functions, improving understanding and collaboration between traders, planners and analysts and delivering a complete visualization of the digital enterprise value chain.



Digital Workforce Knowledge Capture and Retention

A generational shift is occurring in the chemical manufacturing industry. As a generation of highly experienced operators begins to retire it's critical for chemical manufacturers to accelerate the onboarding and training of new operators as much as possible to ensure plant safety and performance. At the same time training budgets are also being tightened increasing the need to deliver training through a sustainable, efficient and effective model. Digital transformation offers several options to address these challenges.

Virtual Reality (VR) and/or Augmented Reality (AR) are digital toolsets capable of connecting control room operators, maintenance, and field personnel in a single realistic learning environment. Through an immersive 3D environment and high-fidelity dynamic simulation operator training is accelerated across several categories:

- Equipment understanding
- Hazop design evaluation
- Operator training (OTS): Procedure training, Safety scenarios, Crew training
- Maintenance planning and execution
- Real-time enterprise asset management

Augmented and virtual reality training solutions facilitate minimized project risk by preventing delays during plant commissioning and start-up and also maximize return-on-investment in plant personnel training. Mobile technology enables workers to become a data capture point, collecting data from non-instrumented and stranded assets, enhancing operational visibility and acting as a data input point for an Asset Performance Management strategy focused on increasing plant and asset uptime and driving reduced maintenance and operations costs.

Mobile technology also offers the ability to bring teams together in virtual settings no matter where they're physically located. People can perform their duties from wherever they are, accessing, monitoring and managing the chemical plant or process in real time from their handheld devices. Workers are no longer tied to the physical plant location but instead carry a virtual version or digital twin of the plant or factory in their pocket at all times. New operators for greenfield plants need to be qualified for start-up and plant operation quickly, to meet plant specifications.

Through mobile technology new maintenance technicians are trained faster as maintenance procedures and decision support workflows are delivered directly to their mobile devices. Mobility is also a tool that millennials, having been born digital themselves, are already accustomed to. This helps to accelerate their assimilation into the workforce. Augmented reality based training through mobile operator rounds can accelerate that process while laying the foundation for improved safety and regulatory compliance.



Digitize Operational Excellence

As the industry-leading mobile workforce and decision support system Mobile Operator Rounds includes configurable software and ruggedized mobile hardware solutions that enable workflow, data collection and general task management for plant operations, maintenance management, production tracking and compliance applications. As part of their overall "Visual Factory" initiative Ascend Performance Materials implemented Mobile Operator Rounds along with other software solutions from Schneider Electric Software and achieved significant results:

- Savings of $500,000 in utilities and materials costs
- More than $1 million in savings from reduced maintenance costs
- Avoided potential plant shutdowns equating to a savings of $2 million

Improved Safety and Regulatory Compliance

Environmental, health and safety compliance is a paramount focus for chemical manufacturing companies. One of the main drivers of this focus is the implementation of a “Zero Accidents” culture. In terms of accident prevention strategies, a Zero Accident culture can be viewed as the idea that all accidents can be prevented through policy and procedure adherence. Many factors contribute to a good safety culture, including skilled employees, continuous safety risk assessment (HAZOP) and good practices and standards, next to primary and secondary process safety.

Environmental regulation and emissions targets have continuously tightened over the past several years. As well as the need to document and audit compliance of new regulations. Examples are the Industrial Emissions Directive by the EU (IED) and implementation into local legislations like TA-Luft in Germany. For example, emissions include flaring activities, which requires the increasingly efficient start up and shut down of plants through tighter process design tolerances and strict, auditable operational adherence to processes and procedures.

Mobilizing the operator workforce helps ensure regulatory compliance as stacks of paper maintenance reports, audit logs and repair procedures become digital versions of themselves. Information is stored digitally in a central location and backed up to the cloud. Regulatory audit trails are automatically generated. As comprehensive operations efficiency models are deployed, visualizing which equipment, processes, teams or sites are underperforming becomes easier and provides part of the foundation for developing an asset performance management strategy that maximizes return on asset investment for chemical manufacturers.

Digital Asset Performance Management in Chemical Manufacturing

Capital expense constraints in chemical manufacturing limit investment in new equipment. While demand increases, requiring greater production from existing machines. A complete digital Asset Performance Management (APM) solution combines enterprise data capture with asset management, advanced workflow, mobility, predictive analytics and risk-based management to drive maximum return on asset investment.

A complete APM solution allows operators and maintenance engineers at chemical manufacturers to automatically generate work orders to relieve maintenance issues as soon as they’re discovered. While advanced data capture and analytic capabilities provide detailed insight into the health of production assets. The integration of these capabilities with advanced workflow facilitates continuous process improvement while ensuring assets are not overly maintained and MRO inventory costs reduced.

A study of common failure patterns by ARC Advisory Group found that a full 82 percent of failure types are random. Only 18 percent are predictable and preventable with traditional maintenance methods. Machine learning helps identify inefficiencies and abnormalities in equipment operation long before regular inspection. Engineers can reference operational models and digital twins for recent abnormalities in design versus operational performance. As data is collected at an operational level and fed into other digital toolsets it imperative that chemical manufacturers make investments in the right digital technology.

Predict Equipment Failures Through Asset Excellence

In a large regulated and non-regulated utility with over 60+ plants in 6 states, including coal, simple cycle combustion turbines, combined cycle and integrated gasification combined cycle plants, Schneider Electric helps monitor and optimize the maintenance of critical power generation assets with Predictive Asset Analytics software. A single early warning of a crack in a turbine rotor saved the utility over $7.5 Million.



Chemical Manufacturing Technology Investment Pillars

Choosing the right technology investment requires analysis of four key technology pillars to ensure successful digital transformation and optimum ROI.

Comprehensive Value Chain

Modern digital platforms must deliver returns across the comprehensive value chain of the enterprise. Technology Investments must enable the digital integration of engineering, planning and operations, control, visualization, information and asset performance solutions to create a 360^0 view, from the shop floor to the top floor.

Open and System Agnostic

Interoperability and cross platform support accelerate a path towards continual process improvement. Rapidly sharing big data and insights across multiple platforms including cloud, mobile, augmented and virtual reality requires open, system agnostic technology solutions that augment rather than rip and replace existing asset investments. An open, system agnostic approach to digital transformation drives long-term value and lower total cost of ownership (TCO).

Digital Ecosystems

Technology investments should be backed by a multidisciplinary ecosystem of technology partners. Ecosystems should include capabilities of design, development, delivery, maintenance and support of industry specific solutions on a global scale. Ecosystem partners may include software developers, technical distributors, system integrators, OEM providers and technology partners, all focused on extending value and driving innovation across industries.

Flexible and Agile Implementation

Adapting to unforeseen events becomes automatic through flexible technology implementation options. True digital transformation platforms provide the ability to choose between deployment options including on premise, cloud or hybrid rollouts. Agility in procurement options allows enterprises to obtain the required tools through several options including perpetual licensing or subscription based services. Solutions for implementing technology on an as needed, staged approach help the enterprise reduce upfront costs and decrease time to value of new technology investments while accelerating a path toward increased profitability.

How to Get Started

Digital transformation is part of an ongoing journey towards continuous process improvement involving the collaboration of people, processes and assets through digital technology. It doesn't happen all at once but instead gains speed and velocity over time as people, processes and assets are digitally fused together to eventually bridge the operations technology and information technology gap. Start small in your strategy and adoption. But start now to maintain or improve your competitive level and market position.

High dollar investments upfront are not required to begin a digital transformation journey. Consulting services on the front end of digital transformation investments can help the enterprise assess its current asset inventory and business operations to help chart an overall digital transformation strategy. While pilot projects of digital technology such as predictive analytics and virtual reality can help the enterprise understand where to make the best technology investments to improve profitability and maximize return on capital.

Schneider Electric is a proven industry leader stacked with technology to make your Digital Transformation journey flexible, effective, measurable and profitable:

- Engineering
- Planning and Operations
- Asset Performance
- Monitoring and Control

About the author

Matt Newton is Senior Technical Marketing Manager for Schneider Electric's Asset Performance Management portfolio. With over 15 years of experience planning, developing, and implementing diverse batch and process automation applications, he has extensive experience designing and implementing industrial Internet of things and machine-to-machine applications from the network edge to the enterprise cloud. A former systems and applications engineer, he is responsible for global marketing activities supporting Schneider Electric's asset performance management product portfolio.

Schneider Electric Software
26561 Rancho Pkwy South, Lake Forest, CA 92630 Telephone: +1 (949) 727-3200 software.schneider-electric.com
© 2018 Schneider Electric Software, LLC. All rights reserved.
PN SE-0310 Rel. 01/18