Introduction
Transitioning to Industry 4.0 is an emerging imperative for chemical manufacturers. “Smart” equipment, products and factories are transforming how companies do business, both internally and with suppliers and customers. Digitization of operations and other processes is enabling functions such as predictive maintenance that were largely unknown a few years ago. Digitization also demands new skill sets for employees, new partnerships and collaborations, and adherence to evolving standards.
Summary

Industry 4.0 is also referred to as “the fourth industrial revolution.” Underpinned by the Internet of Things (IoT), the new era is all about connections: connected people and products within a company; connections among departments within a company; and global connections among producers, suppliers and customers. To maximize the power and potential of such connections, all stakeholders need to be able to communicate effectively and agree on best practices to ensure both smooth daily operations and rapid resolutions should problems arise.

This white paper presents ways to help chemical manufacturers rise to Industry 4.0 challenges, moving from their current situation by learning about and adapting strategies already shown to be effective in pilot projects and in the literature.

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Get connected

Although the Internet of Things (IoT) may sound futuristic to many chemical manufacturers, in fact, that future is very much now. About a year ago, Information Age predicted, “We will see a dramatic digital transformation in manufacturing in 2016, as the industry seeks to become more flexible and agile in its business practices, value chains and customer offerings.” Chemical manufacturers are in the process of transitioning, many with pilot projects and others with full-blown investments in a new “solutions layer architecture.”

Deloitte points to BASF as an example of a company that currently is using connected systems and advanced analytics for predictive asset and process management. And at its smart pilot plant in Kiserslautern, BASF automated the production of liquid soaps, “enabling mass customization without human involvement.” After an order is placed for a customized soap, the radio-frequency identification tags (RFIDs) attached to the soap containers send the specifications for the soap’s composition and packaging to the equipment on the production line using wireless network connections.

In the area of predictive maintenance, Christina Valimaki, Senior Director, Chemicals Industry at Elsevier, recalled the recent case of a chemical manufacturer that became aware a spike in the purchase of certain raw materials. Because all departments in the organization were connected, the operations team was able to discover a leak. “If you have a leak, you’re literally throwing money onto the plant floor, because that material isn’t getting incorporated into the final product,” Valimaki said. “The increase in procurement flagged it, and the company was able to check along the production chain to find the problem.”

In another example, a chemicals company had to deal with unplanned down time and losses due to an extruder that failed more than 90 times in one year. The company gathered and analyzed data from the extruder sensors, maintenance records and other sources to develop a failure-prediction model that generates alerts and recommendations on extruder performance. The result: a reduction in unplanned downtime by 80% and savings in operational expenditures of about $300,000 per asset.

Although the benefits of moving to Industry 4.0 are clear, implementation, for the most part, is a long-term process. China, which had 94 Industry 4.0 demonstration projects underway as of March 2016, discovered that upgrading to Industry 4.0 typically involved investments in hardware, network connections, data collection and storage capabilities, and advanced analytical software and systems. But companies are forging ahead, as part of the government’s Made in China 2025 strategy.

Overall, chemical companies plan to invest 5% of annual revenue (equivalent to US$45 billion) in digital operations solutions through 2019, and 75% expect to have reached advanced levels of digitization by then, according to key findings for chemical manufacturers in a 2016 Price Waterhouse Coopers (PwC) report. By achieving advanced digitization, chemical companies anticipate additional per annum revenue of 3.1% and cost reductions of 4.2%.
Maximize the data

Many chemical manufacturers store financial, sales and marketing data on one system, operations, production and manufacturing in another system, and R&D and engineering in yet another system, according to PwC interviews with industry chemists and chemical executives. But hallmarks of Industry 4.0 are data centralization and harmonization, which enable a holistic view of the organization.

Rajeev Ronanki, a principal at Deloitte consulting, calls for “industrial analytics” as the foundation for “an insight—driven organization that has the vision, underlying technology capabilities, and operating scale necessary to take advantage of data’s full potential.”

That means chemical manufacturers will need to invest in platforms, systems and partners to harness the power of the data they amass as they switch over to Industry 4.0. Consider how this plays out in precision farming, for example. SAP’s Stefan Guertzgen writes, “Imagine a system where sensors are constantly measuring soil quality. Data on water, nutrients, and pesticides are recorded and correlated. Analytics predict weather and its impact on a crop and adjust the rates and amounts of applied materials. Yields and quality are tracked and analyzed to find optimal ratios. Overlaid pricing and expense models recommend crops with the highest possible profit margins.”

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—Rajeev Ronanki, Deloitte consulting
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That’s just one scenario emphasizing the power of advanced analytics to drive action in the real world. Data about chemical processes, energy use, asset performance and production operations can all be used to draw insights and guide decision making.

Transforming to a digital enterprise also requires the right team; therefore, many companies are investing significantly in training their employees and hiring new specialists. According to PwC, “Companies will need to make sure staff understand how the company is changing and how they can be part of it.” Lack of a digital culture and the right training were identified as the biggest challenges, with 69% of those surveyed citing “increasing in-house data analytics technology and skill levels” as the best way to boost their data analytics capabilities. Other companies noted the importance of external partnerships in providing technology and training.

Some organizations are investing in 3D visualizations and virtual reality software as a way of giving operations staff a “virtual” experience of various on-site scenarios. Such programs also enable those involved in specific projects within a facility in the early stages of development to explore a realistic model of the facility, potentially simplifying its subsequent real-world operation.

Researchers in Austria recently described a scenario-based Industry 4.0 Learning Factory concept that is being implemented in the country’s first Industry 4.0 pilot project. A form of interactive learning, scenario-based learning normally involves people working their way through storylines based around complex problems that need solving. It’s another way of bringing employees up to speed during a transition.
Implement standards and best practices

As noted in our previous white paper, companies’ willingness to embrace standards will be key to maximizing the potential of Industry 4.0. Recommendations for implementing the strategic initiative Industrie 4.0, the final report of Germany’s Industry 4.0 working group, points to standardization (development of a “reference architecture”) as a “priority area for action.” In so doing, the authors stress the need for a common approach, a common language, and the incorporation of existing standards. They note that a single approach to standards requires agreement among partners with divergent perspectives involved in different areas of the sector, including manufacturing processes; networked (“smart”) devices; software applications for data acquisition, processing and analysis; planning and management software; and engineering for product lifecycle management.

Recognizing the difficulty of integrating these and other facets/requirements, the working group acknowledges that it makes sense to develop standards incrementally that will gradually be converted into a broad-based international standard for Industry 4.0.

In a recent article for InTech, a publication of the International Standards Association, chief editor Bill Lydon notes that Germany’s Industry 4.0 initiative, which is said to have launched the Industry 4.0 movement, is spawning similar initiatives, notably in China, Japan and India, as well as the US. These nations and others ultimately will need to collaborate on standards.

Harmonization of existing standards took a step forward, according to Lydon, when representatives of the German alliance e-Platform Industrie 4.0 and the US-based Industrial Internet Consortium met in March 2016 to explore potential alignments between their reference architecture efforts.

For now, as these collaborations evolve, chemical manufacturers will need to continue to adhere to current standards and help ensure that their business partners do the same.
Conclusion

At this point, the question for chemical manufacturers is not whether to enter into the fray by adopting Industry 4.0 connectivity and "smart" manufacturing technologies, but rather where to start. According to PwC, "by 2020 advanced implementation of Industry 4.0 will become a 'qualifier to compete' and is also likely to be seen by investors as a 'qualifier for funding.' Companies who have not kept up will not only find themselves struggling to maintain market share but are also likely to face higher capital funding costs."

PwC recommends that manufacturers set a strategy, create pilot projects, define their capabilities and become well versed in data analytics as they move towards becoming a full-fledged digital enterprise.
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