

Changing with the times

Chemical industry's digital transformation accelerates

Digitalization is no longer a future trend but reality for the chemical industry. Digital tools and technologies have become essential for companies' development and growth. Chemical producers are investing to develop in-house digital capabilities and seeking collaboration opportunities.

Sotirios Frantzas

Digitalization has only recently become a key component of chemical companies' strategies, but revolutionizing the use of data analysis techniques and artificial intelligence is now a strategic priority. The urgent need to meet sustainability targets, as well as the emergence of generative AI, has also contributed to an acceleration of the chemical industry's digital transformation.

There has been a substantial shift in how chemical companies approach digitalization, John Papastylianou, founder and CEO of technology company Cyzag Ltd. (London), told *CW*. Investment in digital technologies is no longer a question of "if," but rather "how" and "what" to invest in, Papastylianou said.

Many chemical manufacturers are adopting a holistic approach that focuses on placing the user and operational excellence at the forefront, according to Papastylianou. "Enabling workforces for process improvement, breaking down silos, and maximizing collaboration and knowledge sharing are

primary goals in modern digitalization efforts," he said.

Digitalization is a critical and necessary capability for organizations that want to stay relevant and successful in today's modern world, according to Abhishek Shrivastava, vice president/innovation, decision science and technology at Lubrizol Corp. "It is a key part of our strategy and is leveraged across every business, function and level within Lubrizol. From AI to decision science, these technologies enable us to create more value for our customers, improve our operational efficiency, and enhance our speed to market and innovation capabilities," Shrivastava said.

Lubrizol uses digital tools and technologies across all its businesses, functions and levels of organization, he said. "Lubrizol scientists use advanced analytics and data science to generate insights from our vast amount of data to support our decision making. For instance, we are using data science to accelerate our product development, improve our formulations, and enhance our testing and validation,"

Shrivastava said.

Wanhua Chemical Group Co. (Yantai, China) is committed to enhancing operational excellence through digitalization, Weiqi Hua, the company's executive vice president and chief technology officer, told *CW*. Wanhua's digitalization is at a "leading" level within the Chinese chemical industry, and the company has achieved significant results in global integrated operations, research and development, innovation, intelligent manufacturing and agile supply chains, Hua said.

"We have established six major platforms: intelligent manufacturing, business management, ecosystem collaboration, collaborative office, infrastructure and smart decision-making. We are at a critical stage of transitioning from digitalization to intelligent digitalization. In 2024, we've incorporated 'intelligentization' into our development strategy and designated the year as the 'Year of Intelligent Digitalization.'" Hua said.

Wanhua has established a digital ecosystem core, S/4 HANA, which internally connects R&D, procurement, production and

supply chains for end-to-end process integration, Hua said. Externally, it links employees, customers, suppliers and service partners, ensuring compliant global operations, he said.

Utilizing its manufacturing systems, Wanhua has developed platforms for production operation management, quality management and a global health, safety and environment platform, Hua said. These systems streamline the production supply chain and enable efficient, integrated park operations, he noted.

Digital solutions are also a critical part of the commercial portfolio and strategy of Ecolab Inc. “We combine digital tools, like OMNI and other ECOLAB3D-powered digital services, with advanced chemistry and industry experts to deliver value and achieve strong outcomes for our customers. Ecolab’s digital solutions provide real-time monitoring and predictive analytics for a variety of industrial systems, generating expert insights and recommendations to help our customers maintain reliable, productive performance,” Sarah Rocher, director/digital strategy, heavy water at Ecolab, told *CW*.

Nalco Water, Ecolab’s water and process management business, partnered with a power plant that was facing significant challenges with fouling caused by mussel settlement in its cooling system, Rocher said. Traditional bleach treatment had been ineffective and costly, leading to frequent unscheduled shutdowns for manual cleaning, she said.

Nalco Water implemented a PURATE chlorine dioxide program that was combined with advanced digital technology to monitor condenser performance, Rocher said, noting that clean surface condensers are central to power plant production efficiency. Controlling issues related to fouling can help power plants maintain performance and reduce greenhouse gas emissions through more efficient fuel usage, she added.

OMNI condenser intelligence, powered by ECOLAB3D, helped the plant maintain real-time visibility into condenser efficiency, demonstrating the effectiveness of the chlorine dioxide program, Rocher said. The digital solution also proactively recommended actions to help preserve condenser performance, reducing maintenance-related downtime, she said.

The results showed significant condenser performance improvements, with reduced debris and no new mussel settlements,

Rocher stated. By using the chlorine dioxide and digital solution together, Nalco Water helped the plant save €900,000 per year, including €800,000 from increased power output and €100,000 from reduced CO₂ emission taxes, according to Rocher.

Johnson Matthey PLC is another chemical company focused on digitalization. The company’s catalysts technologies business has done extensive work with machine learning, which is continuing, particularly in catalyst development, according to Maurits van Tol, chief executive/catalyst technologies at Johnson Matthey.

The company has accumulated vast amounts of data over the years, and utilizing data mining to develop new catalyst formulations based on the company’s extensive experimental history has been very effective and “incredibly” valuable, he said.

“In addition, our plants are increasingly adopting advanced technologies. For example, we have a platform called Levo, which is used in methanol and formaldehyde plants. This technology provides our customers with better insights into plant operations, allowing for continuous improvement. By leveraging Levo, customers can optimize their assets and achieve greater efficiency, making it highly beneficial to not only license a methanol plant from Johnson Matthey but also to work with us through this platform to maximize asset performance, leading to substantial additional profits,” Van Tol said. The platform is incorporated into Johnson Matthey’s licensing agreements, enabling customers to utilize it and collaborate with the company for optimization, he said.

Petrochemical producer Borouge PLC (Abu Dhabi, United Arab Emirates) recently emphasized the central role that AI, digitalization and technology play in the company’s strategy to create value, power innovation, and enhance productivity and processes. The company said it realized \$215 million in value creation in the first half of 2024 through a broad portfolio of projects spanning health and safety, sales, sustainability and innovative product development.

“Borouge has already revolutionized industry practice through the installation of

a real-time optimization system across three large-scale ethane crackers and 20 furnaces. The initiative analyzes over 150,000 parameters per hour, enabling instant data-driven decisions, significantly enhancing productivity, optimizing energy consumption and reducing emissions,” the company said.

AI powers transformation

The emergence of AI has significantly influenced how chemical companies view digitalization, because it offers unprecedented levels of efficiency, innovation and productivity, according to Papastylianou. AI technologies are increasingly used by chemical companies to augment human capabilities rather than replace them, he said. “By placing people at the center of operations, AI provides data-driven insights that help employees make better decisions and enhance their ability to manage operations effectively,” he added.

However, the quality of AI models’ output depends on data quality and how well data is organized, Papastylianou noted. “The better the quality and organization of data, the better the output from AI models,” he said.

This means digitalization efforts should focus on centralizing data capture as well as ensuring the ease of use of digital systems, Papastylianou stated. These systems should enable operators and engineers to augment and contextualize data seamlessly, from logbooks to root-cause analysis and strategic projects, he said.

“Digitizing the shop floor removes informational silos and ensures that all relevant data is accessible for analysis. This consolidated data environment enables AI to tap into the collective and historical knowledge of the workforce to drive enhanced decision-making,” he added.

AI has already had, and will continue to have, a significant impact on the chemical industry, Lubrizol’s Shrivastava noted. AI enables Lubrizol to create more value for its customers, improve efficiency and productivity, and drive innovation and differentiation, Shrivastava said. “AI is a gap-closer



SHRIVASTAVA: Decisions supported by data.



ESCHBACH: Interest in AI is growing.

when leveraged the right way, enabling the chemical industry to stay ahead of megatrends and increasing consumer demands at the rapid pace at which the world is moving,” he said.

Lubrizol leverages many AI tools throughout its organization — from natural language processing to machine learning, computer vision and deep learning, to automating, enhancing and innovating its processes, products and services, Shrivastava said.

“We are using computer vision and machine learning to optimize our formulations for the beauty industry at speed and scale. We also use advanced modeling and have developed digital twins to simulate engine and vehicle performance tests for various formulations, significantly reducing cost, lowering emissions and increasing our speed to market,” he said.

Wanhua is actively exploring and promoting the application of AI and big data algorithms in its processes, especially in molecular discovery and reaction optimization, according to Hua. Some of the company’s initial achievements in the field include Bayesian algorithms for reaction optimization that rapidly determine optimal conditions from thousands of experimental combinations, significantly reducing the experimental cycle, Hua said.

“Our goal is to build digital advantages and create a smart Wanhua. We are advancing along the path of ‘standardization-automation-digitalization-intelligentization,’ focusing on AI-enabled R&D, autonomous operations and smart parks,” Hua said.

Cepsa Química, the chemicals business of Cepsa SA, also has great expectations for AI. “It is a key component of our strategy, and we approach it in two different ways. The first approach focuses on productivity, aiming to operate faster and more efficiently. This involves both back-office and front-office applications. For instance, we use generative AI to automate tasks such as job assignments, for product regulatory compliance, and new

customer clustering,” David Liras, IT, digital transformation officer and operational excellence director at Cepsa Química, told *CW*.

The second approach is more transformative, focused on creativity and innovation, he said. The business’s products offer its customers detailed product specifications tailored to each country and region with the help of AI, Liras said. Meanwhile, generative

AI is helping Cepsa Química ensure that its products meet specific property requirements and regulatory standards, as well as aiding the redesign of products and processes to be more sustainable and reduce carbon emissions, Liras said.

Ecolab’s Rocher sees “incredible” potential for the chemicals industry in AI. “Armed with real-time data, forward-looking insights and global access to best-in-class expertise, chemical industry professionals can anticipate more informed decision-making capabilities that lead to improved performance, enhanced sustainability and outsized business outcomes,” she said.

Ecolab has a strong history of deploying machine learning and AI to unlock the full potential of the data the company harnesses, Rocher said. “By applying artificial intelligence, we are able to leverage our deep expertise from working across more than 40 industries. This includes using digital solutions to provide insights about mechanical, operational and chemical processes — finding novel, personalized solutions that meet the specific needs of our customers,” she said.

According to Andreas Eschbach, founder and CEO of software vendor Eschbach GmbH (Bad Säckingen, Germany), the chemical industry’s interest in AI is growing. AI is used extensively in R&D and in improving plant operations, including the creation of digital twins for equipment and entire plants, he told *CW*. The company’s customers are particularly interested in its AI-based Smart Search technology, which helps them

address challenges such as accessing large amounts of historical data, he added.

Bayer AG’s crop science division uses Eschbach’s Shiftconnector platform as the communication and database tool in shift operations at almost all its facilities worldwide, according to Eschbach. Bayer has reported improvements in troubleshooting through the use of the platform, which is crucial, considering the cost of each production hour, Eschbach said.

“Another interesting point raised by the customer is the impact of 24/7 operations. Continuous data production means process engineers need to catch up on 140 hours of data each week. AI helps make this data accessible, aiding both continuous improvement and troubleshooting, providing a clear financial advantage,” Eschbach added.

Sustainability accelerates adoption

The need to reduce energy consumption and achieve carbon neutrality is helping to drive the implementation of new technologies in production, which often also leads to performance improvements, Eschbach said. Optimal performance, however, requires continuous improvement, hence the constant increase in demand for digital tools and technologies, he said.

“New customers are increasingly looking for cloud-based applications, which offer a lower total cost of ownership. We also see a trend towards greater interoperability, connecting systems both vertically and horizontally. This automation and data accessibility are crucial, as many companies still have underutilized data,” Eschbach said.

Wanhua is employing digital technologies to support its sustainability targets. “We are building an energy- and carbon-management platform to automate monitoring and management of energy usage, reducing dependency and costs, thus achieving energy conservation,” Hua told *CW*.

The company is optimizing production processes through automation and intelligent management, lowering costs and optimizing resource efficiency, Hua said. In addition, by leveraging AI and other smart technologies, the company is continuously optimizing logistics routes, reducing costs, enhancing transparency and improving warehouse efficiency, lowering carbon emissions, he said.

Digital tools are also critical to Lubrizol achieving its sustainability goals, according to Shrivastava. “They are helping us to



LIRAS: AI a crucial part of company strategy.



CARVAJAL: Blockchain a secure database.



PAPASTILIANOU: Shift to a more holistic approach.

identify, track, measure and report our sustainability metric such as carbon emissions, water consumption, waste generation and energy efficiency. Digital tools also help us to innovate and create new solutions that can address sustainability challenges and opportunities. An example of this is the testing we do for a lot of our automotive solutions. Digital tools and AI help us replicate years of wear and tear in a fraction of the time, enabling us to come to market with more sustainable solutions faster,” Shrivastava said.

According to Ecolab’s Rocher, digital tools are essential to achieving sustainability targets in today’s complex and interconnected business landscape. “Whether it is water reduction, emissions avoidance, circularity or plastics reduction, digital technologies enable us to make faster and more informed progress toward our enterprise-wide sustainability goals,” she said.

Real-time monitoring and advanced analytics are crucial to identify optimization opportunities that lead to more efficient and responsible use of water, Rocher said. With extensive data on water use and quality, businesses are empowered to make informed decisions that enhance efficiency and performance, she added.

Digital tools do not just complement a sustainability strategy, they are a core component, Rocher said. Ecolab uses its own digital technologies at its facilities to ensure progress toward the company’s enterprise sustainability goals, she said. “In 2023, we delivered on water stewardship projects across our operations that resulted in more than 153 million gallons [about 580,000 cubic meters] of water savings,” she added.

Solvay SA is another chemical company that sees significant potential in digitalization. The company is focused on and investing in the digitalization of its operations to become more efficient and increase its yields. “When we achieve this, we see numerous benefits,” Jean-Charles Djélalian, Solvay’s chief sustainability officer, told *CW*. These include enhanced competitiveness and reduced emissions, since higher efficiency leads to fewer emissions and less waste, Djélalian said.

“We launched a program two years ago called Star Factory. Our goal is for all our plants to transform and become what we call the ‘plant of the future.’ The cornerstone of this transformation is digitalization, which we expect to bring about increased competi-

tiveness and sustainability,” he said.

Solvay’s soda ash plant at Rosignano, Italy is an example of how data analysis has helped with the optimization of operations, Djélalian said. “We began two years ago using data produced by sensors on the plant’s production lines to optimize various processes such as the way we handle raw materials. Initially, we had a massive amount of data but did not know how to utilize it effectively. Over time, we learned that machine learning could help us make the best use of this data,” he said.

The insights gained from analyzing the data have helped Solvay to optimize operations at Rosignano, dramatically increasing the plant’s yield, using less raw materials and generating fewer CO₂ emissions while reducing the amount of residue at the bottom of the plant, Djélalian said.

Collaboration aids development

Digitalization can support a company’s sustainability efforts, improve its competitiveness and optimize the performance of its operations, but collaboration is key to unlocking digitalization’s full potential, according to Lubrizol’s Shrivastava. “[Lubrizol] partners with organizations and firms to leverage their expertise to complement and enhance our own strengths and capabilities. Technology companies serve many different industries, allowing us to leverage best practices and adjacencies as we progress through our digitization journey,” he said.

Cloud-based computing and related tools are a necessity to scale up Lubrizol’s efforts in data engineering and data science, and the company has partnerships with leading organizations to provide those services, Shrivastava said. “These are foundational tools to build our data platform and develop more use cases as our data becomes available and ready at the right cost and scale,” he said.

According to Rocher, Ecolab is actively collaborating with leading technology companies such as Microsoft Corp. and Siemens AG to deploy digital initiatives at

speed and scale. Ecolab and Microsoft collaborated to enhance the visibility of water and sustainability data through ECOLAB3D and Microsoft Cloud for Sustainability, she said. “By integrating the data, we helped our joint customers access centralized reporting so they could monitor progress toward critical business and sustainability goals,” she added.

Ecolab and Siemens have also jointly released a digital solution called Climate

Intelligence, powered by ECOLAB3D and Siemens gPROMS technology, Rocher said. “The solution uses digital twin technology to virtually model different operational scenarios and make recommendations, so customers can identify water and energy savings opportunities without impacting operations,” Rocher added.

Cepsa Química launched last December the first digital sustainability traceability system based on blockchain technology in the detergents and home care sector. The Marco Track & Trace tool was developed in collaboration with Finboot Ltd., a blockchain technology startup. Marco Track & Trace allows Cepsa Química’s customers to track, through a QR code, the origin of the raw materials and certificates, and it guarantees the sustainability of the products they receive, Cepsa said.

“Blockchain is a secure and decentralized database, functioning much like a ledger where we can record all the information we need. This information can then be shared and operated upon later,” David Carvajal, agile agent and product manager at Cepsa, told *CW*.

Blockchain technology is based on five principles: traceability, transparency, immutability, decentralization and security, Carvajal said. Blockchain ensures

traceability by meticulously tracking recorded information and transparency by making data accessible to authorized users, he said. Immutability means data cannot be altered once recorded, while decentralization distributes data across multiple points, enhancing security against attacks, which is further bolstered by cryptographic techniques, he added.



DJÉLALIAN: Digitalization yields many benefits.



ROCHER: Collaboration boosts digital initiatives.



VAN TOL: Using advanced technologies in plants.