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Chemicals Practice

# A new operations formula for the chemicals sector

Facing spiraling costs, looming skills shortages, and the decarbonization imperative, manufacturers of chemicals and agricultural products can't afford to stand still.

*This article is a collaborative effort by Kim Falkenroth-Naidu, Sheng Hong, Anna Littmann, Andreas Seitz, and Richard Sellschop, representing views from McKinsey's Chemicals and Operations Practices.*



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**The chemicals industry produces** many of the key ingredients of the modern world, and in 2021, as the global economy roared back into post-COVID-19 life, the sector enjoyed a boom, with sales surging over 2020 by almost 25 percent to $4.7 trillion.[1] Just one year later, chemicals company CEOs had much less reason for optimism.

The year 2022 was a tumultuous one for the industry. Shortages of critical products and materials remained, as producers struggled to catch up with high demand. Surging commodity prices, especially for natural gas, increased costs across the sector. In Europe, where gas supplies were acutely affected by the war in Ukraine, the prospect of gas rationing during the winter was a real possibility. As central banks increased interest rates to tame inflation, chemicals players saw a steep rise in their cost of capital, making it harder to finance the big, complex assets on which the industry depends.

Beyond these immediate-term problems, the sector is facing significant medium- and long-term challenges too. Skills shortages are one, especially in Western countries where chemicals players have been slow to attract new talent to supplement an aging workforce. In Germany, for example, more than 35 percent of chemicals industry employees are over age 50, and 20 to 30 percent of the workforce is expected to retire by 2030.[2] Moreover, a recent survey of 16,000 Europeans found that despite current uncertainty, fully one-third plan to quit their current job in the next three to six months; in the United States, third-quarter 2022 data show that the number of unfilled jobs remains high at 10.7 million, compared with 7.5 million at the end of 2019.

Decarbonization is another challenge. The manufacture of chemicals is energy- and carbon-intensive, and some processes produce large quantities of carbon dioxide as a by-product, adding to the complexity of decarbonization. This uncomfortable truth is putting the sector under growing scrutiny by regulators, investors, consumers, and activists. And as the industry's direct customers turn their attention to the upstream Scope 3 emissions that account for most of the carbon footprint of many products, they are pressing companies to offer innovative solutions, including greater use of recycled and biobased materials.

## A catalyst for change

One way for chemicals players to overcome these challenges is by reformulating their operations. While the industry has pursued operational excellence for decades, there's one key ingredient available today that many companies are underutilizing: the power of digital technologies.

Over the past decade, Industry 4.0 technologies such as robotics, advanced analytics, AI, and cloud computing have made the leap from pilot to large-scale implementation in a host of industries. Now the chemicals sector not only has the opportunity, but rather the necessity to catch up to not get left behind. Here are just a few of the many ways that digitization could deliver the next level of operational excellence in the industry.

## People and processes

Automating previously manual tasks can address several of the industry's challenges at a stroke: boosting output, increasing efficiency, and making chemicals plants a better place to work. The opportunities are numerous, from the increased adoption of robots and "cobots" to accomplish heavy and repetitive manual tasks, to the use of handheld devices to eliminate form-filling and support operators and maintenance personnel.

Improvements like these directly address some of the issues that make people reluctant to work in the chemicals industry. And the additional productivity they unleash gives plant owners the space to adjust tasks, roles, and shift patterns to further

[1] Lucía Fernández, "Revenue of the global chemical industry 2005-2021," Statista, August 8, 2022.
[2] "Employee age pyramid, chemicals industry," Federal Employment Agency, Federal Republic of Germany, December 2019.

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improve the working environment. Key changes here include offering staff increased flexibility in working hours or the ability to work from home where feasible and allowing more tasks to be completed during the day shift.

Remote working, facilitated by digital technologies, can also allow chemicals companies to make better use of scarce talent. The introduction of remote, centralized control rooms, for example, allows businesses to use their most skilled operators to manage and optimize multiple plants. The same approach can be applied to enable the at-scale application of valuable but complex maintenance and reliability activities, such as condition monitoring and predictive maintenance enabled by advanced analytics and AI.

Implementing automation and digitization at scale requires a range of new skills, from data analytics and machine learning specialists to robotics engineers. For chemicals players, this will present both a challenge and an opportunity. They will need to invest in systematic recruitment, reskilling, and upskilling programs to access the talent they need, but they will also be able to offer attractive, varied career options with opportunities for ongoing learning and development. That will help to make the sector more appealing for younger workers and entrants from other sectors.

## Production performance

It has been a long time since most chemicals players were forced to contend with an inflationary environment. Many companies are still enjoying high demand for their products, but input costs have been rising rapidly, as is now the cost of the capital required to build new plants or invest in equipment to remove bottlenecks from existing production lines.

Technology can help here by enabling companies to make significant increases in the output of their existing production assets, through improvements in yield, throughput, or product quality without significant capital expenditure investments. Advanced analytics approaches allow chemicals players to gain new insights into their production lines, revealing complex interrelationships between material properties and process parameters. One specialty chemicals company applied this approach to a monomer furnace that had become a critical bottleneck, boosting output by 18 to 30 percent. In this case, the only new equipment required was an app that helped operators optimize the furnace control settings.

Leading chemicals players are using technology to transform the way they run their plants, or even manage their businesses. Some companies are using AI to adjust process parameters in real time, using models that have been trained using historical data on process performance. Others are applying advanced-modeling approaches to support decisions about which products they make, when, and how to maximize their margins.

Digital approaches also have plenty of potential beyond the plant. For example, digital tools can boost supply chain resilience by offering close-to-real-time information on shipments, inventory levels, or end-customer demand. Smart pricing models that account for variations in input and processing costs can help to foster alignment between the sales, manufacturing, and procurement functions.

Models of production networks, regional costs, and operating risks can help companies make medium-term decisions about their sourcing and manufacturing footprint.

## Sustainable operations

Digitization won't solve the decarbonization challenge for the chemicals sector, but it can get companies off to a strong start. Improvements to yield and product quality come with meaningful carbon reductions attached, since they require fewer raw materials and less energy to deliver the same amount of product. And the same models can also be used to optimize the efficiency of energy-intensive processes, with direct benefits for both product unit costs and carbon emissions.

Companies are also using advanced analytics techniques to plan, prioritize, and design the new assets and technologies that will help them move further down the carbon abatement curve. These include options that have become economically attractive because of spiking gas prices—such as heat pumps (and other energy-recovery devices to transform waste heat into useful input energy), the replacement of gas boilers with electric units, and the integration of renewable-generation capacity.

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Time is already running short for chemicals companies to address the challenges of demographics, sustainability, and long-term profitability. We believe that chemicals industry CEOs need to have clear answers to five key questions:

— How will we obtain the capabilities we need to drive the digitization of our manufacturing processes?

— What approaches will we use to decarbonize our operations, and how much will they cost?

— What kind of workforce will we need over the next decade and beyond, and how will we attract it?

— How can we maximize the value we generate from our assets in the short, medium, and long term?

— What will our manufacturing operations look like in 2050, and how will we get there?

In a sector as complex and asset-intensive as the chemicals industry, transformation won't happen overnight. Embedding new tools and technologies, and the people and organizational processes required to support them, into a large organization requires years of sustained effort. That effort needs to begin today.



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