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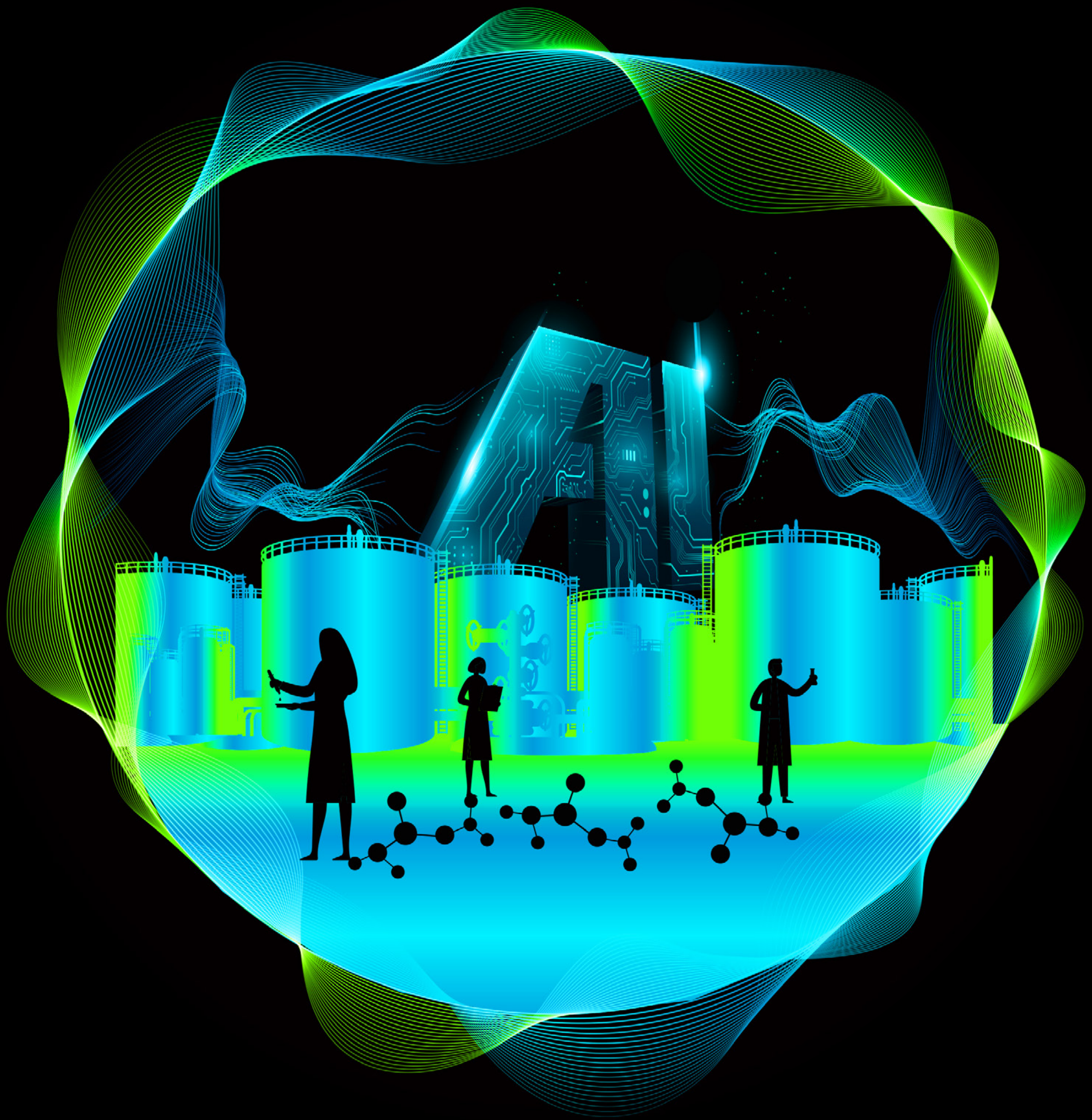

The future of work in chemicals

Redefining the work, workforce, and workplace of tomorrow

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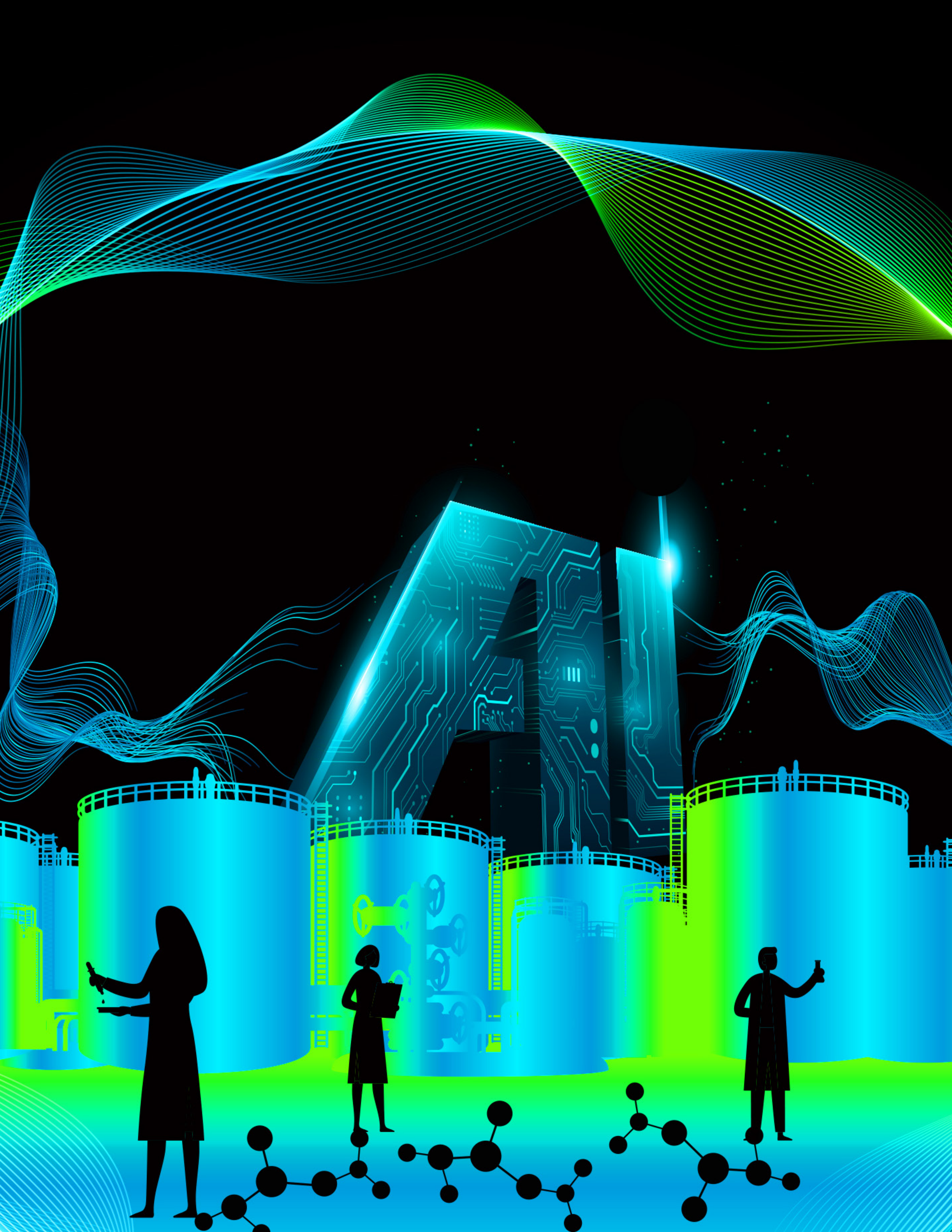

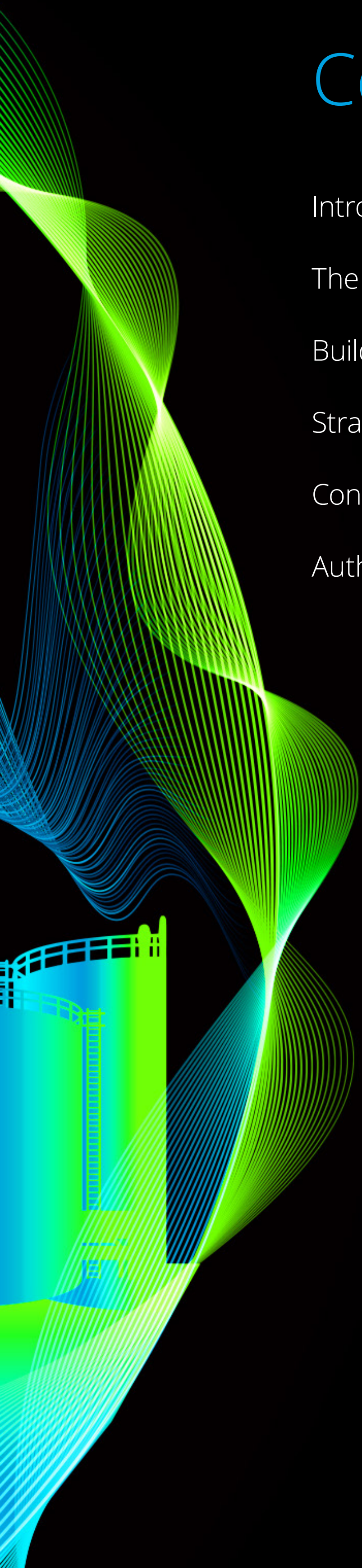

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Introduction: The current talent landscape and the evolution of work

Deloitte's The future of work in oil, gas, and chemicals study highlighted how COVID-19 challenged fundamental and deeply interconnected dimensions of the industry's work, workforce, and workplace. This study explores the opportunities today's changed environment presents chemical companies in transforming themselves to adapt to the changes in the talent landscape and the evolution of work.

Chemicals is one of the most knowledge-intensive industries and a powerful engine of innovation and creativity. For more than two centuries, the chemicals industry has adopted new technologies and provided new jobs for workers. Today, the industry is experiencing exponential change, as technologies such as artificial intelligence (AI) and robotics are rapidly changing the workplace. R&D and specialized solutions and services provided to customers have become the differentiating factors in companies' ability to compete. Moreover, continuing improvements in product development and production processes are driving changes in the nature of the work, including shifts in job roles.

But one of the top challenges facing the transformation of work today is the skills gap. There are not expected to be enough science, technology, engineering, and math (STEM) graduates to fill skilled positions such as advanced chemical engineers, researchers, and scientists. Deloitte's analysis found that about 106,000 jobs could remain unfilled between 2021 and 2030.[1] Also, the industry workforce is aging. As much as 25% of the industry's workforce will likely be eligible to retire in the next five years.[2] The US chemicals industry currently employs some of the oldest personnel among all sectors. In 2019, the chemicals industry workforce's median age was 44.6 years, compared with 42.9 years for the oil and gas industry and 42.3 years for the total US workforce.[3]

Furthermore, the COVID-19 pandemic has caused significant, short-term disruption of the chemicals industry, potentially leading to long-term impacts. Employment in the chemicals industry was also significantly affected by the slowdown related to COVID-19. Based on statistics from the US Bureau of Labor Statistics, the chemicals industry experienced 17,500 job cuts, or 2.1% of the entire workforce.[4] The industry lost 37,700 production jobs, but added 20,200 nonproduction jobs, including researchers and scientists.[5] The workforce's growing diversity is also one of the critical disruptors driving the future of work in the chemicals industry. Changing demographics and skills requirements are drawing in a more diverse workforce (by gender, ethnicity, culture, religion, and identity) to chemical companies than ever before, making it an important consideration to use this powerful trend as a strategic lever.

Given these shifts and challenges, chemical companies should rearchitect *work*, unleash the *workforce*, and adapt the *workplace*.[6] Since redefining the human dimension of work in today's world of perpetual disruption is a continuous process, chemical companies should think and work differently and to challenge the work orthodoxies of the past continually.

The acceleration of new ways of working

The pandemic has brought greater urgency in accelerating companies' digitization efforts to unlock new operational gains. Digitally enabled disruption in major end markets, such as transportation, computers and electronics, semiconductors, agriculture, and housing and construction, is affecting business models across the industry. As a result, the chemical workforce may largely feel under increased pressure to reduce time to market given the emergence of new entrants, increasing bargaining power of existing downstream players, and the power of digital technologies.

Moreover, the ongoing digital disruption has accelerated some talent trends already underway, such as the adoption of automation and more remote work, creating greater demand for workers to fill jobs in critical areas such as data analytics and cybersecurity. There is a growing demand for employees with R&D experience, such as scientists and engineers, and areas that help drive sustainability, but the primary challenge for chemical companies remains recruiting enough employees with these critical skills. Also, existing employees with digital skills are at risk of migrating to other industries, such as technology and pharmaceuticals.[7]

Chemical companies are often defined by their agility, and their success may depend on their ability to quickly develop and commercialize new materials.

The economic downturn is also driving a few fast-growing specialty chemicals businesses to compete with relatively stable industries, such as life sciences, in sourcing talent in the growing material informatics and advanced materials sciences space. Deloitte studied these trends using the framework of work, workforce, and workplace. By shifting the way chemical companies think about work, focusing on rearchitecting work as a flow, and using technology to elevate human capabilities, the chemicals industry can unleash human potential and create a work environment where individuals and teams are empowered with the tools, technology, and culture to contribute their full potential (figure 1).

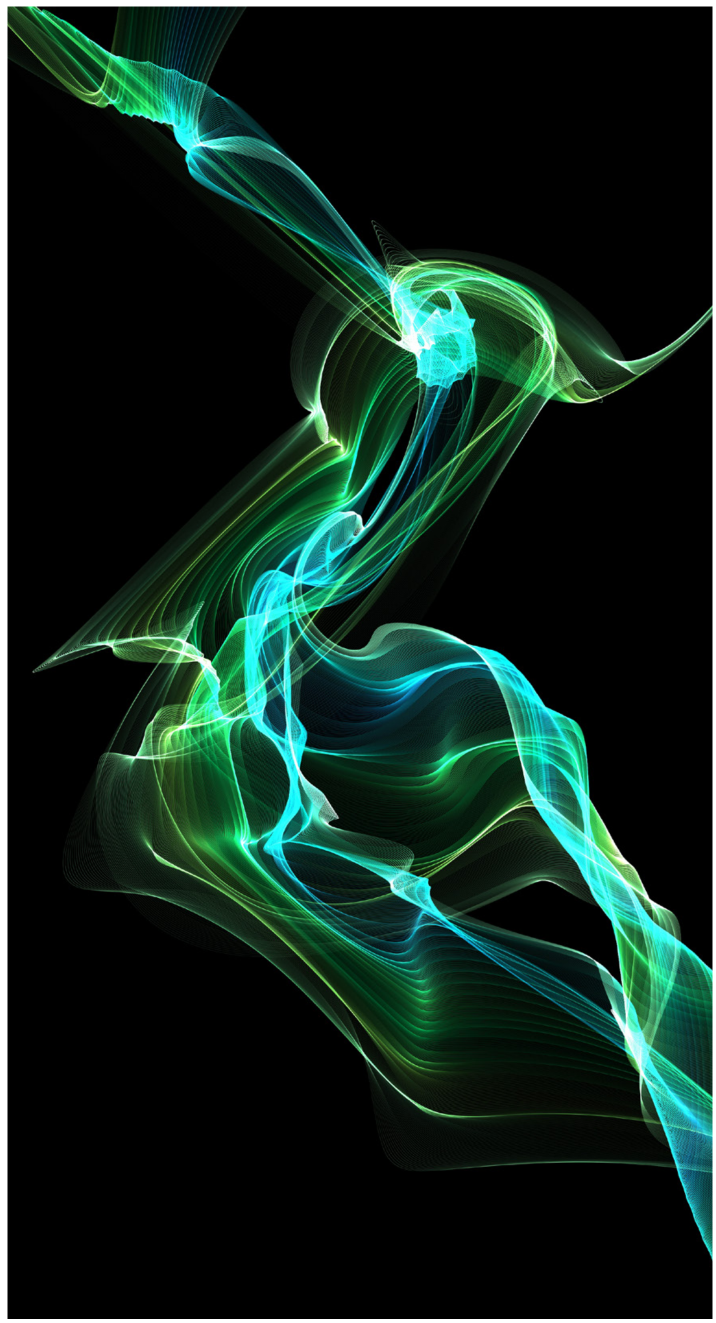


Figure 1. The future of work in chemicals: Moving from concept to action

The future of work in chemicals

Work

The nature of work and job roles is changing. The need for continuous improvements in production processes is driving shifts in job roles. Today, more than four out of every 10 employees have R&D and technical servicing experience. Scientists and engineers compose about 10% of the industry workforce. And the share of jobs with analytical, information technology, and technical competencies is growing.

Workforce

While automation and the use of advanced digital technologies are driving productivity, they are also leading to changes in workforce composition, increasing the need for a workforce with more advanced chemical engineering, data science, and digital skills than before. Digitalizing operations or announcing long-term net-zero plans could boost interest by new graduates. Transformative work, well-defined career paths, and agile working models could be critical to allowing chemical companies to attract new workers and leverage and disseminate tenured employees' knowledge.

Workplace

There is a dramatic change occurring in the chemical industry workplace, largely due to two key factors. The first is globalization: manufacturing and distributing chemical products across the world in a well-controlled manner through enterprise software and enabled systems. The second is interconnectivity: the ability to access, interact with, and work with a skilled workforce worldwide. Moreover, the COVID-19 pandemic is forcing companies to change how and where employees work. Many organizations have already adjusted to working remotely and have restructured their infrastructure to support work-from-home capabilities for their employees.

Rearchitect work

Reevaluate the work being done. Revisit work outcomes and challenge processes. Enable humans and technology to collaborate more effectively in order to unlock human potential at scale over time.

Unleash the workforce

Access needed capabilities across a broader talent ecosystem, curate personalized and elevated experiences for the full workforce, and engage them for impact. Consider capabilities in and around the enterprise. Create and leverage internal talent marketplaces, intelligent machines, ecosystem partners, and suppliers.

Adapt the workplace

Move beyond thinking about workplace as merely physical location. Rather, recognize the role of culture and leadership in creating an optimal workplace environment that maximizes the potential of all workers at all levels. Create a supportive workplace environment that empowers workers with technology and tools to give them the flexibility to choose where and how work gets done.

Source: Deloitte analysis.

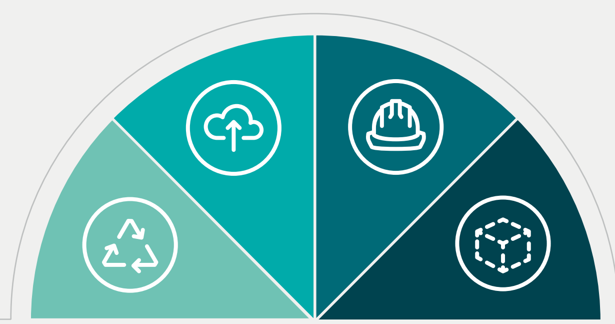
Building the talent organization of the future

Today's changing business environment has given chemical companies the much-needed "why" to transform themselves and find new ways to reclaim their earlier appeal. How can these companies adapt? The four levers of transformation—sustainability, digitalization, recoded careers, and organizational agility—can push chemical companies into the future (figure 2). They may seem a heavy lift at the start, as all initiatives to change an organization or its culture seem initially. But once leadership empowers its people to drive and shape the future, the pathway to talent transformation will likely be widely embraced.

Sustainability:
The COVID-19 pandemic has reinforced the call for long-term decarbonization and transition to cleaner energy sources.[8] The chemicals industry and its served end markets are evolving along with the growing emphasis on sustainability, and new industrial ecosystems such as electromobility are emerging. Chemical companies can be part of the solution by helping to solve sustainability challenges faced by end-use industries and capturing new opportunities. In addition to investing in new technologies and developing new materials, chemical companies should hire new employees with the right technical skills and impart the organization's institutional knowledge of environment, social, and governance (ESG) issues. This way, chemical companies can develop solutions for solving ecosystemwide issues related to energy and material efficiencies and create newer ways of doing business (for instance, creating the circular economy loop, switching to service-oriented solutions, and establishing a dedicated supply chain workforce for advanced materials).

Figure 2. Chemical companies can use the four levers of transformation to prepare for the future

Strategizing and transforming...



...for the industry of the future

Sustainability as a way of business
Accelerated energy transition impacting work

Digitalization transforming work
Integrated human-tech collaboration

Recoded careers to build workforce of the future
Career paths to meet future employee needs

Organizational agility for new business models
Evolved contracting, variabilized processes, and servicing for agile organization

Work
Changing end-market patterns

Workforce
Challenges attracting talent

Workplace
Changing workplace setting

Source: Deloitte analysis.

Digitalization:

Nowadays, many chemical companies are empowered with technology and use it as a critical asset to unlock transformation, boost productivity, and enable organizational changes with real-time collaboration. However, technology is not about substitution, but rather unlocking human potential. Work is increasingly owned by a network of human-machine teams, building and owning the entire value chain. And, if done right, it is the source of productivity, purpose, and bottom-line results.

Advanced analytics and open digital platforms create new insights, leading to new ways of working, accelerating, and growing. For example, Citrine Informatics uses AI to digitize R&D strategies to accelerate material development and drive cost savings.[9] Digital strategies are also helping chemical companies capitalize on shared knowledge and arrive at innovative solutions. As the chemicals industry adapts AI, it results in the value chain becoming smarter and faster than before.

Furthermore, disruptive technologies are being used for commercial models. For instance, Carbon3D is riding on the demand for subscription-based digital manufacturing of physical, real-world products, software-controlled chemistry, and new materials science as a disruptor to markets and industries.[10] In another instance, Citrine is using new analytical capabilities to create value and accelerate progress.[11] The company's usage of consolidated data tracking and data management is driving material development.

Bold, strategic application of digital technologies can drive chemical companies' business performance through three actionable pathways:

- **In silico platforms:** Applying ab initio modeling, AI and machine learning, simulations, advanced analytics, and big data mining to create new insights, leading to new ways of working to achieve innovative, market-leading commercial models
- **Knowledge platforms:** Making information findable and insightful to capitalize on shared knowledge and arrive at innovative solutions
- **Connection platforms:** Connecting people at every step of the research journey by prioritizing data management to drive faster commercialization

Recoded careers:

Today, more than ever, chemical companies need a highly trained and skilled workforce that can bring innovative, accelerated approaches to disrupt end markets and become market leaders (figure 3). As a result, the industry will likely experience a significant change in work profiles and skills needed in the future. For example, the US chemical industry is expected to hire 19,200 fuel cell engineers, 16,100 nano-chemical engineers, and 2,100 computational material scientists through 2029.[12]

In addition to a renewed focus on attracting skilled new employees, chemicals companies should develop the existing workforce. Companies can build an internal opportunity talent marketplace and create personalized experiences. They can curate personalized and elevated experiences that give workers the opportunity to develop and contribute their full potential. For instance, chemical companies can enable teams of data engineers, data scientists, and technical experts to work together to solve internal and customer problems.[13] Also, along with formal training, chemical companies can provide diversified business exposure by moving employees to cross-functional roles every few years to enhance their value and competencies.

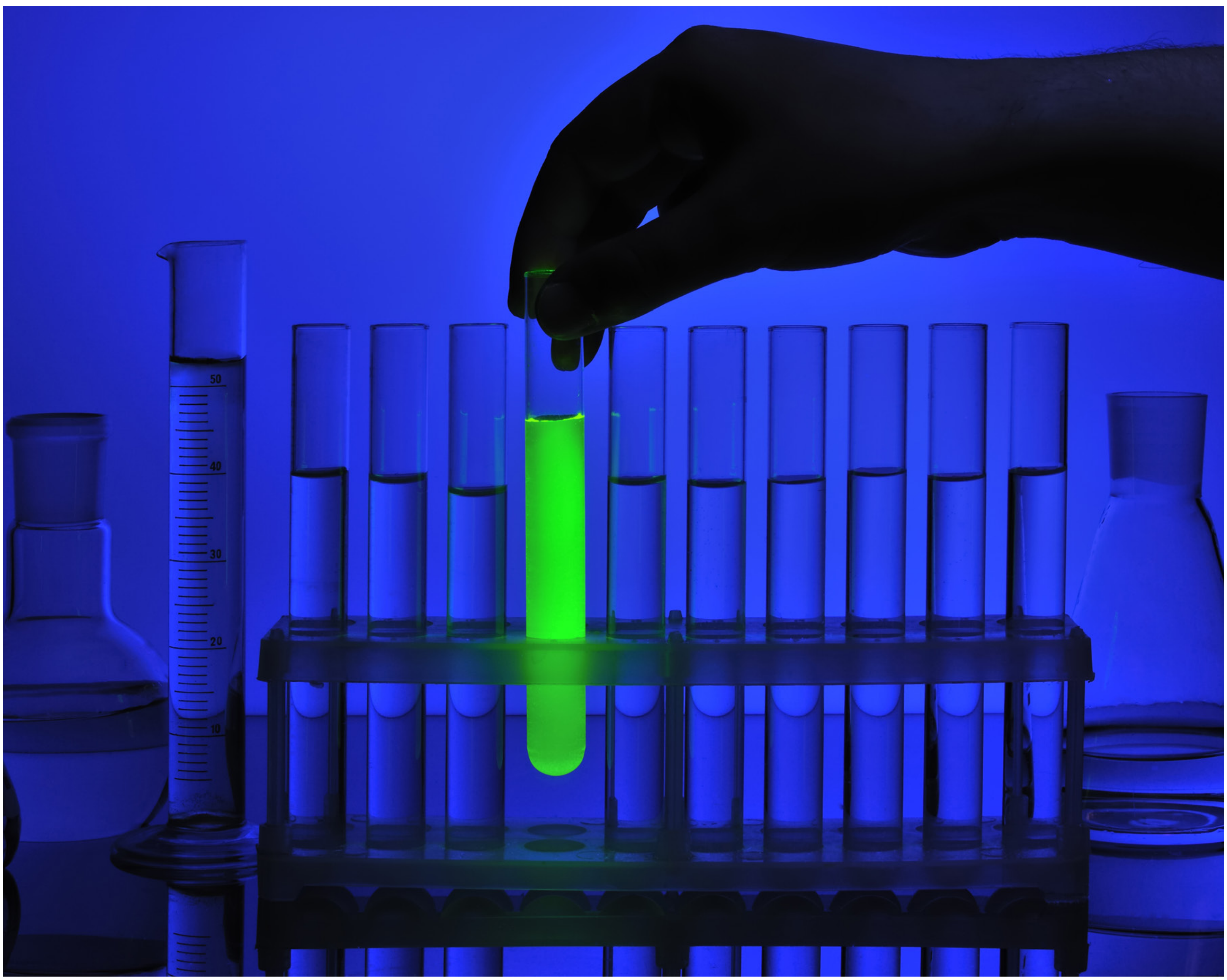
Figure 3. Expected job roles and skills of the future in the chemicals industry

Job role	Description	Skills needed
Computational material scientist	Applies modern computational methods alone or in conjunction with experimental techniques to discover new materials and investigate existing inorganic materials, such as ceramics, composites, semiconductors, nanostructures, and metamaterials; organic materials, such as polymers, liquid crystals, surfactants, and emulsions; and hybrid materials combining both inorganic and organic components, such as polymer nanocomposites, nanocrystal superlattices, and surfactant nanoparticle mixtures.	• Data informatics to predict structure-property relationships for new materials • Computational tools, technical software, and shareware
Nanochemical engineer	Controls nanoparticle growth, shape, and properties to develop nanotubes, nanoprobes, nanomaterials, nanocatalysts, and nanostructures for various energy conversion, medicine, and electronics applications. Applies state-of-the-art experimental techniques and sophisticated computational approaches, including computer simulation to discover the fundamental principles of how nanoscale building blocks can self-assemble and how to guide that process to engineer new materials.	• Heterogeneous catalysis, surface science and chemistry, photophysics, computational modeling, data analytics, and nanoparticle and nanocluster disintegration
Fuel cell engineer	Designs and constructs fuel cell components or systems that produce electricity through a chemical reaction involving hydrogen for transportation, stationary, or portable applications. Conducts fuel cell testing projects, using fuel cell test stations, analytical instruments, or electrochemical diagnostics, such as cyclic voltammetry or impedance spectroscopy.	• Software development, computer-aided design (CAD) software, and advanced mathematical skills
Predictive supply network analyst	Evaluates recommendations from predictive systems, such as scheduling and material orders, and makes final decisions. Identifies market opportunities and proposes collaborative forecasts to customers based on analysis and insights from machine learning and artificial intelligence (AI) tools. Delivers results against key performance indicators, such as out-of-stocks, inventory cycle times, and asset utilization, ensuring that customer service-level agreements have been met. Works collaboratively with engineering, production, and logistics to calibrate demand and supply and eliminate any disruptions or delays.	• Data sciences and big data modeling techniques • Demand analytics, replenishment analytics, and visualization
Digital twin engineer	Creates a virtual representation of both the physical elements and the dynamics of how an IoT-connected plant or platform operates and interacts within its environment throughout its entire life cycle. Ranging from a factory floor to even a whole plant, digital twin engineers use 3D software and simulations to measure plant performance in varying conditions, thereby optimizing design, predicting maintenance, and improving the overall experience.	• Simulations, analytics, systems engineering, software development, sensors, algorithms, and image processing

Source: Deloitte analysis.

Organizational agility:
Organizational agility, driven by levers such as portfolio, assets, and processes, can help the chemicals industry increase efficiency by building a more flexible asset base relying on more diverse feedstocks managed by increasingly digitalized and automated processes. Through a combination of strategic and operational measures such as building asset and feedstock flexibility, expanding portfolio in new growth markets, and adopting operational and digital technologies across the value chain, chemical companies could capture efficiencies. But these efficiencies seem to be plateauing, as the chemicals industry remains cyclical, and the strong margin growth reflects a robust demand recovery in end markets. As a result, while the industry's return on capital (ROC) improved over the past decade, it seems as though it would be challenging to grow past 20%.[14] With dwindling gains from performance levers in the near term, chemical companies can challenge their traditional ways of functioning, including how they have set up their core and support functions and manage talent resources. Chemical companies have an opportunity to cut costs and become more agile by making their people, processes, and technologies more integrated and fit for the post–COVID-19 future.

However, one of the real long-term opportunities presented in the future of work goes beyond doing more of the same faster and cheaper. A big opportunity for chemical companies lies in exploring new sources of value and meaning to remain competitive amid rapidly changing market dynamics.[15] To help succeed at this vision of creating greater value, chemical firms should first consider moving beyond cost as a driver to value; second, by shifting focus from company to customer, workforce, and company, chemical firms can expand the scope of impact.



Strategies for building people-centered, smart, digital workplaces

To address the current challenges and prepare for the future, chemical companies should identify the emerging talent gaps created by the need for new capabilities and develop long-term strategies focused on hiring, reskilling, and redeploying (figure 4). Companies can develop and implement multiple strategies to fill skill gaps and engage the workforce without losing productivity.

Figure 4. Strategies to develop the next-generation workforce and workplace

Source talent both from within and outside the organization

Rebrand the perception of the industry

Develop the current workforce by implementing "work-to-learn"

Leverage exchange of knowledge

Foster diversity and inclusion

Build "future-proof" leadership

Source talent both from within and outside the organization: Chemical companies can address the skills gap by undertaking a number of measures, including looking beyond traditional relationship and engaging in diverse workforce ecosystem, including employees, talent networks, gig workers, and service providers. They can also cofund apprenticeship and skill transfer programs along with the state and local governments to develop a job-ready stream of qualified workers.

Some specific talent access strategies include:

- Leveraging acquisitions to gain the desired talent
- Investing in startups to get access to new technology and talent
- Adding talent from companies with a weaker financial position
- Identifying skills no longer required and considering where and how to redeploy talent
- Increase remote work to deploy the best talent from anywhere
- Partnering with educational institutions for digital skills

Rebrand the perception of the industry: As younger professionals might not view chemical companies as their most attractive option, a potential solution lies in changing their perceptions of the industry. Executives can achieve this by emphasizing that jobs in chemicals are high-tech and cutting-edge. One possible way to do this is by using the new high-tech nature of materials innovation as a branding opportunity; the industry can help improve its attractiveness in material informatics. Second, companies can support STEM initiatives, engage high school and college students by suggesting a clear career path in the chemicals industry, and market the industry as one that provides the world with new products that can improve quality of life and health. Developing and deploying sustained awareness programs that describe what chemical manufacturing is today and what it could be in the future could help dispel the traditional view of chemical manufacturing as industrial and demonstrate the high-tech and advanced nature of chemical jobs.

Develop the current workforce by implementing "work-to-learn": Chemical companies should consider retraining and upskilling their employees to use the new and advanced tools being implemented throughout the industry. Examples of these capabilities include Industry 4.0, modeling and simulation, predictive analytics, and advanced processing techniques. Specifically, chemical companies should consider focusing on:

- Providing strategic training on business acumen and technical skills
- Offering a work environment that is likely to accelerate the career development of employees
- Dedicating a team to new business models and use cases, with a proven methodology applied to data science leadership

Leverage exchange of knowledge: Companies should look to leverage intellectual capital resident within their organizations and increasingly emphasize knowledge management, a means of capturing an organization's expertise wherever it exists and putting this knowledge into action. Technologies such as content management systems, social networking, and decision support systems are important tools in bringing this expertise to bear. Chemical companies can build and drive knowledge transfer programs for the young and newer workforce to learn from the retiring workers to retain their wisdom. Furthermore, chemical leaders should view knowledge management as more than a way of capturing and disseminating information; instead, they should consider it to create knowledge to develop new products, services, or solutions.

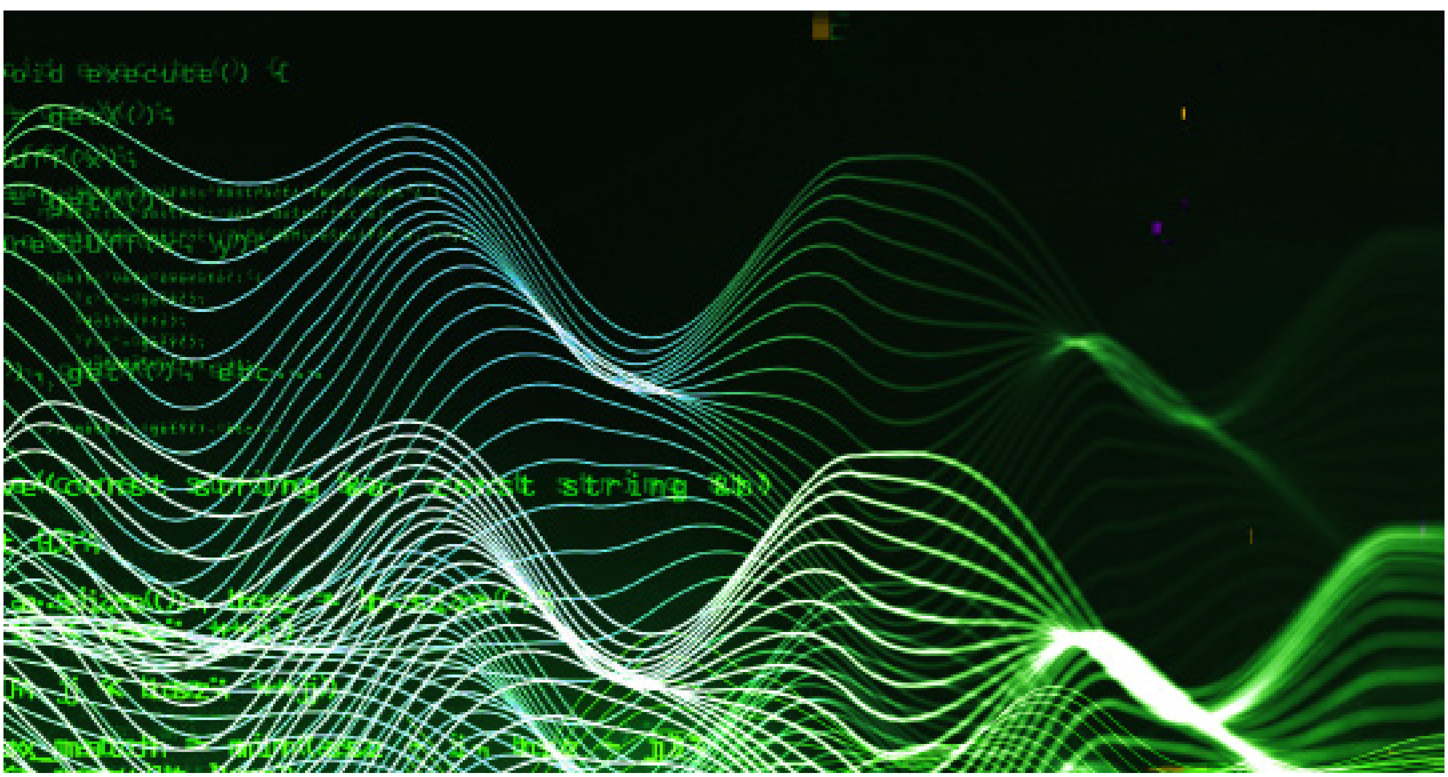
Foster diversity and inclusion: Nurturing diversity in organizations has been shown to enhance innovation by about 20% while decreasing risk by 30%. At the same time, inclusive cultures are 2x as likely to meet or exceed financial targets, 3x as likely to be high-performing, 6x more likely to be innovative and agile, and 8x more likely to achieve better business outcomes.[16] The cost of doing nothing is to likely fall behind. So, to win in the future of work, a focused and strategic approach to fostering inclusion—via inclusive hiring practices, onboarding, ongoing engagement, culture, and the overall worker experience—has become imperative. By focusing on inclusion as a key strategy, chemical companies can embrace, support, and ultimately realize the potential of an increasingly diverse workforce.

Build "future-proof" leadership: Chemical leaders today understand disruption intuitively, as it affects their business, customer base, and growth. However, disruption is no longer an interruption to the pattern, but the pattern itself—a consistent, ongoing reality driven by technological advancements, demographic shifts, and changing customer expectations. As a result, the role of a chemical leader is expected to look dramatically different in this context. To capitalize on the opportunities that disruption brings and address any associated challenges, chemical companies should build a "future-proof" leadership capable of being agile, flexible, and ready to deliver what is required in the future. Chemical companies should nurture leaders who can take a nuanced approach to pursue business goals, considering the new context to achieve such goals. Such an approach should also draw on critical new competencies to get there, including leading through change; embracing ambiguity and uncertainty; and understanding digital, cognitive, and AI-driven technologies.

Conclusion: Equipping for the new realities facing chemical leaders

The chemicals industry is in the midst of significant change. New realities call for new talent capabilities and talent models. While conventional engineering and technical skills will likely still be critical, a confluence of the traditional and nontraditional sources to build and nurture talent can help create the talent pool necessary to compete into the future.

However, a thorough and effective reimagining of talent strategy could require a dramatic shift in thinking. With a dedicated commitment to talent, chemical companies can navigate the future and continue to generate shareholder value. Industry executives will likely be the catalyst to make chemicals an attractive, exciting place to build a career. Industry leaders should act now to build the critical organizational capabilities needed to attract, develop, deploy, and retain high-quality talent.



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