Converting to the digital formula

Digital Reinvention in chemicals

IBM Institute for Business Value

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Altering the composition of the enterprise

Digital technologies are altering chemical companies' operations, including research and development, manufacturing and supply chain. These technologies are also creating unprecedented levels of industry dislocation, with new entrants fundamentally changing the economics of business. To thrive, chemical companies need to conceive and offer compelling new customer or even end consumer experiences, advance their operational efficiency, launch or integrate with new digital offerings, and build innovation ecosystems.We call this process Digital Reinvention™. With input from 300 chemical executives worldwide, we explore how outperforming organizations are doing things differently and what other organizations can learn from them.

Everyone-to-everyone economy

Pressure on the chemical industry is increasing. The outlook continues to be a challenging environment. Rapid technological change is enabling companies to produce according to fluctuations in customer demand, contributing to greater price volatility. Global base chemical capacity continues to increase, while demand growth versus gross domestic product (GDP) is forecasted to decelerate. This is dramatically altering traditional business economics. Value chains are fragmenting as technology disintermediates traditional supply chain networks.[1] Markets have evolved from a state of organizational centricity, in which chemical companies largely define what to produce and market to customers, into a state of individual centricity, in which chemical companies are delivering tailored and customized products.

In 2017, the IBM Institute for Business Value (IBV) conducted a survey in collaboration with Oxford Economics. Of 600 chemicals and petroleum executives who participated, 300 were from the chemical industry. (For more information, see the "Study approach" section.) A majority of the executives surveyed tell us that a number of digital technologies are critical to their business strategies in this new economy.

The new environment confronting the global chemical industry is best understood within what we call the everyone-to-everyone (E2E) economy. The E2E economy has four distinct elements (see Figure 1):

- Orchestrated, based on business ecosystems, which are both collaborative and seamless
- Contextual, in that customer and partner experiences are calibrated and relevant to their specific actions and needs
- Symbiotic, in that everyone and everything, including customers and businesses, are mutually interdependent
- Cognitive, characterized by data-enabled, self-supported learning and predictive capabilities.

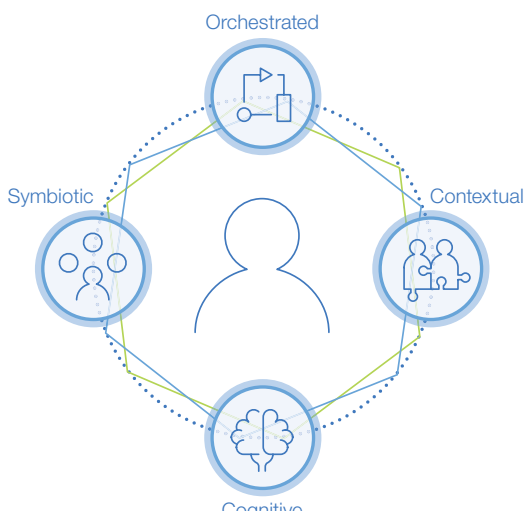
91% of chemical company executives say cloud computing is the technology most important to their organization's business strategies over the next two to three years

74% of executives from outperforming organizations have a transformational vision for the use of digital technologies

84% of executives from outperforming organizations use digital technologies in distribution and logistics

The E2E economy initially impacted end-customer-centered sectors such as retail, automotive and consumer electronics. Now the E2E economy is permeating business-to-business (B2B) industries, including chemicals. Digital technologies such as 3D printing, the Internet of Things (IoT) and adaptive robotics are altering how customers and chemical businesses interact. The chemical industry needs to digitally reinvent its enterprises to keep up with this technological change and the disruption it propagates.

Figure 1



Source: IBV analysis.

Technological disruption and chemicals

Technological disruption in the chemical industry has increased significantly. (See sidebar, "Cyber-physical systems model the chemical enterprise.") The fourth industrial revolution – sometimes referred to as Industry 4.0 – is characterized by increasing digitization, motivating chemical businesses to interconnect products, value chains and business models.

The proliferation of connected devices and IoT technologies is already driving significant change by connecting related industries. For example, the quickly developing IoT in agriculture helps communicate timely, accurate real-time weather forecast data related to dynamic agricultural processes like planting, harvesting and chemical applications.[2] In another example, OnFarm uses sensors and IoT connectivity to enable farmers to optimize water, energy and inputs.[3] Dow Chemical has North American railcars with two radio-frequency identification (RFID) tags; cylinders are tracked with barcodes; and transportation assets are tracked with RFID, cellular GPS or satellite GPS. This provides Dow with a level of real-time visibility for virtually all materials, with event management software orchestrating relevant alerts.[4]

New entrants in the chemical space are employing digital technologies to conceive and realize bold new concepts – disintermediating traditional players. Many have already succeeded in disrupting established processes, a trend that will accelerate.

Cyber-physical systems model the chemical enterprise

Digital manufacturing uses IoT intelligence for dynamic response to product demands. Interconnectivity of machinery sensors and control systems allows real-time optimization of manufacturing and production processes, as well as supply chain networks. These cyber-physical systems also extend to asset management for predictive maintenance, statistical evaluation, and measurements to increase asset reliability and lifespan.

For example, Zymergen, a U.S.-based technology company, uses automation, big data and software algorithms to manufacture high-value chemicals and new materials.[5] And U.S.-based startup NanoMech uses nanomanufacturing technologies to produce new lubricants, specialty chemicals and coatings for customers in the automotive, retail, energy manufacturing, exploration and service, aerospace manufacturing, textiles and advanced military applications industries.[6]

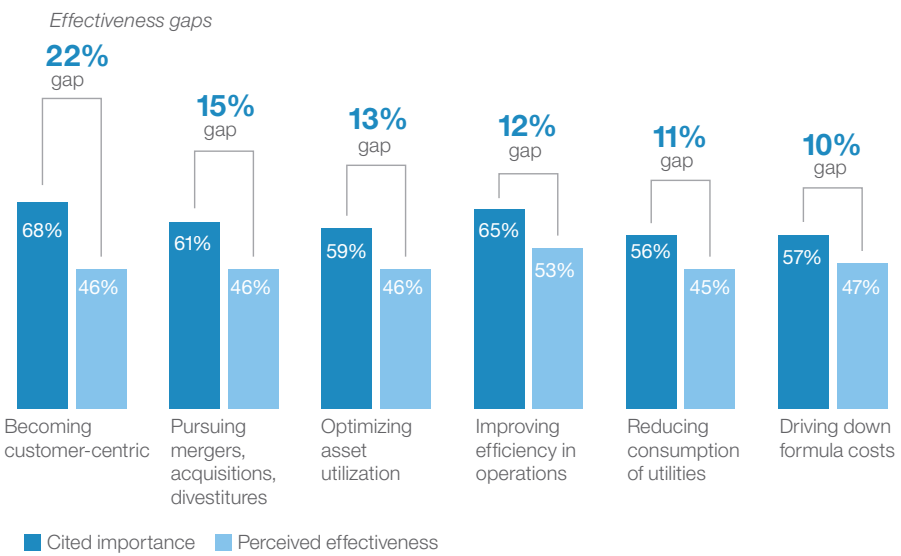
As a consequence of this confluence of new digital technologies, half of the chemicals and petroleum executives who participated in the 2016 IBV Global Ecosystem Survey of more than 2,000 global business leaders, conducted in collaboration with the Economist Intelligence Unit, say that traditional value chains are being fragmented and replaced.[7] Fifty-five percent of chemicals and petroleum executives report that the boundaries between their industry and others are blurring. And 42 percent say that competition from new and unexpected sources is beginning to impact their businesses.[8]

This disruption poses a significant threat to the industry since many chemical organizations are preoccupied with more immediate, day-to-day business. And even with that emphasis, the effectiveness of chemical companies against important organizational objectives shows

large gaps (see Figure 2). Over two-thirds of the 300 chemical industry respondents say it's vital to become customer-centric, for example. Yet less than half indicate that their employees are up to the job. Industry respondents also reveal significant gaps between the cited importance and perceived proficiency of chemical companies in advancing these objectives: pursuing mergers, acquisitions, and divestitures; optimizing asset utilization; and improving operational efficiency.

Figure 2

Chemical companies worry that their organizations are not ready to weather the disruption



Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

Digital Reinvention in the age of E2E

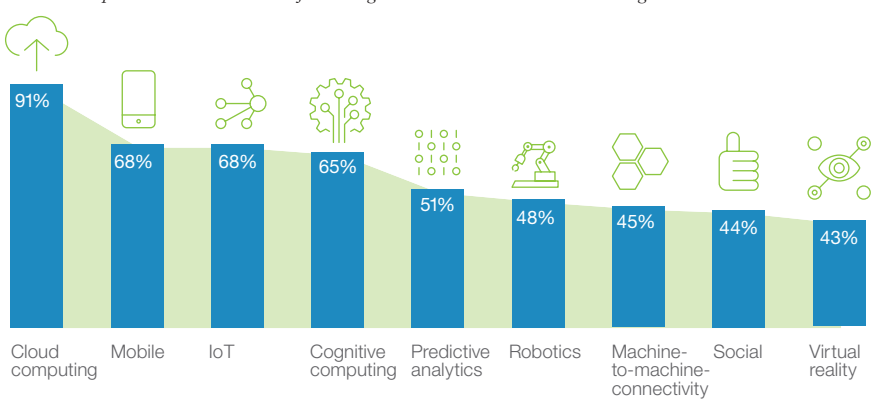
To succeed, chemical businesses will need to embrace new and emerging technologies to create compelling customer experiences and drive new efficiencies, opportunities and innovations. In the process of advancing their digital agendas, leading chemical businesses will need to develop new focus, build new expertise and devise new ways of working. In short, they will need to digitally reinvent their enterprises.

Defining Digital Reinvention

Digital Reinvention combines multiple digital technologies – including cloud computing, cognitive computing, mobile and the IoT – to reconceive customer and partner relationships and operations. Chemical companies see a collection of digital technologies as critical to their strategies (see Figure 3). Cloud computing can be used to run applications and store data anywhere. Mobile technologies allow ubiquitous access to information. The IoT connects sensors and devices to networks.

Figure 3

Chemical companies cite a combination of technologies as critical to their business strategies



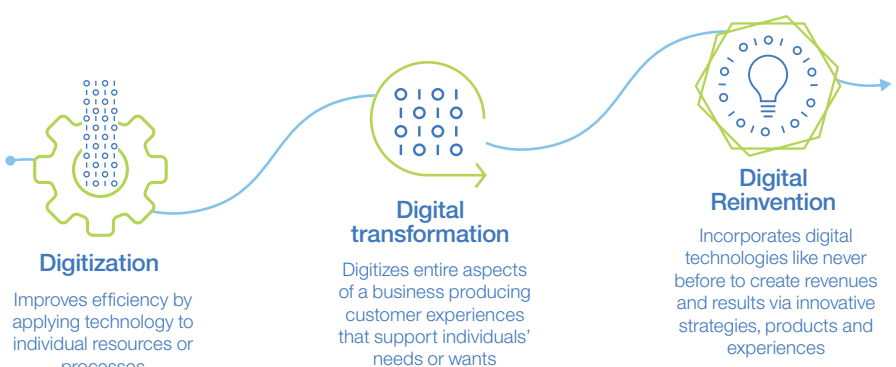
Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

Digital Reinvention involves creation or orchestration of unique, compelling experiences for customers and other stakeholders by way of emergent business ecosystems. The most successful digitally reinvented businesses establish a platform of engagement for their customers, acting as enabler, conduit and partner.[9] Given that the chemical industry is a strategic supplier to virtually all segments of the economy, its initiatives can help other industries create innovative products.

Digital Reinvention differs in concept from both digitization of individual capabilities or functions, and digital transformation (see Figure 4). For chemical organizations, digitization involves digital automation of specific processes such as supply chain. For example, dynamic scheduling can be implemented to connect real-time customer orders with production data to improve the order scheduling process and increase customer fulfillment.

Figure 4

Digital Reinvention follows a path that starts with digitization and progresses through digital transformation



Source: IBV analysis.

Digital transformation ultimately involves integrating across multiple digital processes. An example would be the development of online marketplaces that are fully integrated into supply chains and distribution networks. For example, Echemi, a China-based company, has created a B2B platform focused on chemical trading. Echemi assembles the supply of chemicals with real-time factory information and transparent prices, allowing buyers to easily place and track online orders.[10]

Digital Reinvention goes much further. It involves fundamentally reimagining the way a business operates and engages with its stakeholders. It relies on a range of digital applications and technologies supporting construction of deep, collaborative relationships through fully integrated ecosystems in which customers and partners participate at will. Within that context, Digital Reinvention requires rethinking how chemical organizations operate and engage with partners, customers and the environment as a whole.

Chemical leaders with digital advantages

How can chemical companies best respond to disruption with Digital Reinvention? To help answer this question, we identified a small group of chemical outperformers, consisting of 21 percent of our sample. This group was more effective than its peers, on average, in ten activities:

1. Growing production capability and exports
2. Improving efficiency in operations
3. Reducing consumption of utilities
4. Balancing environmental and economic sustainability
5. Pursuing mergers, acquisitions and divestitures
6. Optimizing asset utilization
7. Managing operational and manufacturing data
8. Increasing the level of automation
9. Driving down formula costs
10. Becoming customer-centric.

Chemical outperformers also report that they deliver 120 percent better revenue growth, 105 percent higher profitability and 114 percent better efficiency than industry peers. When compared to their peers, 30 percent more of these outperformers develop digital strategies and execution plans – and they are better prepared to implement digital technologies. For example, of outperformers:

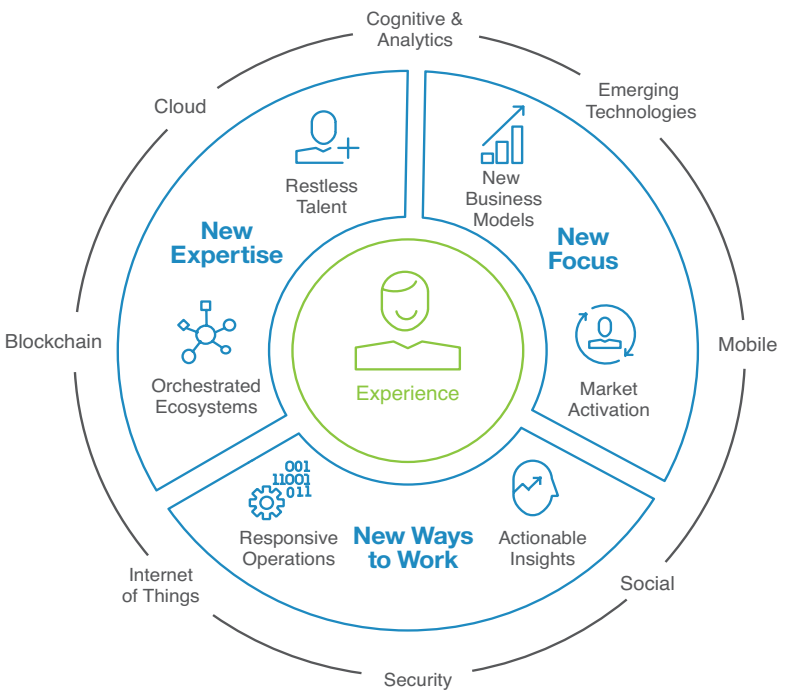
- 74 percent have a transformational vision for the use of digital technologies
- 82 percent support the shift to digital technologies with change management
- 85 percent have identified which business processes can be augmented with digital technologies
- 87 percent track the impact of digital technologies across their businesses.

Readying for reinvention

For successful Digital Reinvention, organizations need to pursue a new strategic focus, establish new ways of working and build new expertise (see Figure 5).

Figure 5

Digital Reinvention revolves around new experiences



Source: IBV analysis.

Pursue a new focus

Chemical businesses need to develop new ways of realizing and monetizing value. Initiatives might include spawning new business models, accelerating innovation and new product development, and developing better, more holistic ways of conducting risk assessments. Leaders will also need to create strategies and execution plans to deliver deep, contextual experiences, often treating B2B clients like end consumers.

The outperforming group sees cloud computing, the IoT and cognitive computing as essential for new business models and innovation (see Figure 6). And 76 percent more of them than their peers have connected their front offices to their back offices.

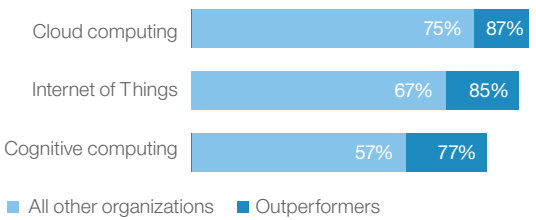
Establish new ways of working

Chemical businesses need to digitize products, services and processes that redefine customer experiences. They will need to augment these steps with digital technologies to create fully integrated, flexible and agile operating environments. Outperformers report embracing these digital technologies at higher rates than their peers, including:

- Cloud computing (20 percent more often)
- The IoT (53 percent more often)
- Predictive analytics (160 percent more often)
- Cognitive computing (181 percent more often).

Figure 6

Outperformers expect a combination of technologies to help them create new business models

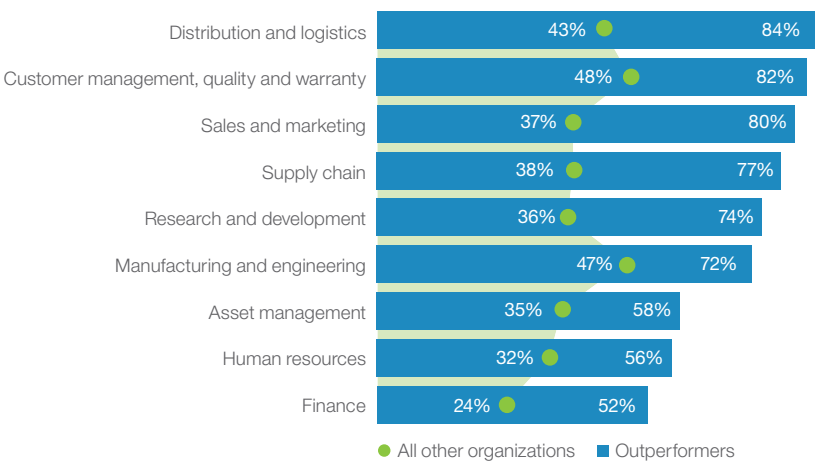


Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

And outperformers are applying these digital technologies across their value chains (see Figure 7). For example, cognitive systems help enhance maintenance operations by recognizing failing assets and demonstrating the "next best action" to engineers via augmented reality devices. Chemical companies use predictive analytics to spot anomalies in the data flow before thresholds are reached. Cognitive computing takes this further by learning new behaviors and trends, and then developing more effective mitigation actions.

Figure 7

Outperformers apply digital technologies holistically across their value chains



Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study.

In terms of priorities, outperformers deem it most important to apply a combination of cloud computing, cognitive computing and the IoT to customer management, quality and warranties, supply chains, and sales and marketing. Customer self-service in product and technical research, as well as troubleshooting, can be addressed with speech-enabled mobile apps that allow clients to find a match between their need and offered products. Cognitive, autonomous supply chains can improve transparency, mitigate risks and disruption, and accelerate decision making using real-time advanced analytics. Sales and marketing can be improved by using digital technologies to accelerate product innovation.

Beyond implementing technology, outperformers have established data management and governance to support Digital Reinvention. These organizations typically employ a Chief Data Officer (CDO) or equivalent. This CDO defines, develops and implements the strategy and methods by which the organization acquires, manages, analyzes and governs data.

In our survey, nearly four times as many outperformers have a CDO relative to their peers (45 percent versus 12 percent). And 61 percent supplement their CDO with a business-driven information governance committee, compared to just 35 percent of their peers. Fifty-three percent of outperformers have also implemented an enterprise data warehouse to manage the deluge of data, versus 35 percent of their peers.

Outperformers have also made changes to their operating models. They report creating service scalability by forming centers of excellence for analytics and cognitive computing 43 percent more often than their peers.

Build new expertise

Chemical businesses need to identify, retain and build the necessary talent to create and sustain a digital organization. It will be vital to perpetuate innovation-infused cultures incorporating design thinking, agile working and fearless experimentation. Leaders will need to contextualize organizational priorities within business ecosystems, seeking both new forms of partnering and new ways to build value within new systems of engagement.

Outperformers overwhelmingly recognize that employee roles and skills will need to evolve. To support Digital Reinvention, they have taken concrete steps toward talent improvements, including:

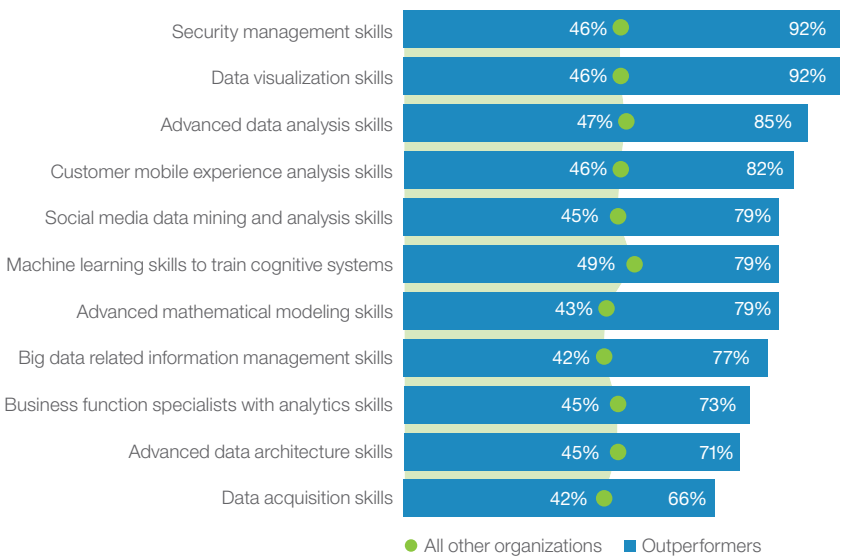
- Targeting acquisitions for digital skills (89 percent)
- Incubating startups to gain access to external digital talent (82 percent)
- Using leadership commitment to drive a digital culture (81 percent)
- Training employees on engaging with digital technologies (77 percent)
- Establishing development programs, such as reverse mentoring with millennial employees (74 percent).

With the transition to digital technologies, outperformers also recognize the need to acquire talent that can move such initiatives forward, including “new collar” skills that may not require a traditional college degree. As such, they report digitizing the recruitment process 81 percent more often than their peers. And they report establishing new centers in talent-rich areas 45 percent more frequently.

Additionally, outperformers recognize the need for specialized skills and have invested in specific roles (see Figure 8).

Figure 8

Outperformers have the new skills to support Digital Reinvention



Source: 2017 IBV Chemicals and Petroleum Digital Transformation Study. Q22: Which of the following skills has your organization invested in to take advantage of digital technologies?

Evonik earmarks large investment in digitalization

The global specialty chemical company Evonik, headquartered in Germany, aims to create new business models, solutions, services for customers, and train staff. To assist with the program, Evonik is setting aside EUR 100 million and has entered into strategic partnerships with the University of Duisburg-Essen (UDE) and IBM. The cooperation between Evonik and UDE focuses on the people and skills at the center of digital transformation, including interactive knowledge transfer, individually tailored training, and digital business partnerships. The first pilot technology project starts with Evonik and IBM co-developing a cognitive, Evonik-specific Chemical and Life Science Knowledge Corpus, resulting in the offering of digital advisory services and implementing efficiency improvements.[11]

Finally, outperformers collaborate more frequently to leverage digital technologies. Ecosystem partners are a pipeline to technology, data and skills. Outperformers often partner with technology firms (85 percent versus 33 percent for their peers) and create other new partnerships to leverage digital expertise (74 percent versus 41 percent for peers). An example would be partnering with a wearables technology company to focus on improving employee safety.

Outperformers also share people with their partners 56 percent more than their peers do. And they share physical assets with partners 81 percent more than peers. For example, chemical companies are acknowledging that proactive management of unused and surplus analytical lab instruments, and plant and packaging equipment, can create additional value.[12] In research and development, chemical companies can drive innovation by linking internal resources to external resources through alliances that could include academic institutions. This can lead to increased revenues that could fund even more innovation in a virtuous cycle – especially relevant in a low-growth environment.

Surfing the digital wave

To set out on the path toward Digital Reinvention, chemical companies can take four initial steps:

Step 1: Envision possibilities
Conduct envisioning sessions based on design thinking to produce a definitive reinvention blueprint. Through deep conversations and in-depth marketing analysis, develop a better understanding of customer needs, aspirations and desires. Brainstorm new ideas to enhance engagement and visualize unexpected customer scenarios. Incorporate external stakeholders, including customers, in these sessions to encourage thinking that goes beyond business-as-usual.

Step 2: Create pilots
Develop prototypes using agile development, test them with customers and get them to market quickly to elicit feedback and iteration. Establish communities of interest to create "safe" environments to beta test innovations, and incorporate them as a central part of design and development processes. For example, chemical companies could test bundling services with existing products to increase the value proposition.

Step 3: Deepen capabilities
Augment digital capabilities with strategic initiatives. Continue to build and deploy necessary applications aligned to the target Digital Reinvention operating model and ecosystem strategy. As pilots evolve, impediments to development will emerge, highlighting limitations in existing capabilities. Adopt a continuous, iterative strategy to address these limitations by building new or extending existing capabilities.

Step 4: Orchestrate ecosystems
Embrace a strategy based on holistic reinvention rather than a series of point solutions, maintaining a clear focus on deep needs, aspirations or desires of customers, clients (such as partners) and colleagues (such as service providers). Use ecosystems to expand and align a broader set of capabilities, and to help create and deliver on customer promises.

Becker Underwood creates a more intelligent supply chain with analytics.

Becker Underwood, the U.S.-based global agriculture chemical company owned by BASF, uses analytics to address the complexity of its supply chain, arising from acquisitions and organic growth. The company creates a 360-degree, real-time view of its customers to understand what they are buying, when they are buying and their payment performance. The information is used to create an aggregate raw materials forecast for suppliers. This has resulted in improved productivity and enhanced communications across the organization, and to suppliers and customers. Inventory turns improved 50 percent and forecasting accuracy increased by 30 percent.[13] According to Nucleus Research, the company achieved a return on investment of 383 percent in four months.[14]

Key questions

- How can you create an ambitious digital strategy that can effectively deal with disruption?
- How can your organization become more agile in its response to unexpected challenges and opportunities?
- What steps can you take to give your workforce the flexibility to quickly embrace new ways of working and new strategic priorities?
- How can your leadership become more visionary, conceiving what customers want before they know it themselves?
- How will you use automation, such as wearables, the IoT and robotics, to achieve significant operational improvements?

Related reports

Womack, David M. "How digital transformation is reformulating the chemicals industry." IBM Chemicals & Petroleum. September 2017. https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=CHW03012USEN

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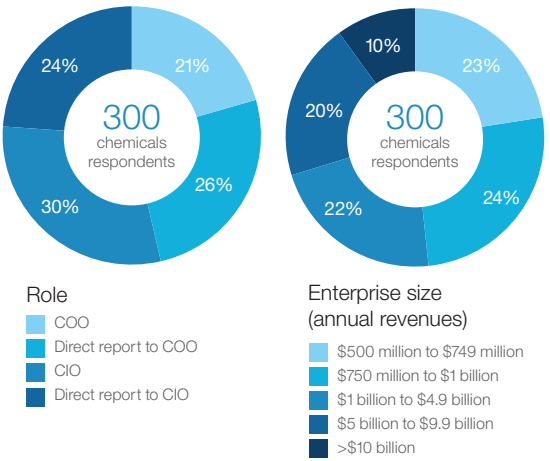
Study approach

In cooperation with Oxford Economics, the IBV surveyed 600 global executives in the chemicals and petroleum industries in the IBM Chemicals and Petroleum Digital Transformation Study. Responding executive roles included COOs and CIOs, and their direct reports. In total, 300 chemical respondents participated in the study. They represented a variety of titles, enterprise sizes and geographies – including 25 percent from North America, 5 percent from South America, 32 percent from Europe, 11 percent from the Middle East and Africa, and 26 percent from Asia Pacific.

Our analysis identified a small group as the most effective organizations (21 percent of our sample). This group of outperformers was more effective than its peers, on average, across ten activities: growing production capability and exports; improving efficiency in operations; reducing consumption of utilities; balancing environmental and economic sustainability; pursuing mergers, acquisitions and divestitures; optimizing asset allocations; managing operational and manufacturing data; increasing the level of automation; driving down formula costs; and becoming customer-centric. All data is self-reported.



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