

strategy&

2019 Digital Operations study for chemicals



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FOREWORD

Digitization and technological advances in energy, such as renewables and improvements in battery storage, are adding to the energy, utilities, and resources (EU&R) industry's skill set. These technologies offer considerable opportunities for transformation and are disrupting the EU&R competitive landscape.

For chemicals companies, digitization in particular offers opportunities to reduce costs in various ways, and is also creating new business models that are being pioneered by new entrants from outside the sector. As a result, many chemicals companies are facing a mix of challenges that can no longer be responded to in the traditional way.

Recently, we explored the building blocks for a successful transformation of the EU&R industry by highlighting the impact of resource and material substitution, decarbonization and waste elimination.

These topics are top of mind for chief executives at chemicals companies. In spite of the wariness that these trends might engender, they do give chemicals companies an opportunity to shift from being product sellers to solution providers. To succeed in this more demanding era, chemicals companies need to not only transform their product portfolios but seek to become more customer-centric providers of B2B solutions.

As our survey reveals, chemicals companies are turning to digitization faster than their peers in the rest of EU&R, but this is not thoroughgoing enough yet to keep up the pace of other industries. While their initial digitization efforts have been targeted at specific bottom-line generating assets such as supply chain and production, we think chemicals companies need to take a more holistic approach to digitization.

I am grateful to my colleagues Iris Herrmann, Marcus Eul, and Marc Münch for having initiated this survey of digital operations in the chemicals sector. This report is a companion piece to an earlier report on digitization in the power and utilities sector and will be further complemented by an examination of the oil and gas sector.

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EXECUTIVE SUMMARY

Few industries would benefit more from digitization than chemicals. Although the industry has been among the most dynamic in developing new materials for a variety of applications, the lifecycles of chemical products are shortening while commoditization is accelerating. As a result, profit margins are suffering.

Competition in the chemicals industry, especially in developing countries, is intensifying and chemicals companies are facing rising costs in meeting increasingly stringent environmental and product safety rules.

And while chemicals companies are designing and manufacturing some of the most advanced and complex materials in the world, from a profit and growth perspective in many ways their overall performance is being held back by product commoditization, rapidly expanding competition in developing countries, and customers demanding more at lower prices. In short, chemicals companies are facing challenges that are testing the nimbleness of their business models even as their industry's products continue to outpace the imagination.

In response to these challenges, chemicals companies are turning to digitization to improve efficiency, optimize their relationships with customers and suppliers, expand their revenue bases and overall improve their bottom lines. In many cases this is happening to a greater extent than at many other companies in energy-related industries.

Chemicals executives certainly have high expectations of digitization. In the 2019 Digital Operations Survey for Energy, by Strategy&, PwC's strategy consulting business, 17 percent of respondents predicted revenue increases of over 20 percent over the next five years from their investments in digital technologies. Eleven percent anticipated the same amount in efficiency gains and cost reductions.

At the same time, executives expect that revenue from their company's traditional product and services would fall to 65 percent of total sales in the next five years, from 73 percent at the time of the survey (*see Exhibit 1, next page*). Filling that gap would be revenue from purely digital content, services and solutions, which is anticipated to reach 21 percent of sales, up some 8 percent points from current figures.

We think this may be too optimistic. While digital implementation is certainly increasing at chemicals companies, the relatively basic applications they are focusing on are not radical enough to be expected to generate huge swaths of additional revenue.

In particular, chemicals companies are paying insufficient attention to products as a service (PaaS) offerings and other innovative monetization strategies as a way to help make up the shortfall between sales from traditional, non-digital products and new digital initiatives.

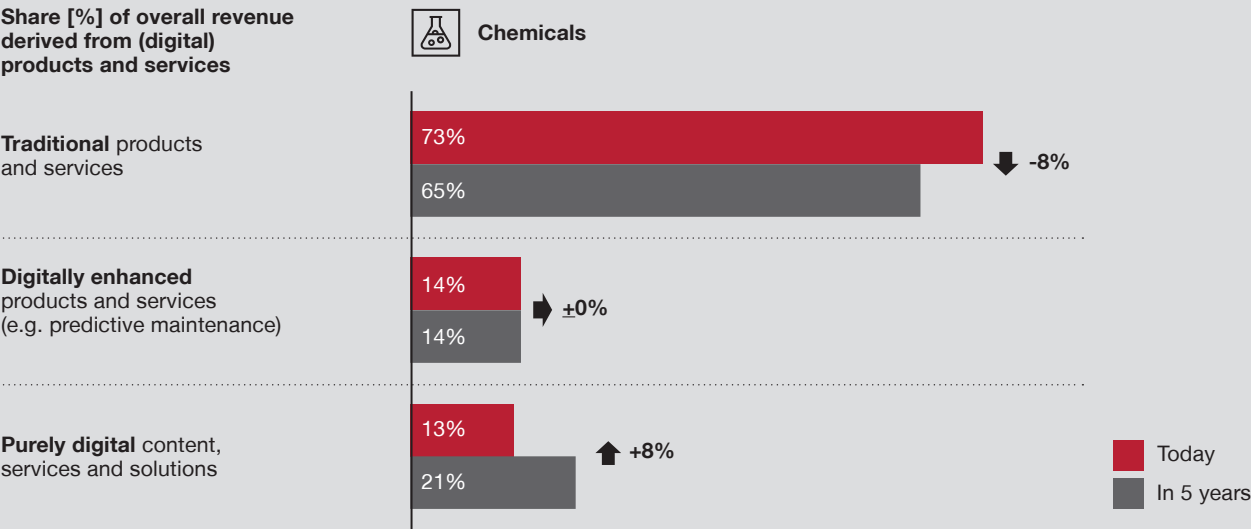
In addition, there are signs that chemicals companies' digitization efforts are not going far enough to cope with the upcoming challenges in certain significant ways. Fewer than half of the chemicals companies surveyed said they had fostered a culture of innovation. Moreover, only 46 percent of chemicals companies said their leadership had a clear vision for the company's digital future and acted as a role model for achieving that.

Furthermore, our survey shows that training and development programs have not kept up with the need for more talent to implement digitization. Only 33 percent of chemical companies said that they "have invested heavily in training to make our staff fit for digital transformation," and only 25 percent had implemented digital technologies such as artificial intelligence (AI), to enhance human resource functions and employee education.

As digitization begins to prove its value to the bottom line, chemicals executives will have to pay more attention to improving their companies' cultures or risk holding back the incremental development of digital technologies.

EXHIBIT 1
Revenue from digital products and services

Survey showed chemicals companies lag in traditional product areas, but lead in digitally enhanced areas



Note: Average revenue shares in percent, differences in percentage points. Base: 509 companies
 Source: PwC's Strategy& 2019 Digital Operations study for energy

Three challenges for chemicals companies

The thorniest problem besetting chemicals companies is a by-product of the dynamics of the industry environment in which they operate: commoditization of their portfolios is accelerating, and substitution pressure rises as chemical substances are increasingly scrutinized for their impact on health or environment. In addition, chemicals companies are under increasing pressure from their customers to come up with more and more innovative applications that can, in turn, help those customers respond to the rapidly-changing environment around them.

For example, automotive companies – which are one of the largest group of consumers of the chemical sector output – are constantly trying to minimize the carbon footprint of their vehicles by building viable electric, hydrogen-powered and autonomous vehicles at a reasonable cost. They are looking to chemicals companies to keep offering new solutions for limiting the size and weight of vehicle components, for improving cables, seals and conductivity, and for streamlining manufacturing processes with the aim of producing more modular, pre-packaged parts. Also new powertrain solutions, such as batteries or fuel cells, can only be achieved with the help of innovative chemicals.

1.

Speed and profitability

The pace of change in vehicle design – and similar scenarios playing in other industries – is shortening chemical product lifecycles and accelerating the commoditization of these companies' portfolios as new solutions quickly become the new standard. Inevitably, profit margins are suffering as chemicals companies are forced to offer discounts sooner than they had planned, while spending more than they might want on product upgrades.

2.

Competitive dynamics

A second issue is that these industry dynamics have opened the door for competitors, particularly in developing countries, to chip away at established chemicals companies' market share. Smaller and more flexible with lower cost structures, these rivals are attracting customers with customizable product lines that often offer more value at lower price points.

3.

Rising standards

And last of all, the chemicals industry is of course dealing with environmental and societal obligations. As customers, regulators and activists raise questions about how well companies are protecting natural resources, addressing climate change and offering good employment opportunities, chemicals companies are often singled out because of the potential for waste and pollution. Ensuring compliance with local rules, high safety standards and voluntary global corporate responsibility guidelines is even more costly for chemicals companies than for many other industries.

Change in mindset – and focus

As these challenges have taken hold, a new attitude towards digitization has emerged among chemicals executives. This is clearly reflected in the results of our survey, which was designed to assess the digital maturity of chemicals companies, both in relation to other energy players and also in relation to peers in the chemicals industry.

Sixteen percent of chemicals companies were ranked as “Digital Champions” and 25 percent as “Digital Innovators”, the second level of digital maturity (see *Exhibit 2*). No less than one third – the largest group – of the chemicals companies were classified as Digital Followers. By contrast, only 7 percent of oil and gas companies and 2 percent of utilities could be characterized as Digital Champions.

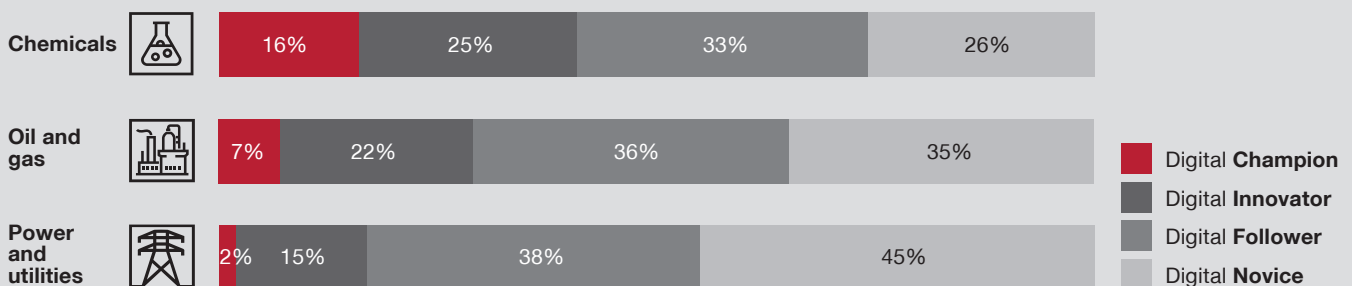
Rather than view digitization solely as a way to tackle a particular operational problem – for example, by using a digitally-predictive maintenance program in a single plant to proactively test for incipient factory equipment break-downs before they turn into a full-blown problem – some chemicals companies are finally starting to adopt digitization as an organizational weapon, through the use of broad digital platforms, to grow profit margins and revenue streams.

Their initial digitization efforts are focused broadly on operations-related functions that are directly impacting the bottom line, such as digital process optimization (wringing out waste and adding efficiency in manufacturing and other production activities); transportation risk management (ensuring quality and safety during transport); integrated planning (using real-time product demand as a lever to drive inventory management and production scheduling); and real-time order management (giving customers more moment-to-moment visibility into shipment locations and expected arrival times). Indeed, according to Strategy&’s survey, 66 percent of chemicals companies have already implemented or piloted digitization in manufacturing, 58 percent in supply chain management, and 66 percent in product development. By comparison, companies in less digitally mature industries – for example, utilities – tend to focus their technology efforts on support and service functions such as marketing and finance, where the returns from a revenue and profit perspective are lower. And expectations among chemicals executives run high for real and tangible performance

EXHIBIT 2 Digital Operations maturity

A third of chemicals companies surveyed, were digital followers

Level of Digital Operations maturity by key industry



Note: Index group distribution in percent. Base: 509 companies
Source: PwC’s Strategy& 2019 Digital Operations study for energy

results. Seventeen percent of chemicals companies envisage revenue increases of over 20 percent during the next five years from their investments in digital technologies and 11 percent anticipate the same amount in efficiency gains and cost reductions).

Digging down into the specific applications that chemicals companies are adopting, digital process optimization, which essentially involves wringing out waste and boosting efficiency in manufacturing, is on top of the list. More than 30 percent of chemicals companies surveyed had already implemented this technology and that number is expected to double in the near future.

Of those companies surveyed (see *Exhibit 3, next page*), more than half responded that they had already implemented, or were piloting, or planned to implement, the following digital applications: digital process optimization; predictive maintenance (proactively addressing potential factory equipment breakdowns); transportation risk management (ensuring quality and safety during transport); and integrated planning (using real-time product demand as a lever to drive inventory management and production scheduling).

However, further down the list are other critical applications – for instance, emissions management and smart energy systems – that chemicals companies should not neglect. These applications are intended to reduce a company’s carbon footprint, which will become increasingly essential in the next few years as environmental and sustainability concerns intensify. Ultimately, regulations and free market solutions, such as “cap-and-trade” policies, will add significant operational expenses in chemicals businesses that have not proactively, facing these issues with technological progress.

In addition, chemicals companies appear reluctant to embrace digital applications that are still at an immature stage. Among these less attractive ideas (for now) are drones and robotics for inspection work, and smart and automated on-site factory logistics and virtual plant layouts, which involves designing a digital version of a new or existing factory to illustrate how manufacturing facilities might respond to different types of real-world conditions.

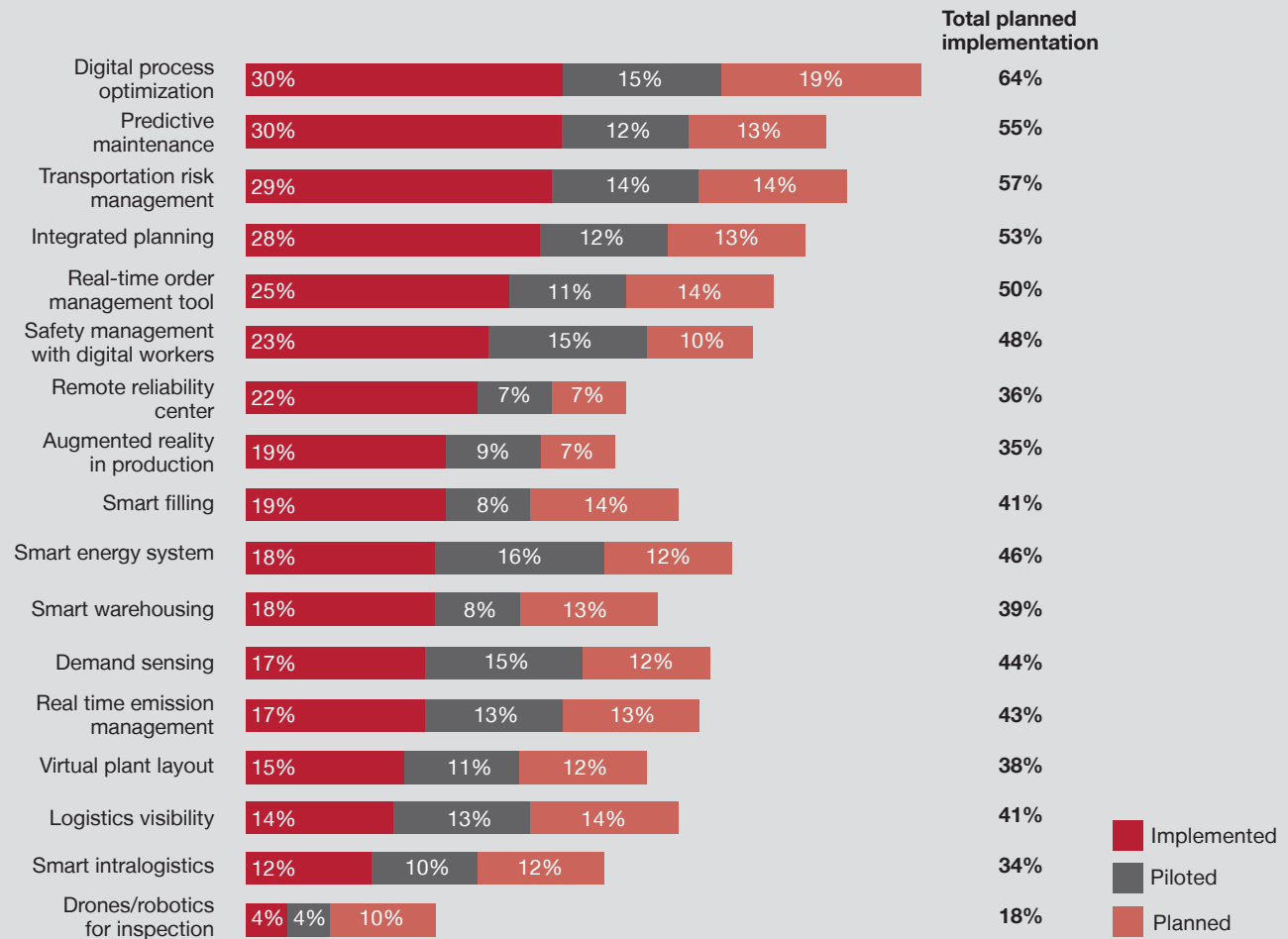


As Chemicals companies are gaining more experience with digital applications, the ones being able to roll-out and scale-up the fastest throughout their network will have a huge competitive advantage.”

EXHIBIT 3

Digital applications: Future potential

More than half of companies surveyed had implemented, or were piloting, or planned to implement key digital applications



Note: Figures in percent. Base: 106 Chemicals companies
 Source: PwC's Strategy& 2019 Digital Operations study for energy

The tools chosen to drive digitization efforts

The main digital technologies that chemicals companies are implementing – according to Strategy&’s survey – are manufacturing execution systems (information networks that connect and control factory operations); cloud computing; track and trace (systems that automatically record shipment information and provide it in real-time); and energy analytics (used for process optimization or predictive maintenance, among other things).

Far fewer companies are investing in what PwC calls the “Essential Eight” technologies, such as blockchain, augmented reality and 3D printing. This may reflect a cautious approach on the part of chemicals executives to change, possibly pointing to a desire to initially capture “low-hanging fruit” and bolster their position in the market. Nonetheless, even in these areas – and especially in AI – chemicals companies far outpace other energy related industries we surveyed.

One sign of the chemicals industry’s appetite to digitize is the fact that most respondents said they planned to use existing in-house skills or ventures with partners to harvest the mature technologies that are on top of their wish lists (see *Exhibit 4, next page*). Digital twins, i.e. computerized virtual replicas of factories, processes, systems and devices to help assess performance and test out new ideas, are also more likely to be developed internally, our survey showed.

That may reflect a desire to protect proprietary operational information from third-parties as well as the challenge of lengthy development time required to produce a digital twin. By contrast, less immediately critical technologies, like blockchain or 3D printing, are more likely to be jointly developed by external partners or directly outsourced to external partners. Limits to dramatic revenue shifts.

Considering the outsized impact that digitization can bring it is not surprising that most executives expect that the revenue mix at chemicals companies will change substantially in the next five years as new technologies are spreading. According to our survey, chemicals executives expect that revenue from their company’s traditional products and services will fall from 73 percent to 65 percent of total sales over the next five years (see Exhibit 1). This gap could be filled by revenue from purely digital content, services and solutions, which was anticipated to reach 21 percent of sales, up some 8 percent points from current figures.

However, that may be overly optimistic. While digital implementation is certainly increasing at chemicals companies, the relatively basic applications they are focusing on are not radical enough to generate huge swaths of additional revenue, as expected.

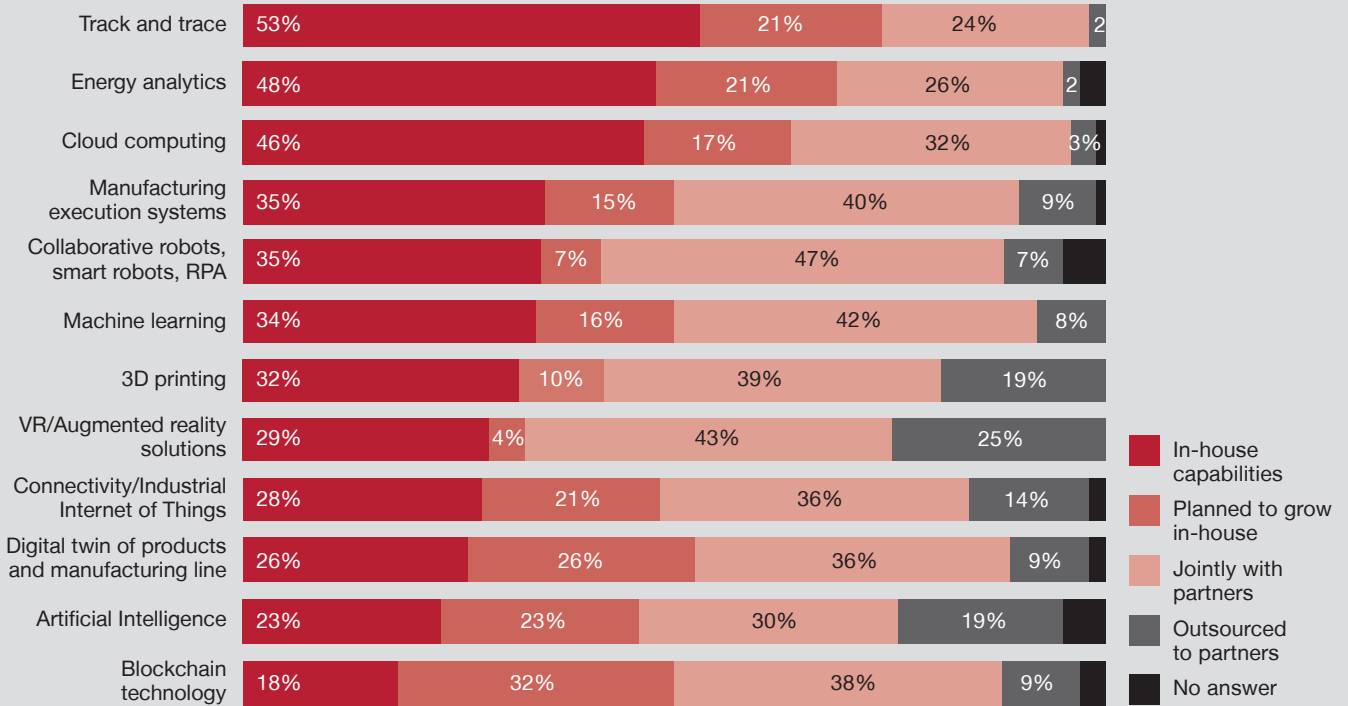
We think that Digital Champions are to some extent pointing the way towards a more sophisticated application of digitization, involving implementation of platforms that offer advanced, individualized services and products. However even those companies are not going far enough, and have so far even limited their own digitization efforts targeted at – for example – improving customer experience through the use of multi-channel sales and marketing programs that offer seamless product information and ordering functions online and in person.

On these platforms, products can be customized based on specific buyer preferences and requirements. The problem is that these types of offerings, while increasingly essential as a lubricant to reduce friction with customers, are becoming increasingly commonplace in all industries. This will not be distinctive enough to make up for lost sales in traditional product lines.

EXHIBIT 4

Digital technologies: Make or buy?

Most respondents said they planned to use existing in-house skills or ventures with partners to harvest the mature technologies that are at the top of their wish lists



Note: Low number of respondents. Results to be interpreted with care. Base: 28-71 Chemicals companies that at least plan to implement the respective technology
 Source: PwC's Strategy& 2019 Digital Operations study for energy

To fill the gap resulting from declining revenues from their company's traditional products and services, chemical companies should consider more advanced digital platforms such as PaaS, which is selling the services associated with a product rather than the product itself. So, for example where a chemicals company is providing polycarbonates to an automotive supplier the chemicals company could – instead of simply selling that product – offer a commitment to deliver specified annual improvements in the performance of the polycarbonate, such as weight reductions or contribution to manufacturing process efficiency.

In addition, the company could work more closely with the supplier and original equipment manufacturer (OEM) to drive improvements in sections of the vehicle. The supplier thereby incurs fewer production costs, wins an innovation partner and only pays for the polycarbonates that are actually used, while the chemicals company becomes a co-equal business partner in the production process, instead of just a recipient of an order. Since many chemicals companies are also participating in consumer goods businesses – for instance, as producers of everything from make-up to pesticides – they have the added potential of developing subscription-based programs to provide monthly refills to consumers as needed or to upsell items as consumer preferences change. Still, despite the promise of PaaS platforms, chemicals companies are well behind utilities and oil and gas companies in this aspect of digitization. In our view, without PaaS and other innovative monetization strategies, chemicals companies could find themselves with a troubling revenue shortfall as sales from traditional, non-digital products decline.

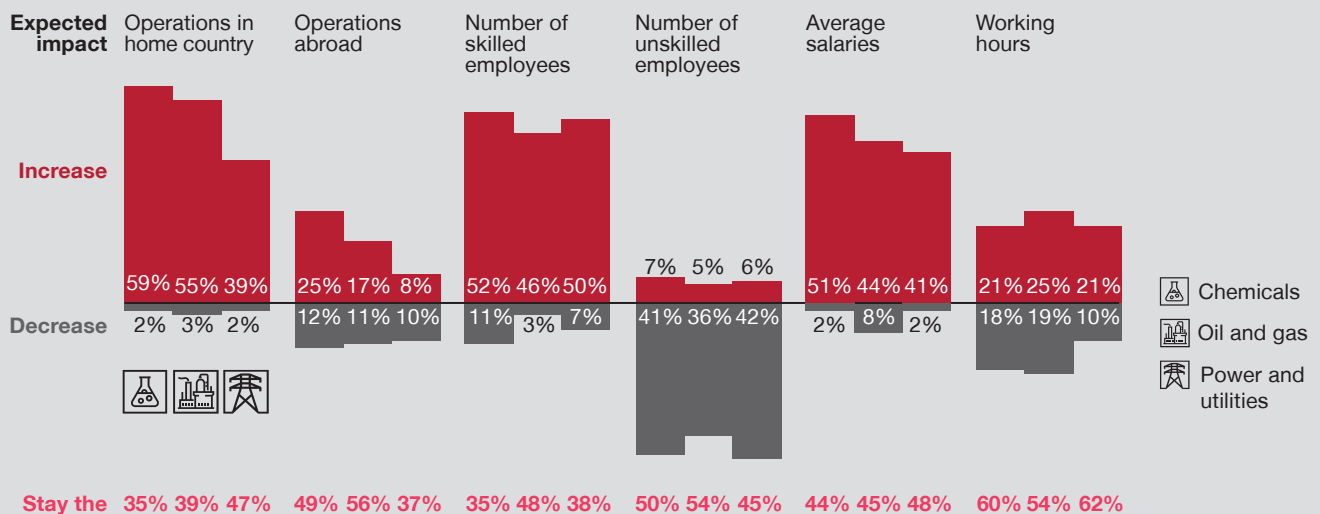
Tackling the culture conundrum

A very real obstacle to a successful digitization effort – and to thus becoming a Digital Champion or Digital Innovator – is that the workforce at many chemicals companies lacks the skills needed to implement and manage digital technologies. Indeed, that shortcoming was cited as one of the top three challenges in digitization by around 30 percent of chemicals executives.

Part of the problem is corporate culture. Fewer than half of the chemicals companies surveyed said that they had fostered a culture of innovation, for example by having flat hierarchies that can facilitate organizational agility, cross-functional collaboration and quick decision-making. Moreover, only 46 percent of these businesses could characterize their leadership as representing a role model for a digital future, with a clear vision for how it will unfold. Training and development programs to improve employee digital skills have also suffered. Only one third of chemical companies said that they “have invested heavily in training to make our staff fit for digital transformation,” and only one quarter of companies surveyed had implemented digital technologies, such as AI, to enhance human resource (HR) functions and employee education. That said, we found in follow up interviews with chemicals companies that decision makers do recognize the critical role of culture and people for a successful digital transformation. And more than half of chemicals companies are optimistic that in the next five years their organizations will have a greater number of skilled employees as a result of digital transformation (see Exhibit 5). To get there, company executives said that planned or piloted comprehensive HR programs, new learning formats and culture change management workshops are in the works to facilitate employee participation in a more technology-rich future. In addition, most companies expect the size of their operations teams to increase in their home countries, where more skilled employees are present. In turn, they anticipate higher average salaries for these workers.

EXHIBIT 5
Digital transformation: Impact on workforce in 5 years

Most chemicals execs expect shift towards more skilled workforce



Base: 509 companies
Source: PwC's Strategy& 2019 Digital Operations study for energy

How to become a Digital Champion

Given the study results, the question arises what it will take to become a Digital Champion in the industry. We see five areas evolving to set the focus on:

- 1. Focus on developing digitally-driven innovative business models and customer-facing functions.** Integrate digital features into existing core products and services to offer additional value to customers and differentiate from competitors. Overcome revenue growth caps in the chemicals industry by monetizing PaaS, which offers attractive opportunities to improve competitiveness, develop closer and enduring relationships with customers and exit the trap of commoditization. Continue to cut costs and optimize manufacturing operations with new technologies and extend the digital transformation to lower costs in marketing, sales and customer service.
- 2. Identify and leverage digital applications and technologies that can develop or enhance the capabilities needed to gain a competitive advantage and to manage the business in a leaner, more agile and customer-focused way.** Decide whether to make or buy new capabilities, which capabilities are available internally, and which capabilities need to be developed through partnerships and other arrangements.
- 3. Integrate digital technologies, applications and initiatives into the overall strategic thrust of the organization.** For technologies and applications already implemented, determine whether they add value to new business models, products and services. If they do, pull them out of their silos and spread them throughout the company to further enhance capabilities and customer offerings. Don't allow new digital initiatives to be designed and isolated into individual business units without transparency on them and lessons learned being shared.
- 4. Create a broad digital ecosystem by combining supplier and customer interactions and information into a single network.** Use this network as the basis of efficiency improvements (both operationally and customer-focused), new product launches, product and service innovation and speedier time to market.
- 5. Align the corporate culture to make it focused on a digital future.** Make sure that innovation is welcomed and encouraged and that failure is acceptable in the service of achieving process and product improvements. Comprehensive HR programs, new learning formats and culture change management workshops should be designed and supported, to arm employees with the skills necessary to innovate.

While the environment for the chemicals industry is going to continue to be dynamic and difficult for some companies, this is a good time – perhaps the most crucial time – to develop and expand digital capabilities and set off towards digital maturity. New technologies, apps, databanks, systems and programs will be an essential lever for maintaining competitiveness, developing additional revenue streams and transforming the business model.

Indeed, the most important lesson from Strategy&'s study is that once chemical companies identify the capabilities that they need to modernize and innovate their business model, and aim at digitization to develop and enhance these capabilities internally as well as with suppliers and customers, they start to transform data into real value.

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