

Digital Transformation:
Are chemical enterprises ready?
January 2017

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Introduction

The global chemical industry is one of the largest sectors within the manufacturing ecosystem.¹ It is a key contributor to economic growth and employment and generates US\$3.9 trillion in sales, as well as directly employs around 20 million globally.² Its products and technologies are ubiquitous in consumer and industrial markets.

In recent years, increased competition, changing customer needs, evolving regulatory environment, and dynamic cost equations have weighed heavily on chemical enterprises, creating a progressively challenging environment. As a result, many chemical enterprises are focused on reinventing their business and operating models through transformational trends emanating from other industries. Yet, due to the global chemical industry's inherent cyclical nature and mostly commoditized existence, there are increased business challenges, as well as pressures to find new sources of growth by delivering innovative solutions to demanding customers.³

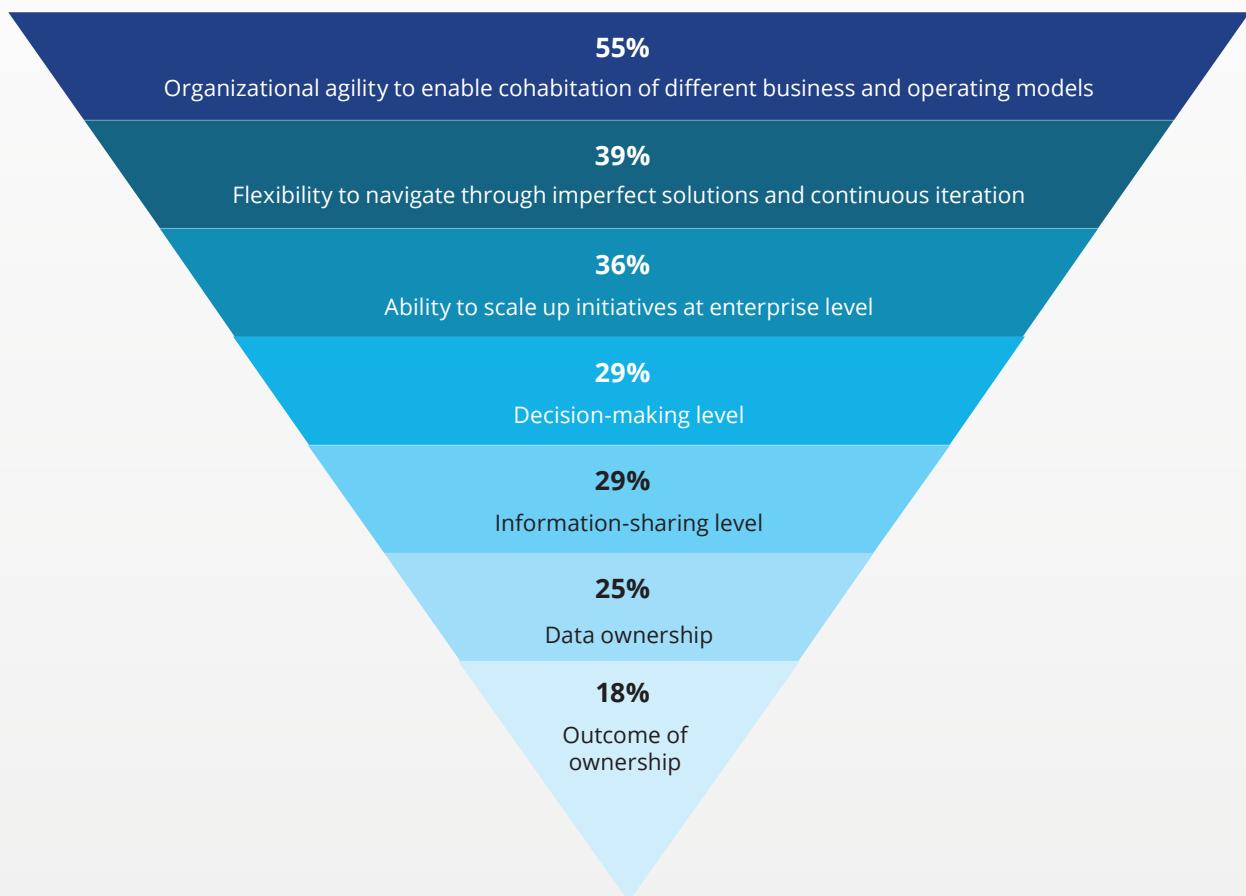
Traditionally, growth for most chemical enterprises is the result of operational and financial improvements, including optimizing asset utilization, improving yields, running efficient operations, enhancing workforce productivity, managing working capital, and ensuring optimal pricing. These performance levers are focused on strengthening the core of the enterprise, resulting in some growth to the bottom line. But, as many global industries and sectors embrace digitization in areas ranging from business processes to customer relationship management, digital transformation is becoming a smart business objective beyond just improving the core of the business. The global chemical industry can benefit from such transformation, which can act as a catalyst to unlock enterprise-wide business innovation.

However, with moderate past growth and estimated future growth (approximately 3 percent annually) of the global chemicals industry,⁴ the pace of digital adoption in the sector has been lackluster. According to Deloitte Touche Tohmatsu Limited's (Deloitte Global) inaugural 2016 *Global Digital Chemistry Survey* (See Sidebar 2), more than 50 percent of chemical enterprises lack a digital strategy and transformation roadmap.⁵ This alarming statistic may be the result of the global chemical industry being asset-heavy and requiring high capital investments. It also presents substantial entry barriers to smaller enterprises that may be more eager to embrace the digital agenda. Another reason could be the lack of business confidence in or knowledge of the potential benefits of a digital transformation, limiting chemical enterprises to making only marginal changes to digitally improve existing processes and systems. In short, chemical enterprises are still likely to question the utility of digital transformation and whether it is just hype or if it can truly drive dramatic business changes. Therefore, it does not come as a surprise that organizational agility (55 percent) and flexibility (39 percent) are the most significant barriers to enabling digital transformation and disruption for chemical enterprises (see Figure 1).⁶

Sidebar 1: Why chemical enterprises score low on digital maturity?

1. **Most chemical enterprises (greater than 50 percent) lack a digital transformation roadmap or strategy.** European chemical enterprises seem to be digitally maturing, while North American and Asian chemical enterprises are likely less digitally mature, being in the early and developing phase. More surprisingly, two out of three chemical enterprises having revenues between US\$5 and US\$25 billion and those focusing on specialties (specialty chemicals, coatings, plastics, and composites) seem to be in the early phase of attaining digital maturity.
2. **A significantly large number of chemical enterprises (75 percent) are focusing on digital initiatives for operational purposes,** which can lead to incremental, organic growth, and margin improvement. Less digitally mature organizations generally focus on individual digital technologies and strategies, which are operational in nature.
3. **Current digital responsibility still resides with the information technology department in many chemical enterprises.** Digitally mature companies generally have business or senior-level executives driving digital initiatives. Information technology likely acts as an enabler, considering the technological complexity and the cyber security imperative that comes along with implementing digital initiatives.

Sources: Deloitte Touche Tohmatsu Limited, *2016 Global Digital Chemistry Survey*, December 2016; MIT Sloan Management Review and Deloitte United States (Deloitte Development LLC), *Strategy, not Technology, Drives Digital Transformation*, July 2015.

Figure 1: Organizational barriers to digital transformation

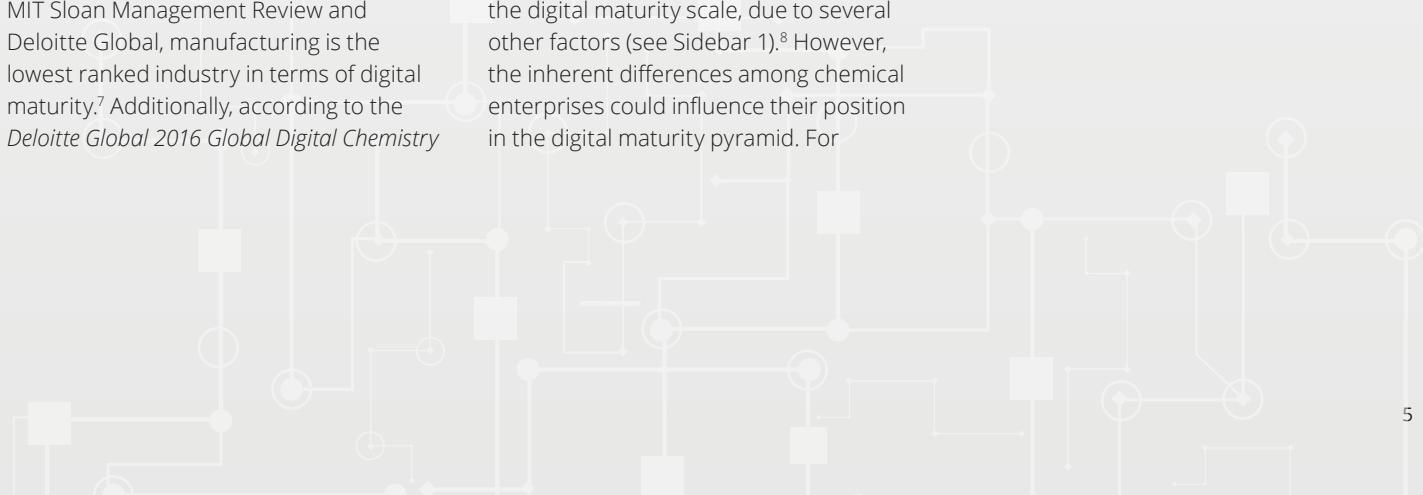
Note: Percentages displayed represent percentage of respondents.

Source: Deloitte Touche Tohmatsu Limited, 2016 *Global Digital Chemistry Survey*, December 2016.

Digital and exponential technologies are not new concepts to the global chemical industry. Despite this, manufacturing industries including chemicals are at the bottom end of the digital maturity pyramid. According to a joint study by MIT Sloan Management Review and Deloitte Global, manufacturing is the lowest ranked industry in terms of digital maturity.⁷ Additionally, according to the *Deloitte Global 2016 Global Digital Chemistry*

Survey (see Sidebar 2) less than one in four chemical enterprises (23 percent) rated themselves “above average” on digital maturity, in comparison to their competitors. Moreover, many chemical enterprises are placed relatively low on the digital maturity scale, due to several other factors (see Sidebar 1).⁸ However, the inherent differences among chemical enterprises could influence their position in the digital maturity pyramid. For

example, a commodity chemicals company may implement digital and exponential technologies for different business purposes than a specialty chemicals company, which creates variation in their digital adoption and maturity.



Most chemical enterprises have likely realized that implementing digital and exponential technologies in only one business or function does not constitute true digital transformation, nor does it justify large scale digital investments. The real objective of digital is to help transform the entire organization by identifying an effective, enterprise-wide, digitally-enabled business transformation roadmap including:

- a) Assessing the maturity in terms of business innovation and digital (and exponential technologies) adoption
- b) Enabling greater collaboration, internally and externally, among organizational functions
- c) Understanding the value generated by the business transformation

And while doing so, chemical enterprises will likely recognize that digital can serve as a unique catalyst to rally the entire organization around continuous innovation and value creation. Digital is not only expected to unlock the innovation potential of chemical enterprises, but also enhance the full spectrum of shareholder value (revenue growth, operating margin, asset efficiency, as well as other company strengths such as sustainability and safety).

However, the path towards digital transformation can be challenged by a range of issues that many chemical enterprises may find difficult to navigate and overcome. While tackling these issues, the following three questions may arise during the chemical executive's decision-making:

- **How do chemical enterprises accelerate and scale up digital initiatives to help realize their potential value?**

According to more than a third of chemical executives surveyed (36 percent), the ability to scale up initiatives at an enterprise level is a top organizational barrier to digital transformation (see Figure 1).

- **How do chemical enterprises anticipate disruptions and turn challenges into growth opportunities?**

Chemical enterprises, on a historical basis, have been slow to adopt and implement new solutions and innovations as they continue to focus on their core business rather than disruptive ones.

- **How do chemical enterprises energize their senior management around adopting a digital agenda?**

Leadership's role in designing and executing a digital strategy is critically important because of the effects digital transformation can have on the entire organization.⁹

As the global chemical industry prepares to embrace digital transformation, many challenges and obstacles can impact the decisions of senior executives. This article intends to mitigate many negative perceptions related to digital transformation and recommend specific steps to navigate through its challenges and realize its benefits.

Sidebar 2: About the Deloitte Global 2016 Global Digital Chemistry Survey

The Deloitte Touche Tohmatsu Limited 2016 *Global Digital Chemistry Survey* includes 102 responding executives from more than 50 chemical enterprises with a balanced mix in terms of size, business, and geography. The results of the survey present a holistic view of the maturity of a chemical enterprises' strategy-led digital transformation along the entire value chain. The overall objective of the survey was to collect information to help identify the value of digital across organizations and its potential to innovate the global chemical industry. The survey results will likely help provide industry executives with a proxy for the digital transformation pulse (its perception, ambition and its future outlook, challenges it faces, and digital maturity). In addition, the results can provide enterprises with the opportunity to assess their company against similar organizations and provide insights into trends that will help them make informed decisions related to a strategy-led digital transformation.

The 2016 *Global Digital Chemistry Survey* marks the beginning of a multi-year research initiative. This effort will explore the opportunities and challenges digital trends present, as well as critical success factors. The research will help foster continuous innovation and increase the social and economic benefits of digital across the chemical enterprise.

Source: Deloitte Touche Tohmatsu Limited, 2016 *Global Digital Chemistry Survey*, December 2016.

Chemical enterprises express digital ambitions, but the path remains laden with challenges inhibiting progress

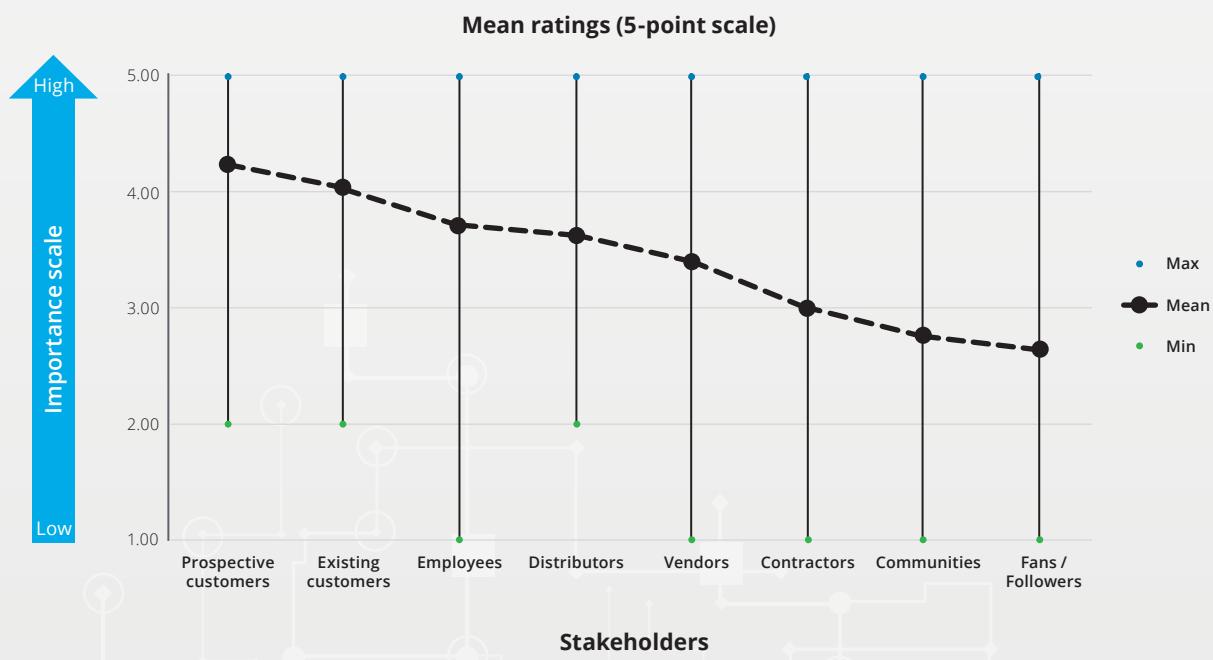
Many ad-hoc approaches and experiments with digital and exponential technologies are underway in the global chemicals industry.¹⁰ Yet, many chemical enterprises are unsure about the advantages that can result from a digital revolution and are cautious towards an enterprise-wide digital makeover.

Despite the current cautious optimism, many chemical enterprises visualize a different digital future. Almost 40 percent of chemical executives expect their organization to be digital trailblazers (or disrupters) by outperforming competitors, according to the Deloitte Global 2016 *Global Digital Chemistry Survey*.

These chemical enterprises differ in the way they approach designing and implementing digital initiatives within their organization. Seven out of ten chemical enterprises focus their digital initiatives towards enhancing organizational effectiveness and efficiency and improving customer experience. Chemical executives

also place more importance on digital initiatives, which enable their leadership to manage and make decisions faster and better, as well as help grow their core and transformational businesses.¹¹

Figure 2: Importance of digital initiatives to help the enterprise engage with different stakeholders



Source: Deloitte Touche Tohmatsu Limited, 2016 *Global Digital Chemistry Survey*, December 2016.

Chemical executives also believe that when it comes to engagement with various stakeholders, digital initiatives are more likely to benefit customers (both prospective and existing), versus

distributors and suppliers (see Figure 2). Yet, viewpoints on this opinion differ based on the type of chemical enterprise. This variance likely indicates that chemical enterprises differ greatly in terms of their

digital maturity, as well as the way they approach new talent management and crowd sourcing—quintessential foundation of exponential organizations.¹²

Digital Transformation: Are chemical enterprises ready?

There are other challenges that may limit chemical enterprises from achieving digital excellence, including:

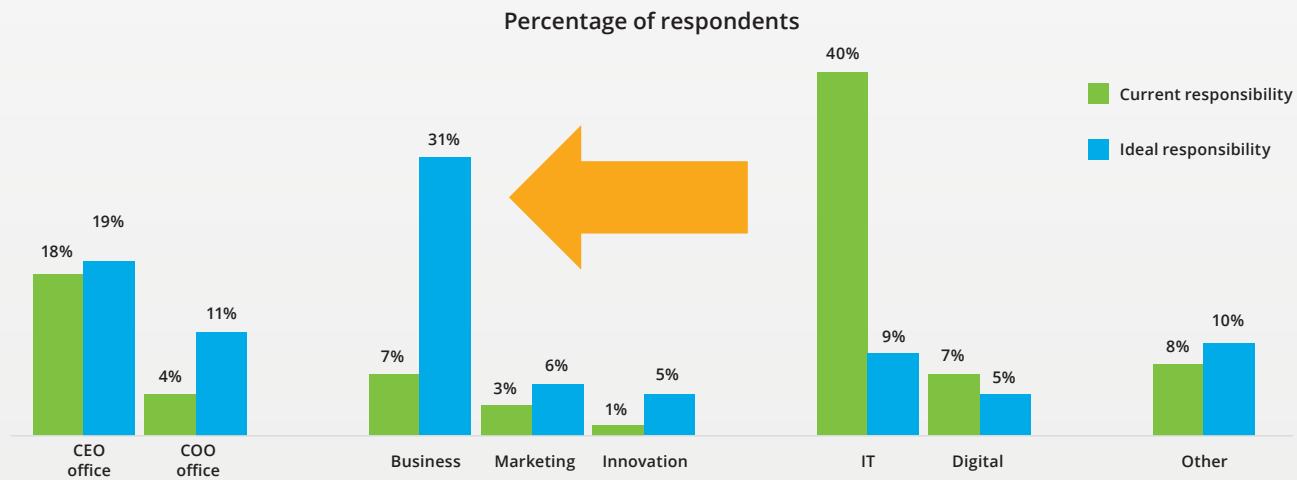
- Current digital responsibilities are misplaced.** While most of the responsibility to execute digital initiatives currently resides with the information technology (IT) or the newly created

digital department, many executives believe that individual business units or functions should take ownership. This is an illustration of developing maturity. Hence, a future shift in responsibility for digital transformation is anticipated from IT to the business unit with corporate oversight (see Figure 3).

- Change management to ease workforce adoption of the digital agenda appear absent.**

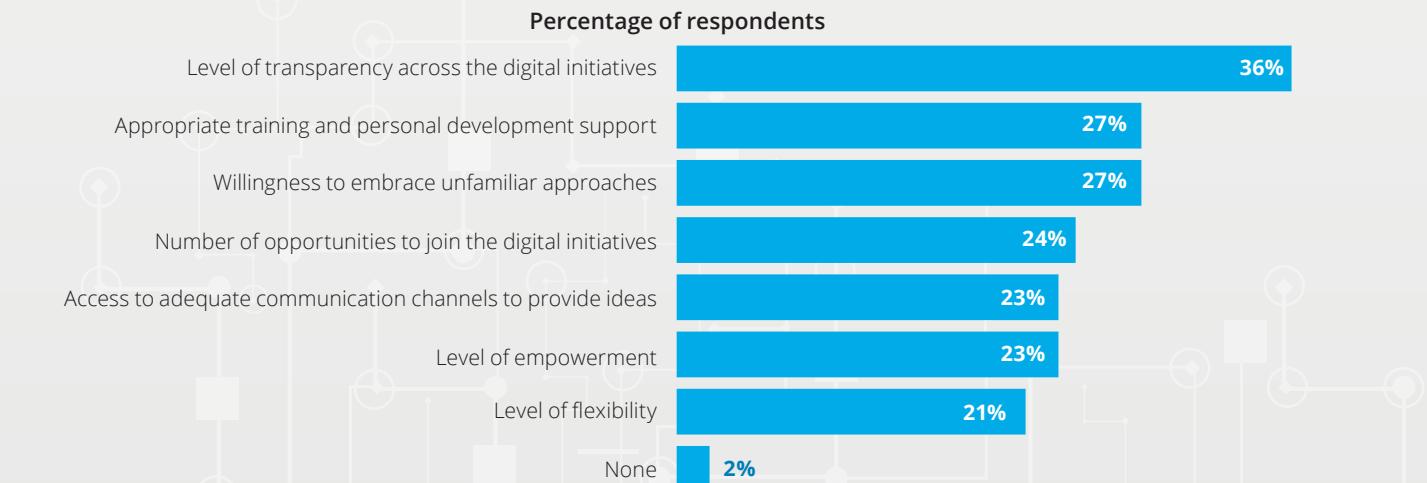
Transparency across digital initiatives, appropriate training, and personal development support, as well as willingness to embrace unfamiliar approaches are underdeveloped areas at the employee level (see Figure 4).

Figure 3: Current and ideal responsibility of digitally-driven initiatives



Source: Deloitte Touche Tohmatsu Limited, 2016 Global Digital Chemistry Survey, December 2016.

Figure 4: Individual challenges inhibiting digital initiatives



Source: Deloitte Touche Tohmatsu Limited, 2016 Global Digital Chemistry Survey, December 2016.

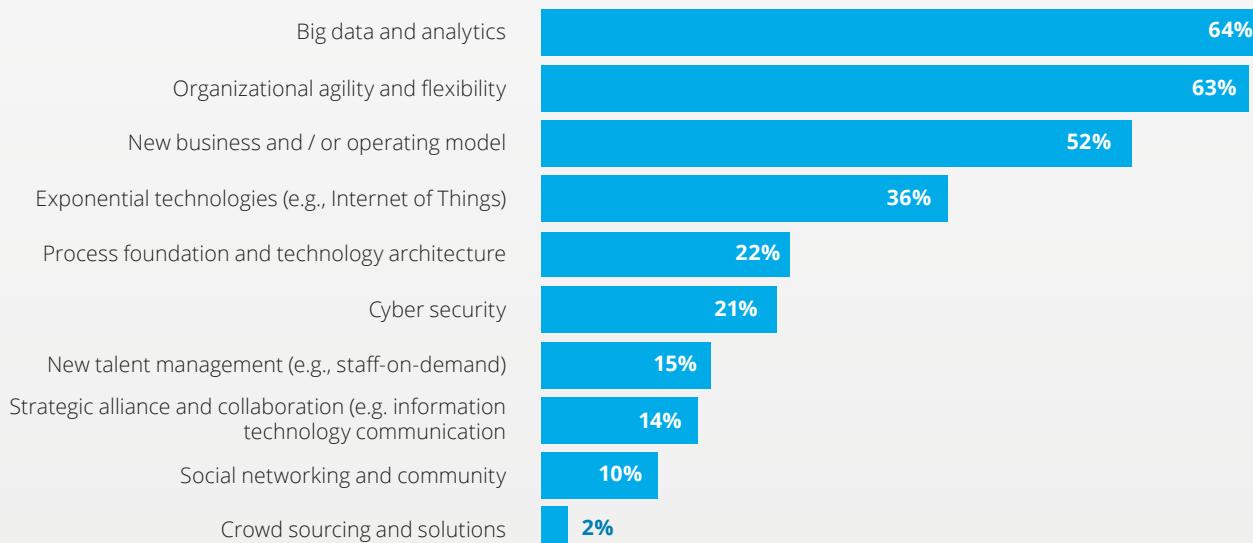
- The critical role of cyber security, talent management, and strategic alliances have not been fully recognized.** Most chemical enterprises believe that if they develop enough experience in big data and analytics,

enable organizational agility and flexibility, and adopt new business or operating model, they can successfully monetize digital initiatives. It is reassuring that these organizations are not exclusively focusing on technology as

an end in itself. Instead, enterprises are thinking in the direction of using technologies to achieve strategic ends (see Figure 5).¹³

Figure 5: Capabilities required to monetize digital initiatives

Frequency of item appearing in the top three



Note: Percentage of respondents who ranked a capability as "1", "2" and "3" have been summed together.

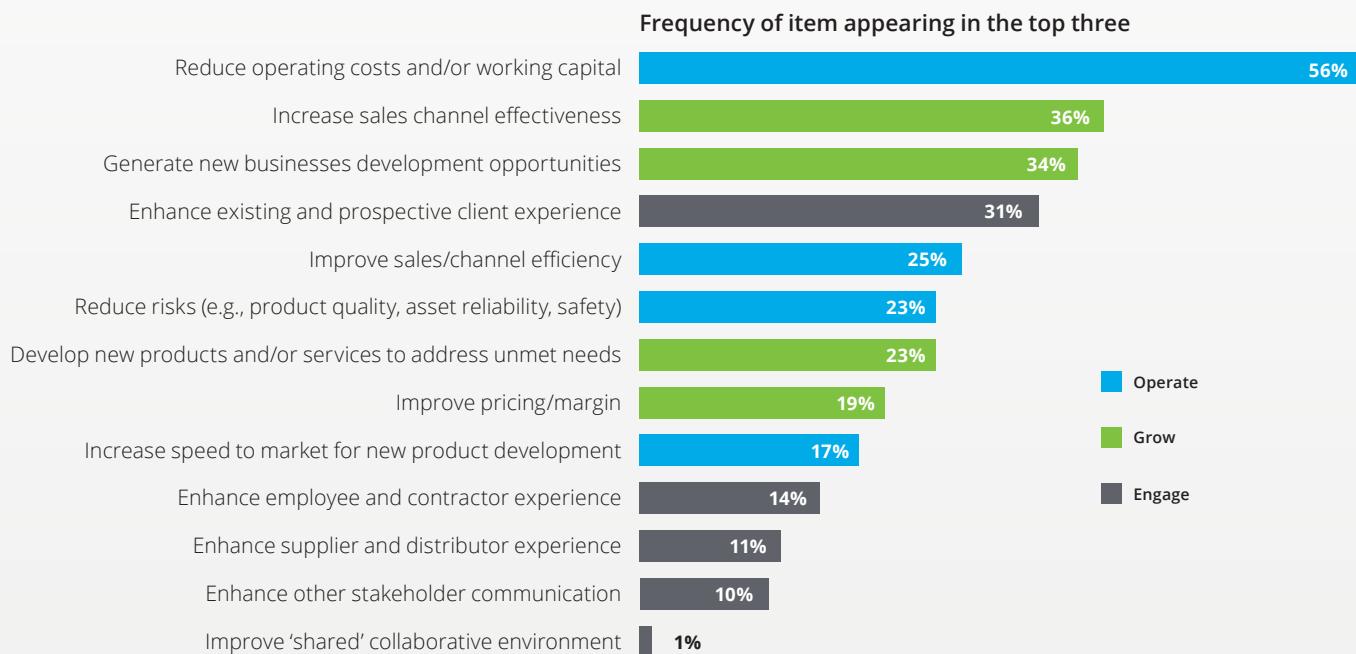
Source: Deloitte Touche Tohmatsu Limited, 2016 Global Chemistry Survey, December 2016.

- Digital opportunities are expected the most in business operations, sales, and marketing in the short term.** Digital initiatives concentrated on operational and commercial excellence are considered to have the highest

impact. However, only two in ten chemical enterprises are directing their digital initiatives towards developing new products and services to address unmet needs or simply increasing the speed-to-market to develop new products. In

addition, very few chemical enterprises are capitalizing on digital initiatives to improve stakeholder engagement (other than customers) and foster a more collaborative environment (see Figure 6).

Figure 6: Areas of digital intervention



Note: Percentage of respondents who ranked an area as "1", "2" and "3" have been summed together.

Source: Deloitte Touche Tohmatsu Limited, 2016 Global Digital Chemistry Survey, December 2016.

If chemical enterprises pursue an ambitious digital strategy that addresses a few of these critical challenges, the approach would serve as a stepping stone

for the global chemical industry's digital transformation landscape. The following sections would highlight the valuable role exponential technologies and digital

strategy can play in enabling a successful business transformation.

Digital is a unique catalyst to foster innovation and transform chemical enterprises

A fair share of chemical enterprises in the Deloitte Global 2016 *Global Digital Chemistry Survey* do realize the growing importance of digital initiatives in boosting their innovation potential, but the vast majority focus on the data aspect.

While nearly six out of ten chemical executives are already looking at information-based operating models, only four out of ten address information-based business models in order to progress from 'chemical sellers' to 'solution providers'. The figures decrease dramatically for digitally-driven ecosystems that extend beyond the use of data analytics and into activities such as building business platforms to leverage stakeholder relationships.¹⁴ Broader than a technology portal, a business platform can connect buyers and sellers, as well as encourage collaboration among partners. The adoption of such open and semi-open platforms is still underdeveloped in digitally-driven ecosystems.¹⁵ However, among digitally maturing chemical enterprises, responses vary depending upon which platforms are critical for them and what role is mostly relevant for them in a particular ecosystem.

Research shows that digital technology can likely at least act as a trigger to foster a culture where innovation is encouraged.¹⁶ However, culture and technology are intricately linked and it is likely difficult to identify, which drives what behavior.¹⁷ Senior leadership in chemical enterprises have the opportunity to proactively drive a digital culture, which will likely help chemical organizations innovate and eventually enable complete transformation focused on business growth and operations. Primary evidence also suggests that digitally maturing organizations have cultures which actively

encourage employees to get engaged in efforts to bolster risk taking, agility, and collaboration.¹⁸

Many chemical enterprises are already using and experimenting with a range of digital levers and exponential technologies to innovate. The challenge is to build and consistently maintain a pipeline of innovation initiatives, which are balanced in their business objectives (grow versus operate), approaches (incremental versus disruptive), and impact horizon (short-term versus long-term):

- **Pushing 'core' processes to the next frontier of excellence:** Boosting basic operational processes with the latest digital and exponential technologies can provide real-time visibility on various performance metrics and give enough bandwidth to modify business plans accordingly. For example, The Dow Chemical Company, the US\$49 billion chemical conglomerate, began using predictive models at an enterprise level in 2012. This process was used to forecast demand in order to optimize its operational performance. These complex mathematical models analyzed every aspect of their business. It also provided real-time data to individual business units, allowing visibility into the progress of their monthly targets and the capacity to adjust strategies accordingly. At the same time, exchange rates and margins were analyzed to help the company in their raw material procurement and

end-product pricing strategies. The application of such advanced analytics was particularly critical, as the company was just starting to establish a foothold in the specialty chemicals sector by anticipating volatile market demand.¹⁹

- **Enhancing customer 'experiences' and integrated commercial systems:**

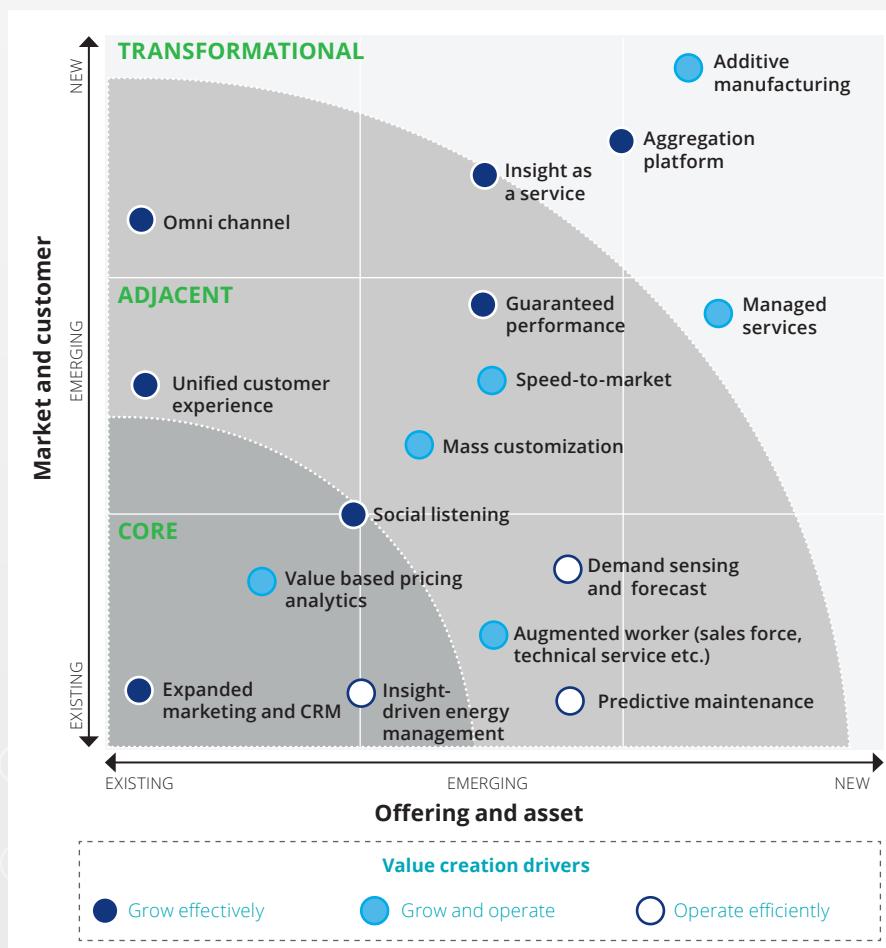
Amplifying the function of legacy IT systems with state-of-the-art digital technologies can lead to more engaging customer relationships and make the job of the sales team easier. For instance, The Linde Group, one of the world's largest industrial gases company, focused on improving customer experience and easing the job of their employees through digital technologies. The company simplified and mobilized web-based business applications – that involved "digitizing pen-to-paper-to-computer processes, real-time quick access to customer data, and enhancing other business processes". This enabled the company employees, including salespeople, to reduce the time to complete tasks "from upwards of 24 hours down to a matter of seconds". For example, salespersons were now able to answer customer queries about price and invoices, while sitting with a customer, in a matter of few seconds. Through reduction of time to service customer requests by implementing digital solutions, The Linde Group was able to have engaging conversations with its customers.²⁰

- Building new transformational offerings and businesses:** Establishing radically new products or services which supplement core offerings not only enhances an enterprise's existing positioning among customers but also brings additional revenue streams. In the US, where climate can play havoc with agricultural yields, having some form of insurance saves farmers from financial distress and secures agricultural

produce. Viewing this opportunity, Monsanto acquired Climate Corporation, a tech firm that designed an app that enables precision agriculture and data-driven farming. The big data app monitors real-time conditions and harnesses predictive analytics to help farmers make smart choices about when to plant, how much water to use, when to harvest, and many other important factors that can optimize their crop yield.

Thus, digital technology is enabling new profit models that offer information-based solutions, complementing Monsanto's existing product offerings. The response has been overwhelmingly positive with 92 million acres (more than a third of US farmland) currently cultivated using the guidance of Climate Corp data.²¹

Figure 7: Role of digital levers and exponential technologies in transforming a chemical enterprise



Source: Deloitte Touche Tohmatsu Limited analysis, December 2016.

Five enablers identified to augment digital initiatives

The following recommendations, derived from the results of the Deloitte Global 2016 *Global Digital Chemistry Survey* and industry observations, can help chemical enterprises in augmenting their digital strategies.

1. Build a robust transformation process, starting with a clear digital enterprise strategy

- enterprise strategy:** A robust digital strategy starts from existing corporate, business, and function strategies and addresses the following five questions to develop a digitally-enabled business transformation roadmap:
- **Aspire:** What is the most valuable ambition to be gained from embracing digital trends?
 - **Play:** At what points in the value chain and business ecosystem can digital address visible gaps?
 - **Win:** How can digital initiatives

reinforce competitive advantage and the customer value proposition?

- **Configure:** What new capabilities and technologies are required to foster business innovation?
- **Execute:** How are different programs prioritized and how can accelerators realize digital's value?

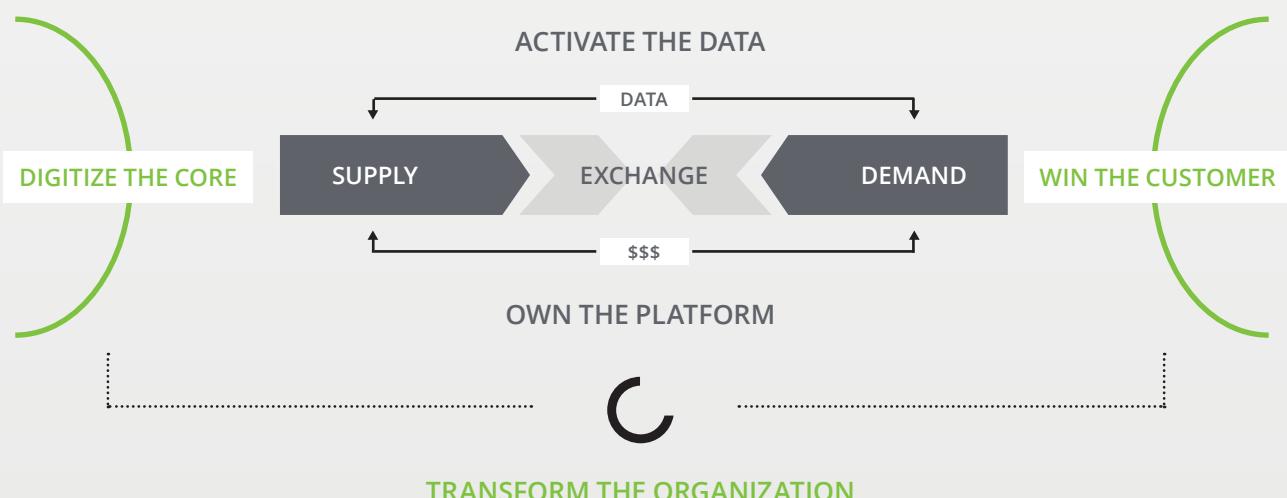
Coming up with possible solutions will likely enable chemical enterprises to develop a thorough digital enterprise strategy that can create differentiation using a combination of digital levers. These include winning the customer,

owning the digital platform, or activating the data to create a higher value proposition for the intended stakeholders (see Figure 8).

2. Enable enterprise-wide scalability of digital by establishing a sustainable insight-driven strategy that builds and strengthens internal capabilities

capabilities: Application of Industry 4.0 or Internet-of-Things (IoT) technologies have increased pace in the last three to four years, with many manufacturing companies employing such technologies to enable smart processes and products.

Figure 8: Making integrated choices in a new business environment



Source: Deloitte Touche Tohmatsu Limited, December 2016.

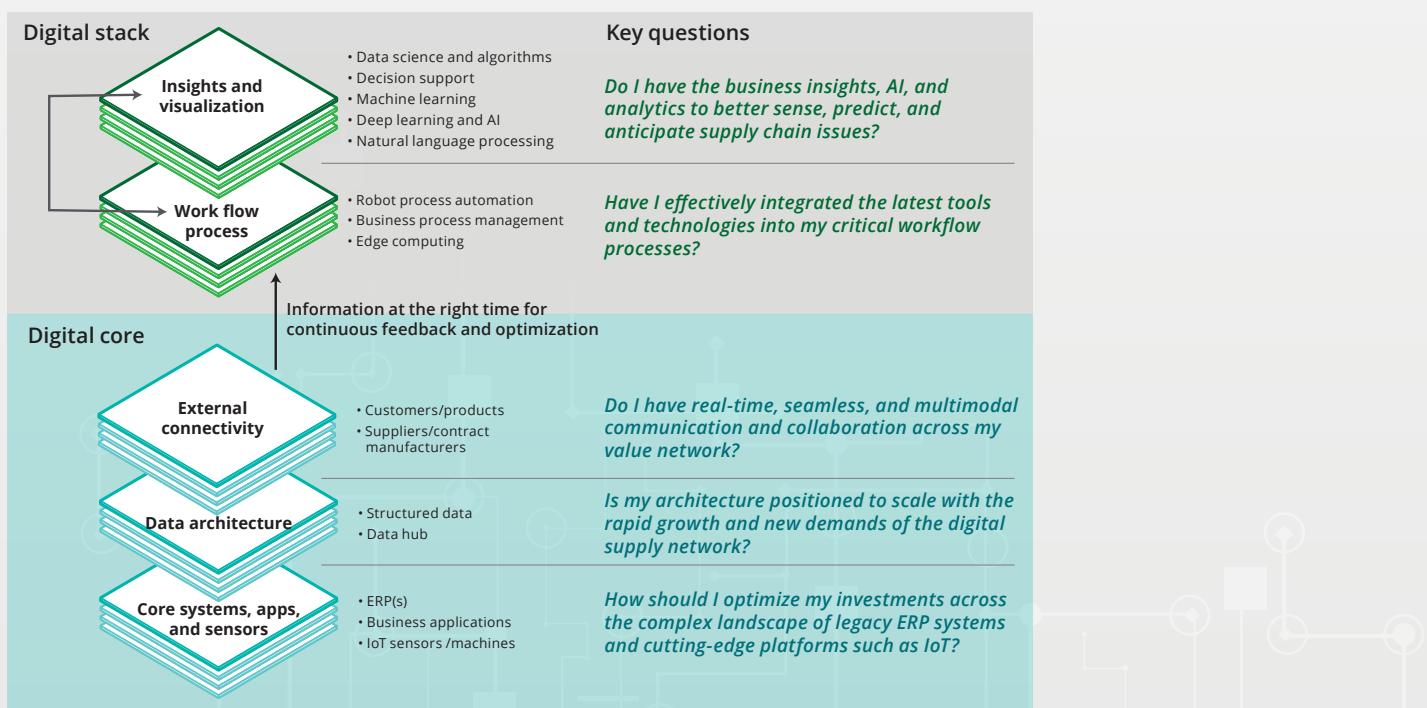
In the Deloitte Global 2016 *Global Digital Chemistry Survey*, predictive analytics and sensors (in line with IoT trends) are the top technologies perceived to support growth and operations for most chemical enterprises. Despite this, chemical enterprises may likely struggle to find the most effective model to integrate these technologies into their organization. The digital stack, as displayed in Figure 9, can help chemical enterprises build their digital footprint, integrate capabilities and information lying in different domains, and optimize their supply chain.²² In traditional settings, data tends to be siloed and information related to different domains like customer engagement, sales processes, operations etc. exist as separate clusters. The digital

stack can help and support a digital chemical enterprise in accessing and using real-time, free flowing integrated information synchronized to happenings across different functions and business units. These digital chemical enterprises should also move from nurturing advanced analytics to augmented intelligence capabilities. But encompassing these data-generating advanced technologies to deliver higher business value is just the first step. Companies should strive to become insight-driven organizations. This means to entrench data and analytics in everyday processes, turn advanced analytics into a core capability, and promote a culture where data-driven decision-making becomes an imperative.²³

3. Create a structured approach to identify risks in complex and dynamic ecosystems: As highlighted earlier, the critical role that cyber security plays in a chemical enterprise has not yet been fully recognized. In fact, it is likely many chemical enterprises underestimate cyber threats, with 20 percent lacking any type of risk assessment in the past 12 months.²⁴ As cyber threats and attacks become more frequent and sophisticated, many advanced manufacturing organizations, including chemical enterprises, run the risk of not securing their data infrastructure fast enough to defend against such attacks. This can limit the reach of new frontiers of operational excellence. Only 52 percent of executives in

Figure 9: The digital stack in supply chain networks

The digital core architecture provides a single place to access near-real-time supply network data



Source: Deloitte Analysis and Deloitte University Press.

advanced manufacturing organizations appear confident that assets are protected from external threats, illustrating the cyber vulnerability of at least half of the manufacturing industry.²⁵

What can chemical enterprises do to mitigate such risk? They need a holistic structured approach or framework, which would address the right questions (see Figure 10):

- Who might attack and where do vulnerabilities lie?
- What would be the primary motive behind the attack?
- What are the various ways by which hackers might breach the cyber network?
- Do current cybersecurity initiatives have the full support of executive board members?

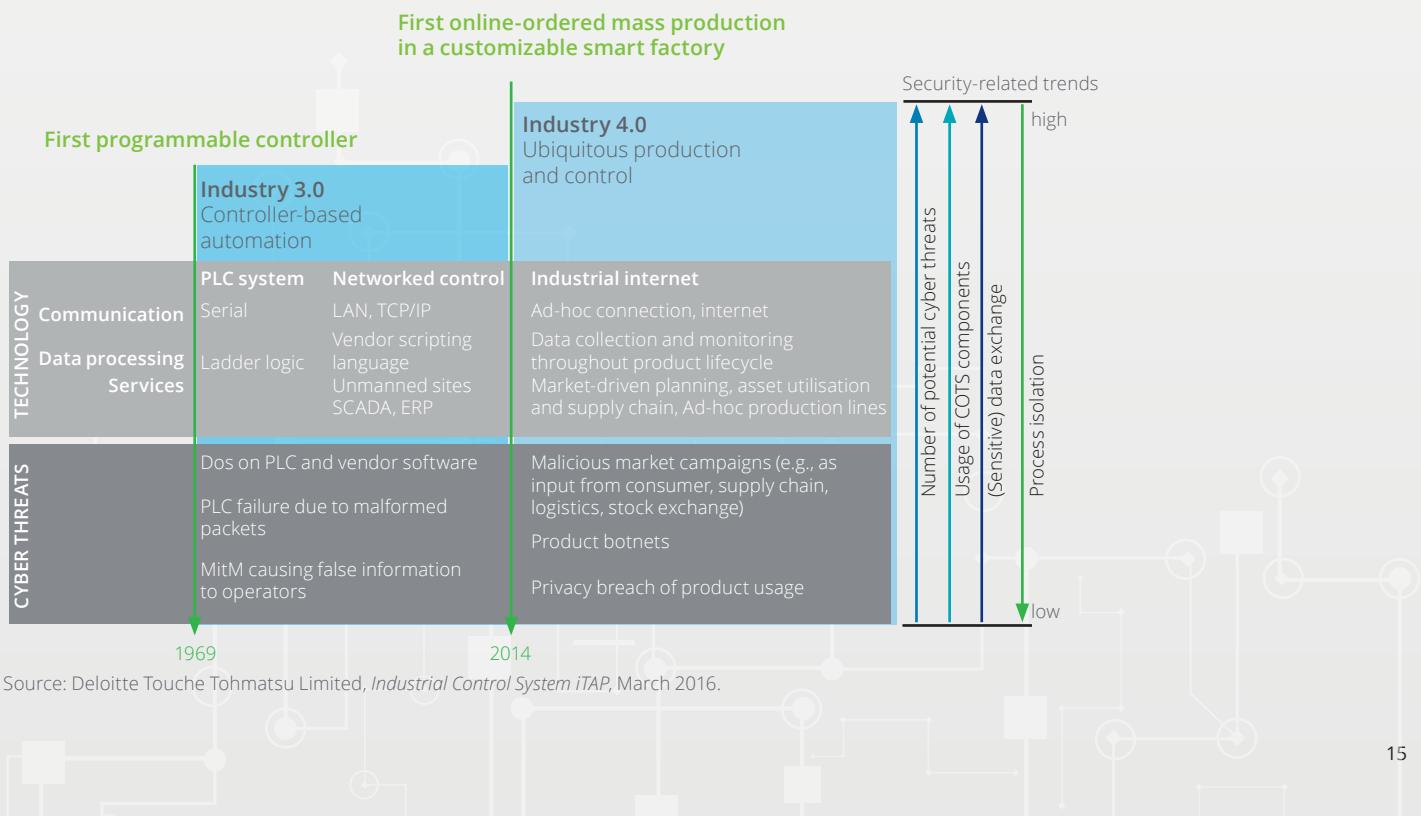
- Are current employees aware of their role in maintaining cyber preparedness?
- Is there talent enough to tackle sophisticated cyber threats?

Answering the above questions can direct chemical enterprises towards the right solutions and empower them to establish a 'secure', 'vigilant' and 'resilient' cyber risk program and governance structure. To date, many chemical enterprises have mainly focused on the 'secure' thread.²⁶

- 4. Establish agile operating models that can engage newly prioritized resources to plan, execute, and manage digital activities:** Almost every chemical enterprise is uniquely positioned today to take full advantage of the opportunities presented by the digital revolution. However, as much as diverse chemical enterprises may

want to incorporate the latest digital and exponential technology trends, their success depends not only on the internal culture, but also on the operating model they select to design and execute the digital agenda. The digital transformation journey should be executed using an operating model best suited to the current digital maturity of an enterprise (see Figure 11). The digitally-maturing chemical enterprises, which tend to be closer to end-markets where digital threats are more pressing in the short-term are gradually transitioning from the 'centralization' model, wherein all digital initiatives are directed from a central unit, to the 'champion' model, wherein digital initiatives are spread across different business units with the central unit only providing support.²⁷ This model further empowers the functional and operational areas, according to the Deloitte Global

Figure 10: Illustrative example of potential cyber threats in the production process

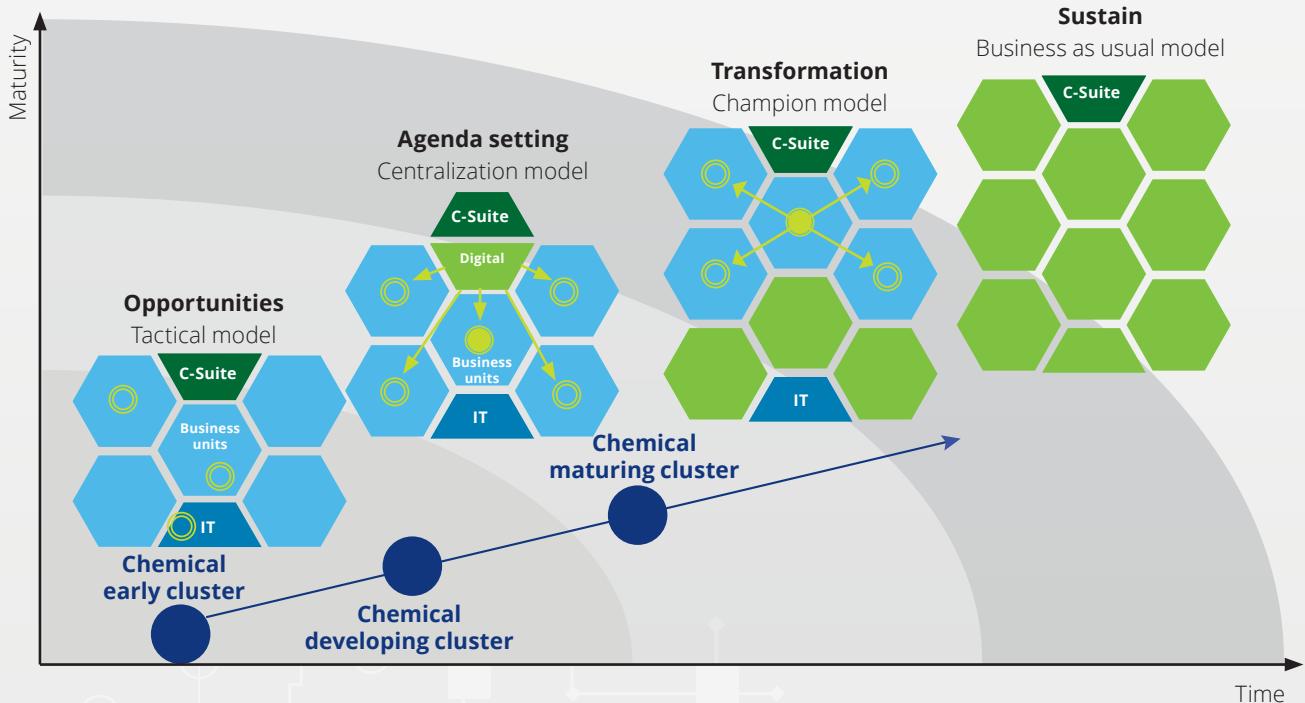


2016 Global Digital Chemistry Survey. These digitally-maturing companies include agrochemicals and industrial gases, or conglomerates with activities in those business segments. In contrast, less digitally-mature companies tend to be leaders in competitive market segments, such as petrochemicals and specialties, and are setting digital agenda under the 'centralization' model.

5. **Embed continuous innovation into a culture that supports new ideas and encourages learning:** In a recent survey, a staggering 87 percent of respondents from different industries said they anticipate disruption caused by digital technologies, but only 44 percent of them agreed their company is adequately prepared to manage digital disruptions.²⁸ Digital embracement levels are even lower for manufacturing industries including chemicals. Enhancing an

organization's digital quotient starts with changing the cultural mindset throughout the enterprise. A culture attuned to digital transformation is a hallmark of digitally-mature companies. Such cultures encourage risk-taking, foster innovation, enable greater collaboration, are insight-driven, and have the ability to quickly react to unforeseen circumstances.²⁹ Thus, in order to move up the digital maturity curve, chemical enterprises need to transform their culture (See

Figure 11: Different digital operating models progressing with digital maturity

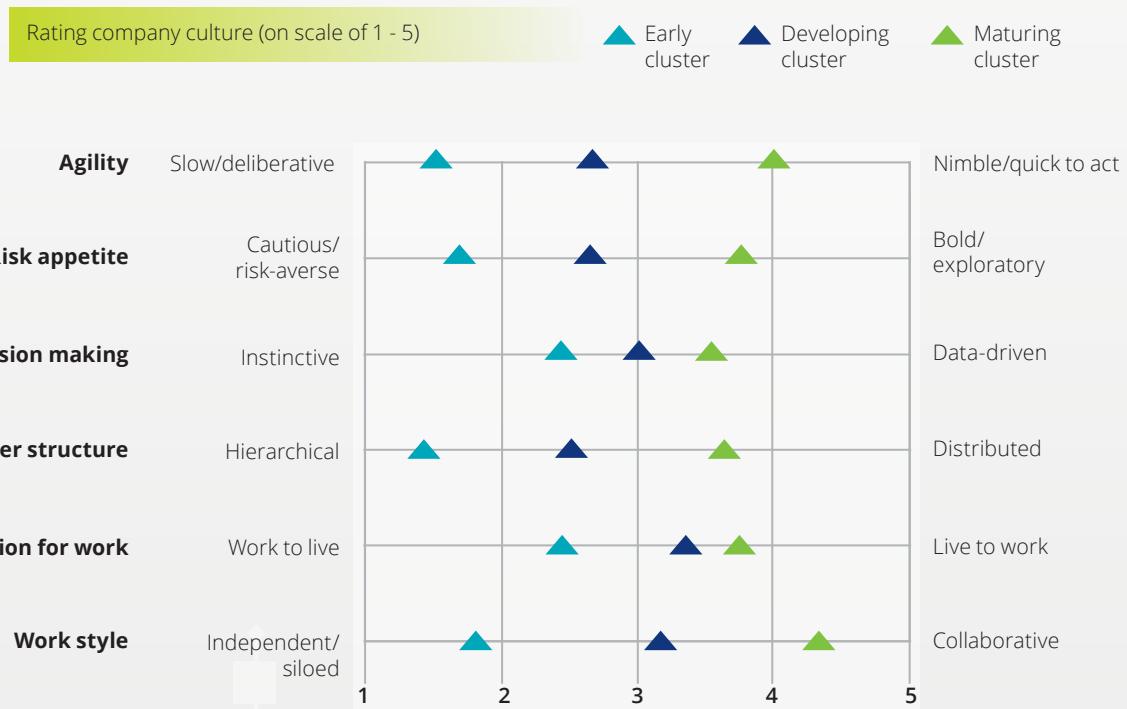


Source: Deloitte United Kingdom (Deloitte MCS Limited), *Building your digital DNA: Lessons from leaders*, January 2015.

Figure 11). This not only gives leaders enough influence to begin a digital transformation, but also infuses the workforce with a sense of purpose in support of that organization's digital

future (see Figure 12). In effect, it involves adopting a 'start-up' culture that would lead them towards true digital transformation.

Figure 12: Three distinct cultural mindsets related to digital maturity levels



Source: MIT Sloan Management Review and Deloitte United States (Deloitte Development LLC), *Aligning the Organization for Its Digital Future*, August 2016.



Conclusion

Any transformation on a grand scale tends to disrupt and uproot existing structures and deeply ingrained mindsets.

Digital is forward looking and is expected to unsettle mindsets around business innovation, digitally-enabled or not. But with that disruption will arise many benefits. This includes increased revenues to enhanced operational performance to successful expansion into new markets and customers. As a result, digital transformation could likely increase profit margins by 8 to 13 percentage points, according to IHS.³⁰

Digital itself, like any other business transformation, should likely demonstrate the value expected to be generated over time. Also, any digital investments made today should likely be at par with expected returns from any other business opportunity made by chemical enterprises. The global chemical industry, though taking first steps towards digital metamorphosis, has likely experienced a positive start to its digital journey but sometimes with mixed results or results not at the scale as expected earlier. While some chemical enterprises have proactively joined consortiums designed to accelerate the adoption of IoT technologies in industrial settings, others are monitoring emerging trends and latest developments waiting for the most opportune time to take the digital plunge.³¹ Some chemical enterprises have adopted digital to

optimize asset utilization and plant efficiency, while others are looking at predictive maintenance and demand forecasting. With digital technologies at the helm, some enterprises are even trying to position themselves as solution providers, rather than just global chemical companies.³²

With a large selection of digital transformation solutions, it may become advantageous for chemical enterprises to pursue digital initiatives to adopt exponential technologies that can have the most defining impact. The following recommendations can help to supplement a company's digital ambitions:

- Digital transformation should likely be driven by corporate, business unit, and functional strategies and by considering the impact of digital on the enterprise's different ecosystems. This can be driven both internally across the organization and externally across direct and adjacent value chains, as well as end-user value chains.
- The most effective starting point likely depends on where the enterprise is today, with regards to its digital maturity, and should likely address specificities across its business and geographic portfolio.

• There is no one approach to digital transformation among chemical enterprises. A variety of operating models exist in different business ecosystems, based on the relevance for a given positioning.

• Enterprise leaders should likely anticipate the early need of a digital transformation campaign to effectively engage the workforce and prepare them culturally for the digital journey.

The digital journey will likely come with challenges that may seem daunting. With the five enablers highlighted earlier, the transformation can follow a systematic approach that is supported by strong alliances and talent management. Collaborating with business partners in given ecosystems and developing new skills in the talent base can only facilitate the passage to the digital heaven and position the enterprise towards greater success.

Endnotes

1. American Chemistry Council, *Guide to the Business of Chemistry – 2016*, June 2016, <https://store.americanchemistry.com/2016GBC>.
2. Cefic, *The European Chemical Industry: Facts & Figures 2016*, October 2016, <http://fr.zone-secure.net/13451/186036/#page=1>; and International Labor Organization, Chemical industries, 2013, <http://www.ilo.org/global/industries-and-sectors/chemical-industries/lang--en/index.htm>.
3. Deloitte Touche Tohmatsu Limited's Global Consumer & Industrial Products Industry Group, *The chemical multiverse: Preparing for quantum changes in the global chemical industry*, November 2010, https://www2.deloitte.com/content/dam/Deloitte/hu/Documents/manufacturing/gx_The%20chemical%20multiverse_12_2_2010.pdf.
4. American Chemistry Council, *Business of Chemistry 2016 (Annual Data)*, June 2016, <https://store.americanchemistry.com/Business-of-Chemistry-Situation-and-Outlook>.
5. Observation by Deloitte Touche Tohmatsu Limited, December 2016.
6. Ibid
7. MIT Sloan Management Review and Deloitte Touche Tohmatsu Limited Kane et.al, *Strategy, not Technology, Drives Digital Transformation*, July 2015, <http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/>.
8. A digitally mature organization is defined as an organization where digital has transformed processes, talent engagement, and business models, according to a joint study by MIT Sloan Management Review and Deloitte United States (Deloitte Development LLC).
9. ZDNet, Sven Denecken, *Digital Transformation, Part 4: The Role of Leadership*, September 2014, <http://www.zdnet.com/article/digital-transformation-part-4-the-role-of-leadership/>.
10. IHS Chemical Week, Westervelt et.al, *Digital transformation: Bringing chemicals into the internet era*, October 2016, http://www.chemweek.com/sections/cover_story/Digital-transformation-Bringing-chemicals-into-the-internet-era_82916.html.
11. Deloitte Touche Tohmatsu Limited, 2016 Global Digital Chemistry Survey, December 2016.
12. Diversion Books, Salim Ismail, *Exponential Organizations: Why new organizations are ten times better, faster, and cheaper than yours (and what to do about it)*, October 2014.
13. MIT Sloan Management Review and Deloitte Touche Tohmatsu Limited, Kane et.al, *Strategy, not Technology, Drives Digital Transformation*, July 2015, <http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/>.
14. In general, **ecosystem** in the business context refers to a collection of different organizations including manufacturers, suppliers, distributors, customers, and government agencies who are involved in the delivery of certain products or services through both competition and cooperation. A **digitally-driven ecosystem** is one where the delivery of products and services involves a digital component and all these different organizations are impacted by the adoption of digital technologies, emanating from either inside the industry or outside it. A **digital ecosystem**, on the other hand, is a subset of tech companies that specialize in the development of hardware, content, and software applications and provide a platform for the creation, distribution, and consumption of digital content, applications, and services, according to Deloitte Touche Tohmatsu Limited.
15. Deloitte Touche Tohmatsu Limited, 2016 Global Digital Chemistry Survey, December 2016.
16. Ibid.
17. Ibid.
18. MIT Sloan Management Review and Deloitte Touche Tohmatsu Limited, Kane et.al, *Aligning the Organization for Its Digital Future*, August 2016, <http://sloanreview.mit.edu/projects/aligning-for-digital-future/>.
19. InformationWeek, Doug Henschen, *Dow Chemical Moves Analytics into Mainstream*, 2012, <http://www.informationweek.com/big-data/big-data-analytics/dow-chemical-moves-analytics-into-mainstream/d/d-id/1106147>.

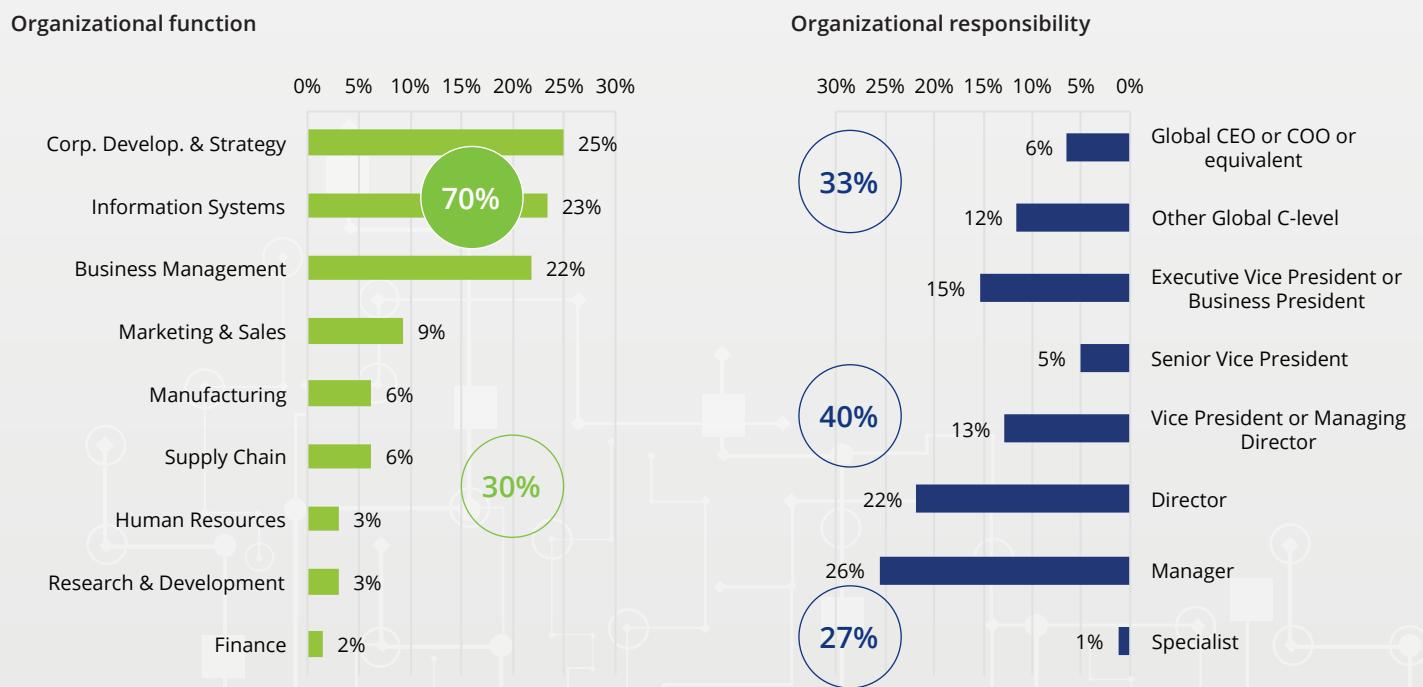
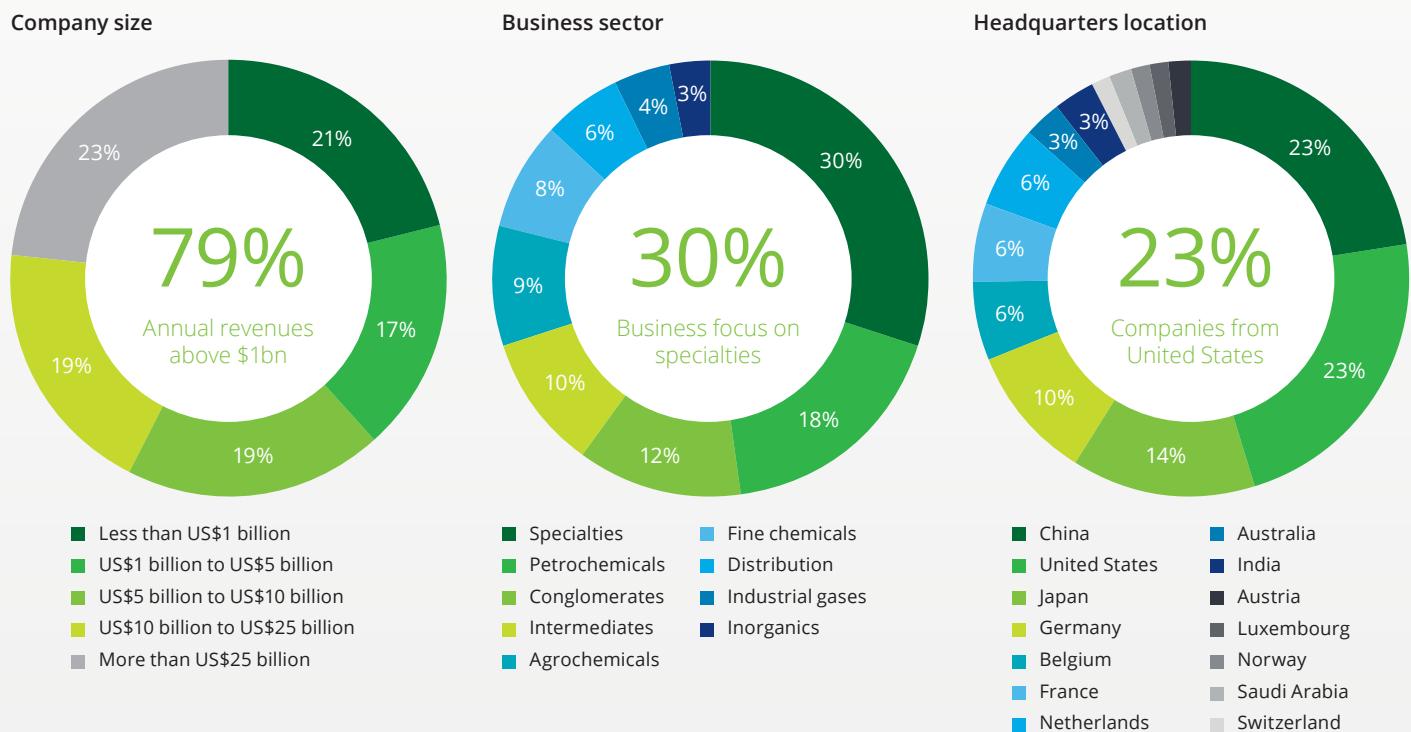
Digital Transformation: Are chemical enterprises ready?

20. Capriza, *The Linde Group Transforms SAP into a System of Engagement, Improving Operational Efficiencies and Customer Service*, 2016, https://www.capriza.com/wp-content/uploads/2016/06/Linde-Case-Study-6.1.16-V3.pdf?utm_source=&utm_medium=inbound&utm_campaign=The%20Linde%20Group%20Case%20Study&utm_content=case%20study.
21. Monsanto Press Release, *Monsanto to Acquire The Climate Corporation, Combination to Provide Farmers with Broad Suite of Tools Offering Greater On-Farm Insights*, October 2013, <http://news.monsanto.com/press-release/corporate/monsanto-acquire-climate-corporation-combination-provide-farmers-broad-suite>; and Reuters, Karl Plume, Monsanto's Climate Corp to expand digital farming platform, August 2016, <http://www.reuters.com/article/us-monsanto-farming-data-idUSKCN10S1Q4>.
22. Deloitte United States (Deloitte University Press), Mussomeli et.al, *The rise of the digital supply network*, December 2016, <https://dupress.deloitte.com/dup-us-en/focus/industry-4-0/digital-transformation-in-supply-chain.html>.
23. Deloitte Canada, *Becoming an Insight Driven Organization: Realize return on your analytics investment sooner*, accessed in December 2016, http://images.info.deloitte.ca/Web/DeloitteManagementServicesLP/%7Bea8a1ed5-e366-4c4f-a24d-9b4f2f1d610f%7D_ca-en-insight-driven-organization.pdf.
24. Deloitte Touche Tohmatsu Limited, *2016 Global Digital Chemistry Survey*, December 2016.
25. Deloitte United States (Deloitte Development LLC) and Manufacturers Alliance for Productivity and Innovation (MAPI), *Cyber Risk in Advanced Manufacturing*, October 2016, <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-manu-cyber-risk-in-advanced-manufacturing.pdf>.
26. Ibid.
27. Deloitte MCS Limited, *Building your Digital DNA: Lessons from Digital Leaders*, 2014, <https://www2.deloitte.com/content/dam/Deloitte/br/Documents/technology/deloitte-uk-building-your-digital-dna.pdf>.
28. MIT Sloan Management Review and Deloitte Touche Tohmatsu Limited Kane et.al, *Aligning the Organization for Its Digital Future*, August 2016, <http://sloanreview.mit.edu/projects/aligning-for-digital-future/>.
29. MIT Sloan Management Review and Deloitte Touche Tohmatsu Limited, Kane et.al, *Strategy, not Technology, Drives Digital Transformation*, July 2015, <http://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/>.
30. IHS Chemical Week, Westervelt et.al, *Digital transformation: Bringing chemicals into the internet era*, October 2016, http://www.chemweek.com/sections/cover_story/Digital-transformation-Bringing-chemicals-into-the-internet-era_82916.html.
31. Ibid.
32. Ibid.

Appendix

The 2016 Global Digital Chemistry Survey was completed by 102 valid respondents (executives) belonging to a balanced mix of companies in terms of size, business, and country of origin during the period of May and June 2016.

Figure 13: Participant demographics for Deloitte Touche Tohmatsu Limited 2016 Global Digital Chemistry Survey



Source: Deloitte Touche Tohmatsu Limited, 2016 Global Digital Chemistry Survey, December 2016.

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