Shift to enterprise-grade AI

How chemicals and petroleum leaders are adopting artificial intelligence

IBM **Institute for Business Value**

IBM

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Talking points

Chemicals and petroleum companies have a sharper focus on artificial intelligence (AI).
More companies are considering the adoption of AI and are prioritizing business functions where it can add value. Our research indicates companies will continue to invest in AI, but with more realistic expectations for ROI. Topline and customer satisfaction value drivers are the primary objectives of implementing AI.

Outperformers are further along with AI.
The outperformers are defined as those organizations that reported better financials (revenue and profit) compared to peers. They are in more mature phases of their AI journeys. Outperformers expect to continue to out-invest their peers in AI.

Strategic outlook and capabilities are required to leverage AI.
The outperformers think strategically about digital technologies, including AI. They leverage analytics and AI across the business. Outperformers capitalize on data. They adhere to data governance.

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Achieving AI at scale

Artificial intelligence is moving beyond the hype cycle, as more and more chemicals and petroleum organizations seek to adopt AI-related technologies. These organizations are focusing on prioritizing functional areas and use cases and placing a stronger emphasis on topline growth. This Research Insights report explores how a subset of this group's most financially successful organizations – the "outperformers" – are approaching AI strategically, pinpointing their investments and developing capabilities to take advantage of AI.

Realizing the value of AI

AI capabilities are rapidly maturing. More chemicals and petroleum executives than ever are determining where and how to leverage AI. But executives are also more discriminating about their organizational priorities for AI and how these leading-edge technologies are rolled out. These CxOs are highly focused on three priority functional areas: information technology, information security, and innovation. These areas support the intensified focus on revenue growth and the customer as the value drivers for AI investments. And while technology availability was the leading concern for executives in 2016, it's now shifted to addressing implementation issues.

So, what do these changes mean? Moving from experimentation to implementation is not straightforward, and many companies are struggling with the transition. However, some businesses are achieving AI at scale successfully – and they are disproportionately outperforming financially. Adopting AI as part of a broader digital reinvention play, investing in select functions, and enhancing organizational capabilities are critical to realizing value in the enterprise.

1

3 distinct

functional priorities indicate
a sharper focus for AI

48%

of outperformers view AI
as a strategic platform

46%

of outperformers use real-time
reporting and dashboarding

Defining artificial intelligence and cognitive computing

For the purposes of this report, cognitive computing was defined for respondents as systems that understand, reason, learn, and interact by continually building knowledge, understanding natural language and reasoning, and interacting more naturally with human beings than traditional programmable systems. AI systems have some, but not necessarily all, of the characteristics of cognitive systems (for example, speech, pattern recognition, decision making, and learning by experience).

In 2018, the IBM Institute for Business Value partnered with Oxford Economics to survey C-level executives and top functional leaders about AI and cognitive computing. (For more about the research, see the "Study approach and methodology section," page 12.) To understand chemicals and petroleum executives' considerations, expectations, and objectives in applying AI, we examined the responses of 251 executives in the industry who participated in a study of more than 5,000 global executives. This report explores how chemicals and petroleum organizational views on AI have evolved over the past two years and how a set of outperformers are achieving advantages with AI.

State of AI

Eighty-nine percent of chemicals and petroleum enterprises are now at least considering AI adoption, compared to 75 percent in 2016, and higher than the 82 percent of total cross-industry responses. And over a third of these enterprises are currently in the evaluation, pilot, or implementation stage. These companies have tempered their investment in AI, expecting to invest 2 percent of their IT spend on AI this year. However, in the next three years, the investment is expected to triple to 6 percent.
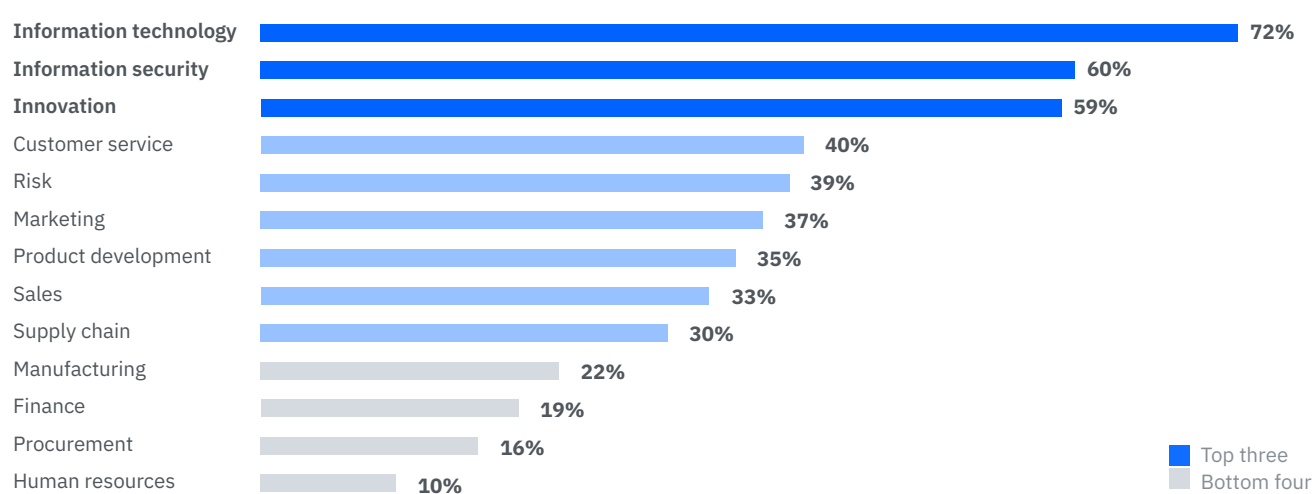
Chemicals and petroleum organizations are discriminating about which business functions they expect will create the most value from AI initiatives. Our recent study data reveals that only three functions were selected by a majority of chemicals and petroleum CxOs, and four functions were selected by less than a quarter of the CxOs (see Figure 1). The top two functions are consistent with the 5,000+ cross-industry responses. The third chemicals and petroleum function was selected fourth by cross-industry respondents.

Eighty-nine percent of chemicals and petroleum enterprises are considering AI adoption.

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Figure 1

Functions where AI provides the most value

Percentage of CxO respondents who say they believe AI would add value

Function	Percentage
Information technology	72%
Information security	60%
Innovation	59%
Customer service	40%
Risk	39%
Marketing	37%
Product development	35%
Sales	33%
Supply chain	30%
Manufacturing	22%
Finance	19%
Procurement	16%
Human resources	10%

■ Top three
■ Bottom four

Source: IBM Institute for Business Value survey on AI/cognitive computing in collaboration with Oxford Economics. 2018.

So why are information technology (IT), information security (IS), and innovation functions the highest priorities? Not only can IT and IS benefit from AI-enabled help desk virtual assistants, process automation, and threat detection, these functions are also often responsible for the data initiatives needed to support AI and for "getting it done." Innovation involves strategic opportunities, and AI can help identify profitable growth plays. For example, AI can be used to provide insight into real-time customer attitudes and their impact on an enterprise's revenues. In mergers and acquisitions, AI systems could suggest potential acquisition candidates and perform in-depth analyses, as well as rank targets to highlight value and synergistic opportunities, visualize trade-offs, and explore what-if scenarios.
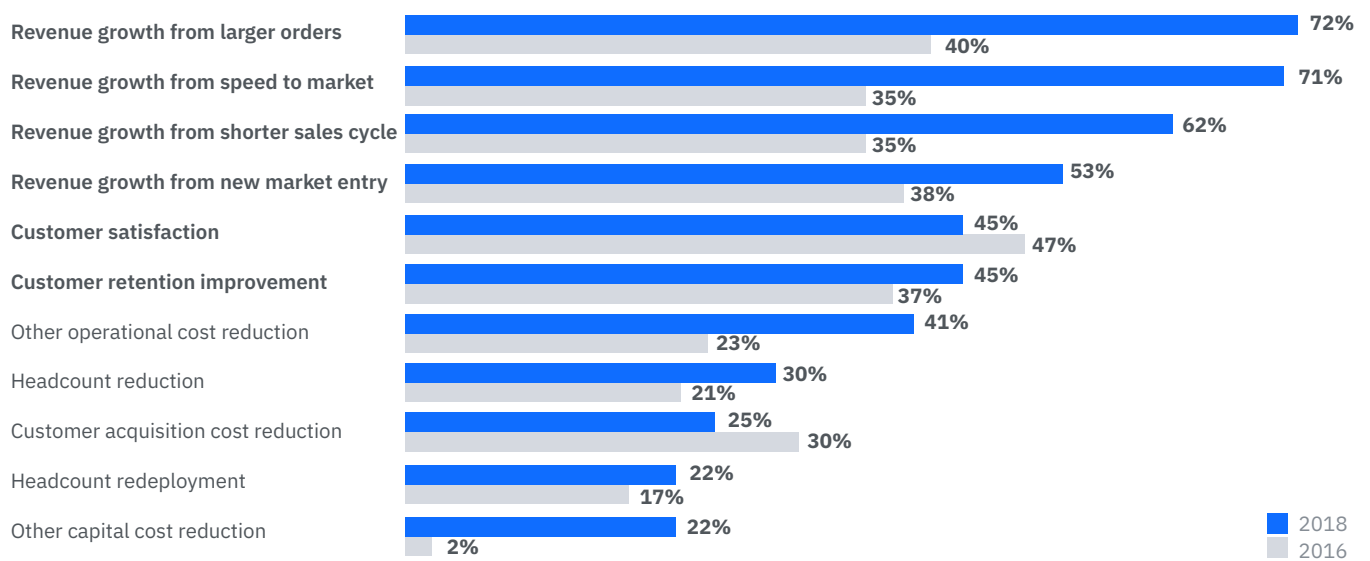
This is supported by the intensified focus on topline growth over the last two years. Chemicals and petroleum executives continue to rank revenue growth and customer satisfaction and retention as primary objectives of their AI investments – significantly above cost considerations (see Figure 2). This is consistent with cross-industry respondents emphasizing customer satisfaction (72 percent) and customer-retention improvement (59 percent). However, chemicals and petroleum companies have a greater focus on revenue drivers compared with their cross-industry peers. Of course, that does not mean cost is unimportant to chemicals and petroleum respondents. Anecdotally, many AI projects have a cost-reduction element that underpins the business case.

Revenue growth from larger orders and from speed to market are the top value drivers for AI investment.

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Figure 2

Topline value drivers: 2016 versus 2018

Value drivers for implementing AI – Chemicals and Petroleum

Value driver	2018	2016
Revenue growth from larger orders	72%	40%
Revenue growth from speed to market	71%	35%
Revenue growth from shorter sales cycle	62%	35%
Revenue growth from new market entry	53%	38%
Customer satisfaction	45%	47%
Customer retention improvement	45%	37%
Other operational cost reduction	41%	23%
Headcount reduction	30%	21%
Customer acquisition cost reduction	25%	30%
Headcount redeployment	22%	17%
Other capital cost reduction	22%	2%

Source: IBM Institute for Business Value surveys on AI/cognitive computing in collaboration with Oxford Economics. 2016 and 2018.

As illustrated in Figure 3, chemicals and petroleum executives have shifted their attention from worrying about whether to adopt AI (availability of technology) to struggling with how to implement AI (skills, regulations, data security). These top concerns match those stated by the cross-industry executives.

In fact, 86 percent of the chemicals and petroleum executives surveyed say they believe AI will have some impact on the demand for skills over the next five years. Without a more sustained focus on developing the skills required, AI initiatives face a higher risk of delay between proof of concept, pilot, and implementation. And the challenge extends beyond data scientists, AI technologists, and IT professionals. Softer skills, such as collaboration and innovation, can be infused throughout strategy, finance, operations, and all business units.

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Figure 3
Barriers in implementing AI: 2016 versus 2018

Barriers – chemicals and petroleum

		2016	2018
	Availability of skilled resources or technical skills	42%	74%
	Regulatory constraints	27%	70%
	Legal/security/privacy concerns about use of data and information	34%	54%
	Availability of data to draw context for decision making	33%	47%
	Degree of organizational buy-in/readiness/cultural fit	38%	42%
	Data governance and policies	32%	37%
	Availability of technology	43%	31%
	Degree of executive support	28%	20%
	Degree of customer readiness	30%	8%

The outperformers

How can chemicals and petroleum enterprises capitalize on AI? To help answer this question, we analyzed survey responses and identified a small group of outperformers. These represented 21 percent of our survey population. This group self-reported that it significantly outperformed in revenue compared to competitors and was significantly more efficient and profitable than similar organizations over the past three years. This percentage of chemicals and petroleum outperformers is consistent with the 20 percent of outperformers from all other industries.

Chemicals and petroleum outperformers are further along the adoption journey. Thirty-eight percent of outperformers are either piloting, implementing, or operating AI today, versus 11 percent of all others in the industry. This is similar to the adoption rate of other industries, in which 39 percent of leaders are piloting, implementing, or operating AI, versus 14 percent of all others.

Bridger Pipeline: Protecting the environment with deep-learning AI[1]

Pipelines provide a safe and efficient way to transport hydrocarbons, enabling reductions in road and rail traffic that cut emissions. While the company was already transporting close to 100 percent of oil to its destination, it determined new technologies could help eliminate the remaining fractions-of-a-percent in losses.

With approximately 3,500 miles of pipeline to manage, Bridger Pipeline was facing a significant challenge in detecting and resolving leaks in a timely way. The company moves 450,000 barrels through this network every day. It had built up a sophisticated monitoring system using smart meters and satellite-enabled surveillance systems, bringing huge volumes of real-time data into its control center 24 hours a day, 7 days a week.

The company is deploying an AI solution to closely monitor the system's condition and detect leaks. Bridger Pipeline anticipates a dramatic reduction in the number of false alarms and a significant increase in sensitivity.

BASF: Supporting smarter supply chain operations with cognitive cloud technology[2]

BASF is one of the world's largest chemicals groups, helping customers in almost every industry to overcome diverse social and environmental challenges with its broad portfolio of chemicals, plastics, performance products, and crop protection products. Its Nutrition & Health division operates global value chains with high service standards, requiring a close coordination between supply and distribution points.

BASF Nutrition & Health identified AI as a potential step change solution to drive innovation in replenishment planning. The company's planners had to comb through a number of systems and reports to get the facts and figures they needed to make informed replenishment decisions, but cognitive technologies would allow them to integrate, analyze and visualize data from multiple sources to make the decision-making process quicker, easier and smarter. The tool would use the latest operational data, such as forecast and actual sales, sales opportunities, and shipping schedules, to provide planners with guidance on replenishment timing and quantity.

A proof of concept demonstrated that AI and machine learning could support supply chains with smart visualization of relevant information to support supply decisions and develop replenishment advice.

Chemicals and petroleum outperformers intend to invest more in AI capabilities. In fact, outperformers say they will invest twice as much as their peers this year (2.8 percent of IT spend versus 1.4 percent). And they expect to triple that investment in the next three years to 7.4 percent.

Based on these leaders' survey responses, chemicals and petroleum organizations should strive for a different mentality to take advantage of AI:

– Think strategically about digital technologies
– Leverage analytics and AI across the business
– Capitalize on data
– Set data governance.

Different mentality to take advantage of AI

Thinking strategically about digital technologies

Technological disruption in the chemicals and petroleum industry has increased significantly. The fourth industrial revolution – sometimes referred to as Industry 4.0 – is characterized by increasing digitization, motivating businesses to interconnect products, value chains, and business models.

To succeed, chemicals and petroleum businesses are combining new and emerging digital technologies – including cloud computing, AI, mobile, and the Internet of Things (IoT) – to reconceive customer and partner relationships and operations, such as digitally reinventing their enterprises. Outperformers are further along in thinking about AI in the context of these other technologies. Over half of the outperformers have developed digitization strategies, compared to just under a quarter of their peers. And these outperformers have made the investments in multiple technologies (see Figure 4).
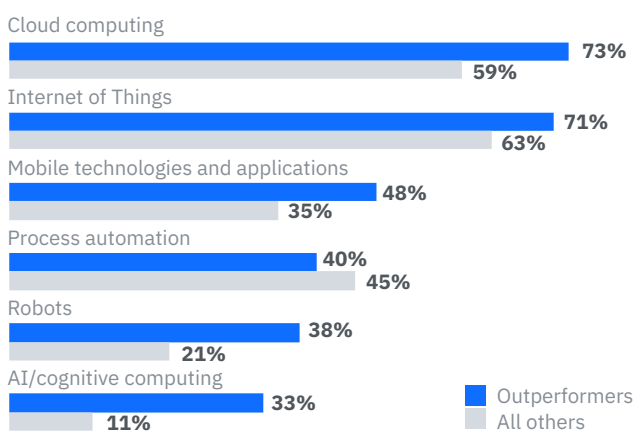
Data-driven platforms have become an increasingly tangible way to realize the benefits of AI.

Figure 4

Outperformers embrace technologies at a higher rate

Invested in technologies for strategic goals

Cloud computing
73%
59%

Internet of Things
71%
63%

Mobile technologies and applications
48%
35%

Process automation
40%
45%

Robots
38%
21%

AI/cognitive computing
33%
11%

■ Outperformers
□ All others

Source: IBM Institute for Business Value survey on AI/cognitive computing in collaboration with Oxford Economics. 2018.

These technologies provide robust data capabilities and infrastructure. Cloud computing can be used to run applications and store data anywhere. The IoT connects sensors and devices to networks. Mobile technologies allow ubiquitous access to information. Process automation enables production efficiency and operational excellence through integrated automation and information management systems, process history data, as well as process and product tracking. Robots can be used for material handling, assembling and disassembling, and dispensing. With AI, the potential to expand insights and capabilities of organizations presents tremendous opportunities.

For chemicals and petroleum companies, data-driven platforms have become an increasingly tangible way to realize the benefits of AI. Strategic platforms powered by AI can predict problems and proactively direct automation to improve quality. Almost a quarter of the chemicals and

petroleum organizations from the most recent IBM Global C-suite Study are investing in the new platform business models.[3] Across all industries, the net impact of this commitment can be estimated at USD 1.2 trillion.[4] Nearly half of the outperformers identified in our research view AI as a strategic platform play. The combination of AI with other emerging technologies, such as cloud computing and IoT, help integrate participants on a platform and support the continuous learning required to succeed. And the digital technologies enable constant roll out of new features in the platform.
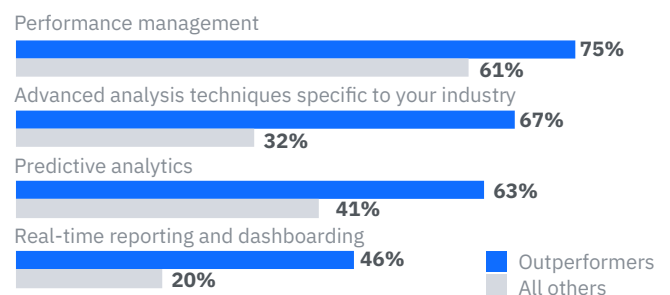
Leverage analytics and AI across the business

Many of the outperformers are advancing their overall analytical capabilities to manage their businesses. They are using analytics or AI solutions to manage performance and provide real-time analysis (see Figure 5). Performance management provides the "blocking and tackling" to run the business by defining the enterprise's strategy and establishing key metrics to measure progress in achieving the objectives outlined in the strategy.

Figure 5

Outperformers use analytics or AI solutions in several of their business units or functions

Usage of analytics or AI solutions within three or more business units or functions

Performance management
75%
61%

Advanced analysis techniques specific to your industry
67%
32%

Predictive analytics
63%
41%

Real-time reporting and dashboarding
46%
20%

■ Outperformers
□ All others

Source: IBM Institute for Business Value survey on AI/cognitive computing in collaboration with Oxford Economics. 2018.

Advanced analysis techniques and predictive analytics improve production efficiency, reduce risks, and enhance customer insights. Real-time reporting and dashboarding provides competitive advantage in speed and depth of insight. Outperformers are automating their processes with analytic solutions beyond traditional business process management or basic robotic process automation. Nearly half are using unstructured data and/or algorithms and involving multiple types of AI technologies and data discovery.

Capitalize on data

The accelerating growth of data is executives' primary challenge. The digital universe will double every two years at least, a 50-fold growth from 2010 to 2020.[5] Organizations are attempting to distill every transaction and every inquiry — even every human interaction — to an essence of 1s and 0s.

So, what is needed to optimize the value of AI? From a data strategy perspective, a robust-but-flexible foundation driven by the core business strategy is critical, as well as an organizational culture supported by governance and policy that encourages adherence to common standards.

A strong data infrastructure, aligned with business architecture that reflects a company's strategic direction, is essential. Nearly two-thirds of outperformers capture, manage, and access business, technology, and operational information about key corporate data with a high degree of consistency across the organization. This compares with just 45 percent of all others. Seventy-five percent of chemicals and petroleum outperformers deliver data to users in a seamless experience, compared to just 59 percent of their peers.

Outperformers are also tapping into a wide variety of data sources, both internally and externally. Nearly three quarters of outperformers have increased their velocity of decision making by using real-time events and data. And over half are leveraging weather data. Weather impacts the movement of raw materials, goods, and products. Storms, flooding, and severe winds can create transportation and delivery nightmares. Chemicals and petroleum companies are likely to need to adjust routing, lead times, and capacity. By incorporating weather data with their operational data, outperformers can dramatically improve supply chain efficiency.

Ninety-four percent of outperformers have interconnected data platforms through application performance interface (API) frameworks with their internal and external business applications. And they are outpacing their peers in using subscription models for platform components (for example, cloud, data, analysis). This infrastructure allows them to nimbly respond to new market dynamics, customer demands, strategic initiatives, and user needs.

Set data governance

Outperformers have put in place data governance practices and leadership. They have clarity of vision around the deluge of data – who owns it, what it means, and how it should be managed. Chemicals and petroleum outperformers drive clear data governance through a Chief Data Officer (CDO) who defines, develops, and implements the strategies and methods through which the organization acquires, manages, analyzes, and governs data.

Because AI and its decisions are grounded in data, the ability to standardize and manage data is crucial for successful operational execution (see Figure 6). Recognizing the importance of metadata for business definition, approved usage, and measured data quality – wrapped around data and interpretable through AI – is fundamental.
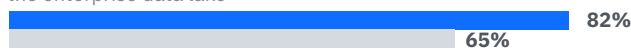
Starting small, failing fast and scaling robustly are keys to successful technology execution.
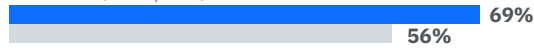

Figure 6

Outperformers create standards for data management
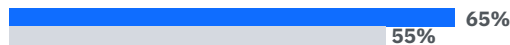
Enterprise data management practices

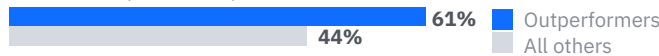Only authorized users can consume the data from
the enterprise data lake

82%
65%

Active governance is used to create and maintain
consistent, complete, and accurate business data

69%
56%

Incoming data and events are registered,
tracked, and auditable

65%
55%

Data integration process/patterns are
standardized, automatic, and reusable

61%
44%

■ Outperformers
■ All others

*Source: IBM Institute for Business Value survey on AI/cognitive computing
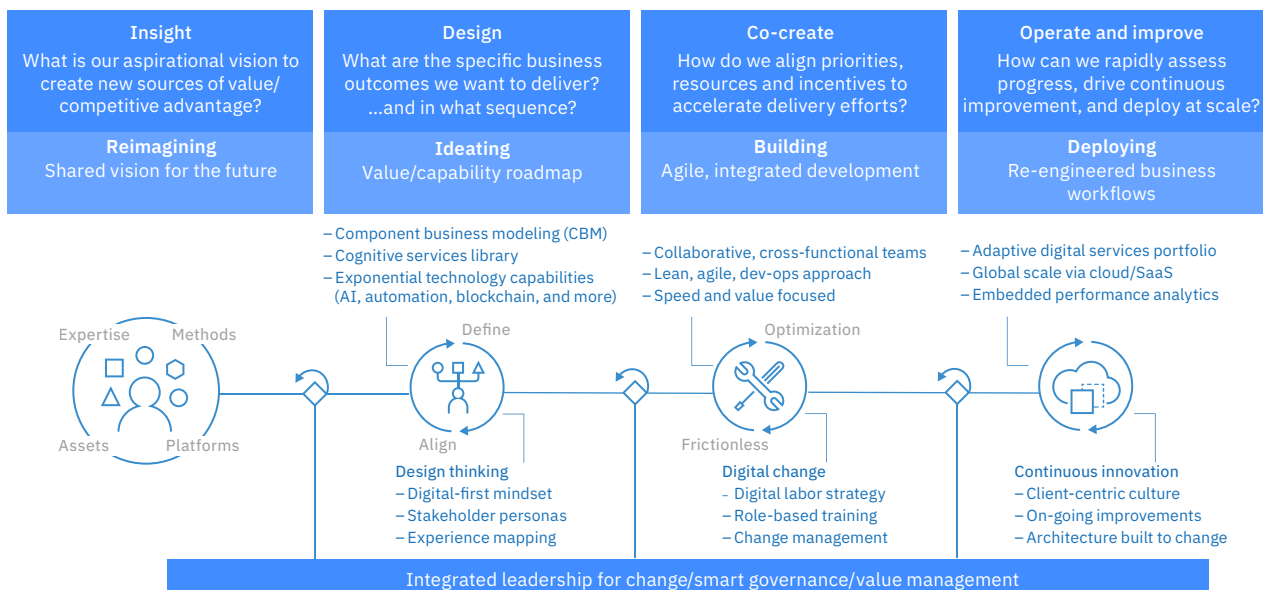in collaboration with Oxford Economics. 2018.*

Getting started

Starting small, failing fast and scaling robustly apply equally to AI as to other areas of successful technology execution.[7] A key example of how to institutionalize the principles of executional agility in practice can be found by examining an innovation platform concept, which we introduced in the IBM Institute for Business Value executive brief "The Cognitive Enterprise: The finance opportunity."[8]

To implement an innovation platform, organizations need to advance through a series of specific steps (see Figure 7). First, define an AI strategy to drive change that includes creating the right governance, operating models, and roadmaps (see Figure 7). Create an innovation platform to drive innovation and develop a "factory" to industrialize and scale — both underpinned by an enterprise-wide AI platform.

As explained in "The Cognitive Enterprise: The finance opportunity," an innovation platform can support an organization through a business transformation "inside-out" by aligning to a company's strategic business imperatives. The innovation platform is supported by a governance model that helps make sure that initial outcomes propel adoption across the organization.[9]

Figure 7

Implementation of an innovation platform

Insight	Design	Co-create	Operate and improve
What is our aspirational vision to create new sources of value/ competitive advantage?	What are the specific business outcomes we want to deliver? ...and in what sequence?	How do we align priorities, resources and incentives to accelerate delivery efforts?	How can we rapidly assess progress, drive continuous improvement, and deploy at scale?
Reimagining Shared vision for the future	**Ideating** Value/capability roadmap	**Building** Agile, integrated development	**Deploying** Re-engineered business workflows

– Component business modeling (CBM)
– Cognitive services library
– Exponential technology capabilities
  (AI, automation, blockchain, and more)

– Collaborative, cross-functional teams
– Lean, agile, dev-ops approach
– Speed and value focused

– Adaptive digital services portfolio
– Global scale via cloud/SaaS
– Embedded performance analytics

Expertise Methods

Assets Platforms

Define

Align

Optimization

Frictionless

Design thinking
– Digital-first mindset
– Stakeholder personas
– Experience mapping

Digital change
– Digital labor strategy
– Role-based training
– Change management

Continuous innovation
– Client-centric culture
– On-going improvements
– Architecture built to change

Integrated leadership for change/smart governance/value management

Source: Menezes, Tony, and Bob Booth. "The Cognitive Enterprise: The finance opportunity." IBM Institute for Business Value. 2018.

Abu Dhabi National Oil Company (ADNOC): Enhancing accuracy, consistency and speed of rock analysis to support better decisions[6]

ADNOC is one of the world's largest producers of oil and gas. It recognizes the value of incorporating AI into its business processes to optimize operations, enhance recovery, and improve decision making.

ADNOC is leading the adoption of AI by streamlining the way it studies Abu Dhabi's hydrocarbon reservoirs. Determining the hydrocarbon storage capacity and production characteristics of carbonate rock samples requires time and technical expertise. ADNOC wanted to speed the process without sacrificing accuracy.

ADNOC developed an automated process for analyzing and categorizing rock samples, speeding the development of geological digital models of reservoirs by introducing AI.

The process increases delivery speed and consistency of reservoir rock sample descriptions, accelerates model construction to de-risk multibillion-dollar reservoir development decisions, and preserves expertise that petrographers have spent decades developing.

Key questions to consider

» Focus: Which functions are your priority areas for AI, and do they support efficiency, profitable growth, and/or customer satisfaction and retention?

» Value: What are the top value drivers for your organization, and how do you plan to measure AI benefits?

» Data: Who owns and maintains your data, and how strong is your organization's data expertise?

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IBM Institute for Business Value

The IBM Institute for Business Value (IBV), part of IBM Services, develops fact-based, strategic insights for senior business executives on critical public and private sector issues.

Study approach and methodology

In cooperation with Oxford Economics, the IBM Institute for Business Value surveyed 5,001 global executives representing 18 industries, including leaders of government agencies and educational institutions, and 19 functions. Roles of responding executives included C-level executives — CEOs, CFOs, CHROs, CIOs, CMOs and COOs — as well as heads of customer service, information security, innovation, manufacturing, risk, procurement, product development, and sales. In total, 251 chemicals and petroleum respondents participated in the study.

Related reports

Chemicals & Petroleum Collective Intelligence: Deriving Insights across the C-suite. https://www.ibm.com/downloads/cas/QXJV0KD2

Converting to the digital formula: Digital Reinvention® in chemicals. https://www.ibm.com/thought-leadership/institute-business-value/report/drchemicals

Extracting digital rewards: Digital Reinvention® in petroleum. https://www.ibm.com/thought-leadership/institute-business-value/report/drpetroleum

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Research insights are fact-based strategic insights for business executives on critical public and private sector issues. They are based on findings from analysis of our own primary research studies. For more information, contact the IBM Institute for Business Value at iibv@us.ibm.com.

Endnotes

1 "Bridger Pipeline LLC: Protecting the environment with deep-learning AI on IBM Power Systems." IBM Case Study. 2019. https://www.ibm.com/case-studies/bridger-pipeline-systems-hardware-oil-ai-deep-learning

2 "BASF: Supporting smarter supply chain operations with cognitive cloud technology." IBM Case Study. 2019. https://www.ibm.com/case-studies/basf

3 "Incumbents Strike Back: Insights from the Global C-Suite Study." IBM Institute for Business Value. February 2018. https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=98013098USEN

4 IBM IBV analysis: Survey data was analyzed, segmented and used to extrapolate a global estimate using country annual GDP and forecasted GDP growth data from publicly available sources, including The World Bank, OECD and the International Monetary Fund.

5 "The Exponential Growth of Data." insideBIGDATA. February 16, 2017. https://insidebigdata.com/2017/02/16/the-exponential-growth-of-data/

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7 Ezry, Rafael, Dr. Michael Haydock, Bruce Tyler, and Rebecca Shockley. "Analytics: Dawn of the cognitive era." IBM Institute for Business Value. October 2016. http://www.ibm.com/business/ value/2016analytics/

8 Menezes, Tony, and Bob Booth. "The Cognitive Enterprise: The finance opportunity." IBM Institute for Business Value. 2018. https://www-935.ibm.com/services/us/gbs/thoughtleadership/cogentfinance/

9 Ibid