Optimizing the chemicals value chain with AI

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By Dr. Viswanath Krishnan,
Spencer Lin and
David Womack

Key takeaways

Optimizing the value chain with AI is a necessity

AI is important to enterprise success as attested by nearly six in ten of survey respondents. Having to adapt with greater speed and agility to address the current landscape, AI assists organizations with the most important business objectives of growing organically and reducing operational costs. However, only four out of ten respondents in our survey of 400 chemicals executives say they're executing an enterprise-wide AI strategy.

Learning from AI champions

We identified a small group of chemicals leaders—22 percent of survey respondents—that have a well-defined enterprise AI strategy. Their enterprises lead in financial performance for revenue growth and profitability. These AI champions are more effective at addressing their business objectives and over three-quarters say they have overachieved expectations for creating value from AI investments over the last three years.

Three elements to succeed with AI

AI champions establish the foundation to take advantage of AI. They execute an AI business blueprint and they infuse the value chain with AI and other exponential technologies.

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The new reality

The chemicals industry is facing incredible challenges amidst the COVID-19 pandemic and the oil price collapse. Demand and supply fluctuations have driven the scale down of manufacturing production to match short-term volatility and reduce both working capital and operating expenses.

After seven years of growing employment in the US, nearly 20,000 jobs are expected to be lost in the chemicals industry in 2020.[1] While challenging external forces are not new to chemicals companies, they are finding themselves having to adapt with greater speed and agility to address the current landscape and prepare for a new market reality.

Overcapacity and declining margins have reduced utilization, halted plant construction, and induced cutbacks and shutdowns. Production has been especially hard hit for coatings and synthetic rubber that feed key end-user markets in automotive, building, and construction. The bright spots are chemical companies producing antibacterial products, hand sanitizer, disinfectants, surfactants for soaps, and personal protective equipment.[2]

Supply/demand imbalance has imposed a new economic situation that challenges organizations' ability to maintain production, sanction new development, or even explore new areas.

Even in the midst of all this, chemicals companies will need to plan for larger transformations and innovation to differentiate themselves. Society, shareholders, and employees have higher expectations for responsible value chains, as well as resilience to the cyclic economic challenges the industry still faces.

Artificial intelligence (AI) is a critical component to help organizations be more equipped to respond with agility and drive business performance with new approaches and ideas. It's essential to catalyze the value chain with AI.

To understand where chemicals companies are with their AI efforts, the IBM Institute of Business Value in conjunction with Oxford Economics surveyed 400 chemicals executives in 18 countries who are involved in defining or executing AI strategies and/or implementations for their organization (see "Study approach and methodology").
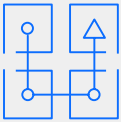
Only

4 in 10

chemicals industry respondents told us they're executing an enterprise-wide AI strategy

39%

return on AI investment has been generated over the past year by "AI champions" compared to a 25 percent ROI for their peers

97%

of "AI champions" say they have built a data-driven culture

Fifty-seven percent of the chemicals industry executives surveyed tell us that AI is important to the success of their organization today. And that number will increase to 80 percent in just three years. Existing AI investments have generated value for their organizations.

An average 28 percent return on investment has been generated in the past year. These investments have impacted both expense (with a 2 percent reduction) and revenue (with a 3 percent increase) over the past three years. AI investments have also reduced time to market for new products and services by 24 days.

AI investment is critical because organizations cannot address their most important business objectives (see Figure 1) without it. Over six in ten of the executives surveyed tell us they are focused on reducing operational costs. When the production process is complex and asset intensive, AI can have a strong influence on operations. Over half of the respondents want to grow market share organically and nearly half say they want to introduce greater levels of robotics and automation.

There are differences by segment. Most notable are consumer products' emphasis on launching new products and services such as expanding presence in areas like toiletries and cosmetics, and pharmaceuticals' desire to improve their cybersecurity by protecting proprietary information around drug development and technology advances.

Since pharmaceuticals is highly recipe-based and highly predictable (no variations in feedstocks and processes), AI's value for reducing operational costs is lower. In addition, since specialty chemicals' processes include packaging, automation/robotics can play a more important role, similar to automotive assembly lines.
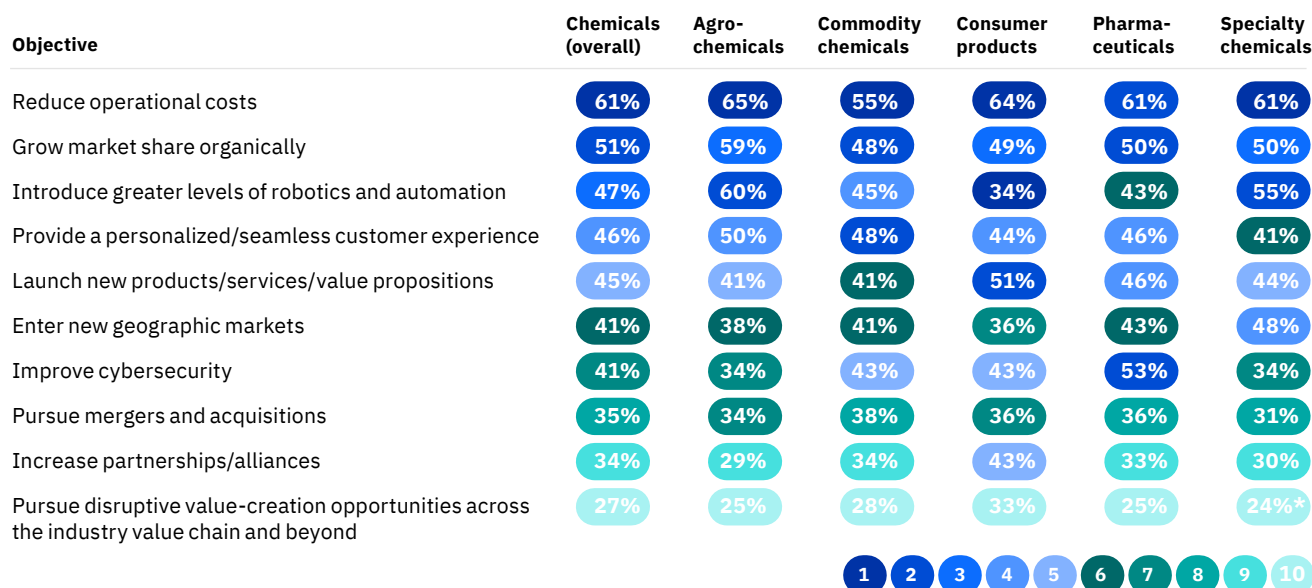
Chemicals companies can
fundamentally reimagine
the way the businesses
operate with AI.

AI is unlike other exponential technologies. AI learns and is guided by algorithms, can adapt, refine, and alter its responses and decisions. AI can be applied in major business processes or activities.

By combining AI with other exponential technologies, chemicals companies can fundamentally reimagine the way the business operates and engages with its stakeholders. This could include developing new ways of realizing and monetizing value, redefining customer engagement, and creating compelling experiences for employees and partners.

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Figure 1

Most important business objectives by segment

Objective	Chemicals (overall)	Agro-chemicals	Commodity chemicals	Consumer products	Pharma-ceuticals	Specialty chemicals
Reduce operational costs	61%	65%	55%	64%	61%	61%
Grow market share organically	51%	59%	48%	49%	50%	50%
Introduce greater levels of robotics and automation	47%	60%	45%	34%	43%	55%
Provide a personalized/seamless customer experience	46%	50%	48%	44%	46%	41%
Launch new products/services/value propositions	45%	41%	41%	51%	46%	44%
Enter new geographic markets	41%	38%	41%	36%	43%	48%
Improve cybersecurity	41%	34%	43%	43%	53%	34%
Pursue mergers and acquisitions	35%	34%	38%	36%	36%	31%
Increase partnerships/alliances	34%	29%	34%	43%	33%	30%
Pursue disruptive value-creation opportunities across the industry value chain and beyond	27%	25%	28%	33%	25%	24%*

1 2 3 4 5 6 7 8 9 10

* Results using low counts are statistically unreliable but can be considered directional.
Source: Q1. What are the most important business objectives of your organization? n=400

State of AI

While respondents stated the importance of AI to their chemicals organizations, the application of AI across the enterprise isn't commonplace. Only four in ten of the chemicals respondents say their companies are executing an enterprise-wide AI strategy.

The good news is that AI investment is being combined with other exponential technologies (see Figure 2). Of these technologies, AI's percentage is expected to grow the fastest from 13 percent to 16 percent of technology budgets in the next three years. Cloud computing's percentage stays flat and robotic process automation increases from 16 percent to 17 percent.

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Figure 2

Today's chemicals technology budgets are spread across digital technologies
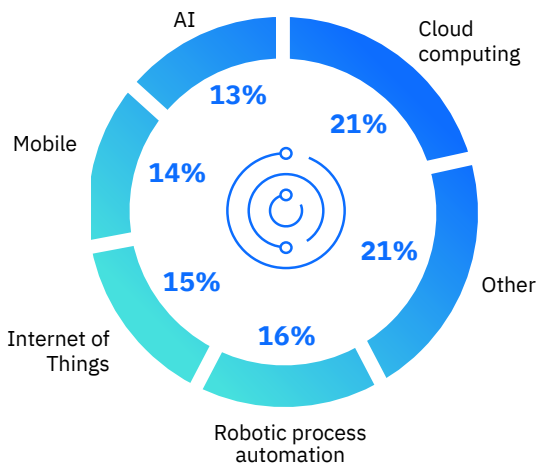
Source: B2. What percentage of your organization's technology budget is invested in the following technologies today and in three years?

Chemicals respondents indicated that AI has been implemented in select areas in their value chain (see Figure 3). In particular, the majority are using AI for research development, product manufacturing, and risk management. The specific application of AI for industry-specific activities support these areas (see Figure 4).

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Figure 3

Areas where AI has been implemented

Research and development — 74%

Product manufacturing — 61%

Risk management — 58%

Forecasting and planning — 47%

Finance and accounting — 46%

Materials sourcing and acquisition — 39%

Inventory management and distribution — 48%

Health, safety and environment — 47%

Marketing and sales — 39%

Order management — 32%

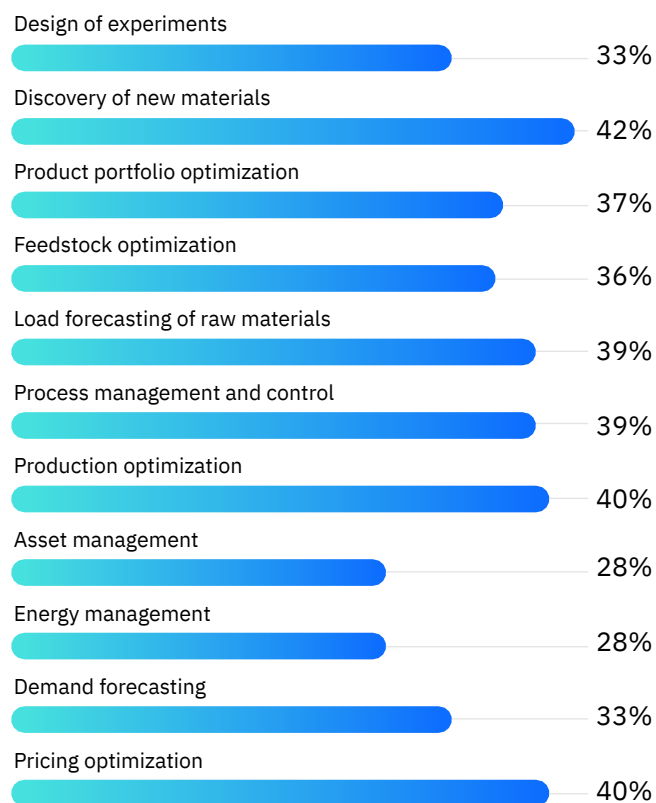Customer service — 28%

Human resources — 17%

Source: Q6. Which technologies have you implemented in the following areas? n=400

In chemical process control, AI optimizes operations and reduces unplanned downtime.

In R&D, AI can classify compounds, a traditionally time-consuming manual process, and predict the future of chemical reactions. Opportunities to apply AI occur in the stages of pharmaceutical discovery. Examples include target validation, virtual screening for rational drug/chemical development, identifying prognostic biomarkers, and analyzing digital pathology data in clinical trials.[3]

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Figure 4
Implementation of AI for industry-specific activities

Design of experiments
33%

Discovery of new materials
42%

Product portfolio optimization
37%

Feedstock optimization
36%

Load forecasting of raw materials
39%

Process management and control
39%

Production optimization
40%

Asset management
28%

Energy management
28%

Demand forecasting
33%

Pricing optimization
40%

Source: Q7. To what degree has your organization implemented AI in industry-specific activities? Respondents selected either "We have made operational" or "We have fully implemented." n=398 to 400

Data-driven decision making can quicken the development process and reduce failure rates in drug discovery. In specialty chemicals, AI can help predict chemical, physical, or mechanical properties of polymers, ceramics, and other materials properties without conducting new experiments.[4]

In manufacturing, production optimization, process management, and control and asset predictive maintenance are the natural applications of AI. In chemical process control, AI optimizes operations and reduces unplanned downtime. Examples include:

– High speed and accuracy thermal control of a continuous flow chemical reactor with computer vision
– A predictive, artificial neural network
– Online reactor monitoring with neural networks
– Deep learning for pyrolysis reactor monitoring in which thermal imaging is used to perform smart monitoring to detect faults using neural networks.[5]

For asset maintenance, AI can identify anomalies, assess their criticality, determine the root cause, predict when maintenance is needed, and help maintenance technicians correctly perform the repair the first time.

AI assists with risk management to help manage uncertainty and volatility. For example, in the supply chain, weather impacts the movement of raw materials, finished goods, and products. Storms, flooding, and severe winds can create transportation and delivery nightmares. AI can help by incorporating weather data with operational data to adjust routing, lead times, and capacity.

Insight: Comparison of survey respondents

The survey of chemicals executives included 224 respondents collected in January through March 2020, dubbed "Pre-COVID-19 respondents," and 176 respondents collected in June and July 2020, named "During Pandemic respondents." The most important business objectives are roughly the same across these two groups, with reducing operational costs as the top imperative and growing market share organically in the top three.

Not surprisingly, the During Pandemic respondents indicate they aren't as effective against those objectives. The combination of the COVID-19 pandemic and the oil price collapse created an environment these respondents weren't necessarily prepared for and exposed the resilience of their operations. This is reflected in lower effectiveness at developing and executing strategy for the During Pandemic respondents compared with the Pre-COVID-19 respondents.

With respect to AI, the importance of AI to future organizational success is similar across the two sets of respondents at eight out of ten. These two respondent groups are also consistent in their AI progress with both at four in ten having either a fully executed AI strategy or have taken steps to transform against their strategy and execution plan. Finally, implementation of AI for ten out of 11 industry-specific activities are similar across groups; the one exception is energy management.

Use of other technology also increasing

AI isn't the only technology that chemicals respondents are using. To assist with product manufacturing, a majority have also implemented the Internet of Things (50 percent) and robotic process automation (64 percent). The power of AI is leveraging the vast amount of information generated by sensors and devices.

Cloud computing is being tapped for application and data storage for select areas:

– Forecasting and planning
– Order management
– Inventory management
– Human resources
– Finance and accounting.

Sixty-seven percent have implemented mobile applications for marketing and sales, and 65 percent for customer service. Mobile technologies allow ubiquitous access to information.

Importance of good data management and IT architecture

The ability to leverage AI is challenged without proper data management and the lack of an enterprise IT architecture to support data initiatives. Much useful data for chemicals companies comes from their laboratories and from their production operations, including technologies, assets, services, and equipment.

Without an emphasis focused on taking advantage of this data and proper data governance, some companies are missing out on insights to drive operational efficiency, enhance customer engagement, and grow through new products and services.

Some companies are missing out on key data insights.

Less than a third of respondents indicated they have enterprise-wide information standards. Only four in ten have common data sourcing and only 36 percent have consistent definition of metrics.

IT infrastructure needs to be nimble enough to respond to new market dynamics, customer demands, strategic initiatives, and user needs. Because AI and its decisions are grounded in data, an enterprise IT architecture is mandatory. Yet, only four in ten chemicals executives told us their organizations have established a comprehensive and consistent enterprise architecture in alignment with business activities to support their digital initiatives.

Under half of the chemical executives surveyed indicated they have developed a hybrid multicloud environment to support the business strategy. Without this cloud environment, organizations will struggle to develop/maintain data in their business around customer touchpoints and across ecosystems.

Learning from AI champions

To help all organizations identify specific strategies to improve their AI capabilities, we analyzed survey responses and identified a small group of chemicals "AI champions," consisting of 22 percent of our survey sample. These executives self-reported that their organizations had a well-defined enterprise-wide AI strategy that their organization understood.

With this strategy in place, AI champions are pursuing different business objectives versus their peers, with an emphasis on the customer and growth rather than on cost (see Figure 5). This is supported by the AI champions' investment in AI initiatives over the next three years focusing on growth-oriented opportunities—54 percent versus 23 percent for their peers.

These leaders deliver better financial performance than industry peers—69 percent versus 42 percent for revenue growth, and 82 percent versus 42 percent for profitability. Their success is also demonstrated in the outperformance in agility and innovation relative to competitors.

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Figure 5

AI champions are pursuing different business objectives versus their peers with an emphasis on growth

Objective	AI champions		All others	
Launch new products/services/ value propositions	56%	1	42%	6
Provide a personalized/seamless customer experience	55%	2	43%	5
Introduce greater levels of robotics and automation	51%	3	46%	3
Grow market share organically	49%	4	51%	2
Pursue mergers and acquisitions	46%	5	32%	8
Enter new geographic markets	46%	6	40%	7
Reduce operational costs	45%	7	65%	1
Increase partnerships/alliances (or collaboration)	40%	8	32%	8
Pursue disruptive value-creation opportunities across the industry value chain and beyond	32%	9	25%	10
Improve cybersecurity	29%	10	44%	4

Source: Q1. What are the most important business objectives of your organization? n=400
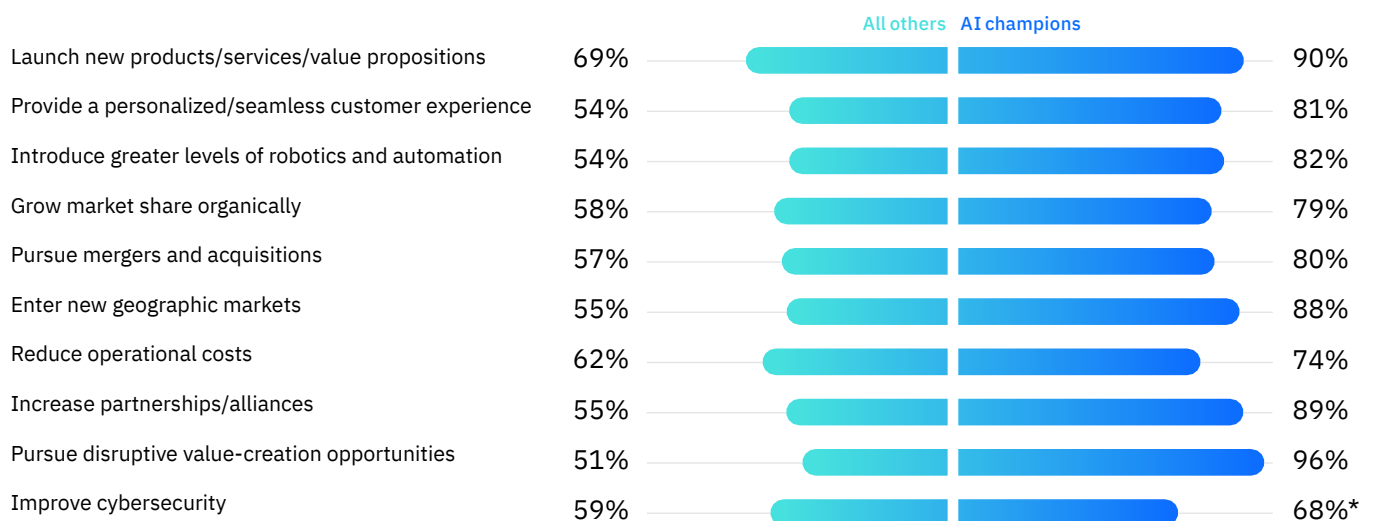
Cost savings and improved production processes can result from AI's use of available data sources.

AI champions are more effective at developing (80 percent) and executing (93 percent) their enterprise strategy versus peers (58 percent and 70 percent, respectively). Their leadership is reflected in being more effective against the most important business objectives (see Figure 6).

Where the AI champions really stand out is the value they have generated with their AI initiatives. Over three quarters of these leaders say they have overachieved expectations for creating value from AI initiatives over the last three years versus just 27 percent of all others.

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Figure 6

AI champions are more effective at addressing business objectives

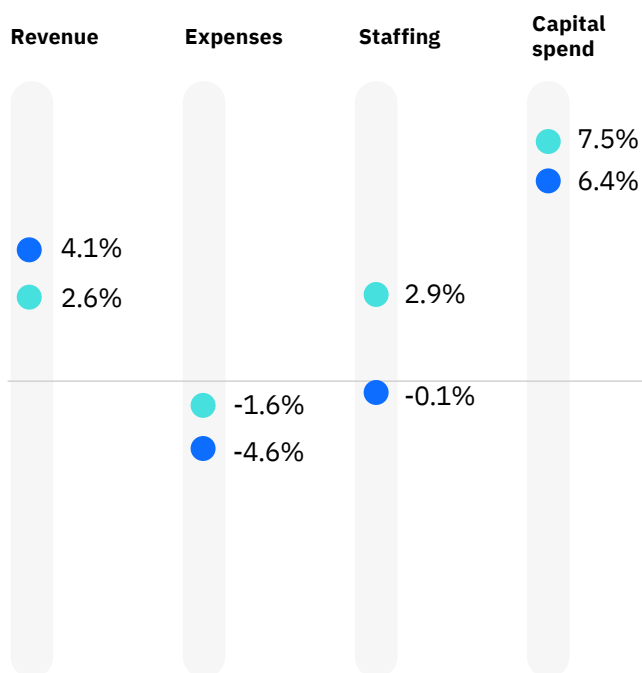|	All others	AI champions
Launch new products/services/value propositions	69%	90%
Provide a personalized/seamless customer experience	54%	81%
Introduce greater levels of robotics and automation	54%	82%
Grow market share organically	58%	79%
Pursue mergers and acquisitions	57%	80%
Enter new geographic markets	55%	88%
Reduce operational costs	62%	74%
Increase partnerships/alliances	55%	89%
Pursue disruptive value-creation opportunities	51%	96%
Improve cybersecurity	59%	68%*

* Results using low counts are statistically unreliable but can be considered directional. Percentages represent the number of respondents who selected 4 or 5 on a 5-point scale. Source: Q2. How effective is your organization at addressing these business objectives? n=400

AI champions have achieved a higher ROI on AI investments—39 percent compared to 25 percent— while spending roughly the same on AI—USD 4.9 million per billion in revenue versus USD 4.4 million per billion in revenue for peers.

AI champions have been able to further increase revenues, reduce expenses, maintain staffing, and spend less on capital based on their AI initiatives relative to their peers (see Figure 7). Using an average USD 5 billion company with a ten percent margin, there's over a USD 200 million profit advantage for AI champions versus their peers.

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Figure 7
Value of AI investments

Revenue

4.1%
2.6%

Expenses

-1.6%
-4.6%

Staffing

2.9%
-0.1%

Capital spend

7.5%
6.4%

AI champions
All others

Percentages represent the number of respondents who selected 4 or 5 on a 5-point scale. Source: B6. How has your organization's AI investments over the last three years impacted the following? n=400

Japan chemical makers: Working together on AI for developing advanced materials[6]

About 20 companies in Japan, including Asahi Kasei, Mitsubishi Chemical, Mitsui Chemicals, Sumitomo Chemical, and Toray Industries, in cooperation with the Ministry of Economy, Trade and Industry, are starting joint management of an AI-based system in 2021 for developing advanced materials using in-country patents.

The system will use AI to analyze a broad array of information to manufacture special materials. The expectation is to shorten development times for new materials from approximately a decade to several months. This moves the development process from traditionally relying on researchers' experience plus trial and error, to employing AI to try out new materials by analyzing big data from past experiments and research papers.

Succeeding with AI

AI champions emphasize three key actions needed to succeed with AI:

– Establish the foundation to take advantage of AI

– Execute an AI business blueprint

– Infuse value chain with AI and other technologies.

Establish the foundation to take advantage of AI

The value of AI is predicated on the ability of the organization to take advantage of data, which is reflected in 97 percent of AI champions building a data-driven culture, compared with 59 percent of their peers. Reduction of data structural complexity becomes a precondition. This means data standards and enterprise data-governance framework are required.

Our research shows that AI champions outpace their peers in data commonality. Nearly three-quarters have a standard financial chart of accounts and over two thirds have a consistent definition of metrics compared to 38 percent and 27 percent of others. Over two thirds of AI champions have common data definitions compared with over a third of their peers.

Access to data is also critical. Nearly three quarters of AI champions use common data sourcing compared to just three out of ten of their peers. Nearly two thirds have put in place an enterprise data warehouse to manage the deluge of data. This reduces the time needed to prepare, validate, and cleanse data. As a result, they can curate the data they have on hand and apply it to decision making. Over two thirds of these leaders have created a flexible data architecture, versus a third of their peers. This architecture provides openness and transparency surrounding data.

Evonik: Creating a virtual assistant for the paint and coatings industry[7]

Evonik is one of the world leaders in specialty chemicals.

After two years of development, the company has launched COATINO, a virtual assistant that's available free of charge to the paint and coatings industry. Formulators can obtain AI-based additive recommendations for applications and individual formulations for pigment concentrates. COATINO can be used not only from any electronic device, but also be operated by voice command.

Recommended products can be dynamically compared with each other so the customer can grasp the differences quickly and can make decisions. Nearly 300 products are available to choose from, including defoamers, dispersing additives, and matting agents. If required, COATINO will send out technical, regulatory, and safety data sheets.
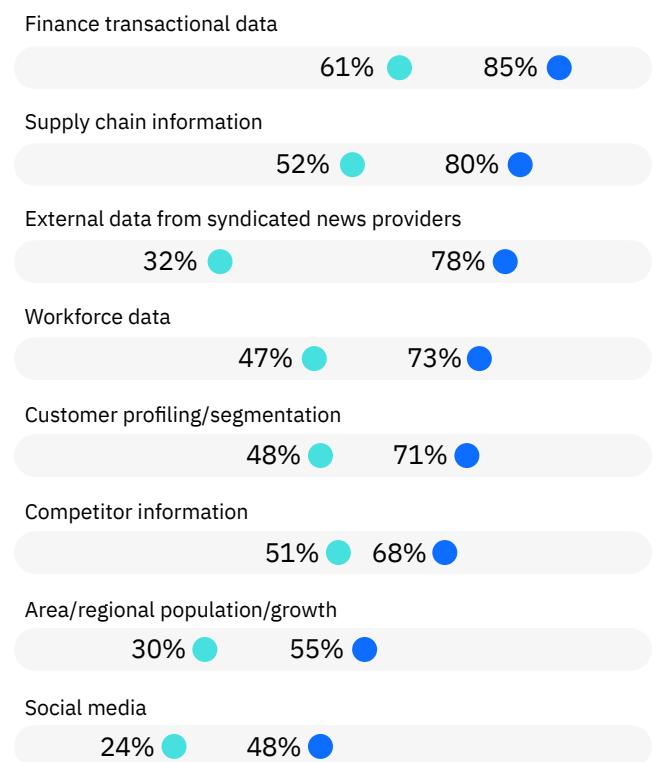
Hybrid clouds provide seamless flow of data so AI champions can use data in new ways.

Data commonality and access to data is supported by a clarity of vision around data management—who owns it, what it means, and how it should be managed. Forty-four percent of AI champions drive clear data governance through a Chief Data Officer (CDO) or an executive in an equivalent position versus 31 percent of their peers. The CDO is supplemented by a business-driven information governance committee for over six in ten of AI champions compared to just 36 percent of others.

Knowledge and insights can be extracted from vast amounts of structured and unstructured data about the business environment and operational conditions (see Figure 8). AI champions take advantage of available data sources to adjust operations, identify workforce needs, adjust competitive responses, and act on emerging trends. For example, market-demand projections influence raw-material sourcing, inventory updates, and energy consumption. This translates to cost savings, improved production processes, and proactive decision making.

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Figure 8

AI champions take advantage of new data sources at a greater rate

Finance transactional data
61% ● 85% ●

Supply chain information
52% ● 80% ●

External data from syndicated news providers
32% ● 78% ●

Workforce data
47% ● 73% ●

Customer profiling/segmentation
48% ● 71% ●

Competitor information
51% ● 68% ●

Area/regional population/growth
30% ● 55% ●

Social media
24% ● 48% ●

AI champions
All others

Percentages represent the number of respondents who selected 4 or 5 on a 5-point scale. Source: Q19. To what extent are the following data sources used to leverage AI? n=382 to 399

AI champions recognize that their talent needs to evolve as part of their AI strategy and implementations.
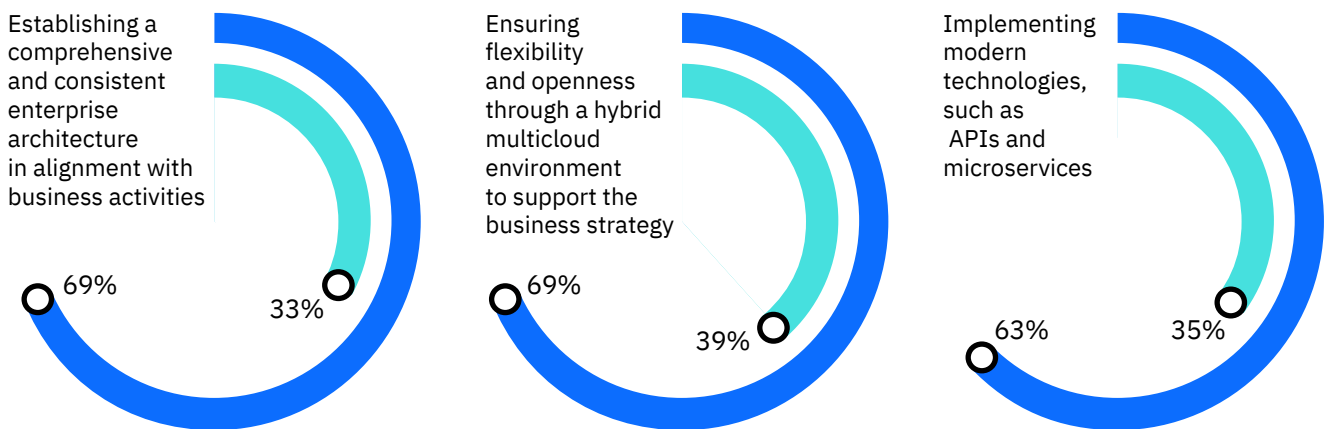
To take advantage of AI and other digital technologies and a plethora of data sources, AI champions have established an enterprise IT architecture (see Figure 9). A comprehensive and consistent enterprise architecture is important to the scaling and compatibility of modular workflows. This technology foundation provides the openness needed for market-making business platforms. Hybrid clouds allow access to exponential technologies and provide seamless flow of data so AI champions can use it in new ways.

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Figure 9

An enterprise IT architecture creates flexibility and openness

Establishing a comprehensive and consistent enterprise architecture in alignment with business activities

69% 33%

Ensuring flexibility and openness through a hybrid multicloud environment to support the business strategy

69% 39%

Implementing modern technologies, such as APIs and microservices

63% 35%

AI champions
All others

Percentages represent the number of respondents who selected 4 or 5 on a 5-point scale. Source: Q16. Thinking about orchestrating your enterprise IT architecture to support AI implementations, to what extent has your organization made progress against each of the following goals? n=400

Yara: Cultivating a high-yielding platform for growth[8]

Headquartered in Norway, Yara is one of the world's leading fertilizer companies and a provider of environmental solutions.

Yara is building a digital farming platform that connects and empowers independent farmers. This platform represents an extension to Yara's existing business model, using farming data to provide enriching outcomes to farming families, and serving as a first-of-a-kind, competitive differentiator in the agriculture industry.

The cloud-agnostic platform aims to cover seven percent of all arable land and help manage existing crops with capabilities such as damage prediction and weather forecasting. It will also use Internet of Things (IoT) sensors and AI to improve agricultural outcomes for the next season. It has already been downloaded by farmers 600,000 times in one ten-week period and its adoption is increasing. The platform follows a pay-as-you-go commercial model and will provide two data services: weather data and crop yield.

Execute an AI business blueprint

AI champions have elevated AI to the forefront in their organizations. As a result, AI champions are further along with executing their enterprise-wide AI strategy.

Sixty-nine percent of AI champions have either a fully executed AI strategy or have taken steps to transform against their strategy and execution plan versus a third of others. These leaders escape from having multiple AI experiments across various functions and run a holistic AI program. An enterprise AI strategy promotes using AI with partners and business ecosystem—in fact, over three quarters of AI champions do this.

Nearly eight in ten of these leaders have put in place the people and skills and 70 percent have put in the financial resources to execute their AI strategies. This compares with less than half of all others. AI champions understand having these assets in place help their enterprises capture AI's value, drive value chain improvements, enhance customer engagement, and provide better risk management.

AI champions overwhelmingly recognize that their talent needs to evolve as part of their AI strategy and implementations. To that end, leaders have made more talent improvements to support AI than their cohorts (see Figure 10).

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Figure 10

AI champions take concrete steps to enhance talent
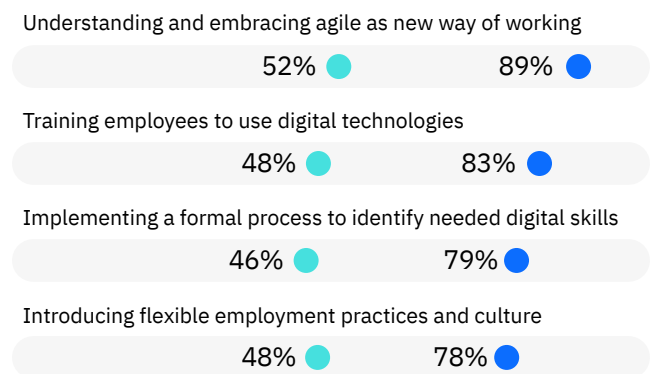
Understanding and embracing agile as new way of working

52% ●   89% ●

Training employees to use digital technologies

48% ●   83% ●

Implementing a formal process to identify needed digital skills

46% ●   79% ●

Introducing flexible employment practices and culture
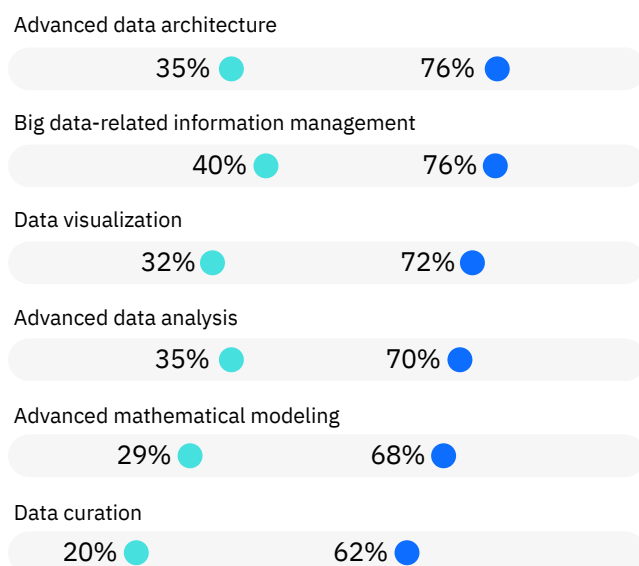
48% ●   78% ●

AI champions
All others

Percentages represent the number of respondents who selected 4 or 5 on a 5-point scale. Source: Q12. To what extent has your organization invested in each of the following talent initiatives associated with your AI implementations? n=397 to 399

To stay ahead of the market and move or shift with changing dynamics and opportunities, AI champions invest in agile project management as a new way to work which allows them to make modifications based on real-time feedback from testing, iterating, and continuously improve throughout the product development and operational processes. Other investments include upskilling their existing employees through digital technologies training and finding new talent.

Twice as many AI champions than others have invested in data skills (see Figure 11) such as advanced data architecture, data visualization, and advanced data analysis. These leaders can leverage the talent with these skills, combined with AI, to enable predictive analytics and prescriptive insights that recommend next best actions. This talent serves as the bedrock for generating insights.

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Figure 11
AI champions have the data skills to take advantage of AI

Advanced data architecture

35% ●   76% ●

Big data-related information management

40% ●   76% ●

Data visualization

32% ●   72% ●

Advanced data analysis

35% ●   70% ●

Advanced mathematical modeling

29% ●   68% ●

Data curation

20% ●   62% ●

AI champions
All others

Percentages represent the number of respondents who selected 4 or 5 on a 5-point scale. Source: Q13. To what extent has your organization invested in the following skills to support the use of AI? n=400

Dow: Scaling digital skills[9]

Dow's ambition is to become the most innovative, customer-centric, inclusive, and sustainable materials science company in the world and has a portfolio of performance materials, industrial intermediates, and plastics businesses. Its digital strategy is to move from being a chemical company that "does digital" to become a digital developer of new materials.

The company created the Dow Digital Operations Center (DOC) that brings together the deep domain expertise resident across the company. The center's employees include expertise in production, maintenance, process control and automation, process development, robotics, manufacturing execution systems, enterprise architecture, mobile technologies, and other areas.

The multidisciplinary team facilitates rapid prototyping of new technologies with data analytics, mobile devices, robotic platforms, advance control, sensors, and data systems connectivity to improve manufacturing and logistics operations and to drive the implementation of advanced IT within the manufacturing organization.

India Glycols: Enabling digital transformation[10]

India Glycols manufactures green technology-based bulk, specialty, and performance chemicals and natural gums, spirits, industrial gases, sugar, and nutraceuticals.

With ambitious plans to improve energy efficiency and enhance manufacturing yield, the company realized its inflexible systems infrastructure was not up to the task. India Glycols deployed SAP S/4HANA and production control applications on IBM Power Systems H922, which represented a significant step in its digital transformation journey. The starting point is operational excellence, enabling essential processes such as material resource planning and order-to-pay. The company was able to achieve 80 percent faster delivery of standard financial reports and 91 percent reduction in time taken to retrieve order-to-pay reports. Critical materials requirements planning information is available daily.

Associated with the business management transformation, India Glycols is deploying a range of Industrial IoT, robotic process automation, and artificial intelligence technologies. The aim is leaner, greener manufacturing capabilities that deliver improved energy efficiency, enhanced manufacturing yield, greater quality, and increased throughput.

AI champions' investment in personal and technology skills drives purposeful agility. Over two-thirds have invested in project management compared with just 37 percent of all others. Nearly two-thirds have invested in tech-savvy skills such as machine learning to train cognitive systems and over half have done so with robotic and process automation skills.

AI champions recognize that navigating a continually evolving environment requires people who can communicate effectively, change course quickly, apply problem-solving and critical-thinking capabilities, and draw and act on insights from vast amounts of data.

Infuse value chain with AI and other technologies

AI champions have applied AI to address their most important business objectives (see Figure 12) especially around customer engagement, growth through new products and services, and automation. In fact, three quarters or more of AI champions have made these AI implementations operational or fully implemented and optimized.

For AI champions, it's about intertwining digital technologies across the entire value chain (see Figure 13) for core industry and support processes. Compared to peers, these leaders have implemented AI for more areas like forecasting and planning, materials sourcing, and finance and accounting.
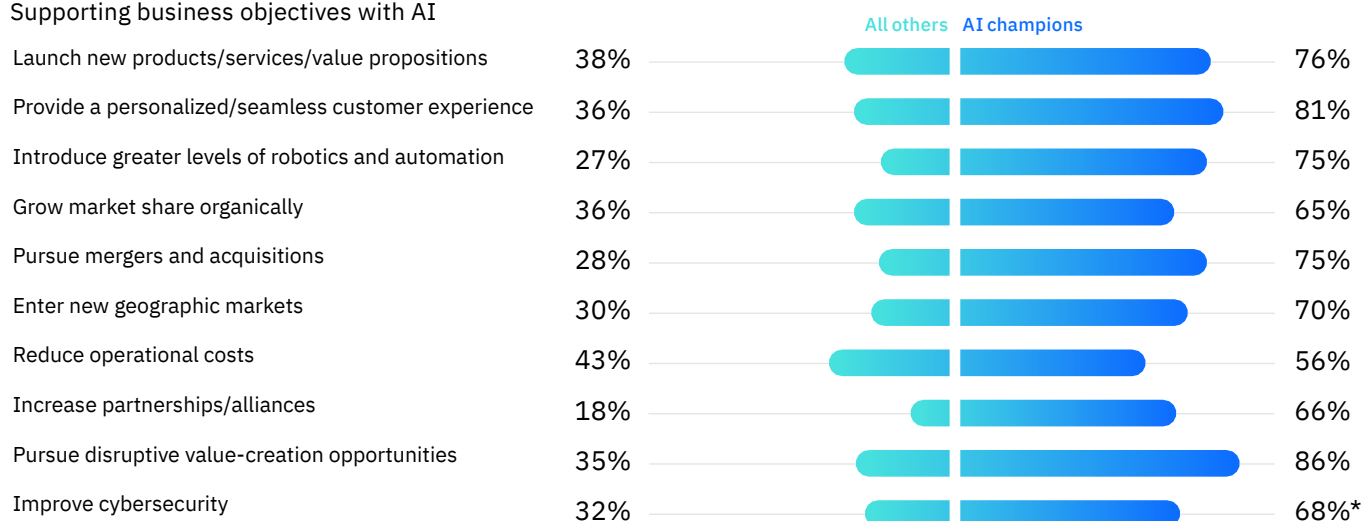
AI algorithms can assist with predicting demand, materials management and translate to reducing planning time, resources, and costs. For finance and accounting, AI can be leveraged to predict revenue or pricing and an AI-powered workflow-reconciliation module can aggregate sub-ledger transactions, perform risk-based reconciliations, and generate cognitive foresight for forecasting and scenario analysis.

AI champions have tapped the power of combined technologies. For example, they've added more cloud computing, IoT, and mobile to go along with their existing investments. Each of these areas contribute to increasing revenues, reducing costs, and managing risks.

AI is helping drive innovation, optimize chemicals processes, and improve resource management.

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Figure 12

Supporting business objectives with AI

	All others	AI champions
Launch new products/services/value propositions	38%	76%
Provide a personalized/seamless customer experience	36%	81%
Introduce greater levels of robotics and automation	27%	75%
Grow market share organically	36%	65%
Pursue mergers and acquisitions	28%	75%
Enter new geographic markets	30%	70%
Reduce operational costs	43%	56%
Increase partnerships/alliances	18%	66%
Pursue disruptive value-creation opportunities	35%	86%
Improve cybersecurity	32%	68%*

* Results using low counts are statistically unreliable but can be considered directional. Source: Q3. To what degree has your organization implemented AI to support the business objectives? n=400

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Figure 13

AI champions use exponential technologies across the industry activities

Area	Artificial intelligence	Cloud computing	Internet of Things	Mobile technologies	Robotic process automation
Research and development	87%				
Forecasting and planning	57%	55%			
Materials sourcing and acquisition	57%				
Order management		61%		52%	
Product manufacturing	64%		59%		62%
Inventory management and distribution		62%			
Marketing and sales		54%		68%	
Customer service		54%		63%	
Human resources		70%			
Finance and accounting	56%	55%	54%		51%
Risk management	69%		53%		
Health, safely and environment			48%	55%	

%	Areas that differ from all respondents

Source: Q6. Which technologies have you implemented in the following areas? n=87

AI champions' advantage with AI are showcased in the implementations for industry-specific areas that support R&D, manufacturing, and sales (see Figure 14). AI is helping them drive innovation, optimize chemicals processes, and improve resource management. For these leaders, there are still opportunities to improve as less than half are using AI for asset management and energy management.

To drive inorganic growth, AI champions are tapping the power of AI for mergers and acquisitions (M&A). Four in ten AI champions are using AI to identify M&A candidates versus 12 percent of their peers. When supported by AI, companies can consider a broader set of potential acquisitions.

Natural language processing (NLP), information discovery, and categorization services can be used to evaluate business news and companies' public remarks,

such as earnings calls. Then, sentiment analysis (such as word usage and speech patterns) can yield, in real time, a set of companies that align with M&A strategy guidelines and potential targets.[11]

Once the most promising target has been identified, 43 percent of AI champions have implemented AI to conduct due diligence compared to 13 percent of cohorts. This includes identification of strategic, operational, financial, compliance, IT, and cybersecurity risks.

The application of AI helps AI champions understand and mitigate value at risk. Better risk assessments help determine if a target's value is truly aligned with the acquirer's needs. These assessments steer pricing guidelines, deal terms, and structure.[12]

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Figure 14

Implementation of AI for industry-specific activities
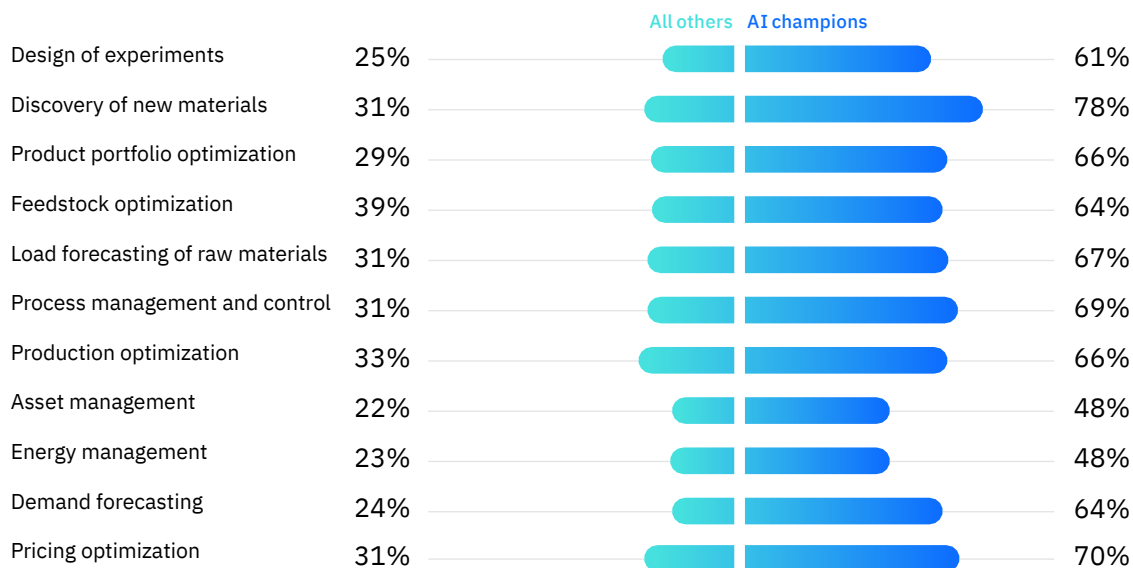
	All others	AI champions
Design of experiments	25%	61%
Discovery of new materials	31%	78%
Product portfolio optimization	29%	66%
Feedstock optimization	39%	64%
Load forecasting of raw materials	31%	67%
Process management and control	31%	69%
Production optimization	33%	66%
Asset management	22%	48%
Energy management	23%	48%
Demand forecasting	24%	64%
Pricing optimization	31%	70%

Source: Q7. To what degree has your organization implemented AI in industry-specific activities? Respondents selected either "We have made operational" or "We have fully implemented." n=398 to 400

Nearly half of AI champions have implemented AI to identify current skills and future skills gaps.

To support customer interactions and engagement, AI champions have implemented AI for marketing, sales, and service (see Figure 15)—two to three times more than their peers for these areas. AI allows these leaders to integrate external data so that marketers can identify prospects and understand customers at an individual level with scale.
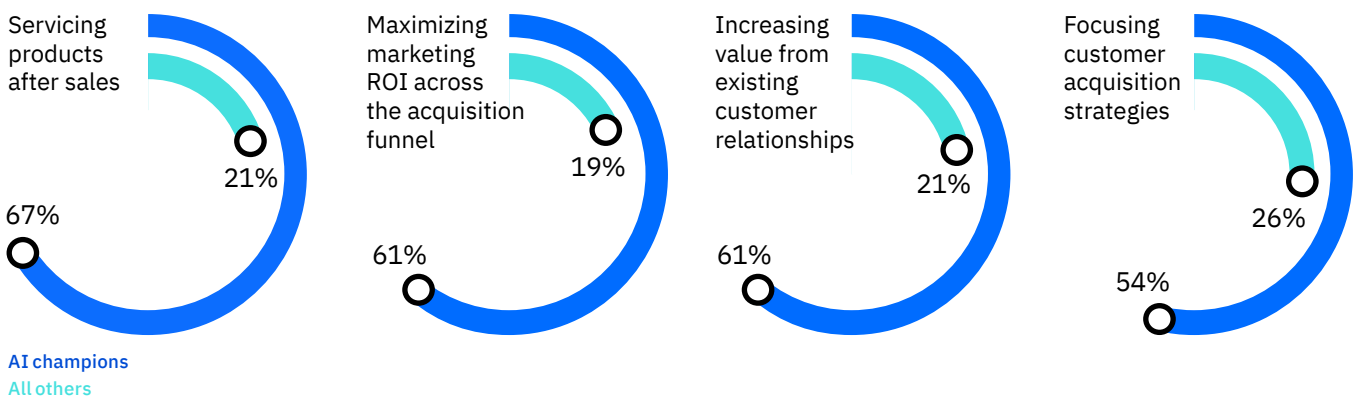
AI can provide deep knowledge discovery, helping sellers take the next best action. With respect to service, AI assistance can perform initial diagnostics and provide resolution recommendations.

Champions harness AI to help their organizations close skills-related gaps by personalizing at scale. AI can help enable personalization and bring meaningful employee experiences to life by understanding the current skills of every employee, knowing where the company and the individual want or need to progress, and personalizing a learning and career path.

Nearly half of AI champions have implemented AI to identify current skills and future skills gaps compared with a fifth of all others. And 45 percent of AI champions have installed AI to personalize learning versus 17 percent of their peers.

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Figure 15

Marketing, sales, and service with AI lead to valuable benefits

Servicing products after sales — 21% / 67%

Maximizing marketing ROI across the acquisition funnel — 19% / 61%

Increasing value from existing customer relationships — 21% / 61%

Focusing customer acquisition strategies — 26% / 54%

AI champions
All others

Source: Q8. [4,5,6,7] To what degree has your organization implemented AI in the following activities? Respondents selected either "We have made operational" or "We have fully implemented." n=400

AI champions recognize that managing knowledge across the organization is critical to being successful. Shared data on buyer behavior, customer profiles, competitive dynamics, and social sentiment can help teams analyze customers through multiple lenses, which helps them better design customer experiences.

Knowledge management and sharing reduces redundant learning activities and allows the exchange of ideas that can result in new products, services, and business models. Over half of AI champions tell us that they have implemented AI to manage knowledge, versus less than a fifth of all others.

AI is the cornerstone to support and track strategy execution for AI champions. In fact, 84 percent of these leaders have adopted AI for this purpose, as opposed to 35 percent of their peers. A company's strategy execution is guided by its KPIs. AI can help determine the outcomes that need to be measured, measurement of the outcomes, and prioritization of the outcomes. These KPIs create accountability for the execution of enterprise strategy.

Strategic KPIs optimized through AI provide analytically enhanced oversight.[13] Without AI to track strategy execution, lower-performing teams could spend 83 percent more time firefighting and dealing with tactical issues rather than strategic plays.[14]

Covestro: Leveraging AI for predictive maintenance[15]

Covestro is among the leading suppliers of premium polymers and operate in three segments: Polyurethanes, Polycarbonates, and Coatings, Adhesives Specialties.

The company conducted a pilot project for predictive, intelligent maintenance of systems leveraging machine learning and artificial intelligence in a production plant. Temperature and vibration sensors were installed in a large engine of the plant and transmitted data on the condition of the engine during operation to software. This information enabled the team to predict possible engine failure eight months in advance. The expansion of intelligent and integrated data management increased plant availability and made production processes more efficient. The company has now continued the project at its production site in Caojing, China.

Action guide

Optimizing the chemicals value chain with AI

AI champions have created the framework to drive AI across the business. To that end, chemicals companies should focus on:

Build a foundation for AI

– Establish commonality and enterprise data governance framework to create trust in data.

– Appoint a Chief Data Officer or business-driven information governance committee.

– Map your data assets—your data, its sources, and platforms—to each of your business goals and AI initiatives.

– Embrace the integration of information technology (IT) and operational technology (OT) domains, a necessity for AI-driven information and recommendation exchange.

– Implement central repositories to aggregate financial, operational, and external curated data.

– Expand AI opportunities and learnings by tapping into new data sources.

– Collaborate with IT to create a flexible data architecture to support accessibility to multiple data sources.

Accelerate the AI journey

– Develop an enterprise-wide AI strategy, with initiatives by value chain area, coordinated technology investments and necessary resources.

– Put in place a leadership team that understand the power of AI and empower the organization to seize new opportunities.

– Add skills in mathematical modeling and data visualization to see correlations and data relationships.

– Provide training and support to staff that will be executing the AI vision.

– Adopt agile principles, determine AI initiative outcomes with clarity and set milestones.

– Develop proactive change management associated with AI initiatives.

Catalyze the business with AI

– Expand horizons on what your enterprise's data can do by using AI to make sense of data in context, automate workflows, and humanize the customer experience.

– Apply exponential technologies across front office activities, with an emphasis on those most aligned to business objectives.

– Move AI into the hands of every employee who interacts with business partners and customers.

– Track strategy execution using AI.

About the authors

Dr. Viswanath Krishnan

linkedin.com/in/v-krishnan

viswanath.krishnan@ibm.com

Dr. Viswanath Krishnan is a global subject-matter expert and executive in the Chemicals and Petroleum industries within IBM. His core expertise is in manufacturing, operations, and supply chains within refineries, petrochemicals, and chemical installations. He focuses on leading development and delivery in AI, IoT, and blockchain solutions as part of the industry's Digital Reinvention®. He is a member of the IBM Industry Academy.

David Womack

linkedin.com/in/ david-womack-4b81454/

dmwomack@us.ibm.com

David Womack is Director, IBM Chemicals and Petroleum Global Strategy and Eminence. He is responsible for identifying new market and solution opportunities, managing the development of the industry-specific solution portfolio, implementing go-to-market plans for business growth, and leading alliances with key business partners associated with these strategies. He is a member of the IBM Industry Academy.

Spencer Lin

linkedin.com/in/spencer-lin-35896317/

spencer.lin@us.ibm.com

Spencer Lin is the Global Research Leader for Chemicals, Petroleum and Industrial Products for the IBM Institute for Business Value. He has more than 25 years of experience in financial management and strategy consulting.

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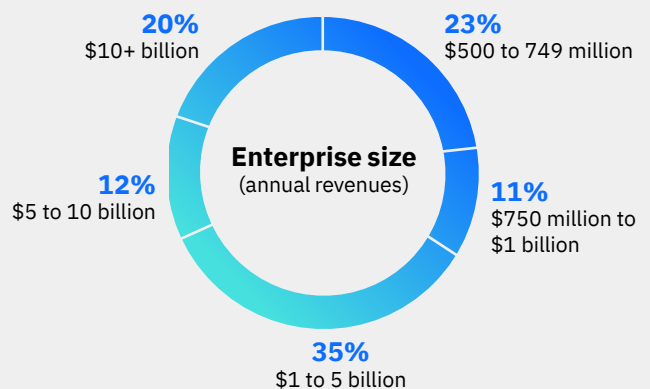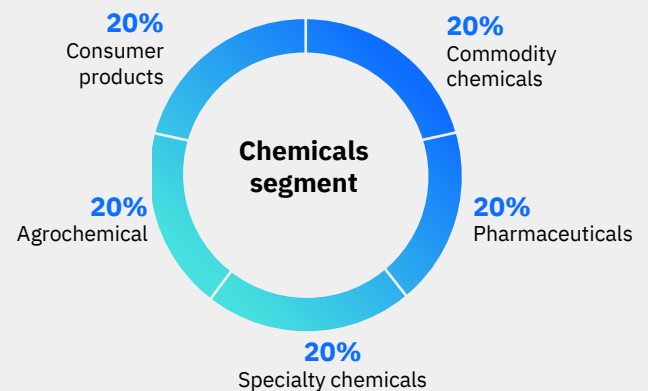
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Study approach and methodology

In cooperation with Oxford Economics, the IBV surveyed 400 chemicals executives in 18 countries from January to March 2020 (224 respondents) and from June to July 2020 (176 respondents). We collected responses from Chief Executive Officers, Heads of Strategy or Heads of Innovation, Chief Digital Officers, Chief Information Officers, Chief Operating Officers and Chief Transformation Officers. Participants come from companies located in the Asia Pacific, Europe, the Middle East, North America, and South America. The 400 chemicals executives come from different segments and from different sized organizations. All data is self-reported.

The 400 respondents come from different segments and sized enterprises.

Chemicals segment

- **20%** Consumer products
- **20%** Commodity chemicals
- **20%** Agrochemical
- **20%** Pharmaceuticals
- **20%** Specialty chemicals

Enterprise size (annual revenues)

- **20%** $10+ billion
- **23%** $500 to 749 million
- **12%** $5 to 10 billion
- **11%** $750 million to $1 billion
- **35%** $1 to 5 billion

Source: D2b. In which primary segment of the Chemicals industry does your organization compete?; D4. What is your organization's approximate annual revenue in USD? n=400

Related reports

Shift to enterprise-grade AI for chemicals and petroleum
https://www.ibm.com/thought-leadership/institute-business-value/report/chemicals-petroleum-ai

An innovative formula for the chemicals industry
https://www.ibm.com/thought-leadership/institute-business-value/report/chemicals-industry-innovation

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