Notes from the AI frontier:
AI adoption advances, but foundational barriers remain

Survey respondents report the rapid adoption of AI and expect only a minimal effect on head count. Yet few companies have in place the foundational building blocks that enable AI to generate value at scale.

Neil Webb

The adoption of artificial intelligence (AI) is rapidly taking hold across global business, according to a new McKinsey Global Survey on the topic.[1] AI, typically defined as the ability of a machine to perform cognitive functions associated with human minds (such as perceiving, reasoning, learning, and problem solving), includes a range of capabilities that enable AI to solve business problems. The survey asked about nine in particular,[2] and nearly half of respondents say their organizations have embedded at least one into their standard business processes, while another 30 percent report piloting the use of AI. Yet overall, the business world is just beginning to harness these technologies and their benefits. Most respondents whose companies have deployed AI in a specific function report achieving moderate or significant value from that use, but only 21 percent of respondents report embedding AI into multiple business units or functions. Indeed, many organizations still lack the foundational practices to create value from AI at scale—for example, mapping where their AI opportunities lie and having clear strategies for sourcing the data that AI requires.

One critical factor of using AI effectively, the results confirm, is an organization's progress on transforming the core parts of its business through digitization. At the most digitized firms,[3] respondents report higher rates of AI usage in more business functions than their peers, along with greater investment in AI and greater overall value from using AI. Another foundational challenge with AI is finding skilled people to implement it effectively. Many respondents say their organizations are addressing the issue by taking a diversified approach to sourcing talent. On the whole, despite reasonable concerns about AI being used to automate existing work, respondents tend to believe that AI will have only a minor effect on overall company head count in the coming years.

Adopting, deploying, and applying AI
How adoption of AI is progressing

The results suggest that most organizations have already begun to adopt AI in their businesses. Forty-seven percent of respondents say their companies have embedded at least one AI capability in their business processes—compared with 20 percent of respondents in a 2017 study who said their companies were using AI in a core part of their business or at scale[4]—and another 30 percent say they are piloting AI. Still, there remains a lot more potential to use AI across the enterprise; as our previous research has shown, AI opportunities exist in every sector and business function.[5] Just 21 percent of respondents say their organizations have embedded AI in several parts of the business, and so far, investments in AI are a relatively small fraction of companies' overall spending on digital technologies. A majority of respondents (58 percent) say less than one-tenth of their companies' digital budgets goes toward AI—though respondents overwhelmingly expect AI investments will increase in the coming years (71 percent say so).

Which AI capabilities have been deployed

Of the nine capabilities we asked about, robotic process automation, computer vision, and machine learning are most commonly deployed. For each of these, at least 20 percent of respondents say their companies have already embedded these technologies into their business processes. Physical robotics and autonomous vehicles are the least commonly deployed, largely because they are relevant only to companies in industries where there's a clear application; in those sectors, respondents report the outsize use of the capabilities. For example, half of respondents in automotive and assembly (compared with 16 percent of the total average) say physical robotics are embedded in at least one function or business unit.

Exhibit 1

AI seems to be gaining the most traction in the areas of the business that create the most value within a given industry.

Business functions in which AI has been adopted, by industry,[1] % of respondents

	Service operations	Product and/or service development	Marketing and sales	Supply-chain management	Manufacturing	Risk	Human resources	Strategy and corporate finance
Telecom	75	45	38	26	22	23	17	15
High tech	48	59	34	23	20	17	21	17
Financial services	49	26	33	7	6	40	9	14
Professional services	38	34	36	19	11	15	16	11
Electric power and natural gas	46	41	15	14	19	14	15	14
Healthcare systems and services	46	28	17	21	9	19	18	13
Automotive and assembly	27	39	15	11	49	2	8	6
Travel, transport, and logistics	51	34	32	18	4	4	2	3
Retail	23	13	52	38	7	9	8	0
Pharma and medical products	31	31	27	13	28	3	6	4

[1] This question was asked only of respondents who said their organizations have piloted or embedded at least 1 AI capability in 1 or more functions or business units. Respondents who answered "don't know" or "none of the above" are not shown. For telecom, n = 77; for high tech, n = 215; for financial services, n = 306; for professional services, n = 221; for electric power and natural gas, n = 54; for healthcare systems and services, n = 67; for automotive and assembly, n = 120; for travel, transport, and logistics, n = 55; for retail, n = 46; and for pharma and medical products, n = 65.

Where AI is being used

By sector, telecom, high-tech, and financial-services firms are leading the way in overall adoption. That said, looking across sectors and functions, the results suggest that companies are generally following the money when deploying AI, which seems to be gaining the most traction in the areas of the business that create the most value within a given industry (Exhibit 1). In retail, for example, the use of AI in marketing and sales processes is most common: 52 percent of retail respondents say they are using AI in marketing and sales, compared with 29 percent of all respondents.
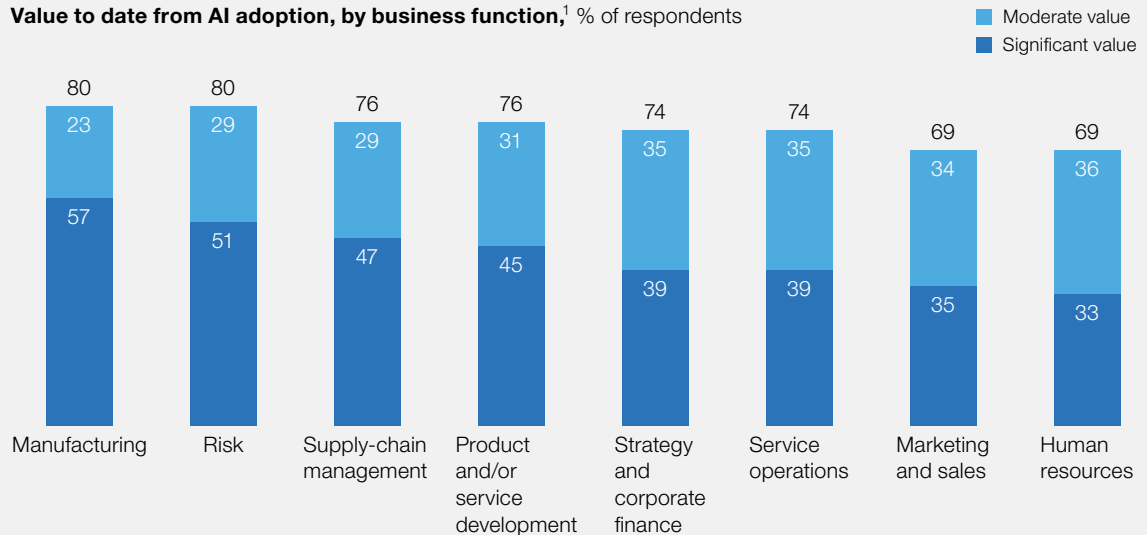
Where AI is creating value

And while the adoption of AI is still in its early days, the results suggest that it's already reaping meaningful rewards. When respondents were asked about the value captured in business functions where they have deployed AI, only 1 percent say they have seen no or negative value from that use—compared with 41 percent reporting significant value and 37 percent reporting moderate value.[6] Across business functions, respondents using AI in manufacturing and risk indicate they are seeing the greatest value (Exhibit 2). More than half of respondents report significant value from using AI in these processes, compared with 35 percent of respondents who report significant business value from using AI in marketing and sales.[7]

Exhibit 2   **Across functions, respondents report that the most significant benefits come from adopting AI in manufacturing and in risk.**

Value to date from AI adoption, by business function,[1] % of respondents

■ Moderate value
■ Significant value

Manufacturing	Risk	Supply-chain management	Product and/or service development	Strategy and corporate finance	Service operations	Marketing and sales	Human resources
80	80	76	76	74	74	69	69
23	29	29	31	35	35	34	36
57	51	47	45	39	39	35	33

[1] Respondents who answered "some value," "no value," or "don't know" are not shown. This question was asked only about the business functions where respondents say their organizations have deployed AI, and only includes responses from respondents who say their organizations have piloted or embedded AI in 1 or more functions or business units. For manufacturing, n = 272; for risk, n = 285; for supply-chain management, n = 299; for product and/or service development, n = 536; for strategy and corporate finance, n = 155; for service operations, n = 669; for marketing and sales, n = 482; and for human resources, n = 198.
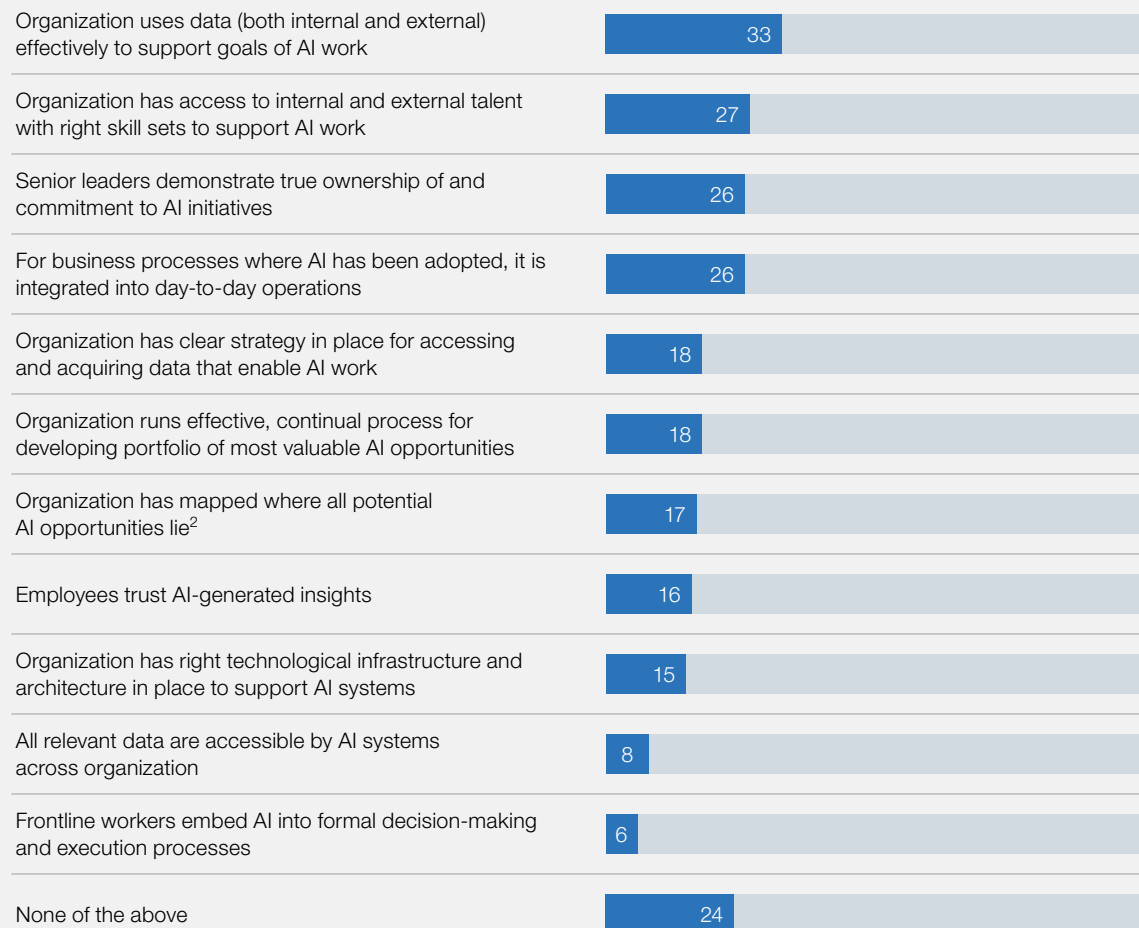
The enablers and challenges of AI

To take advantage of AI's enormous potential, the results confirm, most organizations have a long way to go in developing the core practices that enable them to realize the potential value at scale (Exhibit 3). Just 17 percent of respondents say their companies have mapped out where, across the organization, all potential AI opportunities lie. And only 18 percent say their companies have a clear strategy in place for sourcing the data that enable AI work. Indeed, nearly one-quarter of respondents say their companies have not developed any of the 11 practices we asked about.

Exhibit 3

Few organizations have adopted the core practices that would enable them to realize AI's potential value at scale.

Core AI practices in place at organizations,[1] % of respondents

Practice	%
Organization uses data (both internal and external) effectively to support goals of AI work	33
Organization has access to internal and external talent with right skill sets to support AI work	27
Senior leaders demonstrate true ownership of and commitment to AI initiatives	26
For business processes where AI has been adopted, it is integrated into day-to-day operations	26
Organization has clear strategy in place for accessing and acquiring data that enable AI work	18
Organization runs effective, continual process for developing portfolio of most valuable AI opportunities	18
Organization has mapped where all potential AI opportunities lie[2]	17
Employees trust AI-generated insights	16
Organization has right technological infrastructure and architecture in place to support AI systems	15
All relevant data are accessible by AI systems across organization	8
Frontline workers embed AI into formal decision-making and execution processes	6
None of the above	24

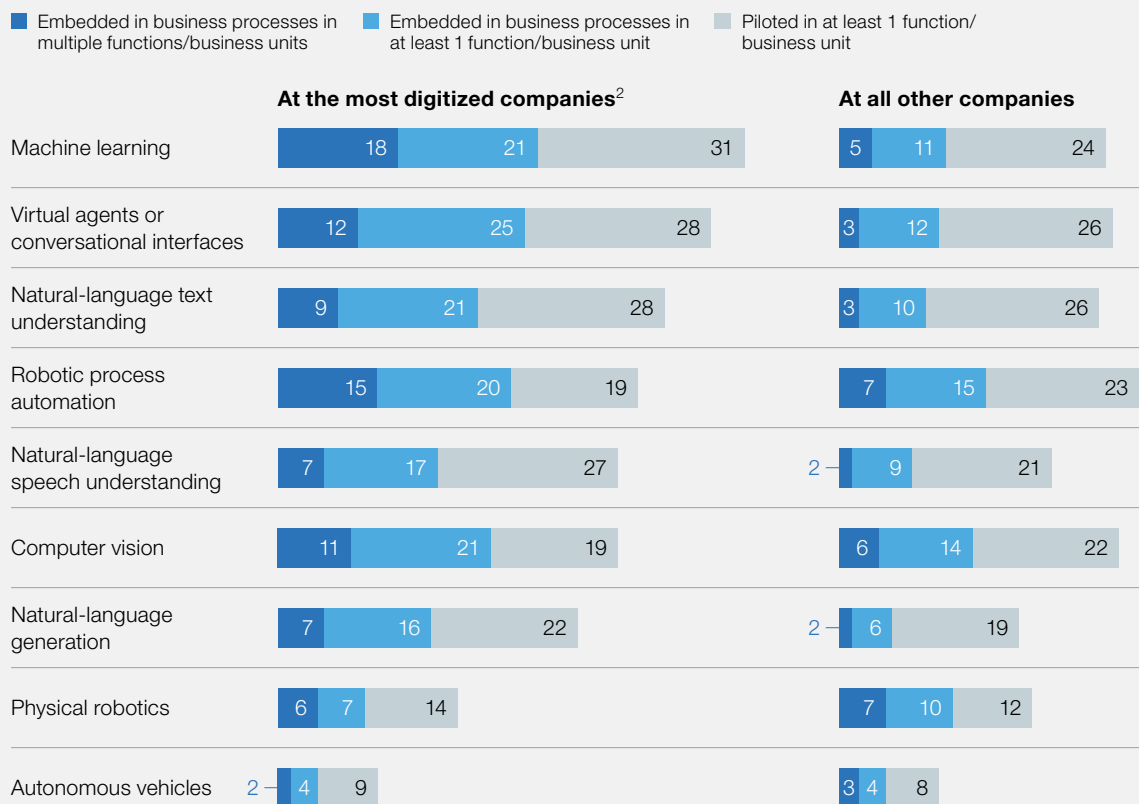[1] This question was asked only of respondents who said their organizations have piloted or embedded AI in 1 or more functions or business units, and they were asked to select all practices that are in place. Respondents who said "don't know" are not shown; n = 1,646.
[2] Including required level of investment, difficulty of implementation, and potential value at stake.

When asked about the biggest challenges to AI adoption, respondents indicate that the most common barrier is also strategy related. They most often cite a lack of a clear AI strategy (Exhibit 4), followed by a lack of appropriate talent, functional silos that constrain end-to-end AI solutions, and a lack of leaders who demonstrate ownership of and commitment to AI.

Exhibit 4

The most frequently cited barriers to AI adoption are a lack of a clear strategy, a lack of talent, and functional silos.

Most significant barriers organizations face in adopting AI,[1] % of respondents

Barrier	Value
Lack of clear strategy for AI	43
Lack of talent with appropriate skill sets for AI work	42
Functional silos constrain end-to-end AI solutions	30
Lack of leaders' ownership of and commitment to AI	27
Lack of technological infrastructure to support AI	25
Lack of available (ie, collected) data	24
Uncertain or low expectations for return on AI investments	24
Underresourcing for AI in line organization	21
Limited usefulness of data[2]	20
Personal judgment overrides AI-based decision making	19
Limited relevance of insights from AI	18
Lack of changes to frontline processes after AI's adoption	12

[1] This question was asked only of respondents who said their organizations have piloted or embedded AI in 1 or more functions or business units. Respondents who said "other" or "don't know/not applicable" are not shown; n = 1,646.
[2] That is, not accessible to or compatible with AI systems.

One critical enabler of AI is a company's progress on its digitization journey. The organizations that have made the most progress in digitizing core business processes are also on the leading edge of AI adoption. At the most digitized firms, 67 percent of respondents say their organizations have embedded AI into standard business processes, compared with 43 percent at all other companies. They are most likely to have adopted machine learning, for example: 39 percent say it is embedded in their processes, compared with 16 percent at all other companies (Exhibit 5).

Exhibit 5

Respondents at the most digitized organizations report greater adoption of AI capabilities than their peers at other companies.

Organizations' adoption of AI capabilities,[1] % of respondents

■ Embedded in business processes in multiple functions/business units ■ Embedded in business processes in at least 1 function/business unit ■ Piloted in at least 1 function/business unit

	At the most digitized companies[2]			At all other companies		
Machine learning	18	21	31	5	11	24
Virtual agents or conversational interfaces	12	25	28	3	12	26
Natural-language text understanding	9	21	28	3	10	26
Robotic process automation	15	20	19	7	15	23
Natural-language speech understanding	7	17	27	2 / 9		21
Computer vision	11	21	19	6	14	22
Natural-language generation	7	16	22	2 / 6		19
Physical robotics	6	7	14	7	10	12
Autonomous vehicles	2 / 4	9		3 / 4	8	

[1] That is, AI products and/or services, including software. Respondents who answered "not at all" or "don't know" are not shown. At the most digitized companies, n = 330; at all other companies, n = 1,798.
[2] Respondents who say their companies have an average level of digitization of 51% or more. Level of digitization is based on the average percentage of the following measures: percentage of the share of sales that come from products and/or services sold through digital channels; of core products and/or services that are digital in nature; of core operations that are automated and/or digitized; and of supply-chain volume that is digitized or moves through digital interactions with suppliers.

The most digitized organizations have also deployed AI in more functions than other companies, though both groups say AI is most commonly used in service operations and in product development. These companies are also investing much more in AI: 19 percent at the most digitized companies say more than one-fifth of their overall digitization spending goes toward AI, while just 8 percent of other respondents say the same. On average, 52 percent of respondents at these firms report significant value from using AI, compared with 38 percent of all others.

And while several of the barriers to AI adoption that we asked about are much less pressing for digitized companies (only 27 percent cite a lack of AI strategy, compared with 46 percent of all others), respondents at these companies are just as likely as their peers to say it's hard to find the right talent for AI. In fact, talent is the biggest challenge for the most digitized organizations, cited by 41 percent of those respondents.

What of the workforce?

AI raises two major questions about companies' workforces: Where will we find the knowledgeable talent to deploy AI? And to what degree will AI's ability to automate activities that we pay workers to do affect the size of the workforce?

With talent being one of the biggest challenges to AI, no matter how advanced a company's digital program, it's perhaps not surprising that companies are leaving no stone unturned when sourcing people and skills. Most commonly, respondents say their organizations are taking an "all of the above" approach: hiring external talent, building capabilities in-house, and buying or licensing capabilities from large technology firms. Across industries, even the ones leading the way in AI adoption (that is, those in telecom, high tech, and financial services) report a mix of internal and external sourcing—though they are more focused than others on developing their own AI capabilities. Respondents in these sectors are more likely than average to say they're building in-house AI capabilities, which requires internal talent with the right skills. In high tech and financial services, respondents are also much likelier to report retraining or upskilling. The same is true of the most digitized companies: respondents are more likely than others to report in-house development of AI capabilities and retraining or upskilling of current employees (Exhibit 6).
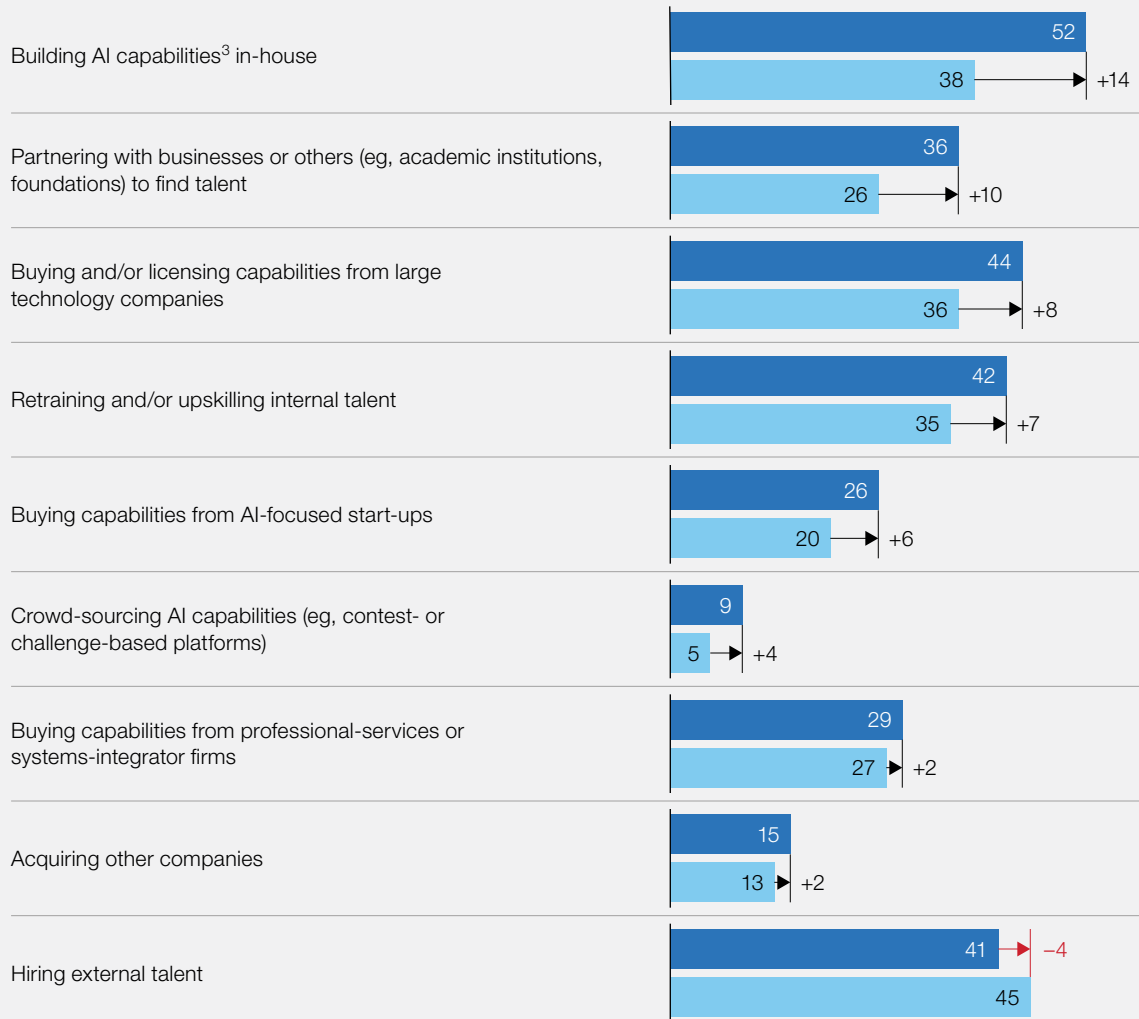
At the same time, the most digitized companies have done more than others to automate human labor via AI. By function, respondents report that their processes for customer service, IT, and service operations are most commonly automated—and the digitized companies are further along than their peers in automating all three. Yet respondents at these organizations, and overall, tend to expect that AI's future effects on total head count will be minor or positive. A plurality of respondents say that, three years from now, AI won't really affect the number of employees at their companies. Among the most digitized companies, respondents are more likely to expect head count will increase than decrease. They are also more optimistic than others that their workforces will grow: 31 percent say so, compared with 18 percent of their peers. These results, along with those from other McKinsey research,[8] suggest that AI's biggest effect on the workforce could be changes in the work that people do, particularly ever-greater collaboration between machines and people, rather than overall workforce reductions.

Exhibit 6

At the most digitized companies, respondents are more likely to say AI capabilities are built in-house and employees are retrained.

How organizations source capabilities and talent needed for AI work,[1]
% of respondents and percentage-point difference

■ At the most digitized companies[2]
■ At all other companies

Building AI capabilities[3] in-house	52 / 38 +14
Partnering with businesses or others (eg, academic institutions, foundations) to find talent	36 / 26 +10
Buying and/or licensing capabilities from large technology companies	44 / 36 +8
Retraining and/or upskilling internal talent	42 / 35 +7
Buying capabilities from AI-focused start-ups	26 / 20 +6
Crowd-sourcing AI capabilities (eg, contest- or challenge-based platforms)	9 / 5 +4
Buying capabilities from professional-services or systems-integrator firms	29 / 27 +2
Acquiring other companies	15 / 13 +2
Hiring external talent	41 / 45 −4

[1] This question was asked only of respondents who said their organizations have piloted or embedded AI in 1 or more functions or business units. Respondents who said "don't know" are not shown. At most digitized companies, n = 293; all other companies, n= 1,347.
[2] Respondents who say their companies have an average level of digitization of 51% or more. Level of digitization is based on the average percentage of the following measures: percentage of the share of sales that come from products and/or services sold through digital channels; of core products and/or services that are digital in nature; of core operations that are automated and/or digitized; and of supply-chain volume that is digitized or moves through digital interactions with suppliers.
[3] That is, AI products and/or services, including software.

Looking ahead

The survey results suggest that digitization and certain foundational practices are critical to creating value from AI at scale. Here are several steps companies can take to capitalize on AI's potential:

- *Make progress on your digital journey.* The results confirm that digitization is a prerequisite and critical enabler for deriving value from AI. The implications of continuing digitization are significant; for many companies, they involve transformation-level changes to the very business processes at the core of the enterprise and new ways in which people will work. But without a strong digital backbone, a company's AI systems will lack the training data necessary to build better models and the ability to transform superior AI insights into behavioral changes at scale.

- *Scale AI's impact across the enterprise.* While most companies have already deployed AI to some extent, few have embedded it into standard operating processes in multiple business units or functions, and about one-third are only piloting the use of AI. While AI is still in its early days, getting stuck in "pilot purgatory" is a real risk.[9] Achieving results at scale requires not only the diffusion of these capabilities across the enterprise but also a real understanding and commitment on the part of leaders to drive large-scale change, as well as a focus on change management rather than on technology alone.

- *Put key enablers in place.* While the adoption of AI is happening fast, the survey suggests that organizations tend to lack many of the foundational enablers required to derive value from AI at scale. These enablers include top-management sponsorship, development of an enterprise-wide portfolio view of AI opportunities, action to close talent gaps, and the implementation of a sophisticated data strategy—all of which require more strategic thinking around AI programs and agendas. Business and technology leaders must work quickly to establish key AI enablers. Otherwise, they risk missing out on the current—and future—AI opportunity. ◼

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[1] The online survey was in the field from February 6 to February 16, 2018, and garnered responses from 2,135 participants representing the full range of regions, industries, company sizes, functional specialties, and tenures. To adjust for differences in response rates, the data are weighted by the contribution of each respondent's nation to global GDP.

[2] The nine capabilities are natural-language text understanding, natural-language speech understanding, natural-language generation, virtual agents or conversational interfaces, computer vision, machine learning, physical robotics, autonomous vehicles, and robotic process automation (RPA). Some would argue that RPA should not be classified as AI in and of itself, but in our experience, RPA systems are increasingly incorporating AI capabilities.

[3] We define the most digitized firms as those that, according to respondents, have an average level of digitization of 51 percent or more. The level of digitization is based on the average percentage of the following measures: the share of sales that come from products and/or services sold through digital channels; of core products and/or services that are digital in nature (for example, virtualized or digitally enhanced); of core operations that are automated and/or digitized; and of supply-chain volume that is digitized or moves through digital interactions with suppliers.

[4] Based on a 2017 survey of C-level executives at 3,073 companies, in 14 sectors of the economy and 10 countries across Asia, Europe, and North America. These respondents were asked about their companies' adoption of AI technologies differently from in our newer survey: specifically, whether the company was exploring it through research, pilots, or proof-of-concept demonstrations; whether the company was currently using the technology, but not in a core part of the business or at scale; and whether the technology was used in a core part of the business and/or at scale. The latter option is most comparable with two of the 2018 survey options: embedded in standard business processes in at least one function or business unit, and embedded in processes across multiple functions or business units. For more on the earlier survey results, see "Artificial intelligence: The next digital frontier?," McKinsey Global Institute, June 2017, on McKinsey.com.

[5] For more, see "Notes from the AI frontier: Applications and value of deep learning," McKinsey Global Institute, April 2018, on McKinsey.com.

[6] The question of how much value the organization has seen from using AI in different functions was asked only of the functions where respondents said their organizations have already deployed AI.

[7] In our view, it's possible that because the deployment of other analytics technologies is relatively common in marketing and sales work, the incremental performance improvement from AI techniques might be lower than in other functions where the use of analytics is less mature.

[8] For more, see "Harnessing automation for a future that works," McKinsey Global Institute, January 2017, on McKinsey.com; "Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages," McKinsey Global Institute, November 2017, on McKinsey.com; and "Skill shift: Automation and the future of the workforce," McKinsey Global Institute, May 2018, on McKinsey.com.

[9] For more, see Oliver Fleming, Tim Fountaine, Nicolaus Henke, and Tamim Saleh, "Ten red flags signaling your analytics program will fail," May 2018, McKinsey.com.

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