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A report from the Deloitte Center for Technology, Media & Telecommunications

Talent and workforce effects in the age of AI

Insights from Deloitte's State of AI in the Enterprise, 2nd Edition survey

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Introduction

Over the past few years, artificial intelligence has matured into a collection of powerful technologies that are delivering competitive advantage to businesses across industries. Global AI adoption and investment are soaring. By one account, 37 percent of organizations have deployed AI solutions—up 270 percent from four years ago.[1] Analysts forecast global AI spending will more than double over the next three years, topping US$79 billion by 2022.[2]

COMPANIES AND COUNTRIES around the globe increasingly view development of strong AI capabilities as imperative to staying competitive. Deloitte's State of AI in the Enterprise, 2nd Edition offers a global perspective of AI early adopters, based on surveying 1,900 IT and business executives from seven countries and a variety of industries.[3] These adopters are increasing their spending on AI technologies and realizing positive returns. Almost two-thirds (65 percent) report that AI technologies are enabling their organizations to move ahead of the competition. Sixty-three percent of the leaders surveyed already view AI as "very" or "critically" important to their business success, and that number is expected to grow to 81 percent within two years.

These leaders see AI rapidly transforming their businesses and industries. Fifty-seven percent predict that AI will "substantially transform" their company within the next three years; two-thirds believe that their industry's transformation will happen within five years. As AI drives these transformations, it is changing how work gets done in organizations by making operations more efficient, supporting better decision-making, and freeing up workers from certain tasks. The nature

of job roles, and the skills that are most needed, are evolving.

Indeed, the effect AI will ultimately have on jobs is uncertain: Are we staring at a dim future in which AI-driven automation has made most jobs obsolete, or is AI ushering in a new age characterized by humans working in collaboration with the technologies—augmented by AI capabilities rather than displaced by them?[4] Early indicators support the optimistic view: While AI adopters express concern about automation as an ethical risk, they emphatically believe that human workers and AI will augment each other, changing the nature of work for the better.

The changing nature of work

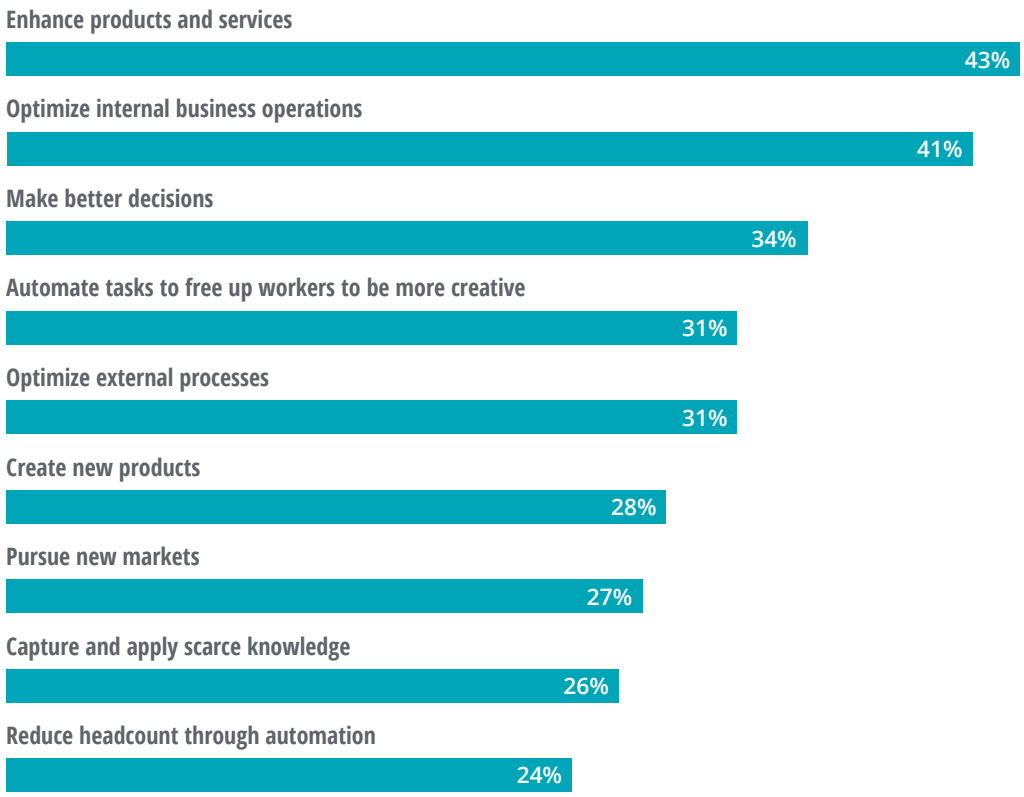
AS AI ADOPTION advances, the way organizations do their work is evolving. Seventy-one percent of adopters report that AI technologies have already changed their company's job roles and necessary skills, and 82 percent believe AI will lead to moderate or substantial changes to job roles and skills over the next three years.

For AI adopters, improving internal business operations is a benefit on par with enhancing products and services (figure 1). TiVo, for example,

FIGURE 1

AI benefits include improving operations and decision-making, as well as freeing up workers to concentrate on less-mundane tasks

Rating each a top-three primary benefit of AI technology for their company



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

streamlines IT operations by using a machine learning[5] platform to automatically detect, classify, aggregate, and route IT incidents.[6] The AI-aided process has reduced actionable events from about 2,500 to 150 daily, enabling the professionals in TiVo's network operations center to more easily manage highly complex operations, 24/7.

"Beyond automating tasks, the other more remarkable impact of AI on an enterprise will be on decision-making: Large organizations still struggle to make good decisions on time."

— ***Jay Dwivedi, president, xInvest Consultants***

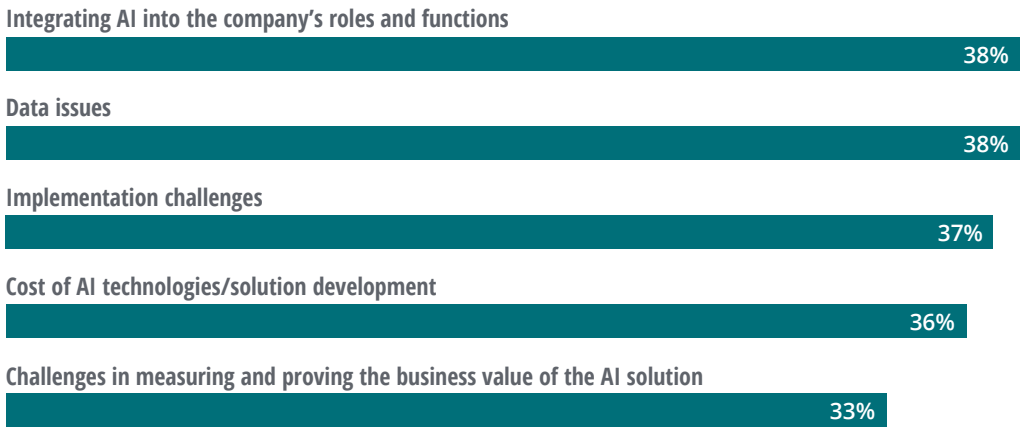
The third AI benefit—making better decisions—also has implications for the nature of work. For example, researchers from MIT have developed a machine learning model designed to help ER physicians determine the optimal time to switch patients suffering from sepsis from one treatment protocol to another—often a challenging decision for clinicians.[7] Trained on historic health data from sepsis patients, the model predicts whether a patient will need vasopressor medications within the next few hours. In a clinical setting, the model could be integrated into a bedside monitor, alerting clinicians ahead of time when a treatment change may be warranted—an example of human experts and AI achieving better decisions together.

Another top benefit of AI involves automating tasks to free up workers to be more creative. Salesforce's Einstein Voice Assistant—a voice-based AI assistant for interacting with Salesforce CRM software—illustrates this benefit: Sales reps and other field workers speak conversationally to the assistant, which transcribes notes, automatically associates them with relevant accounts and contacts, and makes recommendations for follow-up tasks.[8] Workers are freed from mundane data entry tasks and can

FIGURE 2

Integrating AI into a company's operations is a challenge on par with issues around building and deploying AI systems

Respondents ranking each a top-three challenge for their AI initiatives



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

instead concentrate their efforts on their customer interactions.

Changing how work gets done within the organization—by making operations more efficient, supporting better decision-making, and freeing up workers from repetitive tasks—is core to what companies want to achieve with AI. Few anticipate it being easy, though: "Integrating AI into the company's roles and functions" is tied for first place as a challenge for AI initiatives—on par with challenges related to building and deploying AI (figure 2). Moreover, only 38 percent of executives reported their organization has "high expertise" in integrating AI into their business processes, and just 37 percent reported "high expertise" in integrating AI into their IT environments.

Minding the AI skills gap

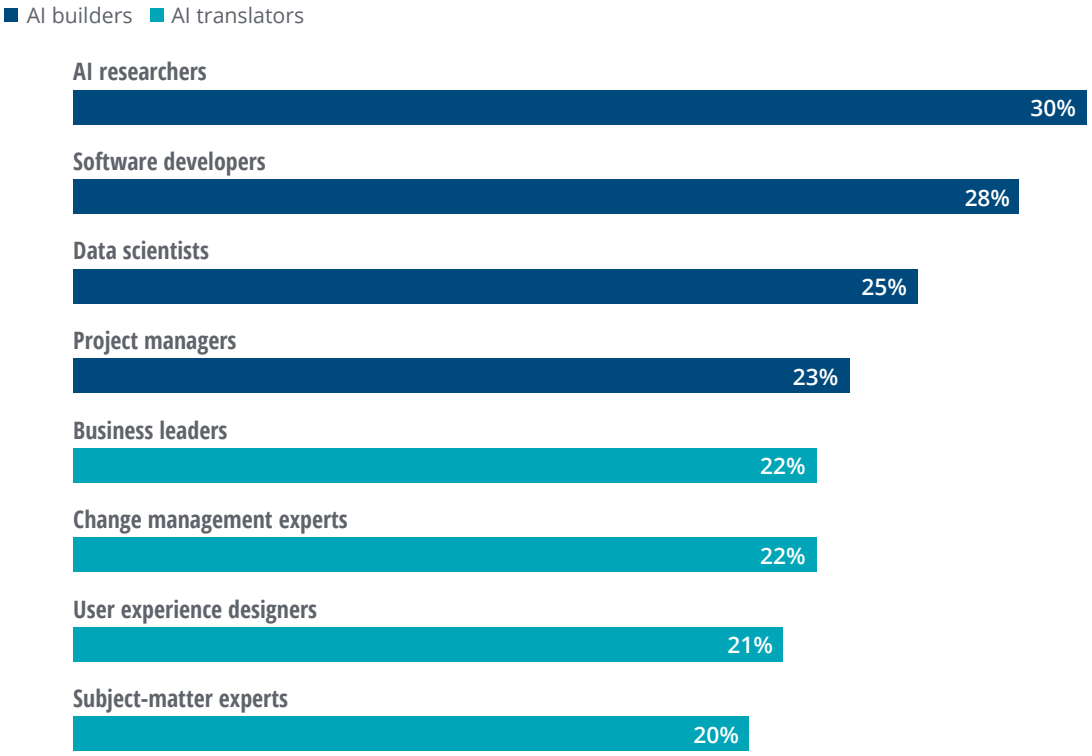
TO MEET THEIR AI aspirations, companies will likely need the right mix of talent to translate business needs into solution requirements, build and deploy AI systems, integrate AI into processes, and interpret results. However, most early adopters face an AI skills gap and are looking for expertise to boost their capabilities. In fact, 68 percent of executives surveyed report a moderate-to-extreme skills gap, and more than a quarter (27 percent) rate their skills gap as "major" or "extreme." The gap is evident across all countries surveyed, ranging from 51 percent reporting moderate-to-extreme gaps in China to 73 percent reporting the same in the United Kingdom.

What do leaders regard as the "most needed" roles to fill their company's AI skills gap? The top four most-needed roles are "AI builders," who are instrumental in creating AI solutions: researchers

FIGURE 3

As companies strive to fill their AI skills gap, "AI builders" are the most sought-after professionals

Respondents rating each a top-two needed skill to fill their company's AI skills gap



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

to invent new kinds of AI algorithms and systems, software developers to architect and code AI systems, data scientists to analyze and extract meaningful insights from data, and project managers to ensure that AI projects are executed according to plan (figure 3). Beyond these AI builders, adopters are seeking "AI translators" who bridge the divide between the business and technical staff—both at the front and back ends of building AI solutions:

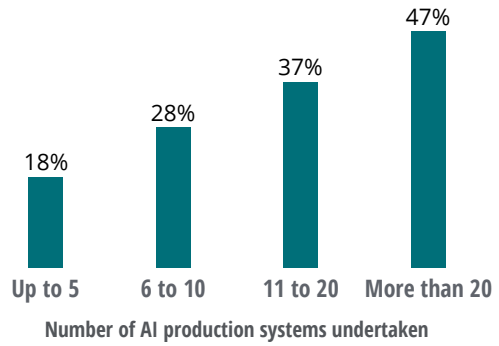
- Business leaders to translate business problems/needs into requirements that guide the building of a solution, and to interpret results from an AI system and make decisions
- Change management experts to implement change strategies and help integrate AI into the organization's processes
- User experience designers to make AI systems easier to navigate
- Subject-matter experts to infuse their domain expertise into AI systems

As adopters gain experience building AI production systems, they amass and hone AI skills. Yet companies with greater AI experience report a *larger* skills gap (figure 4). Within organizations, the supply of AI skills appears unable to keep up with growing demand.

FIGURE 4

Companies with greater experience building AI systems also report a larger AI skills gap

Adopters reporting major-to-extreme AI skills gap



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

As AI experience increases within an organization, the kinds of roles that adopters seek undergo an interesting shift. For companies with relatively little AI experience (they've built five or fewer production systems), AI researchers are the most sought-after, with about a third of surveyed executives rating them as a top-two needed role (figure 5). Business leaders rank near the bottom. By the time adopters have become highly experienced at building AI solutions (they've built 20 or more production systems), however, business leaders have bubbled to the top, and AI researchers have sunk almost to the bottom.

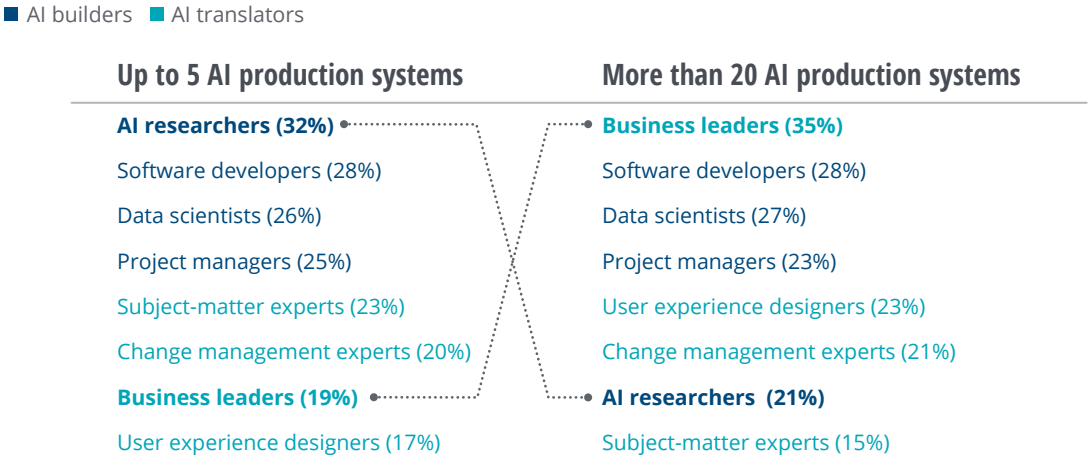
"I'm in favor of education of senior management before establishing technical centers of excellence. Business needs to lead the charge, and leaders need to believe in order to drive the organization forward expeditiously."

— ***Jack C. Crawford, managing partner, Datalog.ai***

FIGURE 5

As companies gain experience building AI systems, skill needs shift from a focus on "AI researchers" to a desire for "business leaders"

Respondents rating each a top-two needed skill to fill their company's AI skills gap



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

What to make of this curious flip? Many companies embarking on AI initiatives may feel they need to hire AI superstars—researchers with advanced degrees who can invent new AI algorithms and techniques—to spearhead their efforts.[9] And by the time organizations have accumulated substantial AI experience, they may have filled their ranks with enough of these brilliant technology experts. At that stage, companies have shifted to seeking business leaders who can play the crucial "translator" role: figuring out what results from AI systems *mean*, and how those results should factor into business decisions and actions.

Many companies embarking on AI initiatives may feel they need to hire AI superstars.

Is it possible that the less-experienced AI adopters are placing *too much* emphasis on finding AI researchers, who are scarce and in such high demand that they command lavish salaries?[10] These heavyweights are certainly called for when one needs to invent new AI algorithms and techniques or create highly customized, domain-specific solutions.[11] But not all companies will need to push these boundaries, and many can turn to an array of AI tools that can be used by software developers without deep AI expertise, such as machine learning application program interfaces (APIs), cloud-based AI services and AI development platforms, pretrained machine learning models, and even automated machine learning (AutoML).[12] It's worth noting (figure 5) that demand for software developers, data scientists, and project managers—the crucial professionals who can plan, architect, and build AI projects, and make use of existing AI tools and techniques to bring a project from concept to

production—doesn't wane as adopters gain more experience building AI solutions.

It's also possible that less-experienced AI adopters may be focusing *too little* on business leaders who are able to understand not only their organization's business strategy but the ways in which AI initiatives can support and accelerate it. In an article headlined, "The AI roles some companies forget to fill," the authors underscore the importance of involving business leaders early in the process: "Many companies rush into the AI race without clear objectives, hope a brilliant AI researcher and a technology team can create something great without guidance, and end up with little to show for it. Recruiting an AI quarterback to provide the business input, and ensuring success with well-defined metrics, is the most important job that most companies miss."[13]

Filling the AI skills gap

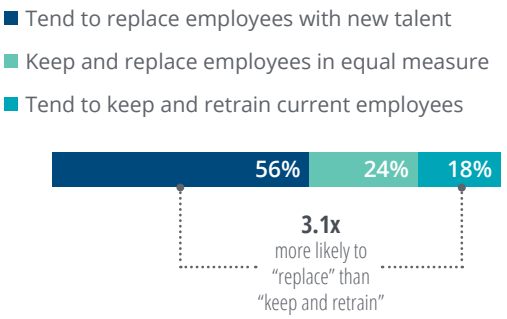
Replace versus retrain

HOW ARE AI adopters attempting to fill their skills gap? Executives revealed a strong inclination to bring in new talent to plug the gap (figure 6). In fact, leaders are 3.1 times more likely to prefer replacing employees with new AI-ready talent, versus keeping and retraining their existing workforce.

Respondents in all countries surveyed lean toward bringing in new talent (figure 7). At one extreme, AI adopters in Canada are 6.2 times more likely to favor replacing over retraining. At the other end, Germany is just 1.7 times more likely to favor replacing employees—perhaps partially due to that country's labor laws, which place stringent requirements around employee dismissals.[14] Notably, there appears to be no correlation between the size of the AI skills gap in a particular country and the preferred approach for addressing it.

FIGURE 6

AI adopters prefer hiring new AI-ready talent to keeping and retraining current workers



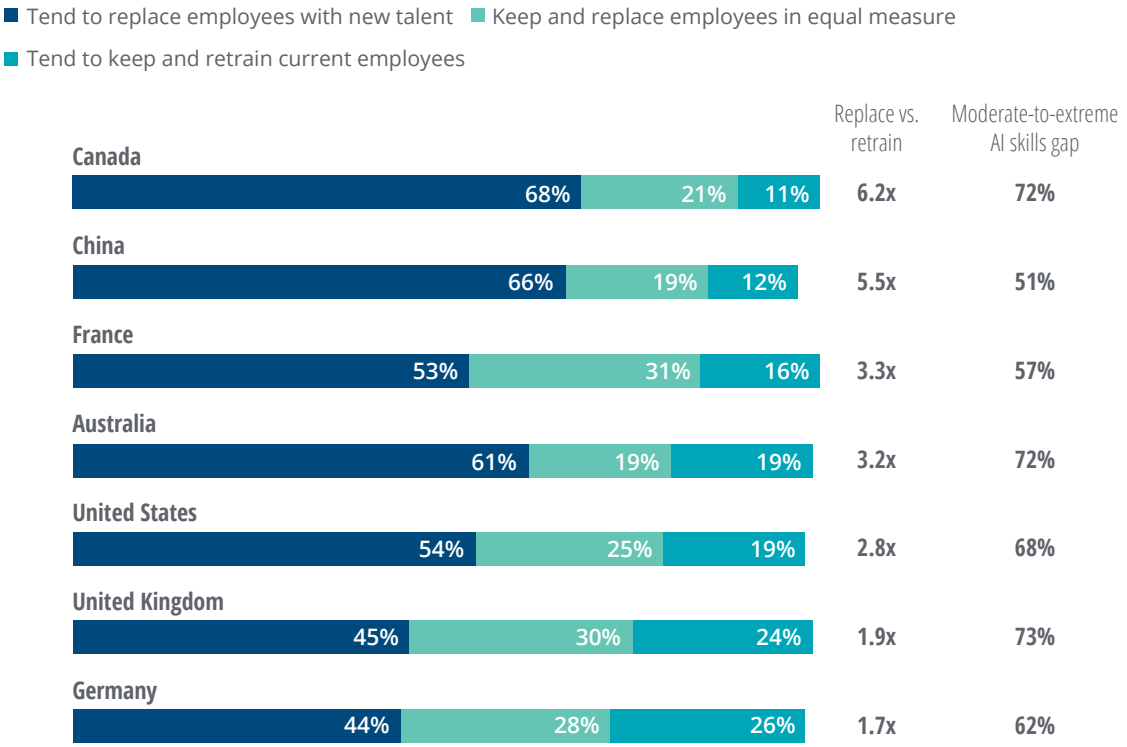
Note: Percentages do not total 100 percent due to a small number of respondents who answered "Don't know."
Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

The desire to replace workers with new, AI-ready talent is clear, but is it a viable strategy at a time when there's fierce competition for expertise? Reports reveal a scarcity of AI talent around the world. Canadian firm Element AI recently analyzed LinkedIn profiles to gauge the size of the worldwide top-tier AI talent pool and counted 36,524 self-reported PhD-level AI experts (including data scientists and machine learning researchers and engineers).[15] We've already noted that not all AI adopters need to hire AI researchers, but for those that do, that's a tiny global pool to fight over. A 2017 report from Chinese tech titan Tencent cast a wider net with looser criteria and estimated that "AI researchers and practitioners" number 300,000 worldwide (200,000 employed, plus 100,000 students in the pipeline).[16] These two reports provide some useful bookend estimates for the global AI talent pool.

At the same time, trends on job search sites indicate strong demand for AI talent.[17] A LinkedIn search for AI-based jobs yields more than 64,000 US openings and over 230,000 worldwide openings.[18] It's hardly surprising, then, that competition for AI-trained professionals is vigorous. Glassdoor chief economist Andrew Chamberlain reports that "the supply of people moving into this field is way below demand."[19] Employers report difficulty filling AI job openings, and some say it's impeding their growth.[20] Articles abound about talent wars for techies such as AI

FIGURE 7

Across surveyed countries, AI adopters consistently prefer hiring new talent to address their AI skills gap



Note: Percentages may not total 100 percent due to a small number of respondents who answered "Don't know."
Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

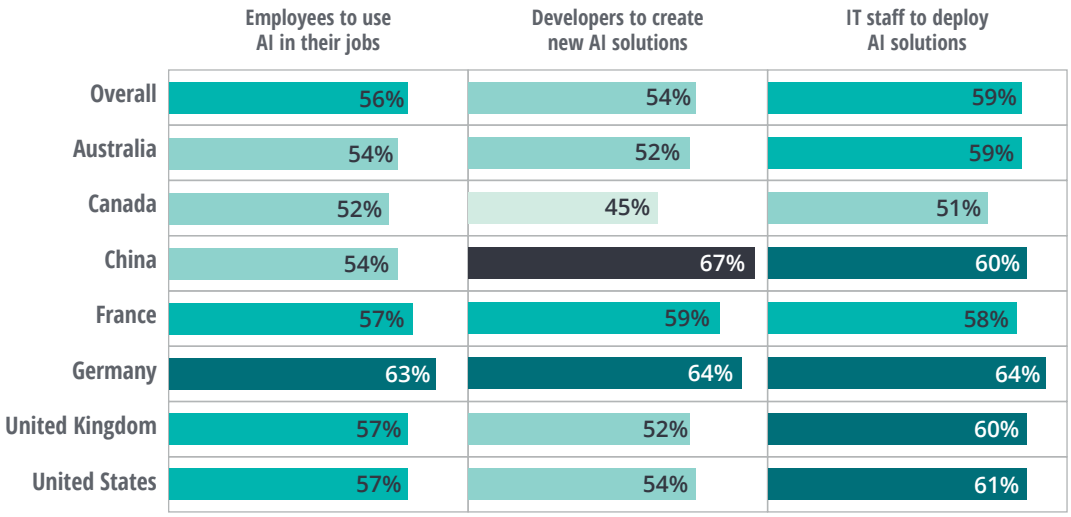
researchers and data scientists (aka "America's hottest job").[21]

Companies may believe that seeking the best external talent will provide an advantage, but they shouldn't overlook the option of training their existing employees. Indeed, notwithstanding their desire to replace workers, AI adopters also report training their current workforces to strengthen expertise and narrow their skills gap. The majority are training developers to create AI solutions, IT staff to deploy those solutions, and employees to use AI in their jobs (figure 8). Companies in Germany appear to be outpacing other countries with their keen focus on training.

FIGURE 8

Companies are focused on training for a world in which humans work side by side with AI

Conducting training for ...



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

Redesigning jobs

Automation and augmentation

THERE'S VIGOROUS DEBATE around the ultimate effect of AI on jobs. Pessimists foresee workers being largely supplanted by robots and automation, and facing a dim future with people competing for the few remaining jobs that require human skills. Optimists believe that AI technologies—like other new technologies before them—will produce more jobs than they eliminate and give rise to new roles that call for new skills and different ways of working.[22]

According to a 2018 World Economic Forum report on the future of jobs, companies expect work tasks to be increasingly performed by machines. In 2018, people carried out an estimated 71 percent of task hours; by 2022, the human share is expected to drop to 58 percent, with machines handling the remaining 42 percent. Despite this sobering finding, the report presents a positive global forecast: While technology advances are expected to displace as many as 75 million existing jobs, emerging tasks and roles are projected to generate upward of 130 million jobs.[23] The report cautions that achieving the predicted net job gains will "entail difficult transitions for millions of workers and the need for proactive investment in developing a new surge of agile learners and skilled talent globally … [I]t is critical that businesses take an active role in supporting their existing workforces through reskilling and upskilling, that individuals take a proactive approach to their own lifelong learning and that governments create an enabling environment, rapidly and creatively, to assist in these efforts."

AI-driven automation is already taking over routine, repetitive tasks in many industries, and may even be used for complex, specialized efforts that were once the bailiwick of highly trained humans, such as radiology and pathology.[24] MIT and CMU researchers—taking the perspective that occupations are collections of tasks—have analyzed nearly 1,000 occupations and more than 18,000 work tasks and assigned each a "suitability for machine learning" (SML) score.[25] Across industries, they concluded that most occupations have at least some tasks that are SML but that there are few, if any, occupations for which *all* tasks are SML. They propose shifting the debate away from a focus on full job automation and "pervasive occupational replacement" and toward the "redesign of jobs and reengineering of business processes."

Deloitte researchers propose reimagining work not as a set of tasks arranged in a predefined process but, rather, as a collaborative effort in which "humans define the problems, machines help find the solutions, and humans verify the acceptability of those solutions."[26] The concept of using computer intelligence to *augment* human capabilities is hardly new: As early as 1960, the computer scientist and psychologist J.C.R. Licklider envisioned symbiotic partnerships between humans and computers in which humans "set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations" and computers "do the routinizable work that must be done to prepare the way for insights and decisions."[27]

One dramatic example demonstrating Licklider's vision comes from a "freestyle chess" match held in 2005, eight years after IBM's Deep Blue supercomputer famously defeated world chess champion Garry Kasparov. Contestants could be any combination of humans and computers, and the surprise victors were two amateurs who "coached" three computers. Kasparov noted that "weak human + machine + better process was superior to a strong computer alone and, more remarkably, superior to a strong human + machine + inferior process. … Human strategic guidance combined with the tactical acuity of a computer was overwhelming."[28]

Where do AI adopters stand on automation and augmentation? At least in the short term, cost-cutting through automation appears alluring: Nearly two-thirds of our survey respondents agree (22 percent *strongly* agree) that their organization would like to cut costs by automating as many jobs as possible. However, the potential for job disruption is concerning, and 36 percent rank job cuts from AI-driven automation as a top-three ethical risk. Despite these worries, they resoundingly believe that AI has the potential to change the workforce positively: Three-quarters agree that AI technologies already empower their employees to make better decisions, and the same proportion foresee human workers and AI augmenting each other, encouraging new ways of working. Seven in 10 believe AI will enhance employee job performance and satisfaction.

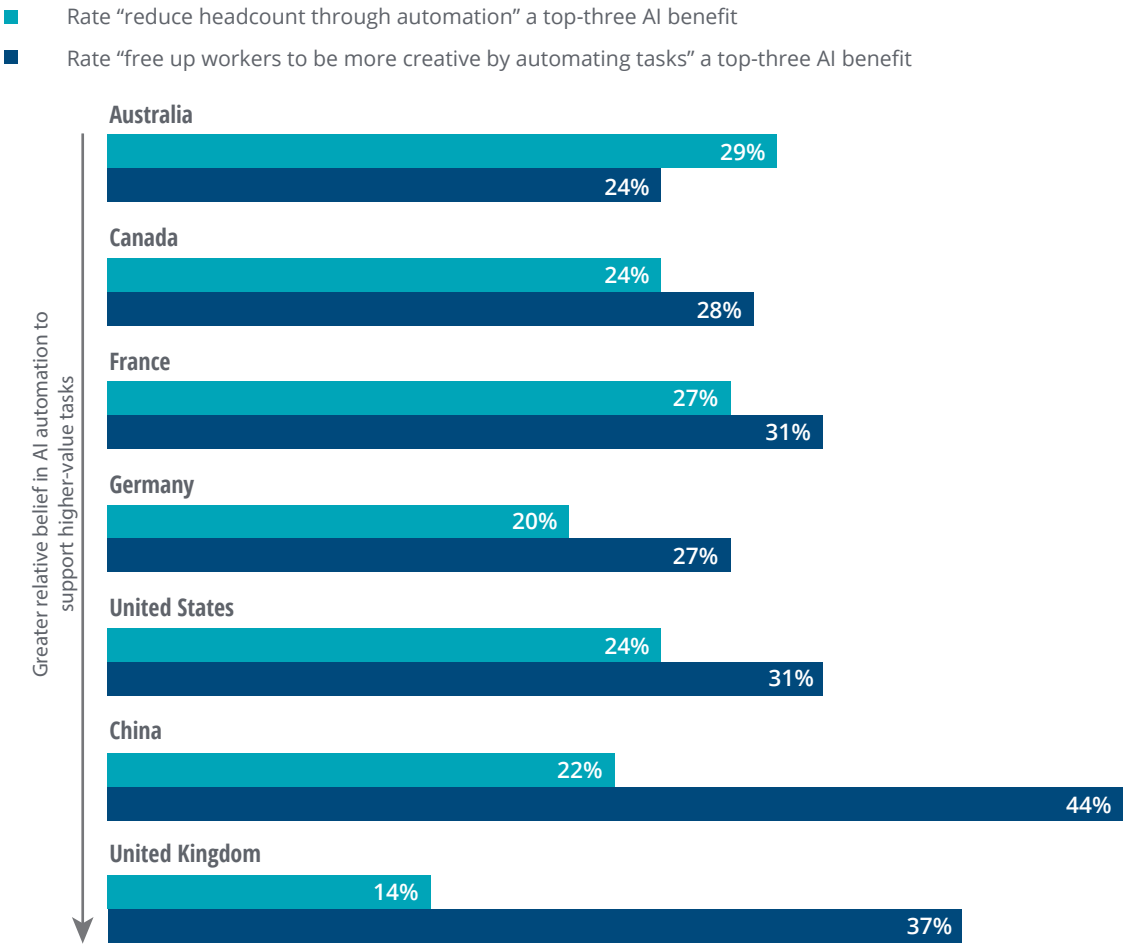
"Focus on augmenting people, not replacing them. Despite concerns, AI is not all about reducing labor costs, and organizations that approach the technology in this manner stand to miss out on real gains. Instead, early AI projects should focus on enabling employees to pursue higher value activities."

— ***Falguni Desai, global head of strategy and transformation, equities, Credit Suisse***

Companies are recognizing that automation is not synonymous with job elimination. Notably, "reduce head count through automation" is the *least popular* AI benefit reported by our survey respondents, and a greater proportion of executives ranked "free up workers to be more creative by automating tasks" as a top AI benefit (figure 1). While executives in Australia see AI automation more as a way to reduce head count, adopters in the other countries surveyed—especially China and the United Kingdom—show a distinct preference for using AI automation to free up workers for higher-value tasks (figure 9). As Licklider predicted, organizations can use AI to automate mundane tasks, freeing up human workers to apply their uniquely human capabilities (such as interpretation, communication, judgment, and empathy) to less-routine tasks, as well as to explore new problems and opportunities.[29] Deloitte researchers believe that companies that use automation primarily to optimize processes and reduce costs (for example, through job cuts) will likely struggle to significantly expand value creation in the long term; they recommend that companies create a strategy around "redefining work"—encouraging workers with newly freed-up capacity to identify and create new sources of value for their businesses.[30]

FIGURE 9

AI adopters see more value in using AI-driven automation to free up workers for more creative tasks than in using it to eliminate jobs



Source: Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1,900 AI early adopters in seven countries.

Across industries, there are signs that organizations are reimagining some jobs as teamwork between humans and AI (see sidebar, "AI and humans in collaboration"). As human-machine collaborations emerge, Deloitte researchers have cautioned that organizations should not outsource fairness, morality, and societal standards to algorithms.[31] Avoiding bias—in AI algorithms and the data used to train them—is an important ethical consideration when building AI solutions.[32] Some experts predict the emergence of new oversight roles to evaluate AI systems for adherence to laws, regulations, and ethical standards.[33]

AI AND HUMANS IN COLLABORATION

Deep learning assists pathologists

For pathologists, recognizing cancer metastases in lymph node tissue is time-consuming and error-prone. Studies indicate that about one-quarter of metastatic cancer stagings would be reclassified upon a second pathologic review and that small metastases can be underdetected when reviews are time-constrained.[34] Google AI has developed a deep learning program—LYmph Node Assistant (LYNA)—to detect metastatic cancer, training it on high-resolution pathology slides of lymph nodes from breast cancer patients. LYNA has been able to detect 92.4 percent of tumors—compared with 73.2 percent recognized by human pathologists—and has accurately identified suspicious areas of tissue that are sometimes too small for human detection.[35]

LYNA could be used to alert pathologists to areas of concern for further human review and diagnosis. In a test with simulated diagnostic tasks, six pathologists saw their average time to review tissue slides reduced from about two minutes to one minute per slide with LYNA's aid.[36] The researchers noted that "pathologists with LYNA assistance were more accurate than either unassisted pathologists or the LYNA algorithm itself, suggesting that people and algorithms can work together effectively to perform better than either alone."[37]

Programmers get a boost from AI

Game company Ubisoft has created Commit Assistant, an AI-based bug detector.[38] When developers commit new code to a codebase, the tool can identify potential bugs—based on what it has learned from past coding errors—and alert developers to review and fix the code. Ubisoft reports the AI assistant can accurately identify six in 10 software problems and expects it to eventually even suggest potential code fixes.

Other tools can provide a time-saving boost to developers during the coding process. Deep TabNine is a deep learning model that has been trained on 2 million GitHub code files.[39] As programmers type code, Deep TabNine predictively presents "code autocomplete" suggestions, not unlike phrase autocompletes on a search engine page.

AI AND HUMANS IN COLLABORATION, CONT.

Virtual agents and humans cooperate on customer service

Companies across industries are employing AI-based virtual agents—chatbots—to handle customer service and IT support calls. These agents can process thousands of calls annually, learning and adapting as they go, leading to reduced time and cost per call and improved customer experience.[40] Some companies view chatbots as a way to lessen the burden on their human support personnel, who are freed up to work on higher-value tasks. In other cases, virtual agents assist human agents by sifting through documents and delivering the right information exactly when needed.

Having humans in the loop is still considered essential.[41] When chatbots get stuck because they can't discern a caller's intent or face a complex issue for which they haven't yet been trained—or when human empathy is needed to soothe frustrated callers—calls typically get routed to humans. And in one survey, 93 percent of chatbot owners reported that having humans interact with bots, for validation and curation, is important to improving chatbot performance.[42] For example, the software company LivePerson offers an AI-powered dashboard that allows humans to serve as "bot managers," monitoring and troubleshooting chatbots.[43] Using sentiment analysis, the dashboard displays real-time customer satisfaction scores for calls, and if a score drops too low, a human bot manager can seamlessly take over and tweak the conversation. Furthermore, LivePerson employs deep learning to recommend "next actions" to human agents and to continually improve chatbot interactions.[44]

Considerations for AI leaders

COMPANIES IN THE AI game are feeling a sense of urgency as their businesses and industries undergo AI-fueled transformation. At a time when competition for AI skills is fierce, maintaining a competitive advantage may depend upon having a strategy for dealing with AI talent shortages and the changing nature of work.

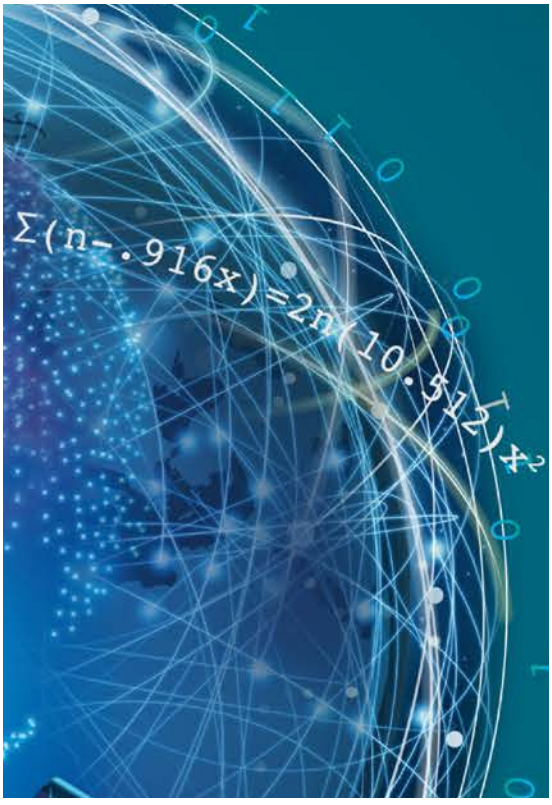
Early adopters should consider strengthening their AI foothold by:

Deciding what skills are needed. From the start, AI adopters should take a close look at how specialized their AI needs are. Then they can consider whether they really need AI research superstars to break new AI ground, or whether they can achieve their goals with a skilled engineering team that can be trained to use available AI tools.

Adopters should also consider involving business leaders early and throughout the life cycle of AI initiatives. These leaders can connect the company's business models and strategy to the requirements for AI systems, as well as establish metrics for project success. Given the challenge of integrating AI into a company's roles and functions, AI adopters should also consider how change management experts might be utilized. These professionals, who work to ensure that organizations actually use new systems or processes after developing them, may be one key to overcoming AI integration hurdles.

Finding the right balance between hiring and reskilling. Given AI talent shortages, replacing existing workers with AI-ready talent is no silver bullet to fix AI skills gaps. In addition to hiring, leaders should consider identifying and reskilling current developers, IT staff, and other employees to help build up the company's AI expertise. Consider establishing programs to train developers to create AI solutions and IT staff to deploy those solutions.

Given the difficulties of integrating AI technologies into the company's operations, leaders should also consider structured programs to train employees on how to use AI systems in the course of their jobs, and also develop structured ways to integrate AI into roles and functions. For their own part, employees should aim to embrace an attitude of



lifelong learning and consider how AI assistance may supercharge their work in the future.

Redesigning work for the age of AI. AI-driven automation will likely change the nature of how many humans conduct their jobs. But automation has a role far broader than reducing head count or optimizing processes: As we saw in the pathology and IT incident management examples, organizations can use automation to free workers from repetitive or error-prone tasks, allowing them to bring their human skills of judgment, interpretation, and empathy to bear on more complex decisions. Leaders should create a vision now for what their "augmented workforce" looks like—and evolve it as their AI capabilities advance. They should consider creating a strategy for "redefining work"—focused on how workers with freed-up capacity can create new sources of business value.[45]

One area where human judgment is absolutely needed is ensuring that organizations build and deploy AI systems in ethical ways. The Notre Dame Deloitte Center for Ethical Leadership promotes the view that *everyone* involved in advancing AI—from corporate boards and management, to researchers and engineers—shares responsibility for applying ethical constructs throughout the AI product life cycle.[46]

Endnotes

1. Pooja Singh, "Enterprise use of AI has grown 270 percent globally over the past four years," *Entrepreneur Asia Pacific*, January 22, 2019.
2. International Data Corporation, "Worldwide spending on artificial intelligence systems will grow to nearly $35.8 billion in 2019, according to new IDC spending guide," March 11, 2019.
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Acknowledgments

The author would like to thank **Jeff Loucks** for astute insights and discussions that helped shape this topic, and **Sayantani Mazumder** for her invaluable data analysis efforts and support in creating this report. Thanks are also due to **Paul Sallomi**, **David Jarvis**, **Natasha Buckley**, and **Susan Hogan** for contributing thoughtful suggestions to our work, and **Jeanette Watson** for her valued guidance.

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