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Skill shift: Automation and the future of the workforce

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Demand for technological, social and emotional, and higher cognitive skills will rise by 2030. How will workers and organizations adapt?

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Skill shifts have accompanied the introduction of new technologies in the workplace since at least the Industrial Revolution, but adoption of automation and artificial intelligence (AI) will mark an acceleration over the shifts of even the recent past.

The need for some skills, such as technological as well as social and emotional skills, will rise, even as the demand for others, including physical and manual skills, will fall. These changes will require workers everywhere to deepen their existing skill sets or acquire new

ones. Companies, too, will need to rethink how work is organized within their organizations.

This briefing, part of our ongoing research on the [impact of technology](#) on the economy, business, and society, quantifies time spent on 25 core workplace skills today and in the future for five European countries—France, Germany, Italy, Spain, and the United Kingdom—and the United States and examines the implications of those shifts.

1. How will demand for workforce skills change with automation?
2. Shifting skill requirements in five sectors
3. How will organizations adapt?
4. Building the workforce of the future

1

How will demand for workforce skills change with automation?

Over the next ten to 15 years, the adoption of automation and AI technologies will [transform the workplace](#) as people increasingly interact with ever-smarter machines. These technologies, and that human-machine interaction, will bring numerous benefits in the form of [higher productivity](#), GDP growth, improved corporate performance, and new prosperity, but they will also change the skills required of human workers.

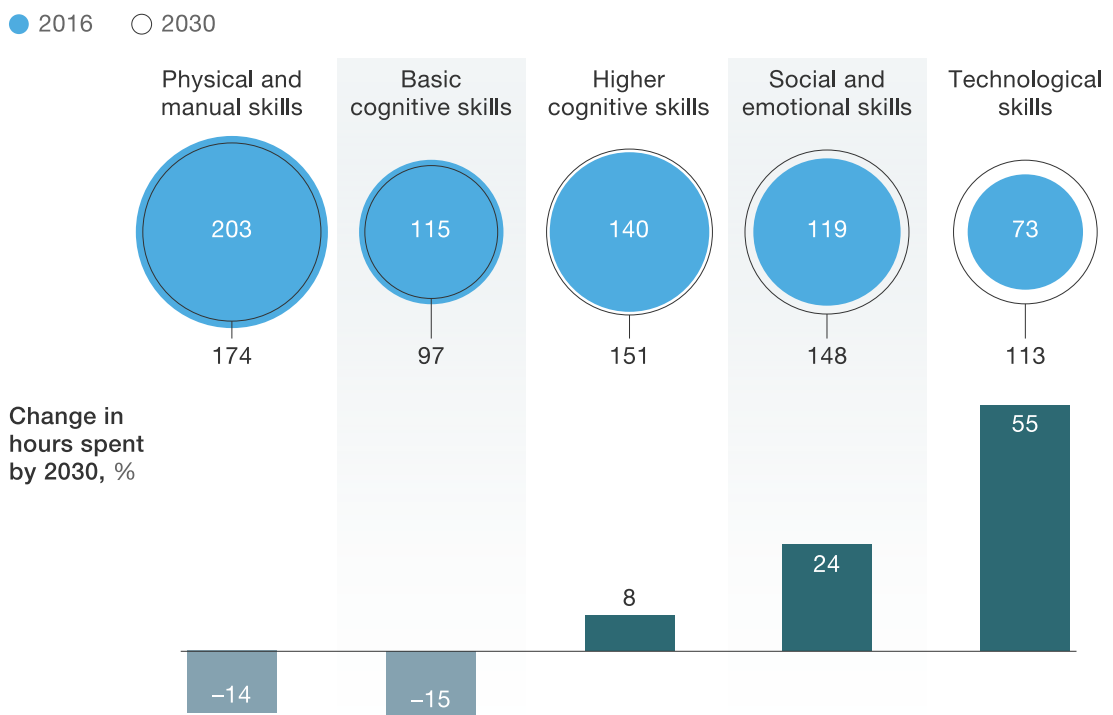
To measure skill shifts from automation and AI, we modeled skill shifts going forward to 2030—and found that they accelerated. While

the demand for technological skills has been growing since 2002, it will gather pace in the 2016 to 2030 period. The increase in the need for social and emotional skills will similarly accelerate. By contrast, the need for both basic cognitive skills and physical and manual skills will decline (Exhibit 1).

Exhibit 1

Automation and artificial intelligence will accelerate the shift in skills that the workforce needs.

Total hours worked in Europe and United States, 2016 vs 2030 estimate, billion



Source: McKinsey Global Institute Workforce Skills Model; McKinsey Global Institute analysis

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All technological skills, both advanced and basic, will see a substantial growth in demand. Advanced technologies require people who understand how they work and can innovate, develop, and adapt them. Our research suggests that through 2030, the time spent using advanced technological skills will increase by 50 percent in the United States and by 41 percent in Europe. We expect the fastest rise in the need for advanced IT and programming skills, which could

grow as much as 90 percent between 2016 and 2030. People with these skills will inevitably be a minority. However, there is also a significant need for everyone to develop basic digital skills for the new age of automation. We find that among 25 skills we analyzed, basic digital skills are the second-fastest-growing category, increasing by 69 percent in the United States and by 65 percent in Europe.

The need for finely tuned social and emotional skills will rapidly grow. Accompanying the adoption of advanced technologies into the workplace will be an increase in the need for workers with finely tuned social and emotional skills—skills that machines are a long way from mastering. In aggregate, between 2016 and 2030, demand for social and emotional skills will grow across all industries by 26 percent in the United States and by 22 percent in Europe. While some of these skills, such as empathy, are innate, others, such as advanced communication, can be honed and taught. The rise in demand for entrepreneurship and initiative taking will be the fastest growing in this category, with a 33 percent increase in the United States and a 32 percent rise in Europe. The need for leadership and managing others will also grow strongly.

There will be a shift in demand toward higher cognitive skills. Our research also finds a shift from activities that require only basic cognitive skills to those that use higher cognitive skills. Demand for higher cognitive skills, such as creativity, critical thinking, decision making, and complex information processing, will grow through 2030, by 19 percent in the United States and by 14 percent in Europe, from sizable bases today. However, work activities that require only basic cognitive skills, such as basic literacy and numeracy, will decline as automation advances. Basic data-input and -processing skills will be particularly affected by automation, falling by 19 percent in the United States and by 23 percent in Europe in the

2016 to 2030 period. The decline will be in nearly all sectors as machines increasingly take over straightforward data-input tasks.

The need for most physical and manual skills will decline, but they will remain the largest category of workforce skills. The demand for physical and manual skills has been declining for 15 to 20 years, and this decline will continue with automation. Between 2016 and 2030, demand for these skills will fall by 11 percent overall in the United States and by 16 percent overall in Europe. The mix of physical and manual skills required in occupations will change depending on the extent to which work activities can be automated. For example, operating vehicles or stocking and packaging products are more susceptible to automation than are assisting patients in a hospital or some types of cleaning. Physical and manual skills will nonetheless continue to be the single largest category of skills (measured by time spent), shrinking from 31 percent of workers' time in 2016 to 25 percent in 2030 across the United States and Western Europe.

A survey of more than 3,000 C-suite executives in seven countries—Canada, France, Germany, Italy, Spain, the United Kingdom, and the United States—that we conducted as part of our research confirms our quantitative findings. Advanced IT and programming skills are viewed as the most important skills needed in the next three years. Higher cognitive skills and social and emotional skills will also be more in demand, while the need for physical and manual skills, particularly for gross motor skills and strength needed for occupations such as moving, machine feeding, and warehouse packing, will likely decline. Executives also expect declines in the need for basic cognitive skills, particularly the basic data-input and -processing skills used by data-entry clerks and typists and in a range of back-office functions.

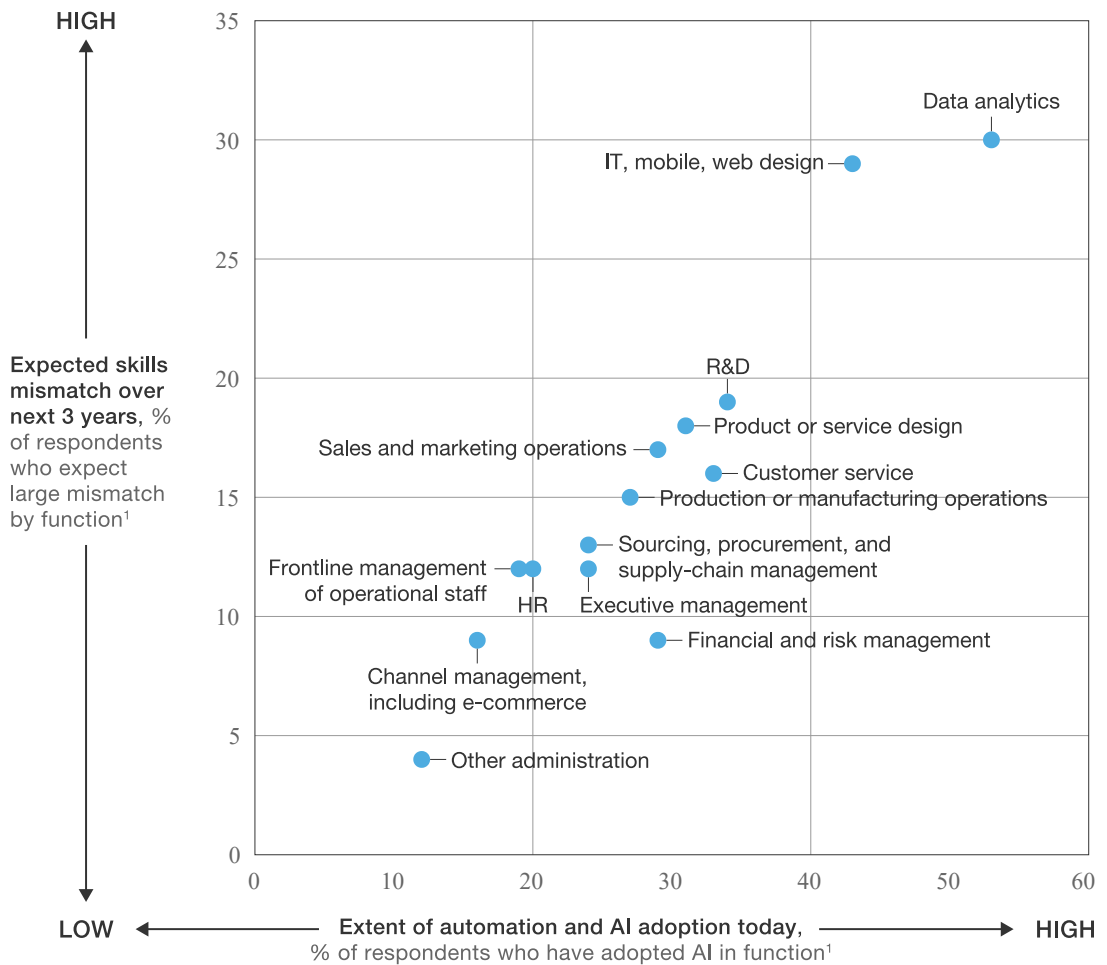
Our survey shows that the functions that are already the most automated are experiencing the largest skill mismatches. These functions include data analytics; IT, mobile, and web design; and

research and development (Exhibit 2). This finding holds true across almost all sectors, with the notable exception of manufacturing, in which skill mismatches are expected to be largest in production and manufacturing operations.

Exhibit 2

The largest skill mismatches will likely occur in the functions that have begun to adopt automation and artificial-intelligence technologies.

Skills mismatch vs automation and artificial intelligence (AI) adoption



¹Based on results of March 2018 survey of 3,031 business leaders in Canada, France, Germany, Italy, Spain, United Kingdom, and United States. Survey questions were, “When you think about how automation and AI will change your workforce skill needs, in which functions do you think skills mismatches will be largest over the next 3 years? (Select up to 3)” and “Which of your organization’s functions have adopted automation and AI technologies to date? (Select all that apply).”

Source: McKinsey Global Institute Workforce Skills Executive Survey; McKinsey Global Institute analysis

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Shifting skill requirements in five sectors

We looked at skill shifts in more detail in five sectors. This analysis highlights many similarities in changing patterns of skills requirements but also some variation. For example, while social and emotional skills will be in growing demand across all five sectors, the need for basic cognitive skills will decline in banking and manufacturing, stay flat in healthcare, and only fall back slightly in retail.

Banking and insurance

Financial services have been at the forefront of digital adoption, and the banking and insurance sector is likely to see significantly shifting demand for skills through 2030. The financial-services sector contains a range of potential uses for AI, especially in forecasting risk and personalizing the marketing of products to customers. The number of workers such as tellers, accountants, and brokerage clerks will decline as automation is adopted. The need for a workforce that uses only basic cognitive skills, such as data input and processing, basic literacy, and basic numeracy, will likely decline, while the number of technology experts and other professionals will grow, as will the number of occupations that require customer interaction and management. This increase will drive strong growth in the demand for social and emotional skills.

Energy and mining

Automation and AI are enabling companies to tap into new reserves as well as increase extraction and production efficiency. Predictable

manual work and administrative jobs that involve data manipulation, such as meter reading, will be susceptible to being displaced, while demand for technological jobs will be buoyant. The demand for physical and manual skills along with basic cognitive skills are expected to decrease, while demand for higher cognitive, social and emotional, and technological skills should grow.

Healthcare

Automation and AI will change the interaction among patients and healthcare professionals. The demand for care providers, such as nurses, will continue to see growth, while the demand for office-support staff will see decreases because of automation of tasks related to record keeping and administration.

Demand for advanced IT skills, basic digital skills, entrepreneurship, and adaptability will see the largest double-digit cumulative growth. However, demand for skills such as inspecting and monitoring patient vitals and medical equipment will stagnate, despite the overall growth in healthcare, as machines take over more routine tasks.

Healthcare is the only sector in our analysis in which the need for physical and manual skills will grow in the years leading to 2030. This variation reflects the gross motor skills and strength needed for occupations such as elder care and physical therapy and the fine motor skills required of registered nurses.

Manufacturing

The next wave of automation and AI in manufacturing will disrupt production functions in factories through better analytics and increased human-machine collaboration. It will also have an impact on product development and on marketing and sales.

The overall need for physical and manual skills in the sector is decreasing at more than twice the rate of that for the whole economy. The need for basic cognitive skills is also declining as office support functions are automated. The number of professionals such as sales representatives, engineers, managers, and executives are expected to grow. This will lead to growth in the need for social and emotional skills, especially advanced communication and negotiation, leadership, management, and adaptability. The need for technological skills, both advanced IT skills and basic digital skills, will increase as more technology professionals are required. Demand for higher cognitive skills will grow, driven by the need for greater creativity and complex information processing.

Retail

Smart automation and AI will continue to reshape the revenue and margins of retailers as self-checkout machines replace cashiers, robots restock shelves, machine learning improves prediction of customer demand, and sensors help inventory management.

The share of predictable manual jobs, such as driving, packing, and shelf stocking, will substantially decline. Jobs that remain will tend to be concentrated in customer service, management, and technology deployment and maintenance. Demand for all physical and manual skills and for basic data input and processing will decline, while growth will be strong in demand for interpersonal skills, creativity, and empathy. Advanced IT skills and programming alongside complex information processing skills will also see a surge in demand.

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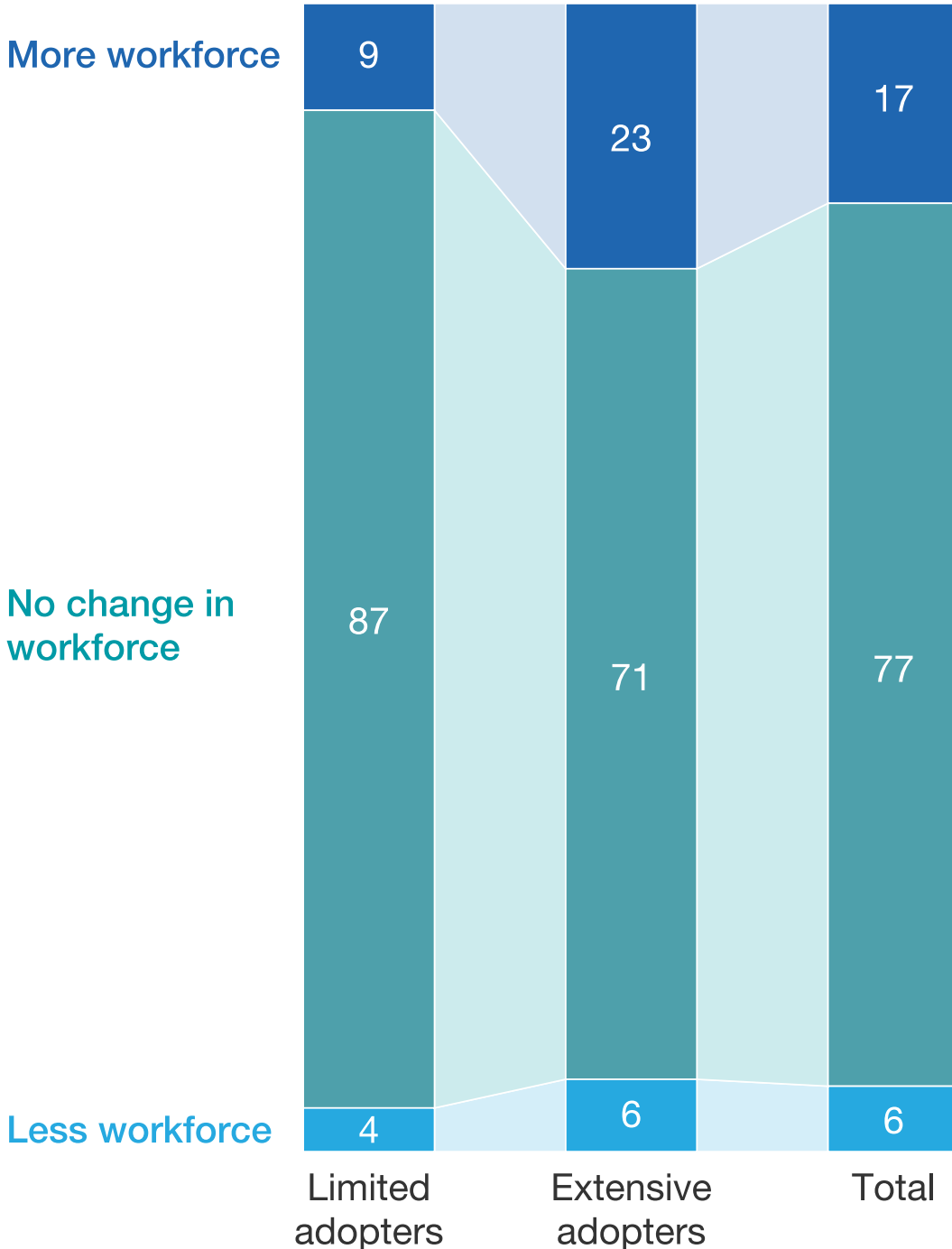
How will organizations adapt?

To harness the new technologies to their full effect, companies will need to retool their corporate structures and their approaches to work. That change will require redesigned business processes and a new focus on the talent they have—and the talent they need.

Exhibit 3

Only about 6 percent of companies expect their workforce in Europe and the United States to shrink as a result of automation and artificial intelligence.

Expected operation-location impact of adopting automation and artificial intelligence (AI) in Europe and United States, by adoption level, % of respondents¹



¹Based on results of March 2018 survey of 3,031 business leaders in Canada, France, Germany, Italy, Spain, United Kingdom, and United States. Survey question was, “What impact do you think adopting automation and AI will have on the geographic location

adopting automation and AI will have on the geographic location of your operations?.”

Source: McKinsey Global Institute Workforce Skills Executive Survey; McKinsey Global Institute analysis

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About 77 percent of the respondents in our survey expect no net change in the size of their workforces in either Europe or the United States as a result of adopting automation and AI technologies (Exhibit 3). Indeed, more than 17 percent expect their workforces on both sides of the Atlantic to grow. The composition of jobs and skills will shift, however. Some jobs will shrink after automation, while others will expand. And about 6 percent of companies foresee an overall decline in the size of their European and US workforces.

Our findings suggest that organizations will change in five key areas —mind-set, organizational setup, work-activity allocation, workforce composition, and C-suite and HR understanding and functions.

Companies will undergo a mind-set shift

A key to companies' future success will be in providing continuous learning options and instilling a culture of lifelong learning throughout the organization. In our survey, this cultural change was ranked by companies across most sectors as the change most needed for developing the workforce of the future.

Basic organizational setup will change, with a strong shift toward

cross-functional and team-based work and an emphasis on agility

More than one in five survey respondents said that introducing more agile ways of working will be a high-priority organizational change, and a similar proportion described more cross-functional collaboration as a key going forward. Unlike traditional hierarchies, which are mainly designed for stability, agile organizations are designed for both stability and dynamism. They typically consist of a network of teams and are notable for rapid learning and fast decision cycles.

Allocation of work activities will be altered, with work being “unbundled” and “rebundled”

Altering work allocation will allow companies to make the most effective use of different qualification levels in their workforce. In our survey, 40 percent of companies describing themselves as extensive adopters of automation and AI expect to shift tasks currently performed by high-skill workers to lower-skill ones. Unbundling and rebundling work raises company efficiency and can also create a new set of middle-skill, “new-collar” jobs. For example, registered nurses and physician assistants now do some of the tasks that primary care physicians once carried out, such as administering vaccinations and examining patients with routine illnesses.

Workforce composition will shift

More work will be done by freelancers and other contractors, a shift that will boost the emerging “gig” or “sharing” economy. In our survey, greater use of various types of freelancers and temporary workers is one of the top organizational changes; 61 percent of respondents expect to hire more temporary employees.

Changes will occur in C-suite and HR areas

In our survey, 19 percent of respondents said their top executives lacked sufficient understanding of technologies to lead the organization through the adoption of automation and AI. In addition, HR will need to change as technology alters the way organizations work as well as the size and nature of the workforce. Nearly all business leaders we surveyed (88 percent) said they believe HR functions will need to adapt at least moderately.

4

Building the workforce of the future

Companies will need to choose from the following five main types of action as they build their future workforce:

- *Retraining*. Retraining involves raising the skill capacity of current employees by teaching them new or qualitatively different skills and hiring entry-level employees with the goal of training them in the new skills needed. These actions ensure that in-house functional knowledge, experience, and understanding of company culture are preserved as employees acquire the skills they need. A key choice

for companies will be whether to pursue training using in-house resources and programs tailored to the company or to partner with an educational institution that will provide external learning opportunities for employees. Responses to our executive survey show that companies plan to focus retraining efforts on skills that are deemed to be of strategic importance to the company, such as advanced IT skills and programming, advanced literacy skills, critical thinking, and problem solving. They are more likely to hire from outside the company for less-complex skills.

- *Redeployment.* Companies can redeploy workers with specific skills to make better use of the skill capacity already available to them. They can do this by unbundling the tasks within a job and then rebundling them in different ways, by shifting parts of the workforce to other tasks that are of higher importance or to other entities, or by redesigning work processes. In a McKinsey survey of company leaders in February 2018, 55 percent of respondents from companies with \$1 billion or more in annual revenue said they would laterally move more people into different or brand-new roles than they would release.
- *Hiring.* Acquiring individuals or entire teams of people with required skill sets is another option—although the supply of talent in the market might be insufficient for all companies to pursue this strategy. The total cost of hiring might be lower than some of the other options, including retraining, depending on the skills needed. However, hiring is always a risk as to how a person will perform on the job. Additionally, it is susceptible to talent shortages in the market. To succeed at hiring key talent, companies need to offer an attractive culture and benefits as well as consider hiring from nontraditional sources. New digital tools can vastly improve the ability to source, assess, and recruit new talent.
- *Contracting.* Companies can deploy skills brought in from outside the organization; for example, they can use contractors,

freelancers, and temporary workers from staffing agencies. Contracting allows companies to acquire rapidly the skills they need (if such talent is available). Its downsides include potential loss of proprietary knowledge and intellectual property as well as poor fit with the company culture. Our survey respondents plan to use contracting to fill mainly noncore or low-skill roles rather than using it to find high-skill talent.

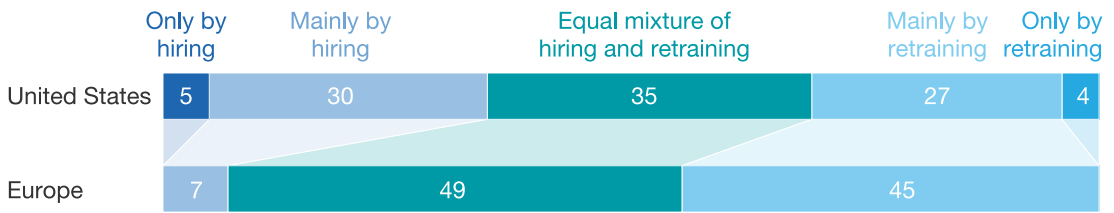
- *Releasing.* Releasing employees might be necessary in some companies, particularly those in industries that are not growing very rapidly and in which automation can substitute for labor in a significant way. Often, this strategy can be accomplished by reducing or freezing new hiring while allowing normal attrition and retirement to proceed or by reducing the work hours of some employees. But sometimes, it may require laying off workers. Releasing workers can be an opportunity to accelerate workforce transformations, with potentially significant cost savings. However, the risk is a potential loss of knowledge of the company, culture, and operations. Layoffs can also diminish employee productivity and satisfaction, and they can be difficult and costly to carry out. In our survey, about 90 percent of respondents say they have “some” or even “significant” responsibility to help laid-off employees learn new skills or find new jobs.

Geography also plays a role in determining which workforce-skill decisions to make, with a net difference between European and US companies. In Europe, just fewer than half of the companies we surveyed aim to focus primarily on retraining the existing workforce, whereas in the United States, that proportion is just over one-quarter. In the United States, by contrast, hiring is an attractive choice, with 35 percent of companies planning to improve workforce skills only or mainly by hiring versus just 7 percent in Europe (Exhibit 4).

Exhibit 4

European companies expect to resolve skill mismatch by retraining workers, while hiring is an equally popular solution among US companies.

Best way for company to resolve potential skills mismatch, % of respondents¹



¹Based on results of November 2017 survey of 1,549 respondents from businesses, public sector, and not for profits across regions, industries, and sectors. Survey question for private-sector organizations with >\$100 million annual revenue who view skill gaps as a top-ten priority was, "How can your organization best resolve its potential skills gaps related to automation and/or digitization over the next 5 years?" (n=197). "Don't know" responses filtered out from data set shown. Figures may not sum to 100%, because of rounding.

McKinsey&Company | Source: McKinsey Global Panel Survey; McKinsey Global Institute analysis

From the results of our survey, we can already see the beginnings of intensified competition for top talent. About one in four respondents said they would try to use connections to industry associations, offer more attractive wages than competitors, directly hire from other companies, or broaden their talent sources to attract the talent they need.

Respondents also said that individuals with a college degree are more likely to be hired or contracted, more likely to receive retraining, and less likely to be displaced.

Other stakeholders also have a role to play in building the workforce of the future

Companies can do much to shape the workforce of the future, but other stakeholders also have an active role to play.

Educational institutions

For now, many companies tend to think in isolation about their retraining programs. For example, in our survey, only 37 percent of respondents considered it important to build partnerships with educational institutions for effective retraining, compared with 47 percent who planned to perform retraining internally. At the same time, a range of higher-education institutions and other experts have called for universities, colleges, and other educators to play a more active role in filling the needs of the labor market, including by increasing data-science and other high-tech courses.

Industry associations and organized labor

Working together as social partners, associations and unions have traditionally played central roles in training efforts in several European countries. Both sets of stakeholders have potentially significant roles to play in addressing shortages of certain skills and retraining in the automation era.

In Sweden, job-security councils funded by companies and unions coach individuals who become unemployed. They provide temporary financial support, transition services, and retraining to help the unemployed quickly find new jobs.

Policy makers

Policy makers will need to clarify the roles of individuals, companies, and state agencies. Examples of such action include revamping labor agencies; several European countries, including Germany, have changed the way their national labor agencies operate by shifting public-employment policy from “passive” (unemployment compensation) to “active” (employment agencies becoming job centers that manage and facilitate retraining of the unemployed). Other initiatives include boosting mobility by moving to portable

benefits, which are not tied to a particular job or company and are owned by workers.

Not-for-profit organizations and foundations

Not for profits have the flexibility to develop innovative approaches to issues relating to skills, and some have been testing novel approaches. Markle, for example, is piloting a program called [Skillful](#) that aims to help workers without a college degree upgrade and market their skills.

Some companies have launched philanthropic initiatives or work with foundations on skills-related issues. For example, [Generation](#) is an independent, not-for-profit youth-unemployment initiative that seeks to close the skills gap for young people by providing them with training for one of 20 professions across four sectors.

Skills are a key challenge of this era

A well-trained workforce equipped with the skills required to adopt automation and AI technologies will ensure that our economies enjoy strengthened productivity growth and that the talents of all workers are harnessed. Failure to address the demands of shifting skills could exacerbate social tensions and lead to rising skill-and-wage bifurcation. The ability to ensure the former scenario—and ward off the latter—will depend in large part on how well the workforce is trained and how adaptable companies and workers will prove to be in the face of multiple new challenges from automation adoption.

Download [Skill shift: Automation and the future of the workforce](#), the full discussion paper on which this article is based (PDF–2.55MB).

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