Look Forward

Artificial Intelligence

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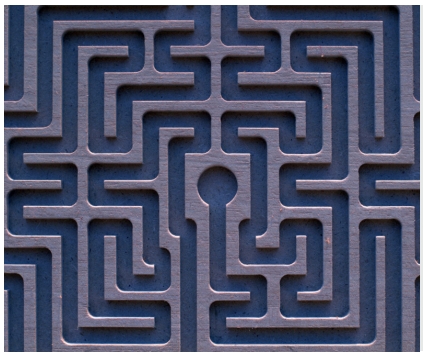

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Change is inevitable, but human capabilities remain essential

While AI will transform labor markets through enhanced productivity and efficiency, human capabilities will remain indispensable for tasks requiring emotional intelligence, creativity and complex decision-making.

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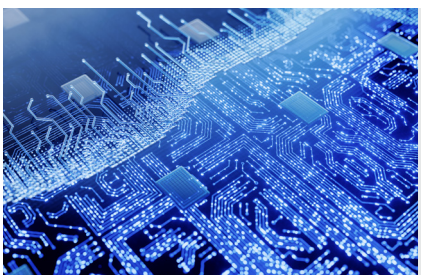

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AI and labor: Change is inevitable, but human capabilities remain essential

While AI will transform labor markets through enhanced productivity and efficiency, human capabilities will remain indispensable for tasks requiring emotional intelligence, creativity and complex decision-making.

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This article is intended to promote discourse regarding the interplay between AI and labor markets. The time frames referenced are meant to provide an illustrative scaffold, and certain concepts, including issues of distribution and governance, and nuances between capital, material, labor and total factor productivity, remain unaddressed here to maximize the reach of this discourse. Those further issues will be the subject of robust economic and policy analysis in additional S&P Global research.

American folk hero John Henry is said to have been "a steel-driving man," a reference to his job hammering a steel bit into rock to make holes for explosives to excavate railway tunnels. A song memorializing John Henry tells of his race against a steam-powered drill, an avatar of the industrial age, which he beats, but at the cost of his life. The tale is one of determination and fortitude, but it is also a warning about the futility of resisting technological advancement.

Highlights

Over time, AI's impact on labor will become increasingly evident across key areas such as efficiency and productivity, creation of new roles, transformative human-AI collaboration, autonomous systems, and labor redistribution and reskilling.

Across short-term (one to two years), medium-term (four to six years) and long-term (seven to 10 years) time frames, we expect AI's integration with labor to progress through distinct phases, each with unique challenges, ethical considerations and risks to balance against the technology's benefits.

Our research suggests that AI's effects will be uneven across the employment landscape. Roles most likely to be affected will be those focused on information collection and processing, data analysis, and machine or process management.

As generative AI expands, it may be tempting to view John Henry's tale as a parable for the future of labor, but this would be a mistake for two major reasons. First, our analysis shows that while large language models will prove effective at many tasks, they will likely have little effect on the market for manual labor. In this sense, the next John Henry is more likely to be a paralegal or a computer systems engineer than a construction worker. Second, industrial-age technological disruptions fall short of the upheaval that generative AI is likely to bring about. Industrial machines replaced workers' roles within a defined task (like steel driving) but left the process intact. We expect that within seven to 10 years, the use of generative AI will upend and redefine many labor processes themselves.

A structured analysis of AI's effects on labor

Since the public launch of OpenAI's ChatGPT in November 2022, conversations about AI and the future of work have polarized, with fear and exuberance in similar proportions. Both extremes reflect emotional responses rather than a practical understanding of how AI will transform the labor landscape. The reality is sure to be more nuanced.

To frame our analysis of AI's effects on labor, we use three periods: the short term (one to three years), the medium term (four to six years) and the long term (seven to 10 years). Each phase will present challenges, ethical considerations and risks that must be balanced against the technology's potential benefits.

As we progress along this timeline, the effects of AI on labor and labor markets will become increasingly evident across a range of key elements.

Short term: Picking the low-hanging fruit

In the next few years, AI applications will likely focus on enhancing labor efficiency and productivity in existing workflows. This focus will be dictated by employers' initial limited understanding of AI's potential in the context of current processes and

AI and labor: Key elements

Efficiency and productivity
Automation of repetitive tasks and improved decision-making across many areas should result in significant gains in labor productivity and efficiency, and in processes as labor is augmented or replaced by AI.

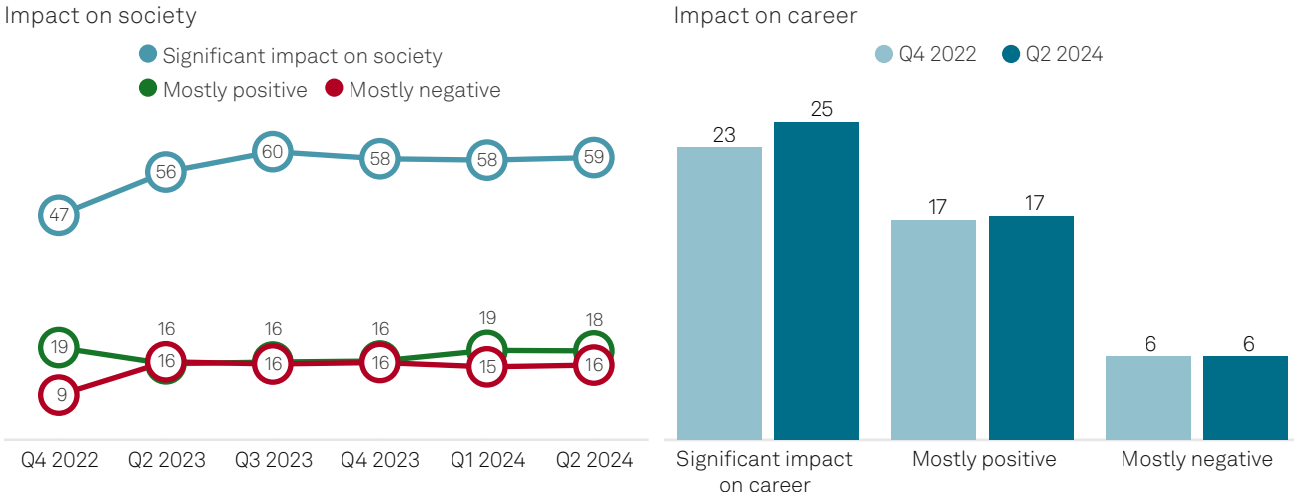
Emerging roles
New job categories such as AI trainers, explainability experts and AI ethicists will emerge, notably in quality and governance functions, and will themselves be augmented by AI. These roles' defining characteristic will be to do what AI cannot: AI excels at finding answers, while humans excel at asking questions. People who prove talented at asking the right types of questions — open-ended, probing and insightful — will be in high demand.

Transformative collaboration
Collaborative intelligence, a paradigm in which humans and AI work seamlessly together, will become increasingly mainstream, likely through the maturation of agent-based models (ABMs), which simulate the actions and interactions of autonomous agents.

The impact of autonomous systems
Improved ABM will also facilitate increased use of autonomous systems, such as self-driving vehicles and AI-powered agricultural robots. The result should be a marked enhancement of some sectors' efficiency and sustainability, notably through the synthesis of analytics and fieldwork.

Labor redistribution and reskilling
The redistribution of labor markets away from roles that are easily replicated by AI will require reskilling and upskilling, with a focus on developing emotional intelligence, critical thinking and interpersonal skills. AI integration will necessitate greater humanity in the workplace.

Expectations regarding AI impact on society and career, 2022–2024 (%)



Data accessed Oct. 31, 2024.
Q. Over the next 2 years, do you think artificial intelligence (AI)/machine learning (ML) will have a positive or negative effect on each of the following? (Choose one for each row.) — Society as a whole; Career.
Q. Over the next 2 years, how much of an impact — if any — do you think advancements in artificial intelligence (AI)/machine learning (ML) will have on each of the following? (Choose one for each row.) — Society as a whole; Career.
Base: All respondents (n=~5,000).
Source: S&P Global Market Intelligence 451 Research's VoCUL: Connected Customer, 2022–2024.

will reflect experimentation as enterprise decision-makers learn about AI's core competencies, develop integration approaches and refine their strategies. Companies will likely begin leveraging AI to streamline operations, reduce costs and improve decision-making. Stakeholders will need to determine adequate levels of prudence in adoption, change-management and governance. Adoption without sufficient checks could lead to negative consequences, such as job displacement and privacy concerns, and even where care is taken, the ride is likely to be bumpy and include some retrenchment.

Adoption and implementation of AI in various job families may add complexity to work, posing both opportunities and risks. A key challenge will be to balance the allocation of work between human strengths and AI capabilities in a way that enables the opportunities and abates the risks. Recent data suggests there is reason for optimism. S&P Global Market Intelligence 451 Research surveyed about 5,000 respondents regarding the impact of AI on jobs and on society at large. Between two waves of the survey in 2022 and 2024, respondent expectations regarding AI's impact on society notably shifted, with a significant increase in the expected degree of impact and a modest bias toward positive expectations. In that period, sentiment regarding AI's impact on jobs remained stable. Notably, among those who expect AI to significantly impact their career, more than twice as many expect a positive impact on work versus a negative impact.

Enhanced automation and productivity

AI-driven automation will increase across capacities including manufacturing, logistics, customer service and data management. By combining information, systems and robotics to handle repetitive tasks, these developments should allow human workers to focus on more complex and creative activities or those with social aspects, such as management, coaching and inspiration. Application is likely to involve assessing the division of labor between tasks that require or benefit from human performance and those that are "machine ready." For instance, AI-powered chatbots and virtual assistants will continue to evolve, in some cases providing more sophisticated support to human customer service agents, and in other cases providing direct customer support without human intervention.

Meanwhile, optimization agents will assess operations to reduce human input and maximize AI's potential for productivity gains. While this concept may evoke sci-fi tropes that fuel fears of AI, this assessment is a crucial step to maximizing the effectiveness of a mutualism between AI

and humans: parsing the tasks that humans are especially good at versus those at which AI excels and facilitating interoperability between the two.

Diving deeper, we see that concerns about AI's impact on jobs vary across industries, with some showing major concerns while others appear more optimistic. Measures that allay these concerns by abating negative impacts and supporting positive ones may present new opportunities in the work mix for existing positions and may even create new positions to help evolve the workforce toward a future that includes AI.

AI capabilities can improve workforce tooling, especially in minimizing administrative burden, reducing overhead and providing objective performance feedback. In another survey, S&P Global Market Intelligence 451 Research asked approximately 450 respondents about their preferences for workforce tooling innovations. The overwhelming majority focused on efficiency gains and reducing administrative overhead, presumably to allow better focus on "value-add" tasks. Other tools, such as digital twins of physical objects and processes, received less priority among respondents, but these innovations are crucial for providing the digital infrastructure whereby AI can operate.

Improved decision-making and knowledge

Discriminative AI systems, which excel at classification, have proven adept at complex data analysis and assisting decision-making across industries such as automotive, manufacturing and logistics. We expect that the combination of discriminative AI and generative AI will also improve service economy activities by drawing on troves of service-oriented data collected over the past two decades. Financial institutions, for example, could use AI algorithms to expedite portfolio managers' analysis of market trends, risks, correlation and other factors. In healthcare, AI could help diagnose diseases and recommend treatment plans based on vast amounts of medical data, potentially enhancing patient outcomes and reducing diagnostic errors.

Generative AI concerns vary across industries (%)

	Business services (n=89)	Construction & environmental services (n=244)	Education & training (n=218)	Financial services (n=145)	Food, beverage and agriculture (n=243)	Government (n=69)	Healthcare (n=290)	Real estate (n=67)	Software, IT and computer services (n=256)	Travel, tourism & hospitality (n=79)	Consumer retail & sales (n=173)
Scams/fraud	48	40	51	43	46	62	52	49	36	53	52
Misuse with ill intentions	28	42	47	44	36	51	43	49	41	43	46
Risks to my data privacy	43	41	45	48	40	49	47	51	37	53	54
Disinformation/misinformation	37	35	50	34	28	52	45	54	40	58	54
Increased isolation/less human contact	37	34	40	34	34	41	42	34	37	43	39
Too much trust put into results	43	31	46	34	33	44	36	45	45	43	36
Ethical concerns	32	28	44	34	27	33	34	49	32	43	38
Copyright infringements/intellectual property violations	35	26	40	35	22	38	30	34	32	30	28
Potential to replace me at my job	23	21	27	32	27	28	21	21	28	24	27

Data accessed Oct. 31, 2024.
Q. Which concerns, if any, do you have regarding the future of generative AI? Please select all that apply.
Base: All respondents (n=5,019).
Source: S&P Global Market Intelligence 451 Research's VoCUL: Connected Customer, Disruptive Experiences 2024.

AI's impact on labor

A deeper dive into skills and occupations

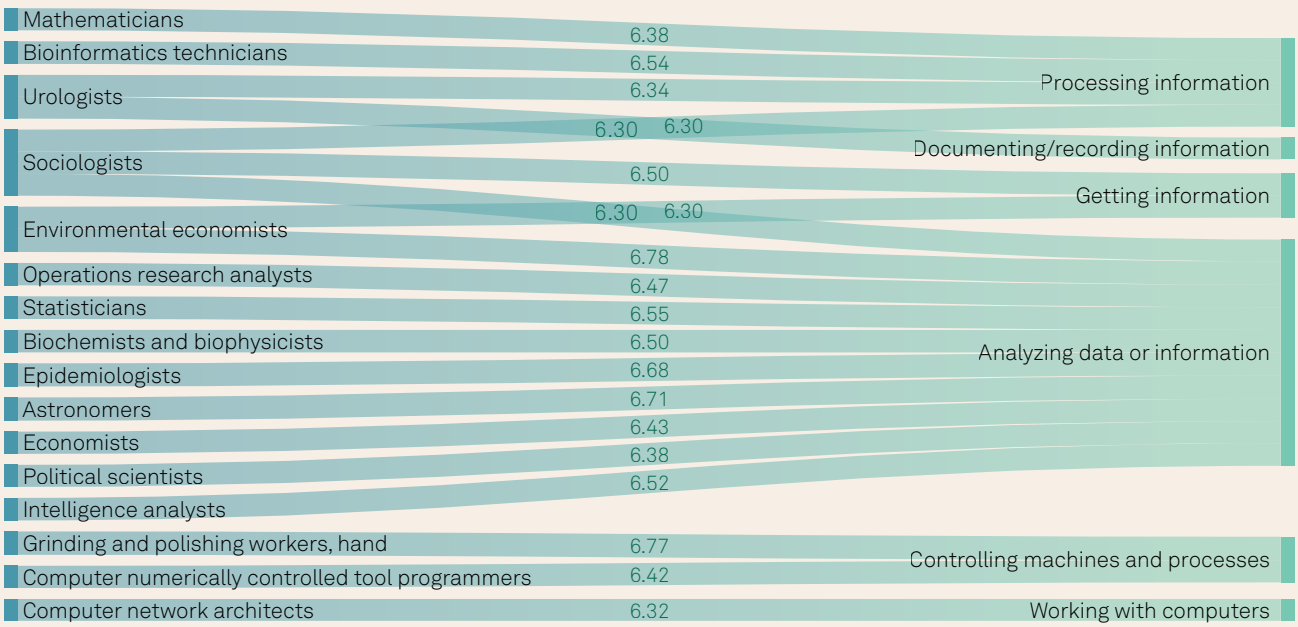
Multiple AI technologies, especially machine learning (ML) and generative AI (GenAI), could improve the speed, quality and efficacy of performance for a variety of jobs. These enhancements may not only streamline existing job processes but also redefine what is possible in many occupations.

To quantify the expected impact, we have used the US Labor Department's O*NET database to break down nearly 900 jobs into key component skills, then qualitatively scored those skills from 1 to 5 on their perceived "disruptability" by ML and GenAI. An analytical skill such as parsing swaths of data would readily incorporate AI, scoring at or near 5, while a personal care skill such as performing manicures is farther from AI disruption, scoring nearer to 1.

After scoring a range of skills for their susceptibility to disruption, we mapped those skills to associated occupations and assigned each occupation a composite score of 1-10 based on its concentration of disruption-prone skills. A job with a score of 1 means we expect little or no near-term disruption from AI, while 10 indicates the highest level of disruption.

Many jobs in the sciences reflect the highest level of AI disruption. However, this does not mean AI-based processes will replace humans in these jobs. Rather, the "firepower" provided by ML and GenAI should help practitioners of hard sciences such as chemists, physicists and materials scientists, as well as social scientists such as sociologists and economists, to make discoveries and advance new applications with unparalleled speed.

Occupations involving information analytics will likely experience high levels of disruption

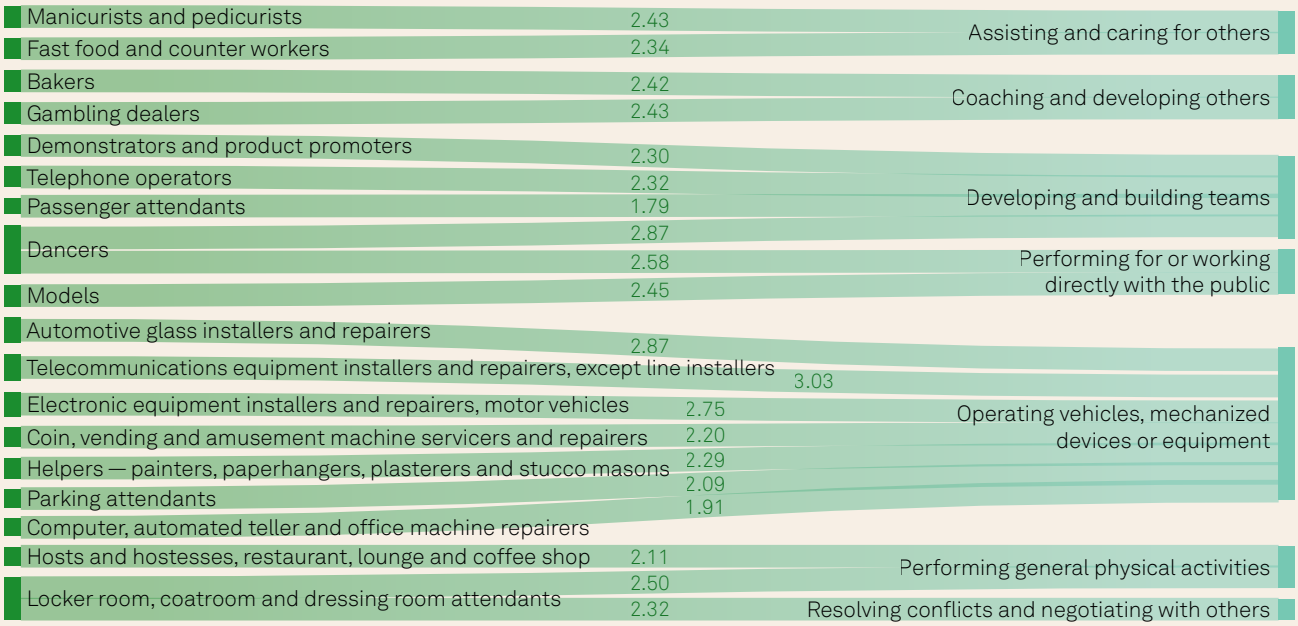


Data as of Oct. 11, 2024.
A score of 10 represents the highest projected level of occupational disruption from AI.
Sources: National Center for O*NET Development; S&P Global.

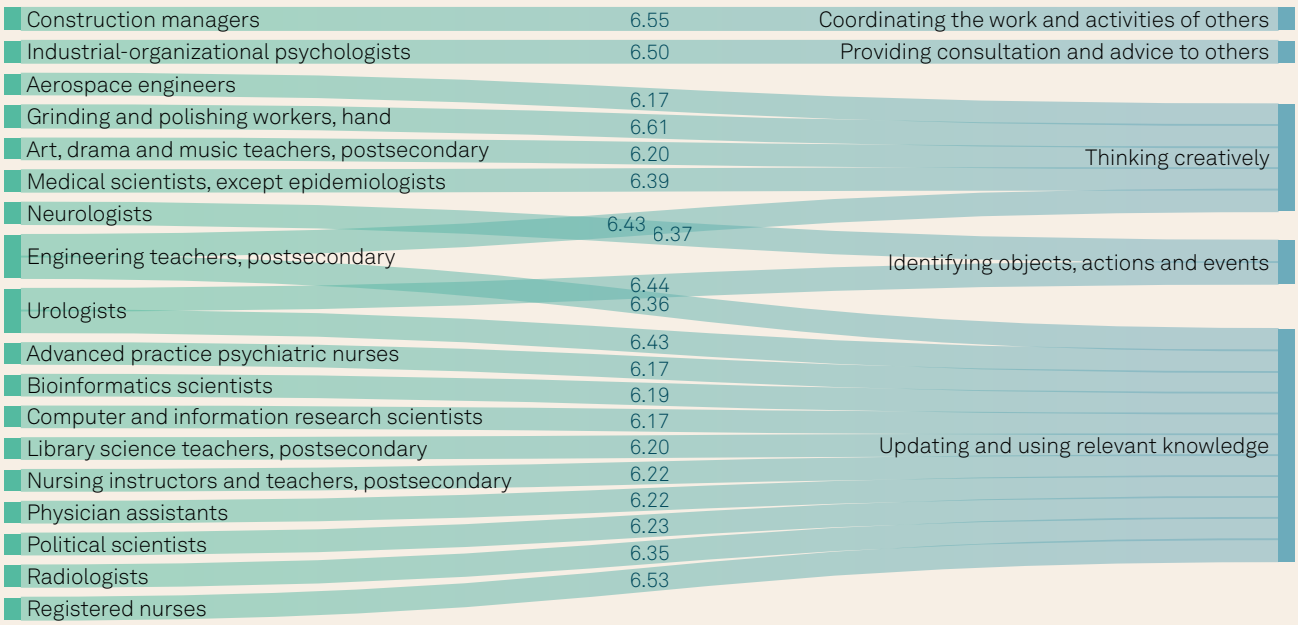
In contrast, occupations such as manicurists, models, bartenders, dancers and waiters will likely be minimally disrupted by ML and GenAI applications in the short term. However, these roles may be augmented by factors such as improved insight into customer preferences and better access to quality control as AI technology continues to develop.

Between these extremes, we expect a cross-section of occupations such as information security analysts, medical practitioners, fraud examiners and financial analysts will increasingly leverage AI for faster and deeper analysis, providing headroom to engage in human-centric skills such as interpersonal relations and creative or critical thinking.

Occupations focused on people skills and physical work are less likely to be impacted by AI in the near term



Many occupations, especially knowledge workers, will likely gain efficiency and headroom with AI

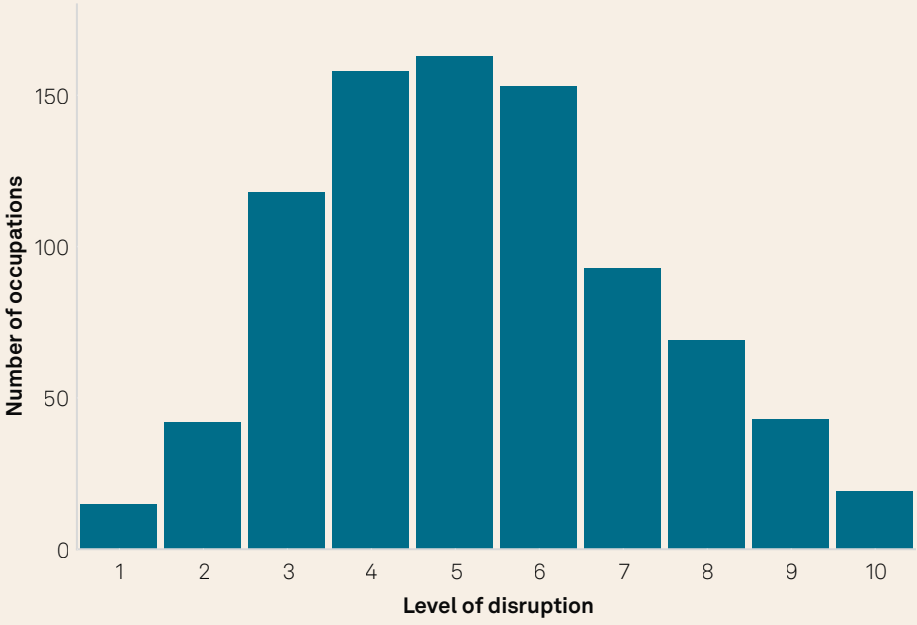


Data as of Oct. 11, 2024.
A score of 10 represents the highest projected level of occupational disruption from AI.
Sources: National Center for O*NET Development; S&P Global.

This nuance is critical because there is heightened concern in the workforce about job replacement by AI. While this is possible, we believe that fear of widespread job replacement is predicated on the misguided notion of a lack of incremental technological advancement among workers and occupations, and an absence of human-technological integration.

That premise is flawed: All jobs evolve with the introduction of new technologies, and a job may adapt depending on what skills are needed by human capital, which elements can be augmented by technology, and what value the combination of people and technology can bring to those who rely on the job's performance.

Distribution of occupations by projected level of AI disruption



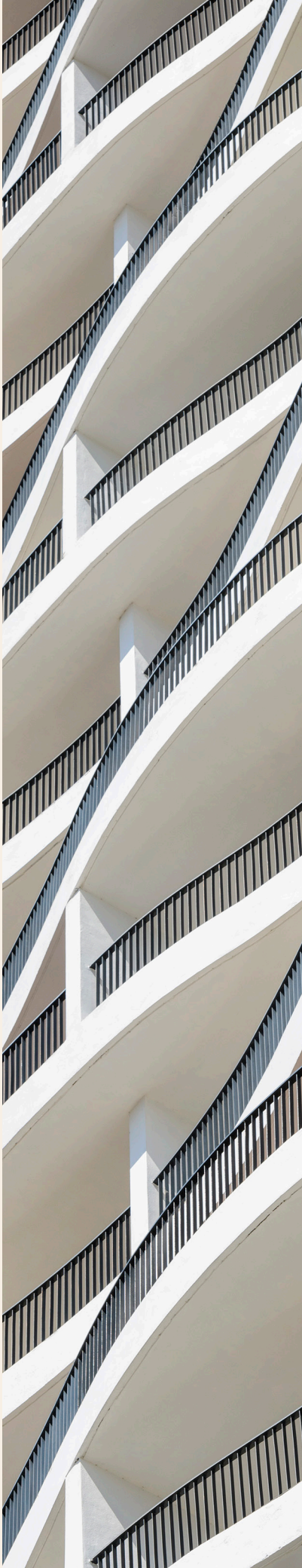
Data as of Oct. 11, 2024.
A score of 10 represents the highest projected level of occupational disruption from AI.
Sources: National Center for O*NET Development; S&P Global.

We estimate 85% of job skills will be significantly impacted by ML and GenAI (disruption score of 3 or greater), while 60% will be acutely impacted (disruption score of 4 or 5). When these are mapped to the top required skills by occupation, we see the plurality of jobs will be at least moderately disrupted.

Rather than ringing alarm bells, this illustrates a broad opportunity for AI to enhance customization, customer/stakeholder focus and adaptability through the combination of AI-augmentable skills, such as data processing and analysis, with human aptitudes such as creativity, critical thinking, relationship-building and personal service.

Many jobs will change with these new technologies, and society must rethink what the future could look like when AI and human intelligence coexist in a paradigm of mutualism. We expect that humans will need deeper relationship skills, including interpersonal and communication skills, empathy and emotional intelligence, as well as critical thinking and creative skills, while AI will need greater capabilities of context, performance and interoperability.

Most jobs will likely need people who can communicate and cooperate with machines in a way that maximizes their efficacy to deliver the highest value and service to those who need it. Success in this vein will require perhaps the most human skill of all: imagination.



Medium term: Significant advancements

Over the next three to five years, AI will significantly reshape labor markets, driven by increased investment in and knowledge of AI systems, and by competitive dynamics that should reduce AI's implementation costs.

We expect significant advancements in machine learning, natural language processing and robotics, particularly due to improvements in agent-based systems (in which AI systems make decisions and take actions), inference (applying learning from patterns in data) and orchestration (connecting processes and systems). During this period, it will be crucial to address AI's ethical considerations and privacy concerns as regulatory scrutiny will also increase. Wider deployment of AI will also raise the risk of automating deficiencies, including bias, in downstream processes.

Expansion of AI-augmented roles

As AI technologies mature, the scope of roles augmented by AI will expand, especially in fields such as marketing and customer analytics. For example, improvements in AI's ability to meaningfully analyze vast amounts of data on consumer behavior and preferences will facilitate highly personalized marketing campaigns (akin to personalized treatment plans in healthcare). In education, AI-driven platforms will offer bespoke learning experiences, including educational content tailored to individual student needs and pacing, and corporate and client training that meets specific demands.

Emergence of new job categories

An increasing focus on governance, risk mitigation, bias mitigation and other AI-related issues will foster the emergence of new job categories. For example, AI trainers and explainability experts will be needed to ensure that AI systems are fit for purpose, transparent, understandable, and compliant with existing systems and governance frameworks. Skills to address and monitor AI ethics and quality will be crucial for responsible AI deployment, including the safeguarding of fairness and identification of biases.

Long term: Transformative changes

AI will become increasingly transformative over longer time frames due to the technology's advancing maturity, humanity's growing expertise in effective implementation and the regulatory landscape's increasing clarity. Collaborative intelligence, a framework in which humans and AI work together, should notably increase.

In creative industries, AI will assist humans by generating ideas, drafts and prototypes. Architects, for example, could use AI-driven design software to explore innovative building designs that incorporate complex environmental and structural factors, leveraging datasets that encompass architectural history, art, design, materials science and weather patterns.

Autonomous systems

AI will support autonomous systems that transform industries. Autonomous vehicles will revolutionize transportation and logistics, reducing the need for human drivers and increasing efficiency. In agriculture, AI-powered robots with computer vision and sensors to detect air pressure, moisture, color and light could oversee planting, crop monitoring and harvesting, increasing productivity and sustainability. Challenges will include cost-effectiveness, which must surpass that of human labor to justify adoption.

Predictive maintenance

Manufacturing and heavy industries will benefit from AI-enabled predictive maintenance. AI will analyze data from sensors embedded in machinery to predict when maintenance is required, preventing costly breakdowns and minimizing downtime. This capability requires AI's data processing and pattern recognition abilities, coupled with digital telemetry systems to detect acoustic, visual and even olfactory signals.

Autonomous data analysis

In fields such as finance and research, AI-driven data analysis is already indispensable. AI systems can sift through vast amounts of data, identify trends and generate insights with speed and accuracy far beyond human capacity. This capability

will be increasingly crucial for making informed decisions in dynamic environments and will enable a better understanding of the world around us, including risks such as climate change, the energy crisis and geopolitical dynamics.

Shifting labor dynamics

Advancements in the capabilities of AI systems and the dynamics of their integration with human labor will necessitate broader rethinking to understand the adaptations required of both AI and human work paradigms to improve cooperation.

Humans, for instance, outperform machines in relational tasks such as comprehensive (verbal and nonverbal) communication and, at least to date, innovation. Thus, in a framework of human-AI mutualism, we expect the balance of such tasks to fall to humans, while many data analysis and computational tasks will fall to AI. This may require workforce education in interpersonal skills such as emotional intelligence, empathy and clarity of communication. Humans will also need better human-to-AI communication skills, such as prompt engineering, and a deeper understanding of AI operational requirements.

Consider a typical customer service scenario: A customer is unsatisfied with the quality of goods received. In a world where AI and humans work together, required skills include understanding the customer's problem (human), analyzing possible solutions (AI), relaying options with empathy to address the customer's emotional and social needs (human), and executing a course of action to address functional needs (AI).

Leadership and the workplace of choice

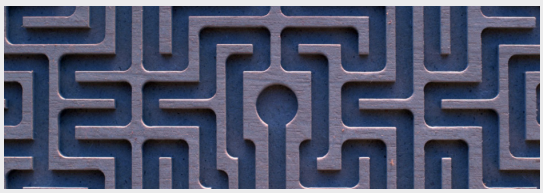
Leadership in an AI-augmented world will evolve as workers look to their leaders for vision, systems thinking, and the ability to both analyze (extrapolate trends using context, qualitative judgments and data-driven insights) and synthesize (understand the interoperability of moving parts and connection to a greater whole). As leaders will manage humans and AI systems together, the importance of these abilities cannot be overstated.

Analytical functions will become more crucial as AI adoption takes hold, requiring leaders to adapt to increasing customization and diversification of product offerings, as well as to the interplay of skilled workers and AI systems required to deliver those products. An understanding of synthesis will be critical as many traditional work functions and systems become intersecting, looping and chained processes in increasingly complex designs.

Such complexity will likely change what humans demand of their workplaces. Traditional compensation schemes such as salary and variable pay will likely be augmented by purpose, culture and fit as an increasing proportion of tasks allocated to human workers will require distinctly human capabilities, such as emotional and social engagement. Organizations must recognize that their brand represents not only their product or service offerings or standard of quality to customers but also a workplace of choice for employees. Workplaces will need to earn their employees' business, especially as employees' nuanced personalities and skills become features in the workplace itself, as much of the labor characterized by homogeneity becomes the province of AI systems.

Looking forward: From steam to silicon

The idea of the modern-day John Henry will remain relevant as AI's remit expands and matures. However, it is equally likely that many mundane, monotonous and undesirable elements of work could become increasingly automated, and that, as a result, humans — particularly those who learn to work in partnership with AI — may find increasing value and standing in the labor force by cultivating and expressing their most fundamentally human qualities.



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