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Which U.S. Workers Are More Exposed to AI on Their Jobs?

About a fifth of all workers have high-exposure jobs; women, Asian, college-educated and higher-paid workers are more exposed. But those in the most exposed industries are more likely to say AI will help more than hurt them personally

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How we did this

Pew Research Center conducted this study to understand how American workers may be exposed to artificial intelligence (AI) at their jobs. The study emphasizes the impact of AI on different groups of workers, such as men and women and racial and ethnic groups, and it includes new survey findings on how American adults think AI will impact them personally, setting it apart from preceding analyses.

By exposure to AI, we refer to the likelihood that the activities workers perform on their jobs may be replaced or aided by artificial intelligence. We make no determination as to whether workers may lose their jobs as a result or gain new jobs, and we also do not consider the role of robots.

Most of the analysis is based on data from the Occupational Information Network (O*NET), Version 27.3. O*NET analysts rate the importance of 41 work activities related to job performance in individual occupations. We grouped these activities into three categories based on their likely exposure to AI: low exposure, medium exposure and high exposure. Occupations were ranked by the relative importance of low or high exposure activities. Those in the top quarter of each ranking are the least or most exposed occupations. The remaining occupations have medium exposure.

Data on the employment and earnings of workers in individual occupations and their demographic profiles are from the Current Population Survey (IPUMS). Monthly files from January to December 2022 were combined to form an annual file. Earnings data is available for a quarter of this sample. The AI-exposure rankings of 873 detailed occupations from the O*NET data are matched to 485 broader occupations listed in the CPS.

A part of the analysis is based on a Pew Research Center survey of 11,004 U.S. adults conducted from Dec. 12 to 18, 2022. Everyone who took part in the survey is a member of the Center's American Trends Panel (ATP), an online survey panel that is recruited through national, random sampling of residential addresses. This way, nearly all U.S. adults have a chance of selection. The survey is weighted to be representative of the U.S. adult population by gender, race, ethnicity, partisan affiliation, education and other categories. Read more about the ATP's methodology.

Here are the questions used for this report, along with responses, and its methodology.

Terminology

Artificial intelligence (AI): Broadly speaking, AI refers to a range of applications of machine learning, computer vision and natural language processing that allow computers or machines to perform tasks autonomously. AI can substitute for or complement a variety of human tasks, such as writing, drawing, providing customer service, reading radiology scans, driving cars and more. ChatGPT and Dall-E are examples of AI-driven technologies.

Low or high exposure to AI: We rated a set of 41 job-related work activities common to all occupations as having low, medium or high exposure to AI. How much an occupation is exposed to AI depends on which of these work activities is more important in that particular job. The importance scale runs from one (not important) to five (extremely important). In this report, we focus on the importance of low- and high-exposure activities. In one step of analysis, occupations are ranked by the relative importance of high exposure activities in them; the jobs ranking in the top 25% are occupations that we rate as most exposed to AI. In another step, occupations are ranked by the relative importance of low-exposure activities in them. Those ranking in the top 25% are occupations that are least exposed to AI. A full description of the ranking process is in the methodology.

The terms **occupation** and **job** are often used interchangeably in the report, as are the terms **earnings** and **wages**.

White, Black, Asian and **American Indian or Pacific Islander** workers include those who report being only one race and are not Hispanic. **Hispanics** are of any race.

High school graduate refers to those who have a high school diploma or its equivalent, such as a General Education Development (GED) certificate, and those who had completed 12th grade, but their diploma status was unclear (those who had finished 12th grade but not received a diploma are excluded). Adults with **some college** include those with an associate degree and those who attended college but did not obtain a degree.

U.S. born refers to individuals who are U.S. citizens at birth, including people born in the 50 U.S. states, the District of Columbia, Puerto Rico or other U.S. territories, as well as those born elsewhere to at least one parent who is a U.S. citizen. The terms **foreign born** and **immigrant** are used interchangeably in this report. They refer to people who are not a U.S. citizen at birth.

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Which U.S. Workers Are More Exposed to AI on Their Jobs?

About a fifth of all workers have high-exposure jobs; women, Asian, college-educated and higher-paid workers are more exposed. But those in the most exposed industries are more likely to say AI will help more than hurt them personally

Artificial intelligence (AI) recently gained new attention with the release of ChatGPT and Dall-E. These tools and the broader array of AI-driven business applications represent a new reality for workers.

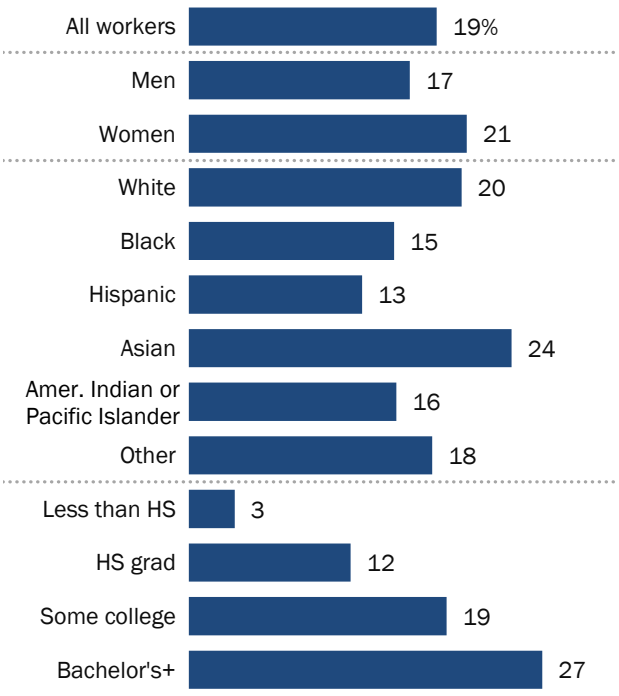
Historically, changes in technology have often automated physical tasks, such as those performed on factory floors. But AI performs more like human brainpower and, as its reach grows, that has raised questions about its impact on professional and other office jobs – questions that Pew Research Center seeks to address in a new analysis of government data.

What we found

- In 2022, **19% of American workers were in jobs that are the most exposed to AI**, in which the most important activities may be either replaced or assisted by AI.
- **23% of workers have jobs that are the least exposed to AI**, in which the most important activities are farther from the reach of AI. Other workers, nearly six-in-ten in all, are likely to have varying levels of exposure to AI.

What shares of workers are most exposed to AI in their jobs?

% of U.S. workers employed in jobs that are the most exposed to AI in 2022



Note: Occupations are ranked by the relative importance of work activities with high exposure to AI. Those in the top 25% are the "most exposed," some 122 in number. Estimates by education level are for workers ages 25 and older. White, Black, Asian, and American Indian or Pacific Islander workers include those who report being only one race and are not Hispanic. "Other" includes all other single race groups and people reporting two or more races. Hispanics are of any race.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
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- Jobs with a high level of exposure to AI **tend to be in higher-paying fields where a college education and analytical skills can be a plus.**

Certain groups of workers have higher levels of exposure to AI

- **Those with more education:** Workers with a bachelor's degree or more (27%) are more than twice as likely as those with a high school diploma only (12%) to see the most exposure.
- **Women:** A greater share of women (21%) than men (17%) are likely to see the most exposure to AI. This is because of differences in the types of jobs held by men and women.
- **Asian and White:** Asian (24%) and White (20%) workers are more exposed than Black (15%) and Hispanic (13%) workers.
- **Higher-wage workers:** In 2022, workers in the most exposed jobs earned $33 per hour, on average, compared with $20 in jobs with the least amount of exposure.

Workers seem more hopeful than concerned about the impact of AI on their jobs

- A recent Pew Research Center survey finds that many U.S. workers in more exposed industries do not feel their jobs are at risk – they are more likely to say AI will help more than hurt them personally. For instance, 32% of workers in information and technology say AI will help more than hurt them personally, compared with 11% who say it will hurt more than it helps.

Which jobs are more exposed to AI? Work-related tasks vary in their exposure to AI. Some activities, such as repairing equipment, may have low exposure to AI, while others may have a medium or a high degree of exposure. Also, activities with different levels of exposure may be equally important within many jobs.

In our analysis, jobs are considered *more exposed* to artificial intelligence if AI can either perform their most important activities entirely or help with them.

For example, AI could replace, at least to a degree, the tasks "getting information" and "analyzing data or information," or it could help with "working with computers." These are also

Jobs in U.S. that are likely to have high, medium or low exposure to AI

High exposure
- Budget analysts
- Data entry keyers
- Tax preparers
- Technical writers
- Web developers

Medium exposure
- Chief executives
- Veterinarians
- Interior designers
- Fundraisers
- Sales managers

Low exposure
- Barbers
- Child care workers
- Dishwashers
- Firefighters
- Pipelayers

Note: Occupations are grouped by the relative importance of work activities with low, medium or high exposure to AI.
Source: Pew Research Center analysis of O*NET (Version 27.3).
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among the key tasks for judicial law clerks and web developers, and they are more exposed to AI than other workers. However, AI alone cannot "assist and care for others" or "perform general physical activities." Thus, nannies – for whom these are essential activities – are less exposed to AI.

In our analysis, jobs that placed in the top 25% when ranked by the importance of work activities with *high exposure* to AI were judged to be the most exposed. Jobs that placed in the top 25% when ranked by the importance of work activities with *low exposure* to AI are the least exposed. The remaining jobs, such as chief executives, are likely to see a medium level of exposure to AI. (Refer to the appendix for an extended list of examples of occupations in each group.)

Will exposure to AI lead to job losses? The answer to this is unclear. Because AI could be used either to replace or complement what workers do, it is not known exactly which or how many jobs are in peril. For this reason, our study focuses on the level of *exposure* jobs have to AI. It sets aside the question of whether this exposure will lead to jobs lost or jobs gained.

Consider customer service agents. Evidence shows that AI could either replace them with more powerful chatbots or it could enhance their productivity. AI may also create new types of jobs for more skilled workers – much as the internet age generated new classes of jobs such as web developers. Another way AI-related developments might increase employment levels is by giving a boost to the economy by elevating productivity and creating more jobs overall.

Overall, AI is designed to mimic cognitive functions, and it is likely that higher-paying, white-collar jobs will see a fair amount of exposure to the technology. But our analysis doesn't consider the role of AI-enabled machines or robots that may perform mechanical or physical tasks. Recent evidence suggests that industrial robots may reduce both employment and wages. Moreover, jobs held by low-wage workers, those without a high school diploma, and younger men are more exposed to the effects of industrial robots.

What data did we use? This analysis rests on data on the importance of 41 essential work activities in 873 occupations from the U.S. Department of Labor's Occupational Information Network (O*NET, Version 27.3). We used our judgment to determine which of these activities have low, medium or high exposure to AI, but focus on the importance of low- and high-exposure activities. For additional analysis, the 873 occupations were further grouped to a total of 485 for which government data on employment and earnings of workers were available. That allowed us to analyze the potential impact of AI on different groups of workers. Other findings about how workers feel about AI come from a Center survey of 11,004 U.S. adults conducted between Dec. 12 and 18, 2022. (Refer to the text boxes and methodology for more details.)

Our other key findings

- **Most workers are more likely to work in jobs with less exposure to AI than in jobs with more exposure.** This is true among men, Black and Hispanic workers, younger workers, and workers with less formal education, among others.
- **Asian workers and college graduates are among the highest paid of workers most exposed to AI.** The most exposed workers earn more than the least exposed workers no matter their demographic characteristic, and the gap is especially striking among men, Asian workers and foreign-born workers.
- **Analytical skills are more important in jobs with more exposure to AI.** These skills include critical thinking, writing, science and mathematics. Mechanical skills, such as equipment maintenance, are more important in jobs with less exposure to AI.
- **Scarcely any U.S. businesses – less than 3% – reported using advanced technologies such as machine learning or machine vision software to produce goods or services in 2020,** according to the most recent available data from the U.S. Census Bureau. Still, these were large businesses who accounted for about 11% to 16% of overall employment.

Jump to:

- Exposure of workers to AI
- Earnings of workers with more, or less, exposure to AI
- Workers' views on the risk of AI to their jobs
- Skills needed in high- and low-exposure jobs
- Use of AI-related technologies by U.S. businesses

How we determined the degree to which jobs are exposed to artificial intelligence

In our analysis, we considered two major questions when assessing the exposure of jobs to AI:

1. *What is the likelihood that a work activity may be substituted for or complemented by AI at this time? Is the likelihood high, medium or low?*

2. *How important are activities with high or low exposure to AI in any given job, relative to the importance of other activities?*

Classifying work activities by exposure to AI

The O*NET database lists a set of 41 work activities in common across all occupations. Examples of these activities are getting information, selling or influencing others, and handling and moving objects (refer to the methodology for the complete list). We used our collective judgment to designate each activity as having high, medium or low exposure to AI. Consensus on some activities, such as performing general physical activities or processing information, was reached quickly. The former is judged as having low exposure to AI and the latter is judged as having high exposure.

In other instances, we used additional details on a work activity to reach consensus. The question we asked ourselves at this stage was the following:

Are most of the detailed tasks that comprise a work activity exposed to AI?

For example, the job activity "performing for or working directly with the public" is ambiguous on the surface. But consider the list of detailed tasks that comprise this broad activity:

- Audition for roles
- Perform for recordings
- Perform music for the public
- Collaborate with others to prepare or perform artistic productions
- Entertain public with comedic or dramatic performances
- Perform dances
- Operate gaming equipment
- Conduct amusement or gaming activities
- Respond to customer problems or complaints
- Respond to customer inquiries
- Answer customer questions about goods or services
- Communicate with customers to resolve complaints or ensure satisfaction
- Resolve customer complaints or problems
- Correspond with customers to answer questions or resolve complaints

The consensus we reached was that most of these detailed tasks, such as interfacing with customers or creating music, had a high degree of exposure to AI. Only a few tasks – auditioning, comedic or dramatic performances and dancing – were considered to have relatively low exposure to AI. For that reason, the broad activity "performing for or working directly with the public" is deemed to have high exposure to AI.

How we determined the degree to which jobs are exposed to artificial intelligence *(continued)*

At the other end of the exposure scale is the work activity "coaching and developing others," entailing:

- Coach others
- Encourage patients during therapeutic activities
- Visit individuals in their homes to provide support or information
- Encourage students
- Interact with patients to build rapport or provide emotional support
- Support the professional development of others
- Encourage patients or clients to develop life skills

The focus of most of these detailed tasks involves personal interaction. So, we judged that the activity "coaching and developing others" has low exposure to AI.

Overall, 16 work activities were assessed to have high exposure to AI, 16 more were judged to have medium exposure, and nine were deemed to have low exposure. (Refer to the methodology for where each activity was classified.)

Determining the level of exposure of a job to AI

The 41 work activities listed in O*NET are spread across all occupations in the O*NET database. That is to say, each occupation is a mix of low, medium and high AI-exposure activities. The question then is:

> *Which work activities are relatively more important in a job? Are high- or low-exposure activities more important than other activities?*

To answer this, we first estimated the averages of the importance ratings for high-, medium- and low-exposure activities in each job, where the rating of each activity within a category is taken from the O*NET database. The rating for each activity ranges from one (not important) to five (extremely important).

Overall, among the 873 occupations we looked at, high-exposure activities were rated as being important to extremely important in 77% of occupations, and medium-exposure activities were similarly important in 72% of occupations. Low-exposure activities were rated as important in 39% of occupations. This suggests that high, medium and low exposure could simultaneously be important in a job.

The final step was to estimate the *relative* importance of high-, medium- or low-exposure activities in each job – that is, to determine which tasks are more important than the others in any given job. This procedure is described in the methodology. Occupations were then ranked two ways, once by the relative importance of high-exposure work activities and again by the relative importance of low-exposure work activities.

In our analysis, jobs that are most exposed to AI are in the top 25% of occupations ranked by the relative importance of high-exposure activities. Jobs that are least exposed to AI are in the top 25% of occupations ranked by the relative importance of low-exposure work activities. The other jobs may be thought of as having a medium level of exposure to AI. (Refer to the appendix for examples of occupations that are among the most or least exposed or have a medium level of exposure.)

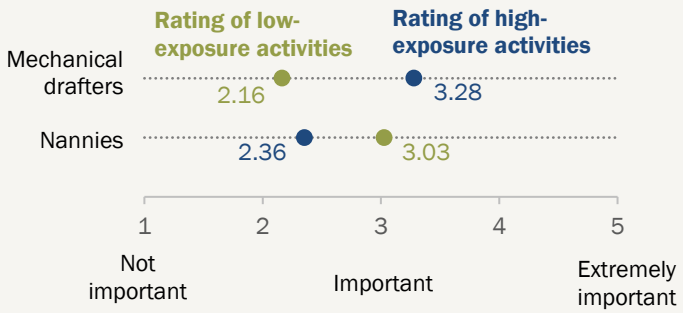
How we determined the degree to which jobs are exposed to artificial intelligence *(continued)*

To take an example, consider mechanical drafters, who prepare detailed working diagrams of machinery and mechanical devices. Mechanical drafters are among the workers most exposed to AI. For them, high-exposure activities have an average rating of 3.28 but low-exposure activities have an average rating of 2.36, where a rating of 3 means an activity is important.

For nannies, among the least exposed workers, high-exposure activities have an average rating of 2.36 but low-exposure activities have a rating of 3.03.

Activities with high exposure to AI are more important for mechanical drafters, less important for nannies

Average importance ratings of low and high AI exposure activities



Source: Pew Research Center analysis of O*NET (Version 27.3).
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Previous research on the impact of AI on U.S. workers

Our analysis follows in the footsteps of other researchers who have recently examined the impact of AI on the workplace. Eloundou, Manning, Mishkin and Rock (March 2023) conclude that about one-in-five U.S. workers may see an impact on half or more of their job tasks. Felten, Raj and Seamans (April 2021) find that white-collar occupations requiring advanced degrees are most exposed to AI, as are industries providing financial or legal services. Webb (January 2020) reports that high-skill occupations, highly educated and older workers will be more impacted by AI, but he does not draw conclusions about the nature or the extent of the impact on workers. Our findings are broadly consistent with the results of these analyses.

1. Exposure of workers to AI

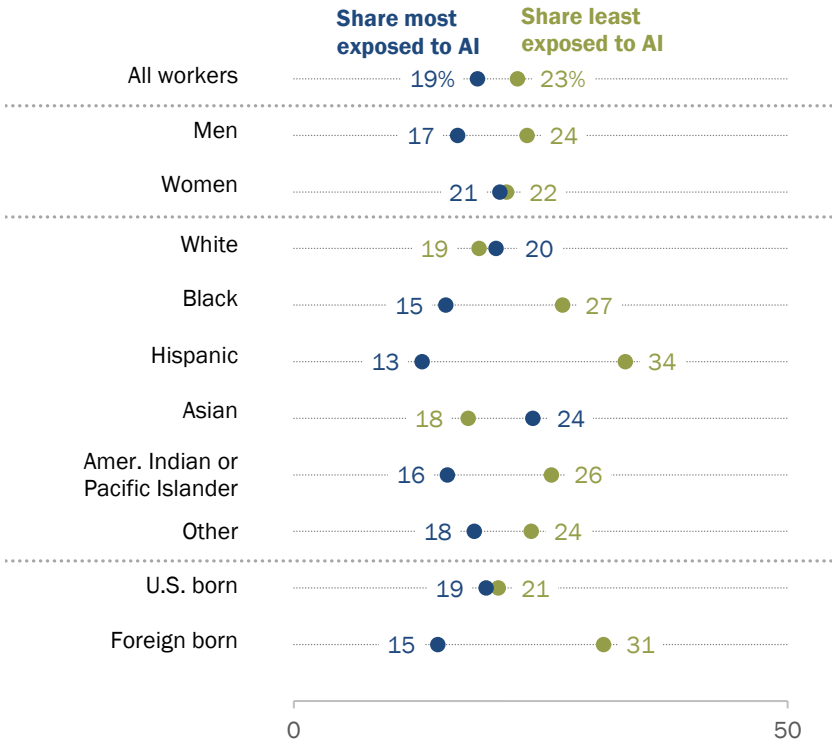
Although artificial intelligence may appear to be everywhere all at once, workers overall are more likely to be in jobs that are the least exposed to AI than the most exposed. In 2022, nearly one-in-four U.S. workers (23%) were employed in the least exposed jobs, compared with one-in-five workers (19%) in the most exposed jobs, our analysis found.

This difference applies across most groups of workers, arising from differences in the types of jobs they do. For instance, men are more likely than women to work in jobs in which physical or manual tasks are performed, such as in construction, production, repair and maintenance occupations. Our analysis shows that 24% of men worked in jobs that are least exposed to AI in 2022, while 17% were in the most exposed jobs. However, women are about equally likely to work in jobs that are the most or the least exposed to AI.

Black, Hispanic, and American Indian or Pacific Islander workers are more likely than other racial and ethnic groups to be employed in the least exposed jobs by large margins. For instance, only 13% of Hispanic workers are in jobs that are the most exposed to AI, compared with 34% who are in the least exposed jobs.

More workers are in jobs that are least exposed to AI than in jobs that are most exposed to AI

% of U.S. workers employed in jobs that are the most or the least exposed to AI in 2022



Note: Occupations are ranked by the relative importance of work activities with high or low exposure to AI. Those in the top 25% are the "most exposed" or the "least exposed," about 120 each in number. White, Black, Asian, and American Indian or Pacific Islander workers include those who report being only one race and are not Hispanic. "Other" includes all other single race groups and people reporting two or more races. Hispanics are of any race.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
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Black and American Indian or Pacific Islander workers are more likely to be employed in the least

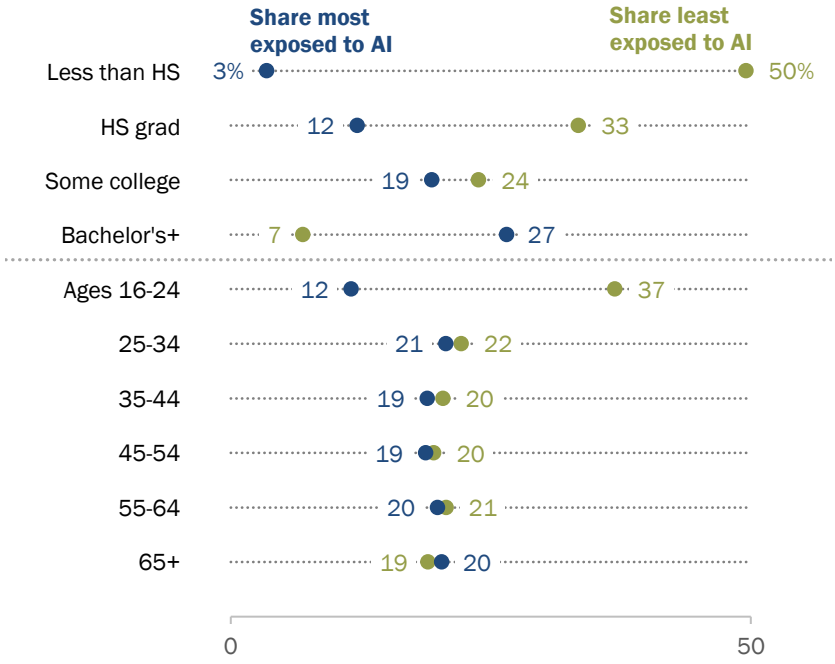
exposed jobs by a margin of about 10 percentage points each. Asian workers, who are more likely than average to work in professional and technical occupations, are a notable exception: Their share in the most exposed jobs exceeds the share in the least exposed jobs by a margin of 6 points.

The share of foreign-born workers in the least exposed jobs is about double the share in the most exposed jobs – 31% vs. 15%. This is perhaps because about half of the foreign-born workers in the U.S. are Hispanic, and foreign-born workers overall are more likely to work in construction, maintenance occupations and production occupations.

Half of workers without a high school diploma and a third of those with a high school diploma only hold jobs with the least exposure to AI. Workers with these levels of education comprised about 31% of the U.S. labor force ages 25 and older in 2022. But only 7% of workers with a bachelor's degree or higher level of education – 44% of the U.S. workforce 25 and older – are in the least exposed jobs.

Younger workers and workers with less formal education are least exposed to AI

% of U.S. workers employed in jobs that are the most or the least exposed to AI, 2022



Note: Occupations are ranked by the relative importance of work activities with high or low exposure to AI. Those in the top 25% are the "most exposed" or the "least exposed," about 120 each in number. Estimates by education level are for the sample of workers ages 25 and older.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
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Except for those ages 16 to 24, about one-in-five workers in all age groups are likely to see either a high or a low degree of exposure to AI. The youngest workers are about three times as likely to work in the least exposed jobs as in the most exposed jobs – 37% vs. 12%.

A handful of occupations account for large shares of men and women who have high exposure to AI

Overall, nearly 13 million men and 14.6 million women were employed in 2022 in occupations that have the most exposure to AI. Among these occupations, some 825,000 men worked as sales representatives alone. The top five jobs for men among the most exposed occupations accounted for a total of 3.6 million jobs for them, representing 28% of all men facing the greatest exposure to AI.

This concentration is even more pronounced for women. Some 5.8 million women who face the most exposure to AI on their jobs were employed in just five occupations, representing 40% of the total. These jobs are largely administrative in nature, with accounting and auditing jobs exposing large numbers of both men and women to AI.

Jobs with high exposure to AI that employ the most men and women

Among the U.S. jobs most exposed to AI, the top 5 that employed the greatest number of men and women, 2022

Men	Number employed (thousands)
All jobs with the most exposure to AI	*12,962*
Sales representatives, wholesale and manufacturing	825
Lawyers	731
Computer occupations, all other	720
Couriers and messengers	690
Accountants and auditors	682
Women	
All jobs with the most exposure to AI	*14,572*
Secretaries and administrative assistants, except legal, medical and executive	1,775
Office clerks, general	1,060
Receptionists and information clerks	1,059
Accountants and auditors	973
Bookkeeping, accounting and auditing clerks	964

Note: Occupations are ranked by the relative importance of work activities with high exposure to AI. Those in the top 25% are the "most exposed," about 120 in number. "Computer occupations, all other" refers to miscellaneous computer-related jobs not explicitly listed in the source data. Explicitly listed jobs include computer programmers, web developers, computer systems analysts and several others.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
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2. Earnings of workers with more, or less, exposure to AI

In 2022, the average hourly earnings of workers in the jobs most exposed to artificial intelligence stood at $33, compared with $20 in jobs with the least amount of exposure. Men working in high-exposure jobs earned $39 per hour, much greater than the earnings of men in the least exposed jobs. Women in high-exposure jobs made $28 per hour, also notably more than what the least exposed women earned, according to our analysis. (Dollar amounts are expressed in 2022 prices.)

Workers in jobs most exposed to AI also earn more than workers likely to see a medium level of exposure. These workers, in jobs neither the most nor the least exposed to AI, earned $30 per hour, on average. Men in these jobs made $31 per hour, but women earned $29 per hour, about the same as women most exposed to AI.

Asian workers and college graduates are among the highest paid of workers most exposed to AI

Looking at other groups of workers, the average hourly earnings of workers in the jobs most exposed to AI ranged from $19 for those without a high school diploma to $41 for Asian workers and college graduates in 2022. In part, this is because not all groups of workers have the same jobs within the broader set of occupations most exposed to AI. For instance, Asian workers represent 8% of employment in the most exposed occupations, but they account for about a third of all computer hardware engineers. Similarly, college graduates are more likely than average to be aerospace engineers or in similar jobs.

Higher-wage workers are more exposed to AI

Average hourly earnings of U.S. workers in jobs most or least exposed to AI, 2022

Note: Occupations are ranked by the relative importance of work activities with high or low exposure to AI. Those in the top 25% are the "most exposed" or the "least exposed," about 120 each in number.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) outgoing rotation groups file.
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No matter their demographic characteristic, the most exposed workers earn more than the least exposed workers. Among racial and ethnic groups, Asian workers employed in the most exposed jobs earned about twice as much as Asian workers in the least exposed jobs – $41 vs. $20.

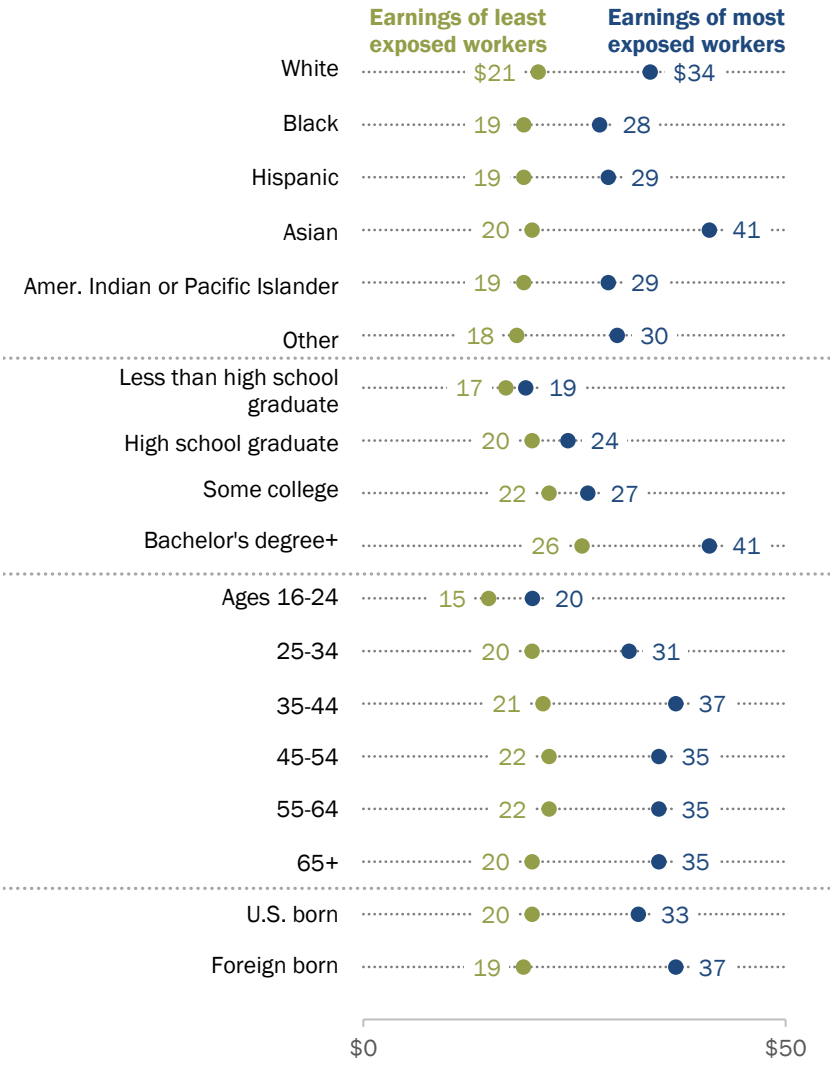
Across education levels, the largest gap in earnings surfaces among those with college degrees. The most exposed college graduates earned $41 per hour in 2022 and the least exposed earned $26 per hour. A gap of about $11 to $16 per hour prevails among all workers ages 25 and older.

Foreign-born workers who are most exposed to AI are also among the higher-paid workers, making $37 per hour in 2022. This was about double the earnings of foreign-born workers who are the least exposed ($19). The earnings gap among U.S.-born workers is less pronounced but still large.

Most groups of workers in the most exposed jobs also typically earn about as much as or more than workers in jobs with a *medium* level of exposure to AI. For instance, Asian workers in the most exposed jobs earned $41 per hour, compared with $35 per hour among Asian workers in jobs with a medium level of exposure. Several other groups of workers in the most exposed jobs earned about $2 to $4 more per hour than workers in jobs with more mid-level exposure to AI. (Refer to the appendix for the full set of estimates.)

Asian workers and college graduates are among the highest-paid of workers most exposed to AI

Average hourly earnings of U.S. workers in jobs most or least exposed to AI, 2022



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Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) outgoing rotation groups file.
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3. Workers' views on the risk of AI to their jobs

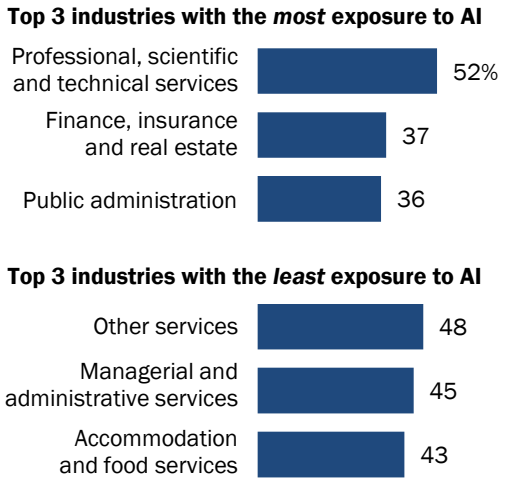
One reason artificial intelligence will penetrate more deeply into some sectors of the U.S. economy than others is that the mix of jobs varies across industries.

We found in our analysis that about half of workers (52%) in the professional, scientific and technical services sector face a high degree of exposure to AI, more than double the rate for workers overall. Exposure is also much greater than average for workers in finance, insurance and real estate (37%) and public administration (36%).

At the other end of the spectrum, about half of workers (48%) in the other services sector, including repair, maintenance, personal and household services, are likely to experience little exposure to AI. More than four-in-ten workers in managerial and administrative services (45%) and accommodation and food services (43%) should see relatively minimal exposure to AI. These are sectors in which workers, like nannies, are more likely to engage in physical or social tasks. (The appendix provides a complete list of industries and their exposure to AI.)

Which industries will see the most or least exposure to AI?

% of U.S. workers in an industry who are most likely to see high or low exposure to AI, 2022



Note: Occupations are ranked by the relative importance of work activities with high or low exposure to AI. Those in the top 25% are the "most exposed" or the "least exposed," about 120 each in number. The chart shows the shares of workers in each industry employed in the most or least exposed occupations. "Other services" includes repair and maintenance, personal and laundry services, membership organizations and private household services.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
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Workers in more exposed industries see less risk to their jobs from AI

A recent Pew Research Center survey shows that many workers who are likely to see more exposure to AI do not necessarily feel their jobs are at risk. In particular, U.S. adults working in the most exposed industries are less concerned about the impact of AI on them personally.

In the survey, 16% of all U.S. adults said they think AI will help more than hurt them personally over the next 20 years, and 15% said they thought AI would hurt more than help. But workers in different industries had notably different views on this question. Our new analysis shows that about one-third (32%) of workers in the information and technology sector said that AI will help

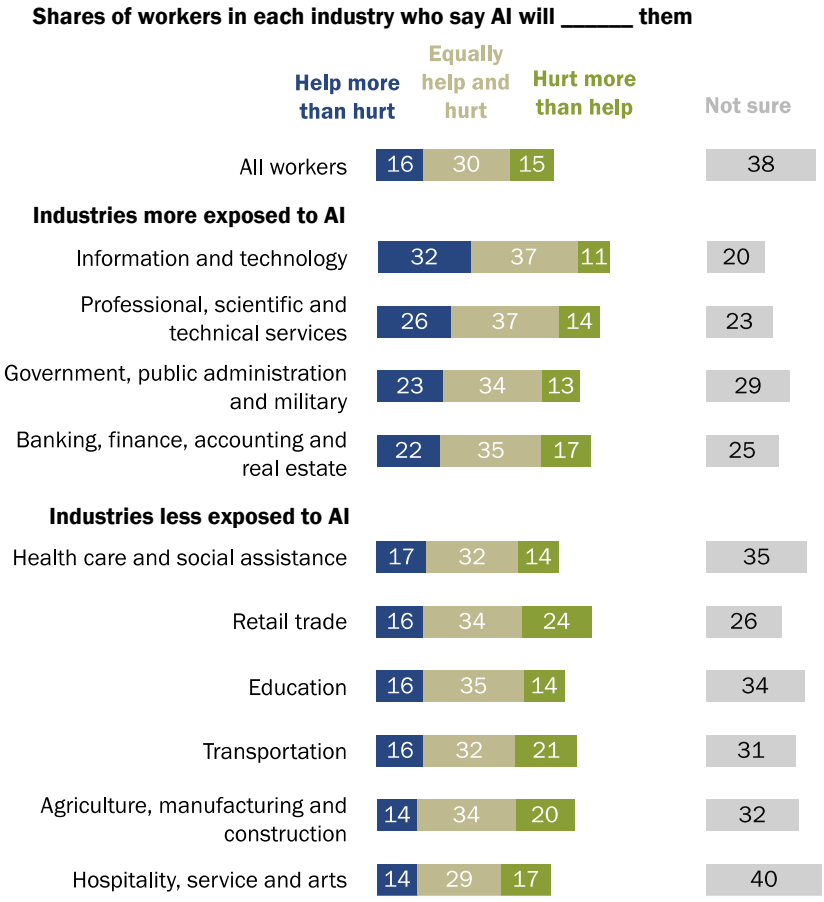
more than hurt them personally. Another 37% said AI will equally help and hurt, and only 11% said it will hurt more than help.

Additionally, about one-in-four workers in professional, scientific and technical services (26%) said AI will help more than hurt, and 23% in government, public administration and military said the same.

In contrast, relatively few workers in hospitality, services and arts (14%) think AI will help more than hurt them personally. Four-in-ten workers in this sector are not sure about AI's potential impact on them, which is among the higher shares across industries. There is a similar variance in the opinion of workers across industries about whether the use of AI in the workplace will help or hurt the *U.S. economy* (these estimates are in the appendix).

Workers in information and technology and other industries more exposed to AI see more help than harm from the technology

% of U.S. workers who say that, over the next 20 years, the use of artificial intelligence in the workplace will _____ them personally, by industry



Note: Sample includes employed adults only. Share of respondents who did not give an answer are not shown.
Source: Survey of U.S. adults conducted Dec. 12-18, 2022.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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In a recent report based on our survey, we also found that many groups expected to be more exposed to AI are more optimistic about its impact on them. Notably, Asian adults, college graduates and upper-income workers were more likely than other workers to say they think the use of AI in the workplace over the next 20 years will help more than hurt them personally at the workplace. Women were half as likely as men – 11% vs. 22% – to say this, but they were also more likely than men to say they were not sure of AI's potential impact on them personally.

4. Skills needed in high- and low-exposure jobs

In addition to the work activities they must perform, workers can also be classified by the skills they are required to have in order to perform their jobs. The O*NET database lists a total of 35 key skills, such as critical thinking, writing, science, negotiation, time management and repairing. In this analysis, we grouped these skills into five major skill families: social, fundamental, analytical, managerial and mechanical (refer to the text box for definitions of different skill groups). Then we looked at how these different job skills map with our assessment of how exposed different jobs are to artificial intelligence.

Our analysis shows that analytical skills, such as science, mathematics and programming, are more important in jobs that have high exposure to AI. In contrast, mechanical skills are more important to jobs with lower exposure to AI. The nature of these relationships is apparent from the charts that plot the importance of these skills and work activities across the 873 occupations we studied: The need for one rises with the need for the other.

Skill groups

We group the 35 skills whose importance is rated in O*NET into the following five major groups:

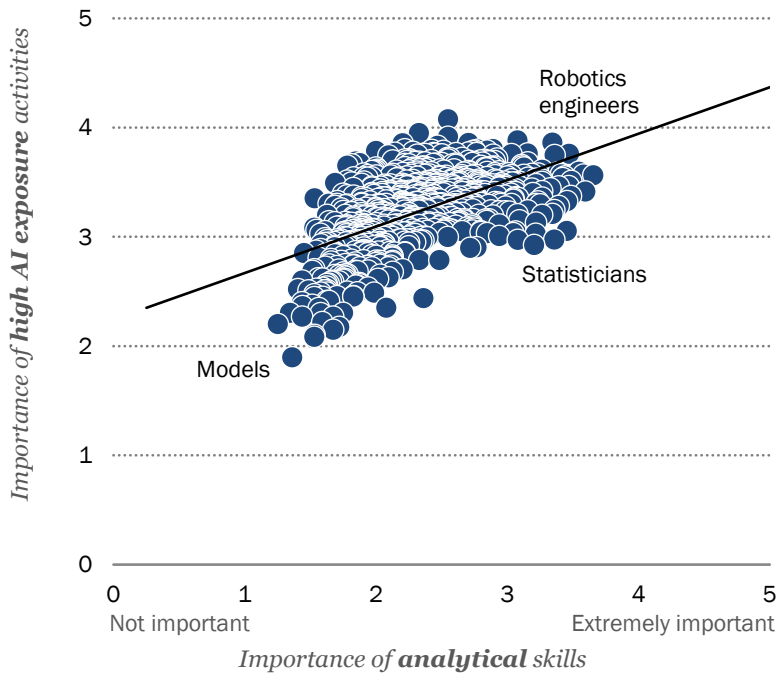
Social skills – instructing, service orientation, monitoring, social perceptiveness, coordination, negotiation, persuasion
Fundamental skills – critical thinking, writing, speaking, reading comprehension, active listening, active learning, learning strategies, judgment and decision-making
Analytical skills – science, mathematics, programming, complex problem-solving, systems analysis, systems evaluation, operations analysis, technology design
Managerial skills – management of personnel resources, management of financial resources, management of material resources, time management
Mechanical skills – troubleshooting, equipment selection, equipment maintenance, repairing, installation, operation monitoring, quality control analysis, operation and control

Looking at the relationship between the importance of high AI exposure activities and analytical skills, jobs such as robotics engineers appear at the top right of the plot. For these engineers, analytical skills have an importance rating of 3.47 and high AI exposure activities have an importance rating of 3.76, both falling between "important" and "very important" in O*NET terminology.

Jobs in which analytical skills are not important and AI exposure is limited appear on the bottom left. For example, consider models, including fashion models or those who pose for artists or photographers. For them, analytical skills have an importance rating of 1.36 and high AI exposure activities have an importance rating of 1.90, both lying between "not important" and "somewhat important."

Analytical skills are more important in jobs that are likely to have greater exposure to AI

Importance of high AI exposure activities in jobs versus the importance of analytical skills in those jobs, across 873 occupations



Note: Job activities and worker skills are assigned a rating based on their importance to a job. The importance rating scale runs from one (not important) to five (extremely important). Analytical skills include skills such as mathematics, science and complex problem solving. The occupations shown are illustrative.
Source: Pew Research Center analysis of O*NET (Version 27.3).
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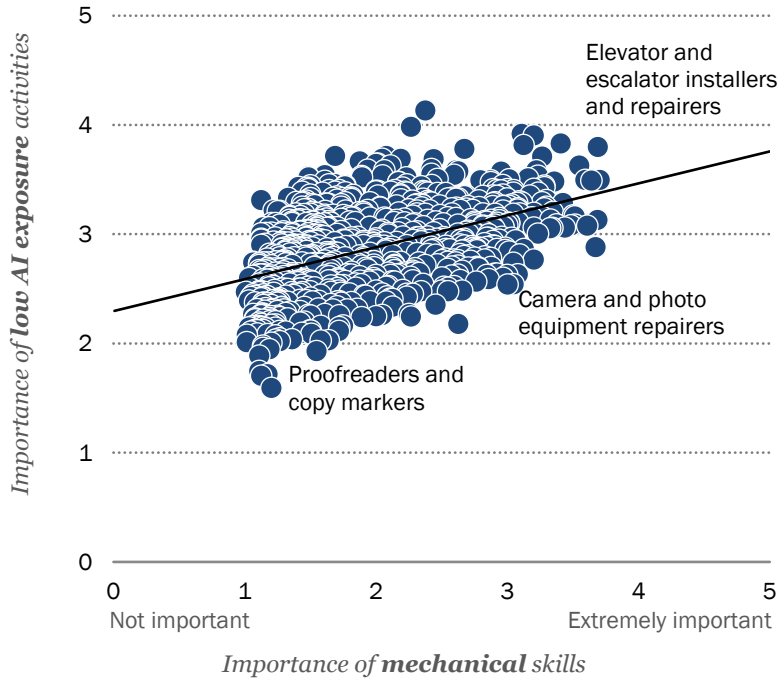
On the other hand, mechanical skills, such as repairing and installation, are more important in jobs in which low AI exposure skills are more important. For elevator and escalator installers and repairers, who appear at the top right, mechanical skills have an importance rating of 3.69 and low AI exposure activities have an importance rating of 3.80, both between "important" and "very important."

For proofreaders and copy markers, mechanical skills have an importance rating of 1.17 and low AI exposure activities have an importance rating of 1.72, between "not important" and "somewhat important."

Mechanical skills are more important in jobs that are likely to have less exposure to AI

Importance of low AI exposure activities in jobs versus the importance of mechanical skills in those jobs, across 873 occupations



Note: Job activities and worker skills are assigned a rating based on their importance to a job. The importance rating scale runs from one (not important) to five (extremely important). Mechanical skills include skills such as installation, equipment maintenance and repairing. The occupations shown are illustrative.
Source: Pew Research Center analysis of O*NET (Version 27.3).
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Relatedly, among the workers employed in jobs most exposed to AI, about six-in-ten (59%) have jobs in which fundamental skills like critical thinking are most important. Nearly half (48%) work in jobs in which analytical skills are most important. Smaller shares have jobs in which managerial (34%) or social (26%) skills are more important, and very few (2%) are employed in jobs in which mechanical skills are most important.

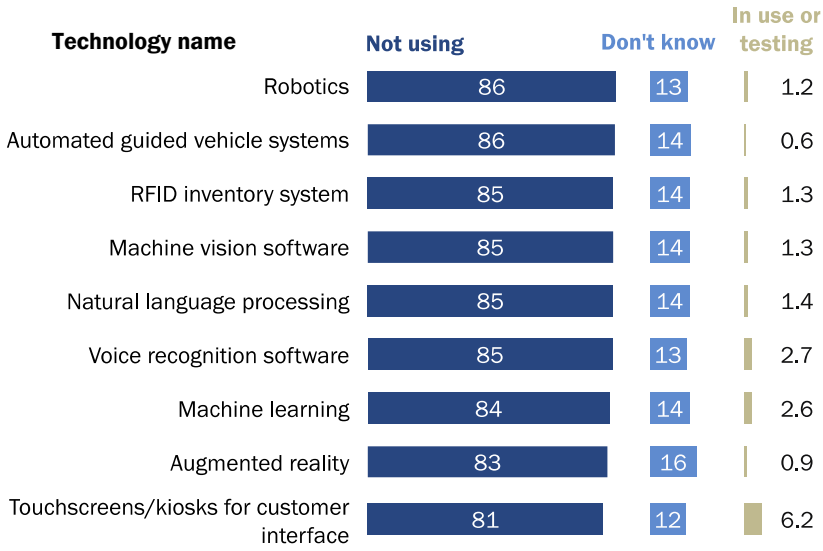
5. Use of AI-related technologies by U.S. businesses

Because of the newness of the technology, not much is known about the use of artificial intelligence in the business world. The most recent data collected by the government pertains to 2020, and AI systems have grown dramatically since then. While some policymakers are moving to create the ground rules for artificial intelligence, it is a rapidly evolving technology for which the speed of deployment and the purposes of adoption are hard to track in real time.

The early reading suggests that AI has some distance to travel before its adoption is on par with other computer-based technologies. The 2020 data collected in the Census Bureau's Annual Business Survey shows that the use of advanced computer-based technologies then was scarce among U.S. businesses. About nine-in-ten businesses or more reported that they were either not using or did not know if they were using AI-related technologies such as natural language processing, machine learning, machine vision software or augmented reality to produce goods or services.

Very few U.S. businesses reported using advanced technologies to produce goods or services in 2020

% of U.S. businesses using or applying a given technology to produce goods or services, 2020



Note: RFID refers to radio-frequency identification.
Source: U.S. Census Bureau, Annual Business Survey, 2021.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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With the exception of touchscreens and kiosks for customer interface, only about 1% to 3% of businesses said they were using or testing any of the technologies to supply goods or services.

Nonetheless, the businesses that were using or testing a technology had a much larger footprint in the labor market. Notably, while only about 1% of firms were using or testing robotics, those companies accounted for 20% of U.S. employment in 2020. Firms applying machine learning, machine vision or natural language processing accounted for about 11% to 16% of employment.

The use of touchscreens and kiosks for customer interface affected firms employing 27% of all workers.

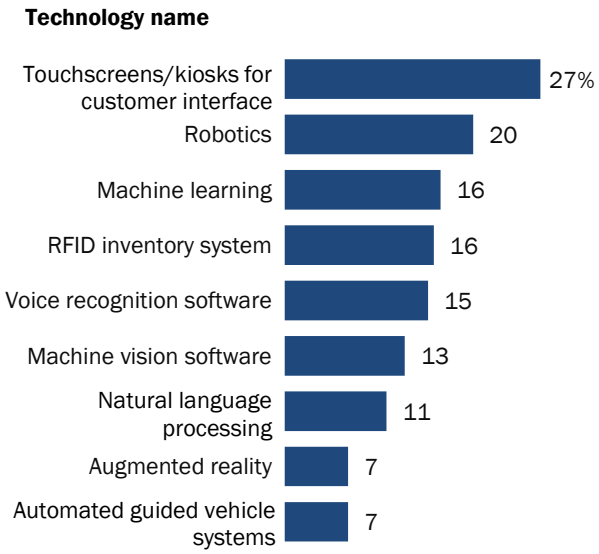
These estimates show that the adoption of advanced technologies at the time was led by large businesses, and their decisions related to the use of AI affected a larger share of workers.

More direct evidence on the business use of AI comes from the Annual Business Survey conducted in 2019, which collected data for 2018. That survey found that about 3% of firms were using AI and 2% were using robotics. This lagged well behind the use of technologies such as specialized software (38%), cloud computing (32%) and dedicated equipment (18%). But firms using AI or robotics accounted for about 13% and 15% of U.S. employment, respectively.

The share of firms using AI was higher in the information sector, the professional, scientific, and technical services sector, and the finance and insurance sector. This is consistent with the analysis in this report, which finds that these sectors are among the top four in terms of the share of their workforce that is most exposed to AI.

How many workers were affected by the use of advanced technologies in 2020?

% of U.S. workers employed in businesses that used a given technology to produce goods or services in 2020



Note: RFID refers to radio-frequency identification.
Source: U.S. Census Bureau, Annual Business Survey, 2021.
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Acknowledgments

This report is a collaborative effort based on the input and analysis of the following individuals. Find related reports online at pewresearch.org/internet.

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Methodology for O*NET analysis

Data sources

The analysis in this report is based on the combination of work requirements and job skills data from the U.S. Department of Labor's Occupational Information Network (O*NET, Version 27.3) and data on the occupation, employment and wages of workers from the Current Population Survey (CPS). Additional analysis is based on a Pew Research Center survey of 11,004 U.S. adults conducted from Dec. 12 to 18, 2022.

Occupational Information Network (O*NET): The O*NET database provides a variety of information related to the requirements of about 900 occupations. The occupations are classified according to a coding scheme that is consistent with the 2018 Standard Occupational Classification. Among other things, O*NET includes information on 41 work activities and 35 specific skills representing occupational and worker requirements for job performance (working with computers or critical thinking, for example). Each work activity or skill is rated on a scale of 1 to 5 measuring its importance to job performance, from not important to extremely important. This report focuses on the importance ratings of the 41 work activities, but also examines the relationship between the importance of job skills and the exposure of work activities to AI. The ratings are based on information generated by trained job analysts and surveys of job incumbents.

Current Population Survey (CPS): Conducted jointly by the U.S. Census Bureau and the Bureau of Labor Statistics, the CPS is a monthly survey of about 60,000 households and is the source of the nation's official statistics on unemployment. The CPS sample covers the civilian, noninstitutionalized population. Employment status is available for all eligible persons 16 or older, and data on earnings are available for about one-quarter of the sample. The CPS lists nearly 500 occupations that are an aggregation of the more detailed occupations listed in O*NET. In this report, 12 monthly CPS files were combined to generate annual estimates of occupational employment and earnings in 2022. The CPS microdata files used in this report are the Integrated Public Use Microdata Series (IPUMS-CPS) provided by the University of Minnesota.[1]

[1] Flood, Sarah, Miriam King, Renae Rodgers, Steven Ruggles, J. Robert Warren and Michael Westberry. 2022. Integrated Public Use Microdata Series, Current Population Survey: Version 10.0 [dataset]. IPUMS.

Classifying work activities by exposure to AI

The 41 work activities listed in O*NET were classified as having low, medium or high exposure to AI based on the collective judgment of Center analysts. This process, described in greater detail in the body of the report, resulted in the following classification of work activities, where 16 activities are judged to have high exposure, 16 more have medium exposure and nine have low exposure:

Work activities with high exposure to AI

Activity ID	Activity
4.A.1.a.1	Getting information
4.A.1.a.2	Monitoring processes, materials, or surroundings
4.A.2.a.2	Processing information
4.A.2.a.3	Evaluating information to determine compliance with standards
4.A.2.a.4	Analyzing data or information
4.A.2.b.1	Making decisions and solving problems
4.A.2.b.2	Thinking creatively
4.A.2.b.5	Scheduling work and activities
4.A.3.a.3	Controlling machines and processes
4.A.3.a.4	Operating vehicles, mechanized devices, or equipment
4.A.3.b.1	Working with computers
4.A.3.b.2	Drafting, laying out, and specifying technical devices, parts, and equipment
4.A.3.b.6	Documenting/recording information
4.A.4.a.8	Performing for or working directly with the public
4.A.4.c.1	Performing administrative activities
4.A.4.c.3	Monitoring and controlling resources

Note: The activity ID is the identifier for a work activity as listed in the O*NET data.
Source: Pew Research Center analysis of O*NET (Version 27.3).
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Work activities with medium exposure to AI

Activity ID	Activity
4.A.1.b.1	Identifying objects, actions, and events
4.A.1.b.2	Inspecting equipment, structures, or materials
4.A.1.b.3	Estimating the quantifiable characteristics of products, events, or information
4.A.2.a.1	Judging the qualities of objects, services, or people
4.A.2.b.3	Updating and using relevant knowledge
4.A.2.b.4	Developing objectives and strategies
4.A.2.b.6	Organizing, planning, and prioritizing work
4.A.4.a.1	Interpreting the meaning of information for others
4.A.4.a.2	Communicating with supervisors, peers, or subordinates
4.A.4.a.3	Communicating with people outside the organization
4.A.4.a.6	Selling or influencing others
4.A.4.b.1	Coordinating the work and activities of others
4.A.4.b.3	Training and teaching others
4.A.4.b.4	Guiding, directing, and motivating subordinates
4.A.4.b.6	Providing consultation and advice to others
4.A.4.c.2	Staffing organizational units

Note: The activity ID is the identifier for a work activity as listed in the O*NET data.
Source: Pew Research Center analysis of O*NET (Version 27.3).
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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Work activities with low exposure to AI

Activity ID	Activity
4.A.3.a.1	Performing general physical activities
4.A.3.a.2	Handling and moving objects
4.A.3.b.4	Repairing and maintaining mechanical equipment
4.A.3.b.5	Repairing and maintaining electronic equipment
4.A.4.a.4	Establishing and maintaining interpersonal relationships
4.A.4.a.5	Assisting and caring for others
4.A.4.a.7	Resolving conflicts and negotiating with others
4.A.4.b.2	Developing and building teams
4.A.4.b.5	Coaching and developing others

Note: The activity ID is the identifier for a work activity as listed in the O*NET data.
Source: Pew Research Center analysis of O*NET (Version 27.3).
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Determining the level of exposure of a job to AI

The 41 work activities we focus on are listed as requirements for all occupations in the O*NET. This means that each occupation is a mix of low, medium and high AI-exposure activities and has at least some exposure to AI. The question then is: Which of these three groups of activities is *relatively* the most important for an occupation?

To determine this, we performed four steps of analysis. First, we estimated the importance rating for low-, medium- and high-exposure activities in each job. The individual work activities that comprise each exposure group are rated on a scale of 1 to 5 measuring its importance to job performance, from not important to extremely important. These ratings are as listed in the O*NET. The average of the importance ratings for the individual work activities that make up the low, medium and high exposure groups is the importance rating of that exposure group.

For instance, the importance of high-exposure activities overall in a job is the average of the importance ratings of 16 individual high-exposure activities in that job. For mechanical drafters, the importance ratings of high-exposure activities range from 4.72 for working with computers to 3.66 for documenting or recording information, and to 1.82 for monitoring and controlling resources. These ratings scores, along with the scores for the other 13 high-exposure activities, are averaged to yield an overall importance rating of 3.28 for high-exposure activities for mechanical drafters. (The full list of high-exposure activities is above.)

Overall, among the 873 occupations we looked at, activities with high exposure to AI rated as being important to extremely important in 77% of occupations (an average importance rating score of 3 to 5, on the overall scale of 1 to 5). Medium-exposure activities rated this important in 72% of occupations, and so did low-exposure activities in 39% of occupations. It is possible that high-, medium- and low-exposure activities could simultaneously be important in a job, i.e., have an average rating of 3.

The second step was to determine which low-, medium- or high-exposure activities in each job were more important than the others. The process may be illustrated by looking at the job of mechanical drafters. For them, the average importance ratings of the three groups of activities are as follows: low exposure – 2.16; medium exposure – 2.88; and high exposure – 3.28. In our ranking system, this meant that high-exposure activities are more important than other activities for mechanical drafters.

We took a third step for the sake of comparing across occupations by exposure to AI. This was to estimate the *relative importance* of each activity. For mechanical drafters, the sum of the

importance ratings of low-, medium- and high-exposure activities is 8.32. The relative importance of low-exposure activities is 0.26 (or 2.16/8.32), that of medium-exposure activities is 0.35 (or 2.88/8.32), and that of high-exposure activities is 0.39 (or 3.28/8.32). These measures of the relative importance of activities were used to rank occupations. An occupation in which the relative importance of high-exposure activities is less than 0.39 – pharmacists, for instance – are less exposed to AI than mechanical drafters.

Which occupations are most or least exposed to AI

In the final step, we ranked occupations two ways: by the relative importance of low-exposure activities, and by the relative importance of high-exposure work activities. Jobs that are most exposed to AI are in the top 25% of occupations ranked by the relative importance of high-exposure activities. Jobs that are least exposed to AI are in the top 25% of occupations ranked by the relative importance of low-exposure work activities. Each set of occupations consists of about 218 occupations.

In principle, it is possible that there is overlap between the lists of the most and the least exposed occupations: There may be occupations in which both high- and low-exposure activities are relatively important in comparison with other occupations. Indeed, there is one occupation that appears on both lists – coin, vending, and amusement machine servicers and repairers. In this occupation, the relative importance of high-exposure activities is 0.36, followed by 0.34 for low-exposure activities. These scores are sufficient to place this occupation in the top 25% of either ranking. We leave it in place among both the most and the least exposed occupations.

As described below, the procedures for determining the exposure of jobs to AI were repeated after the O*NET data had been matched to the CPS data.

Matching O*NET and CPS data

The O*NET files do not contain data on the employment or wages of workers in individual occupations. For that reason, the work activity and skills importance ratings from O*NET were matched to data from the CPS, which does record that information. Although both the O*NET and the CPS use the same standard occupational classification, there is one key difference: O*NET lists about 900 occupations coded at the eight-digit level, the finest detail possible, whereas the CPS lists fewer than 500 occupations coded at the four-digit level. In other words, an occupation listed in the CPS typically encompasses more than one occupation listed in O*NET. Thus, some of the occupational data in O*NET must be combined to match with the CPS data. This was done in three steps, as detailed below:

Step 1: The work activity and skills importance ratings for eight-digit occupations in O*NET were aggregated to the six-digit level. For example, "financial managers," a six-digit occupation (2018 SOC code 11-3031), is broken into two eight-digit occupations in O*NET: "financial managers" (code 11-3031.00) and "treasurers and controllers" (code 11-3031.01). The activity and skills ratings for these two eight-digit occupations in O*NET were averaged to estimate the ratings for financial managers at the six-digit level. This process was repeated as necessary, and the result was a set of importance ratings for about 750 six-digit occupations.

Step 2: The ratings for six-digit occupations were further aggregated to the four-digit level using an occupational crosswalk from the Bureau of Labor Statistics. For example, "education and childcare administrators," a four-digit occupation, consists of the following three six-digit occupations: "education and childcare administrators, preschool and daycare," "education and childcare administrators, kindergarten through secondary," and "education and childcare administrators, postsecondary." In this step of the aggregation process, the activity and skills ratings for the various education administrators are averaged using the employment in each occupation as the weight. If employment data were not available, simple averages of the ratings for six-digit occupations were used to estimate ratings for the broader four-digit occupations. The result of this process was work activity and skills ratings for 485 four-digit occupations that we could match to data on employment and earnings in these occupations from the CPS.

The combined O*NET and CPS dataset provides virtually complete coverage of U.S. employment. The 485 occupations in the dataset employed 148 million workers, close to the official government estimate of total U.S. employment of 158 million in 2022.

Which occupations are most or least exposed to AI: A second set of rankings with CPS data

After the 873 O*NET occupations had been matched to 485 CPS occupations, it was also necessary to rank the shorter list of occupations by their exposure to AI. The process for doing this was the same as described above. That is, the 485 CPS occupations were ranked two ways, by the relative importance of low- and high-exposure activities, respectively. As before, jobs that are most exposed to AI are in the top 25% of occupations ranked by the relative importance of high-exposure activities. Jobs that are least exposed to AI are in the top 25% of occupations ranked by the relative importance of low-exposure work activities. Each group consists of about 120 occupations. Examples of CPS occupations that are the most or least exposed are listed in the appendix.

Determining job skills

For some of the analysis, we group the 35 skills rated in the O*NET into five major families of job skills – social, fundamental, analytical, managerial and mechanical (see the table below). The grouping is similar to the O*NET classification of skill categories. In general terms, social skills refer to interpersonal skills; fundamental skills lay the foundation for acquiring other skills; analytical skills capture scientific and technological prowess; managerial skills pertain to the management of people, things and finances; and mechanical skills describe the ability to work with and to control machinery or equipment.

O*NET skill elements that represent social, fundamental, analytical, managerial and mechanical skills

Social skills	Element ID	Analytical skills	Element ID
Monitoring	2.A.2.d	Mathematics	2.A.1.e
Social perceptiveness	2.B.1.a	Science	2.A.1.f
Coordination	2.B.1.b	Complex problem-solving	2.B.2.i
Persuasion	2.B.1.c	Operations analysis	2.B.3.a
Negotiation	2.B.1.d	Technology design	2.B.3.b
Instructing	2.B.1.e	Systems analysis	2.B.4.g
Service orientation	2.B.1.f	Systems evaluation	2.B.4.h
		Programming	2.B.3.e

Fundamental skills	Element ID	Mechanical skills	Element ID
Reading comprehension	2.A.1.a	Equipment selection	2.B.3.c
Active listening	2.A.1.b	Installation	2.B.3.d
Writing	2.A.1.c	Operation monitoring	2.B.3.g
Speaking	2.A.1.d	Operation and control	2.B.3.h
Critical thinking	2.A.2.a	Equipment maintenance	2.B.3.j
Active learning	2.A.2.b	Troubleshooting	2.B.3.k
Learning strategies	2.A.2.c	Repairing	2.B.3.l
Judgment and decision-making	2.B.4.e	Quality control analysis	2.B.3.m

Managerial skills	Element ID
Time management	2.B.5.a
Management of financial resources	2.B.5.b
Management of material resources	2.B.5.c
Management of personnel resources	2.B.5.d

Note: The element ID is the identifier for a job skill as listed in the O*NET data.
Source: Pew Research Center analysis of O*NET, Version 27.3.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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As with work activities, the importance of each detailed skill element to an occupation is given a numerical rating on a scale of 1 (not important) to 5 (extremely important) in the O*NET data. A simple average of the ratings of detailed skills is used to represent the importance of a skill group to an occupation.

For example, the O*NET, Version 27.3 importance rating for each of the seven social skills for chief executives is as follows: 4.12 for monitoring, 4.25 for social perceptiveness, 4.25 for coordination, 4.12 for persuasion, 4.12 for negotiation, 3.12 for instructing and 3.12 for service orientation. The average of these scores – 3.87 – is the measure of the importance of social skills for chief executives. A similar process is used to determine the importance ratings of fundamental (4.08), analytical (3.03), managerial (4.06) and mechanical skills (1.31) for chief executives.

Hourly wages

Wage estimates pertain to a worker's main job. Workers paid by the hour report hourly wages. For workers who are not paid by the hour, the hourly wage is calculated as weekly earnings divided by the usual numbers of hours worked in a week. The CPS collects data on wages from outgoing rotation groups only, which represent one-quarter of the monthly sample. Self-employed workers are excluded from this subsample.

Statistical significance

Comparisons between estimates drawn from the CPS are tested for statistical significance using the "pweight" option in Stata. All tests for statistical significance are conducted using 99% confidence intervals. Replicate weights are not available for the monthly CPS files.

Survey methodology

The American Trends Panel survey methodology

Overview

The American Trends Panel (ATP), created by Pew Research Center, is a nationally representative panel of randomly selected U.S. adults. Panelists participate via self-administered web surveys. Panelists who do not have internet access at home are provided with a tablet and wireless internet connection. Interviews are conducted in both English and Spanish. The panel is being managed by Ipsos.

Data in this report is drawn from the panel wave conducted from Dec. 12 to Dec. 18, 2022. A total of 11,004 panelists responded out of 12,448 who were sampled, for a response rate of 88%. The cumulative response rate accounting for nonresponse to the recruitment surveys and attrition is 4%. The break-off rate among panelists who logged on to the survey and completed at least one item is 2%. The margin of sampling error for the full sample of 11,004 respondents is plus or minus 1.4 percentage points.

Panel recruitment

The ATP was created in 2014, with the first cohort of panelists invited to join the panel at the end of a large, national, landline and cellphone random-digit-dial survey that was conducted in both English and Spanish. Two additional recruitments were conducted using the same method in 2015 and 2017, respectively. Across these three surveys, a total of 19,718 adults were invited to join the ATP, of whom 9,942 (50%) agreed to participate.

American Trends Panel recruitment surveys

Recruitment dates	Mode	Invited	Joined	Active panelists remaining
Jan. 23 to March 16, 2014	Landline/ cell RDD	9,809	5,338	1,504
Aug. 27 to Oct. 4, 2015	Landline/ cell RDD	6,004	2,976	881
April 25 to June 4, 2017	Landline/ cell RDD	3,905	1,628	434
Aug. 8 to Oct. 31, 2018	ABS	9,396	8,778	4,119
Aug. 19 to Nov. 30, 2019	ABS	5,900	4,720	1,476
June 1 to July 19, 2020; Feb. 10 to March 31, 2021	ABS	3,197	2,812	1,542
May 29 to July 7 Sept. 16 to Nov. 1, 2021	ABS	1,329	1,162	790
May 24 to Sept. 29, 2022	ABS	3,354	2,869	1,702
	Total	**42,894**	**30,283**	**12,448**

Note: RDD is random-digit dial; ABS is address-based sampling. Approximately once per year, panelists who have not participated in multiple consecutive waves or who did not complete an annual profiling survey are removed from the panel. Panelists also become inactive if they ask to be removed from the panel.

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In August 2018, the ATP switched from telephone to address-based recruitment. Invitations were sent to a stratified,

random sample of households selected from the U.S. Postal Service's Delivery Sequence File. Sampled households receive mailings asking a randomly selected adult to complete a survey online. A question at the end of the survey asks if the respondent is willing to join the ATP. In 2020 and 2021 another stage was added to the recruitment. Households that did not respond to the online survey were sent a paper version of the questionnaire, $5 and a postage-paid return envelope. A subset of the adults who returned the paper version of the survey were invited to join the ATP. This subset of adults received a follow-up mailing with a $10 pre-incentive and invitation to join the ATP.

Across the five address-based recruitments, a total of 23,176 adults were invited to join the ATP, of whom 20,341 agreed to join the panel and completed an initial profile survey. In each household, one adult was selected and asked to go online to complete a survey, at the end of which they were invited to join the panel. Of the 30,283 individuals who have ever joined the ATP, 12,448 remained active panelists and continued to receive survey invitations at the time this survey was conducted.

The U.S. Postal Service's Delivery Sequence File has been estimated to cover as much as 98% of the population, although some studies suggest that the coverage could be in the low 90% range.[2] The American Trends Panel never uses breakout routers or chains that direct respondents to additional surveys.

Sample design

The overall target population for this survey was non-institutionalized persons ages 18 and older, living in the U.S., including Alaska and Hawaii. All active panel members were invited to participate in this wave.

Questionnaire development and testing

The questionnaire was developed by Pew Research Center in consultation with Ipsos. The web program was rigorously tested on both PC and mobile devices by the Ipsos project management team and Pew Research Center researchers. The Ipsos project management team also populated test data that was analyzed in SPSS to ensure the logic and randomizations were working as intended before launching the survey.

[2] AAPOR Task Force on Address-based Sampling. 2016. "AAPOR Report: Address-based Sampling."

Incentives

All respondents were offered a post-paid incentive for their participation. Respondents could choose to receive the post-paid incentive in the form of a check or a gift code to Amazon.com or could choose to decline the incentive. Incentive amounts ranged from $5 to $20 depending on whether the respondent belongs to a part of the population that is harder or easier to reach. Differential incentive amounts were designed to increase panel survey participation among groups that traditionally have low survey response propensities.

Data collection protocol

The data collection field period for this survey was Dec. 12 to Dec. 18, 2022. This survey included a postcard experiment in which postcard notifications were mailed to half of ATP non-tablet household panelists with a known residential address on Dec. 12. The other half of ATP panelists did not receive any postcard mailings. The survey-level response rate was 89% among those mailed the postcard and 88% among those who were not mailed the postcard.

Invitations were sent out in two separate launches: soft launch and full launch. Sixty panelists were included in the soft launch, which began with an initial invitation sent on Dec. 12. The ATP panelists chosen for the initial soft launch were known responders who had completed previous ATP surveys within one day of receiving their invitation. All remaining English- and Spanish-speaking panelists were included in the full launch and were sent an invitation on Dec. 13.

All panelists with an email address received an email invitation and up to two email reminders if they did not respond to the survey. All ATP panelists that consented to SMS messages received an SMS invitation and up to two SMS reminders.

Invitation and reminder dates, ATP Wave 119

	Soft launch	Full launch
Initial invitation	Dec. 12, 2022	Dec. 13, 2022
First reminder	Dec. 15, 2022	Dec. 15, 2022
Final reminder	Dec. 17, 2022	Dec. 17, 2022

Data quality checks

To ensure high-quality data, the Center's researchers performed data quality checks to identify any respondents showing clear patterns of satisficing. This includes checking for very high rates of leaving questions blank, as well as always selecting the first or last answer presented. As a result of

this checking, eight ATP respondents were removed from the survey dataset prior to weighting and analysis.

Weighting

The ATP data is weighted in a multistep process that accounts for multiple stages of sampling and nonresponse that occur at different points in the survey process. First, each panelist begins with a base weight that reflects their probability of selection for their initial recruitment survey. These weights are then rescaled and adjusted to account for changes in the design of ATP recruitment surveys from year to year. Finally, the weights are calibrated to align with the population benchmarks in the accompanying table to correct for nonresponse to recruitment surveys and panel attrition. If only a subsample of panelists was invited to participate in the wave, this weight is adjusted to account for any differential probabilities of selection.

American Trends Panel weighting dimensions

Variable	Benchmark source
Age (detailed) Age x Gender Education x Gender Education x Age Race/Ethnicity x Education Born inside vs. outside the U.S. among Hispanics and Asian Americans Years lived in the U.S.	2021 American Community Survey (ACS)
Census region x Metro/Non-metro	2021 CPS March Supplement
Volunteerism	2022 American Trends Panel Annual Profile Survey/2019 CPS Volunteering & Civic Life Supplement
Voter registration	2018 CPS Voting and Registration Supplement
Party affiliation Frequency of internet use Religious affiliation	2022 National Public Opinion Reference Survey (NPORS)
Additional weighting dimensions applied within Black adults	
Age Gender Education Hispanic ethnicity	2021 American Community Survey (ACS)
Voter registration	2018 CPS Voting and Registration Supplement
Party affiliation Religious affiliation	2022 National Public Opinion Reference Survey (NPORS)

Note: Estimates from the ACS are based on non-institutionalized adults. Voter registration is calculated using procedures from Hur, Achen (2013) and rescaled to include the total U.S. adult population. Volunteerism is estimated using a model to account for potential changes in volunteering behavior due to the coronavirus outbreak that began in February 2020.

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Among the panelists who completed the survey, this weight is then calibrated again to align with the population benchmarks identified in the accompanying table and trimmed at the 1st and 99th percentiles to reduce the loss in precision stemming from variance in the weights. Sampling errors and tests of statistical significance take into account the effect of weighting.

The following table shows the unweighted sample sizes and the error attributable to sampling that would be expected at the 95% level of confidence for different groups in the survey.

Sample sizes and margins of error, ATP Wave 119

Group	Unweighted sample size	Plus or minus ...
Total sample	11,004	1.4 percentage points
White, non-Hispanic	7,220	1.7 percentage points
Black, non-Hispanic	1,447	3.9 percentage points
Hispanic	1,482	4.4 percentage points
Asian, non-Hispanic	371	7.0 percentage points
Ages 18-29	930	4.3 percentage points
30-49	3,514	2.4 percentage points
50-64	3,157	2.5 percentage points
65+	3,367	2.5 percentage points
Full-time workers	5,265	2.0 percentage points
Part-time workers	1,232	4.4 percentage points
Not working	4,463	2.3 percentage points

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Sample sizes and sampling errors for other subgroups are available upon request. In addition to sampling error, one should bear in mind that question wording and practical difficulties in conducting surveys can introduce error or bias into the findings of opinion polls.

A note about the Asian adult sample

This survey includes a total sample size of 371 Asian adults. The sample primarily includes English-speaking Asian adults and, therefore, may not be representative of the overall Asian adult population. Despite this limitation, it is important to report the views of Asian adults on the topics in this study. As always, Asian adults' responses are incorporated into the general population figures throughout this report. Because of the relatively small sample size and a reduction in precision due to weighting, we are not able to analyze Asian adults by demographic categories, such as gender, age or education.

Adjusting income and defining income tiers

To create upper-, middle- and lower-income tiers, respondents' 2021 family incomes were adjusted for differences in purchasing power by geographic region and household size. "Middle-

income" adults live in families with annual incomes that are two-thirds to double the median family income in the panel (after incomes have been adjusted for the local cost of living and household size). The middle-income range for the American Trends Panel is about $43,800 to $131,500 annually for an average family of three. Lower-income families have incomes less than roughly $43,800, and upper-income families have incomes greater than roughly $131,500 (all figures expressed in 2021 dollars).

Based on these adjustments, 28% of respondents in Wave 119 are lower income, 46% are middle income and 18% fall into the upper-income tier. An additional 6% either didn't offer a response to the income question or the household size question.

For more information about how the income tiers were determined, please read this Methodology.

Dispositions and response rates

Final dispositions, ATP Wave 119

	AAPOR code	Total
Completed interview	1.1	11,004
Logged on to survey; broke off	2.12	237
Logged on to survey; did not complete any items	2.1121	61
Never logged on (implicit refusal)	2.11	1,134
Survey completed after close of the field period	2.27	4
Completed interview but was removed for data quality		8
Screened out		0
Total panelists in the survey		**12,448**
Completed interviews	I	11,004
Partial interviews	P	0
Refusals	R	1,440
Non-contact	NC	4
Other	O	0
Unknown household	UH	0
Unknown other	UO	0
Not eligible	NE	0
Total		**12,448**
AAPOR RR1 = I / (I+P+R+NC+O+UH+UO)		88%

Cumulative response rate as of ATP Wave 119

	Total
Weighted response rate to recruitment surveys	12%
% of recruitment survey respondents who agreed to join the panel, among those invited	71%
% of those agreeing to join who were active panelists at start of Wave 119	49%
Response rate to Wave 119 survey	88%
Cumulative response rate	**4%**

Topline questionnaire

2022 PEW RESEARCH CENTER'S AMERICAN TRENDS PANEL
WAVE 119 INTERNET & SCIENCE TOPLINE
DECEMBER 12-18, 2022
N=11,004

NOTE: ALL NUMBERS ARE PERCENTAGES UNLESS OTHERWISE NOTED. THE PERCENTAGES LESS THAN 0.5% ARE REPLACED BY AN ASTERISK (*). ROWS/COLUMNS MAY NOT TOTAL 100% DUE TO ROUNDING.

	Sample size	Margin of error at 95% confidence level
U.S. adults	11,004	+/- 1.4 percentage points

ASK ALL:
EMPLSIT What is your current work situation?

Dec 12-18, 2022		Oct 10-16, 2022
48	Work full time for pay	48
12	Work part time for pay	12
11	Not currently working for pay	12
7	Unable to work due to a disability	8
21	Retired	20
1	No answer	1

ASK ALL:
JOBAPPYR Have you applied for a job at any point in the past 12 months?

Dec 12-18, 2022	
26	Yes, I have
73	No, I have not
*	No answer

ASK IF CURRENTLY WORKING FOR PAY (EMPLSIT=1-2) [N=6,497]:
INDUSTRY What industry or field do you currently work in?[3]

Dec 12-18, 2022	
8	Hospitality or service
16	Health care and social assistance
12	Manufacturing, mining, or construction
10	Retail and trade
10	Education
7	Banking, finance, accounting, real estate, or insurance
5	Transportation
7	Government, public administration, or military
8	Information/technology
1	Agriculture, forestry, fishing, and hunting
9	Professional, scientific, and technical services
2	Arts, entertainment, and recreation
3	Other **[TEXT BOX – RESPONSES NOT SHOWN]**
*	No answer

[3] INDUSTRY was also asked in Wave 77, but in that wave was only asked of those who were currently employed full- or part-time and had only one job or considered one of their multiple jobs their primary job.

DISPLAY TO ALL:

AIWRK1 Artificial intelligence (AI) can be used by employers to collect and analyze data, make decisions and complete tasks. Some employers are using AI in hiring, for worker evaluations or even to do jobs humans used to do.

ASK ALL:

AIWRK2 Over the next 20 years, how much impact do you think the use of artificial intelligence (AI) in the workplace will have on… **[RANDOMIZE ITEMS]**

		A major impact	A minor impact	No impact	Not sure	No answer
a.	Workers generally Dec 12-18, 2022	62	21	2	15	*
b.	You, personally Dec 12-18, 2022	28	35	19	19	*
c.	The U.S. economy Dec 12-18, 2022	56	22	3	19	*

ASK ALL:

AIWRK3 Thinking about the use of artificial intelligence (AI) in the workplace over the next 20 years, what do you think the outcome will be for… **[RANDOMIZE ITEMS IN SAME ORDER AS AIWRK2; RANDOMLY DISPLAY RESPONSE OPTIONS 1-3 OR 3-1 IN SAME ORDER FOR EACH ITEM, WITH OPTION 9 ALWAYS LAST]**

		AI will help more than it hurts	AI will equally help and hurt	AI will hurt more than it helps	Not sure	No answer
a.	Workers generally Dec 12-18, 2022	13	32	32	22	1
b.	You, personally Dec 12-18, 2022	16	30	15	38	1
c.	The U.S. economy Dec 12-18, 2022	19	34	20	27	*

Appendix

CORRECTION (Oct. 26, 2023): A previous version of the bar chart "Shares of workers in an industry who are most likely see low exposure to AI" included one mislabeled category. "Retail trade" should have been included, at 20%, and the actual share for "Managerial and administrative services" was 45%.

20 occupations most likely to have low exposure to AI

Barbers
Child care workers
Dishwashers
Elevator and escalator installers and repairers
Fence erectors
Firefighters
Gambling services workers
Helpers – installation, maintenance and repair workers
Janitors and building cleaners
Landscaping and groundskeeping workers
Laundry and dry-cleaning workers
Maids and housekeeping cleaners
Nursing assistants
Orderlies and psychiatric aides
Passenger attendants
Personal care aides
Pipelayers
Pressers, textile, garment and related materials
Sawing machine setters, operators and tenders, wood
Skin care specialists

Note: Occupations are ranked by the relative importance of work activities with low exposure to AI. Those in the top 25% are most likely to see low exposure. The 20 jobs in this table are from among the 121 jobs ranked as most likely to see low exposure and for which employment and earnings data were available in the Current Population Survey. Occupations are listed in alphabetical order.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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20 occupations most likely to have a medium level of exposure to AI

Chief executives
Credit authorizers, checkers and clerks
Customer service representatives
Education and child care administrators
Fashion designers
Financial examiners
Fundraisers
Human resources managers
Interpreters and translators
Lodging managers
Marketing managers
Materials engineers
Medical scientists
Postsecondary teachers
Public relations specialists
Purchasing managers
Sales engineers
School psychologists
Teaching assistants
Veterinarians

Note: The table shows a sample of occupations which are neither the most nor the least exposed to AI. Occupations are listed in alphabetical order.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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20 occupations most likely to have high exposure to AI

Architectural and civil drafters
Billing and posting clerks
Biological technicians
Bookkeeping, accounting and auditing clerks
Commercial and industrial designers
Computer hardware engineers
Court reporters and simultaneous captioners
Credit analysts
Data entry keyers
Judicial law clerks
Loan interviewers and clerks
Medical transcriptionists
Other drafters
Paralegals and legal assistants
Payroll and timekeeping clerks
Production, planning and expediting clerks
Proofreaders and copy markers
Switchboard operators, including answering service
Tax preparers
Title examiners, abstractors and searchers

Note: Occupations are ranked by the relative importance of work activities with high exposure to AI. Those in the top 25% are most likely to see high exposure. The 20 jobs in this table are from among the 122 jobs ranked as most likely to see high exposure and for which employment and earnings data were available in the Current Population Survey. Occupations are listed in alphabetical order.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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How the earnings of workers vary across jobs with different levels of exposure to AI

Average hourly earnings of U.S. workers in jobs most likely to see low, medium or high level of exposure to AI, 2022

	Low exposure	Medium exposure	High exposure
All	$20	$30	$33
Men	21	31	39
Women	18	29	28
White	21	32	34
Black	19	26	28
Hispanic	19	25	29
Asian	20	35	41
American Indian or Pacific Islander	19	26	29
Other	18	27	30
Less than high school graduate	17	19	19
High school graduate	20	24	24
Some college	22	27	27
Bachelor's degree	26	39	41
Ages 16-24	15	17	20
25-34	20	27	31
35-44	21	33	37
45-54	22	34	35
55-64	22	33	35
65+	20	33	35
U.S. born	20	30	33
Foreign born	19	30	37

Note: Occupations are ranked by the relative importance of work activities with low or high exposure to AI. Those in the top 25% are the most likely to see low or high exposure, about 120 each in number. Estimates by education level are for workers ages 25 and older. White, Black, Asian, and American Indian or Pacific Islander workers include those who report being only one race and are not Hispanic. “Other” includes all other single race groups and people reporting two or more races. Hispanics are of any race.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
“Which U.S. Workers Are More Exposed to AI on Their Jobs?”

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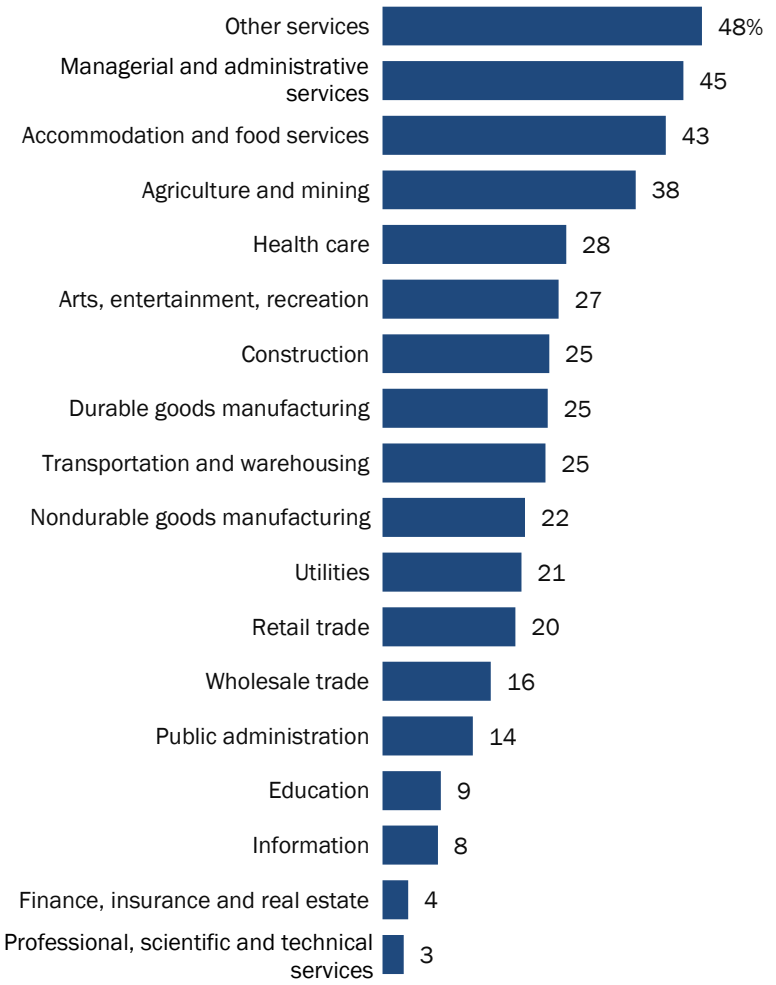
Shares of workers in an industry who are most likely see low exposure to AI

% of U.S. workers in each industry who are among the least exposed to AI, 2022



Note: Occupations are ranked by the relative importance of work activities with low exposure to AI. Those in the top 25% are the least exposed, about 120 in number. The chart shows the shares of workers in each industry employed in those occupations. "Other services" includes repair and maintenance, personal and laundry services, membership organizations, and private household services.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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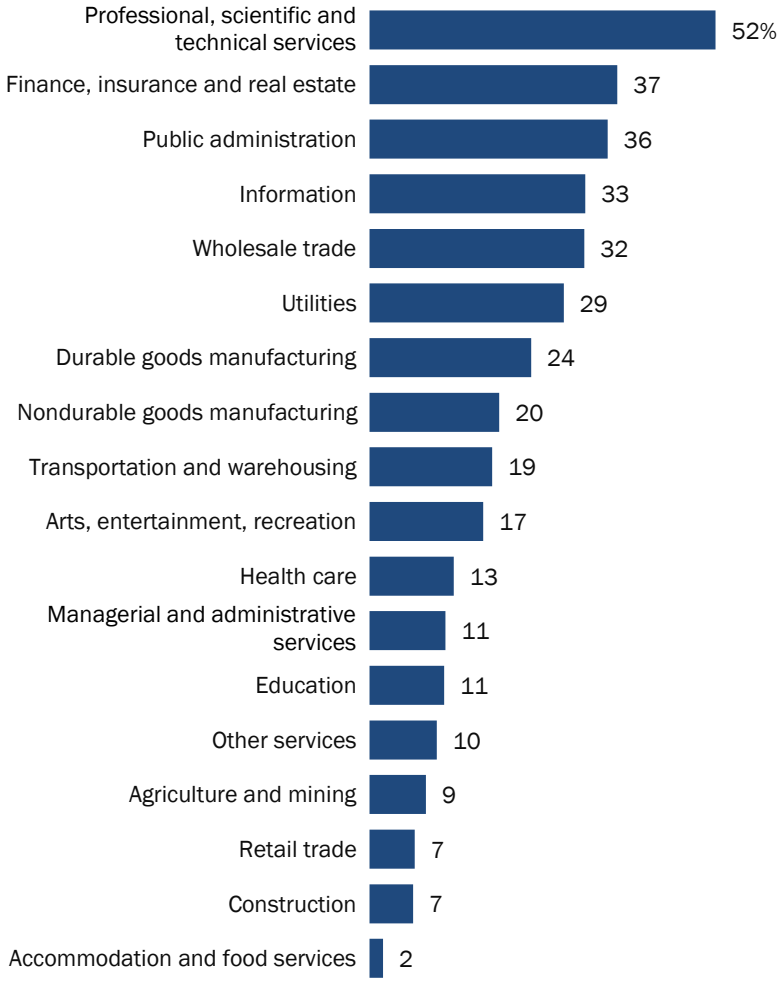
Shares of workers in an industry who are most likely see high exposure to AI

% of U.S. workers in each industry who are among the most exposed to AI, 2022



Note: Occupations are ranked by the relative importance of work activities with high exposure to AI. Those in the top 25% are the most exposed, about 120 in number. The chart shows the shares of workers in each industry employed in those occupations. "Other services" includes repair and maintenance, personal and laundry services, membership organizations, and private household services.
Source: Pew Research Center analysis of O*NET (Version 27.3) and 2022 Current Population Survey (IPUMS) annual data.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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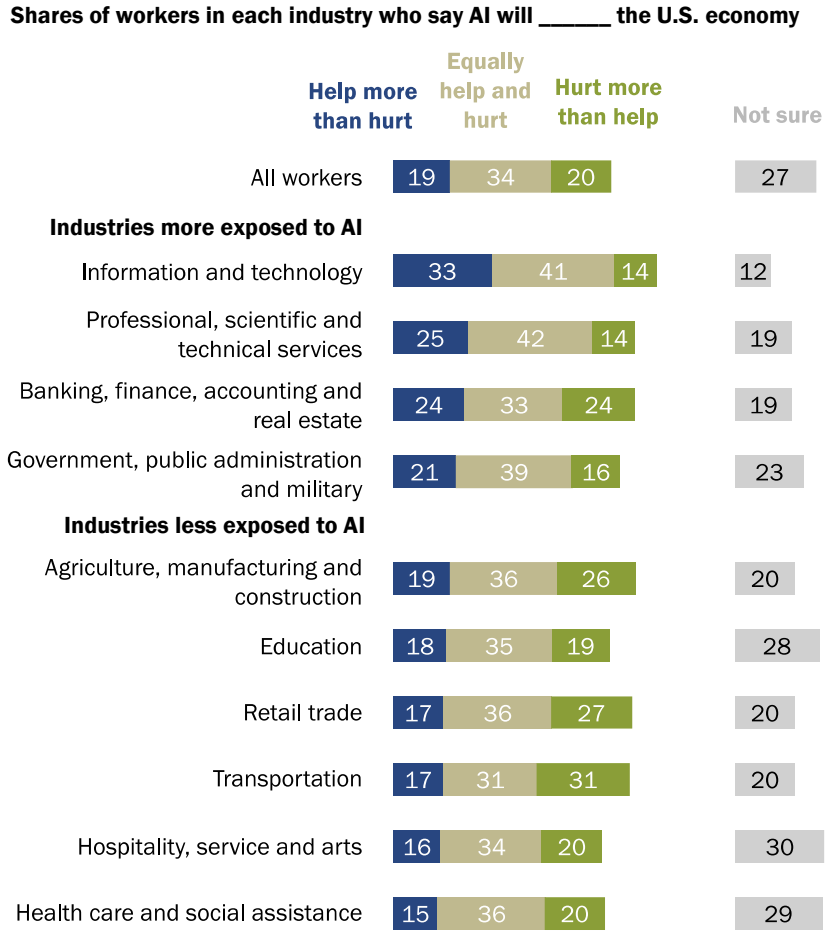
Workers in more exposed industries see less risk for the U.S. economy from AI

% of U.S. workers who say that over the next 20 years the use of artificial intelligence in the workplace will _____ the U.S. economy, by industry



Note: Sample includes employed adults only. Share of respondents who did not give an answer are not shown.
Source: Survey of U.S. adults conducted Dec. 12-18, 2022.
"Which U.S. Workers Are More Exposed to AI on Their Jobs?"

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