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PwC's 2024 AI Jobs Barometer

How will AI affect jobs, skills, wages, and productivity?

pwc.com/aijobsbarometer

PwC's 2024 AI Jobs Barometer goes beyond predictions about AI's impact to find evidence by analysing over half a billion job ads. The Barometer reveals how AI is transforming the world of work, making people and businesses more productive while changing what it takes for workers to succeed.

Headline Findings

4.8x

Sectors with highest AI penetration are seeing almost fivefold (4.8x) greater labour productivity growth. Rising labour productivity can generate economic growth, higher wages, and enhanced living standards.

25%

Jobs that require AI specialist skills carry up to a 25% wage premium in some markets.

3.5x

Growth in jobs that require AI specialist skills has outpaced all jobs since 2016 (well before ChatGPT brought fresh attention to AI), with numbers of AI specialist jobs growing 3.5 times faster than all jobs.

25%

Skills sought by employers are changing at a 25% higher rate in occupations most able to use AI. To stay relevant, workers in these jobs will need to build or demonstrate new skills.

Half a billion job ads reveal AI's impact

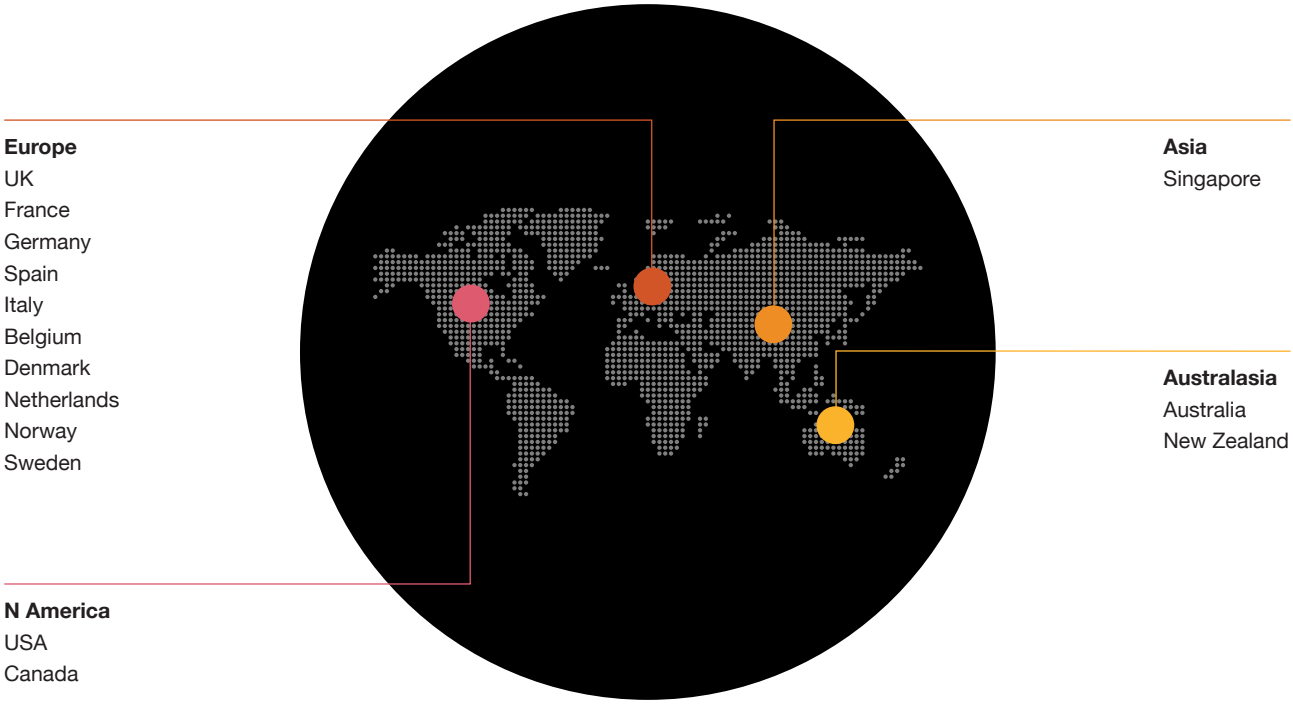
AI is the Industrial Revolution of knowledge work, transforming how all workers can apply information, create content, and deliver results at speed and scale. How is this affecting jobs? With the AI Jobs Barometer, PwC set out to find empirical evidence to help sort fact from fiction.

PwC analysed over half a billion job ads from 15 countries to find evidence of AI's impact at worldwide scale through jobs and productivity data.

PwC tracked the growth of jobs that demand specialist AI skills (such as machine learning or neural networks) across countries and sectors as an indication of AI penetration.[1] We find that AI penetration is accelerating, especially in professional services, information & communication, and financial services. Workers with specialist AI skills command significant wage premiums, suggesting that their abilities to deploy AI are valuable to companies.

1 AI's true penetration into the economy may be even greater than reflected in this analysis. By focusing on job ads, this analysis captures AI's impact on job changers, but does not capture AI usage or upskilling for existing employees.

The AI Jobs Barometer uses half a billion job ads from 15 countries to examine AI's impact on jobs, skills, wages, and productivity



But AI's impact is not limited to only those workers who have specialist AI skills. Many, if not most, workers who use AI tools in their work do not have or need these specialist skills. For example, a limited number of workers with specialist AI skills may design an AI system or tool for a company that is then used by hundreds or thousands of the company's customer service agents, analysts, or lawyers - none of whom have specialist AI skills. In fact, one thing that makes a well-known form of AI - generative AI - such a powerful technology is that typically it can be operated using simple everyday language with no technical skills required.

To capture AI's impact on all jobs, PwC analysed all jobs (and sectors) by their level of 'AI exposure.' A higher level of AI exposure means that AI can more readily be used for some tasks. Examples of occupations with higher AI exposure are financial analysts, customer service agents, software coders, and administration managers. The analysis revealed that sectors with higher AI exposure are experiencing much higher labour productivity growth. At the same time, the skills demanded by employers in AI-exposed occupations are changing fast. Read on to learn more.

Key Terms

‘AI specialist skills’: Specialist, technical AI skills like deep learning or cognitive automation. See Appendix One for AI skills list.

‘AI specialist jobs’: Jobs that require specialist, technical AI skills.

‘All jobs’: All jobs in all occupations.

‘AI-exposed’: Describes all jobs or sectors in which AI can readily be used for some tasks (based on definition of AI Occupational Exposure developed by Felten et al.)

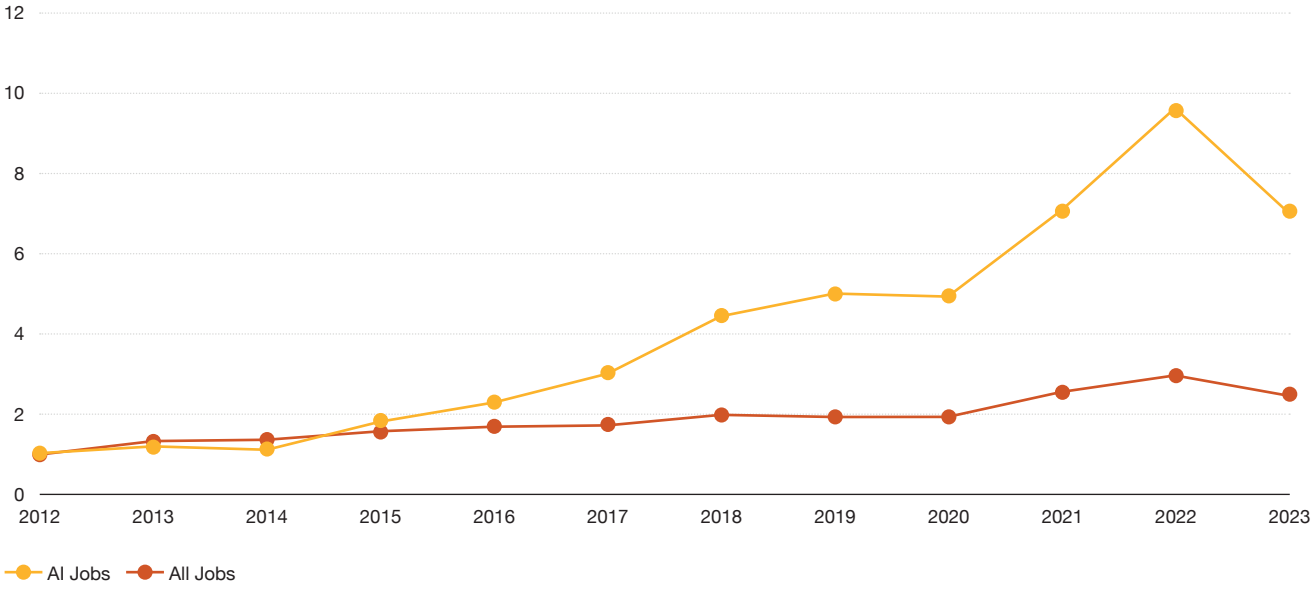
AI penetration is accelerating

Attention to AI's impact on the jobs market exploded in November 2022 with the launch of ChatGPT 3.5. However, the data shows that AI had quietly exerted a growing impact on the jobs market years before. Growth in AI specialist jobs has outpaced growth in all jobs since 2016, well before ChatGPT brought fresh focus to AI.

Today, there are seven times as many postings for specialist AI jobs as there were in 2012. In contrast, postings for all jobs have grown more slowly, doubling since 2012. Put another way, openings for jobs that require specialist AI skills have grown 3.5 times faster than openings for all jobs since 2012.

Growth in AI jobs has outpaced all jobs since at least 2016

Number of Job Postings, relative to 2012



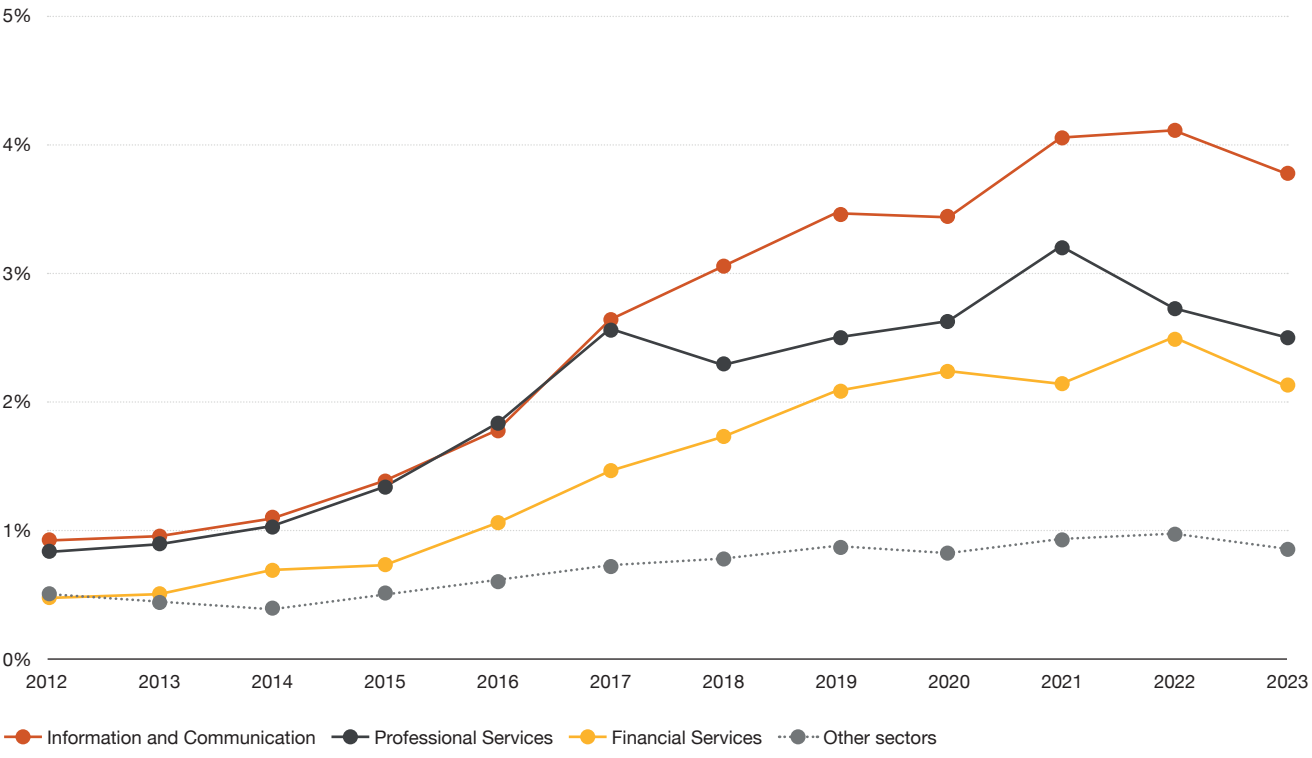
Source: PwC analysis of Lightcast data. The analysis represents six of the fifteen countries: US, UK, Singapore, Australia, Canada, and New Zealand. Nine countries have been excluded due to data prior to 2018 being unavailable: France, Germany, Belgium, Denmark, Spain, Italy, Netherlands, Norway, and Sweden.

The 2022 peak in job postings above represents exceptionally high demand for workers which gradually eased in 2023 as job market conditions returned toward normal.

Knowledge work sectors have higher AI penetration

Knowledge work sectors in particular are seeing growing demand for jobs that require specialist AI skills. The share of job ads requiring these skills is higher in professional services, information & communication, and financial services - precisely those sectors predicted to be most exposed to AI.[2] Financial services has a 2.8x higher share of jobs requiring AI skills vs other sectors, professional services is 3x higher, and information & communication is 5x higher.

Share of job postings by sector requiring AI skills



Sources: PwC analysis of Lightcast data, UK Government Impact of AI on Jobs 2023. "Other sectors" includes Agriculture, Mining, Power, Water, Retail trade, Transportation, Accommodation, Real Estate, Administrative activities, Arts and Entertainment, Household activities, Construction, Manufacturing, Education, Health and Social Activities and Extraterritorial Activities sectors. Chart includes all 15 countries in this study.

2 AI Occupational Exposure (AIOE), constructed by Felten et al (2018, 2019), scores and measures the degree to which occupations rely on abilities in which AI has made the most progress in recent years, meaning AI can more readily be used for some tasks in those occupations.

AI specialist jobs command up to a 25% wage premium on average

AI's value to companies is made clear by what is happening with the wages of workers with AI specialist skills - the very people who are making the AI revolution possible.

25%

Up to 25% wage premium for workers with specialist AI skills

As we have seen, growth in jobs demanding AI specialist skills has outpaced growth in all jobs since 2016. What's more, these jobs carry up to a 25% wage premium on average, underlining the value of these skills to companies.

Below are average AI wage premiums for five countries for which there is sufficient data to perform the analysis. To show how this wage premium can affect individual occupations, wage premiums for selected occupations are given.

Wage premium for job vacancies which require AI skills by country

Occupation	Country AI Wage Premium				
	USA	UK	Canada	Australia	Singapore
Database Designers and Administrators	+53%	+58%	+8%	+14%	+35%
Lawyers	+49%	+27%	-	-	-5%
Sales and Marketing Managers	+43%	+14%	+3%	+7%	+3%
Financial Analysts	+33%	+32%	-	-	+11%
Applications Programmers	+32%	+24%	-	+7%	+34%
Systems Analysts	+30%	+34%	+15%	+7%	+28%
Accountants	+18%	+5%	+17%	-	+4%
Average wage premium across all jobs	**+25%**	**+14%**	**+11%**	**+6%**	**+7%**

Sources: PwC analysis of Lightcast data, ISCO-08 Occupation Codes (4-digit level). 2023 data. These findings do not demonstrate a causal relationship. These estimates are calculated by comparing the average salaries of AI job postings to those of non-AI postings for the same occupations. Two filters are applied to ensure (1) the count of AI job postings and (2) the ratio of AI jobs:non-AI jobs being compared is above a certain threshold. The analysis provided represents five of the 15 countries: UK, USA, Singapore, Canada and Australia. The remainder of the countries have been omitted from this analysis as the data was less extensive: New Zealand, Italy, France, Germany, Spain, Belgium, Netherlands, Denmark, Norway and Sweden.

For example, job ads for US sales managers that require AI specialist skills offer wages that are on average 43% higher than job ads for sales managers that do not require AI skills. Canada's accountants can enjoy a 17% wage premium if they have AI specialist skills, and UK employers are willing to pay a 27% premium for lawyers equipped with AI skills.

AI appears to be driving a productivity revolution

So far this report has discussed jobs which require specialist AI skills like deep learning or natural language processing. But many, if not most, workers who use AI tools in their work do not have these skills. To understand how AI is affecting *all* jobs, PwC examined jobs and sectors by their levels of 'AI exposure' which means the degree to which AI can readily be used for some tasks. PwC's analysis revealed how higher levels of AI exposure appear to be affecting workers' productivity, numbers of job openings, and the skills that jobs require. First, let's see how AI may be affecting productivity.

Labour productivity growth has been sluggish in many nations for years. OECD countries have experienced a lost decade of labour productivity growth with weak average annual rises of 1.1% from 2011 to 2020, followed by declines in both 2021 and 2022.[3]

4.8x

higher growth in labour productivity in AI-exposed sectors

3 OECD, Labour Productivity and Utilisation. The pandemic had a negative impact on productivity in 2020-2022.

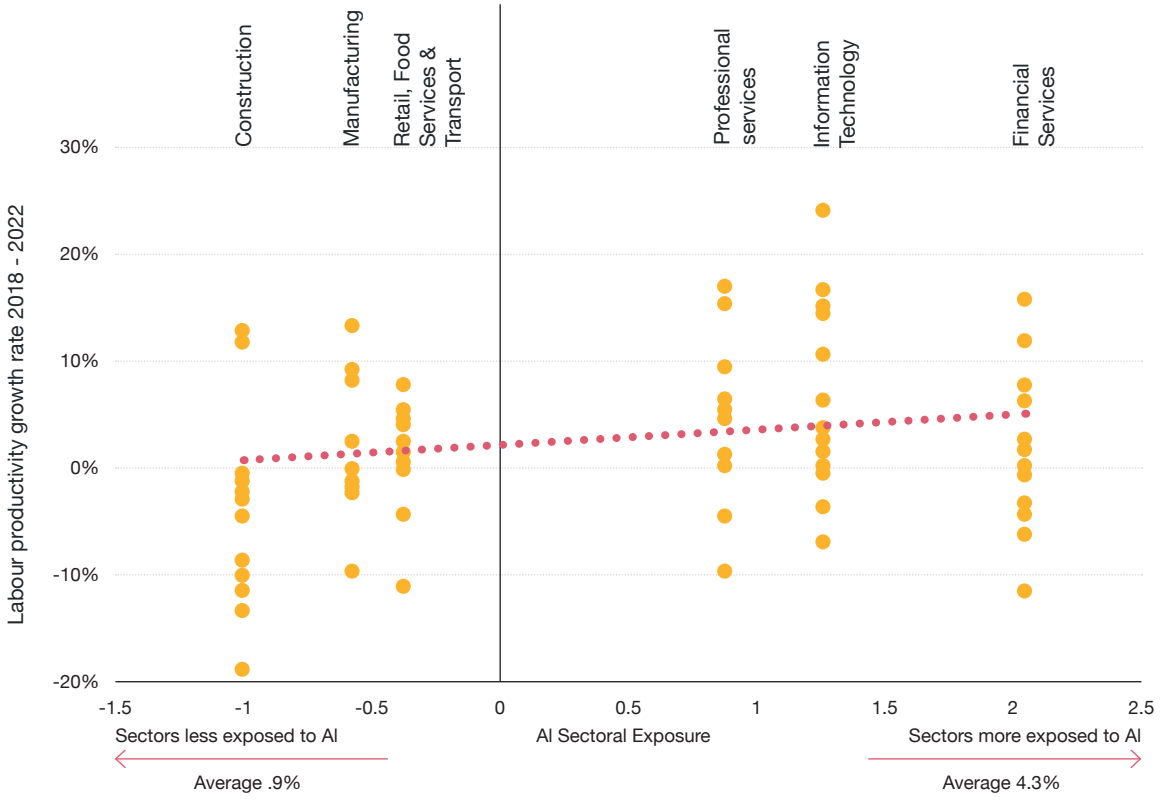
This stagnant labour productivity is a serious problem because it is a drag on economic growth, reducing potential tax revenues, chipping away at investment in public services and flatlining living standards.

Recently there has been much speculation that AI can supercharge workers' productivity. The good news is there is now evidence to suggest that this is not just wishful thinking, and is already fast becoming reality.

We have seen that three sectors - financial services, IT, and professional services - have higher AI exposure and higher AI penetration. How is this affecting productivity?

The data shows that these three sectors are seeing nearly 5x faster productivity growth than sectors with lower AI exposure (such as transport, manufacturing and construction).

AI exposure and labour productivity growth rate by sector. Each dot represents a country.



Sources: PwC analysis of OECD data, Felten et al. (2018, 2019). The AI Occupation Exposure (AIOE) constructed by Felten et al's (2018, 2019) AI Occupational Exposure (AIOE) scores and measures the degree to which occupations rely on abilities in which AI has made the most progress in recent years, meaning AI can more readily be used for some tasks. The AIOE score is a relative measure, where higher numbers indicate greater exposure to AI, meaning that even negative values still imply a certain degree of exposure to AI. To measure the growth rate in labour productivity, PwC used the OECD's GVA per person employed metric, indexed on 2018. Due to the availability of the OECD data, PwC focused on just six sectors. The 2023 OECD labour productivity data has not been released.Therefore the labour productivity growth rate between 2018 and 2022 is considered. If the view that AI is increasing productivity is correct, it would be expected that the pattern of stronger productivity growth for AI-exposed sectors would continue or accelerate in 2023. The '4.8x higher growth' is a comparison of averaged labour productivity growth rates; absolute growth rates are 0.9% and 4.3%.

While it is not possible to prove causation, this is an intriguing pattern. Unlike the computer revolution which took significant time to enhance productivity (economist Robert Solow once observed that the impact of the computer age was evident everywhere but in the productivity statistics), the data suggests AI is already doing so, right now. AI may be compressing the 'productivity J-curve'[4] in which new technologies can take significant time to cause a sharp uptick in productivity.

PwC's 2024 Global CEO Survey confirms that 84% of CEOs whose companies have begun to adopt AI believe it will increase efficiency in their employees' time at work.[5] Increasing productivity means more than just doing the old things faster. It also means finding new, AI-powered ways to create value. In fact, 70% of CEOs say that AI will significantly change the way their company creates, delivers and captures value over the next three years.

AI does more than help workers do the old things faster. AI opens the door to new business models and ways of creating value.

The implications for business are huge. Global CEOs anticipate that one form of AI - generative AI - will deliver significant top and bottom line benefits, with 46% saying it will increase profitability, and 41% saying it will increase revenue.

Investors agree. PwC's 2023 Global Investor Survey shows that investors believe accelerated adoption of AI is critical to the value equation, with 61% of investors saying faster adoption is very or extremely important. When responses indicating 'moderately important' are included, the proportion jumps to 85%.

All of this adds up to a positive story for the global economy: a revolution in productivity and value creation.

4 Productivity J-curve,' Brynjolfsson et al., National Bureau of Economic Research.

5 Around a third of the respondents in our 2024 Global CEO Survey have begun to adopt AI. Of these, 84% believe it will increase employees' efficiency. These findings suggest that companies leading the way on AI deployment are seeing the benefits.

AI is helping to ease labour shortages

In AI-exposed occupations such as customer services and IT - a number of which have acute labour shortages - jobs are still growing, but 27% more slowly on average.

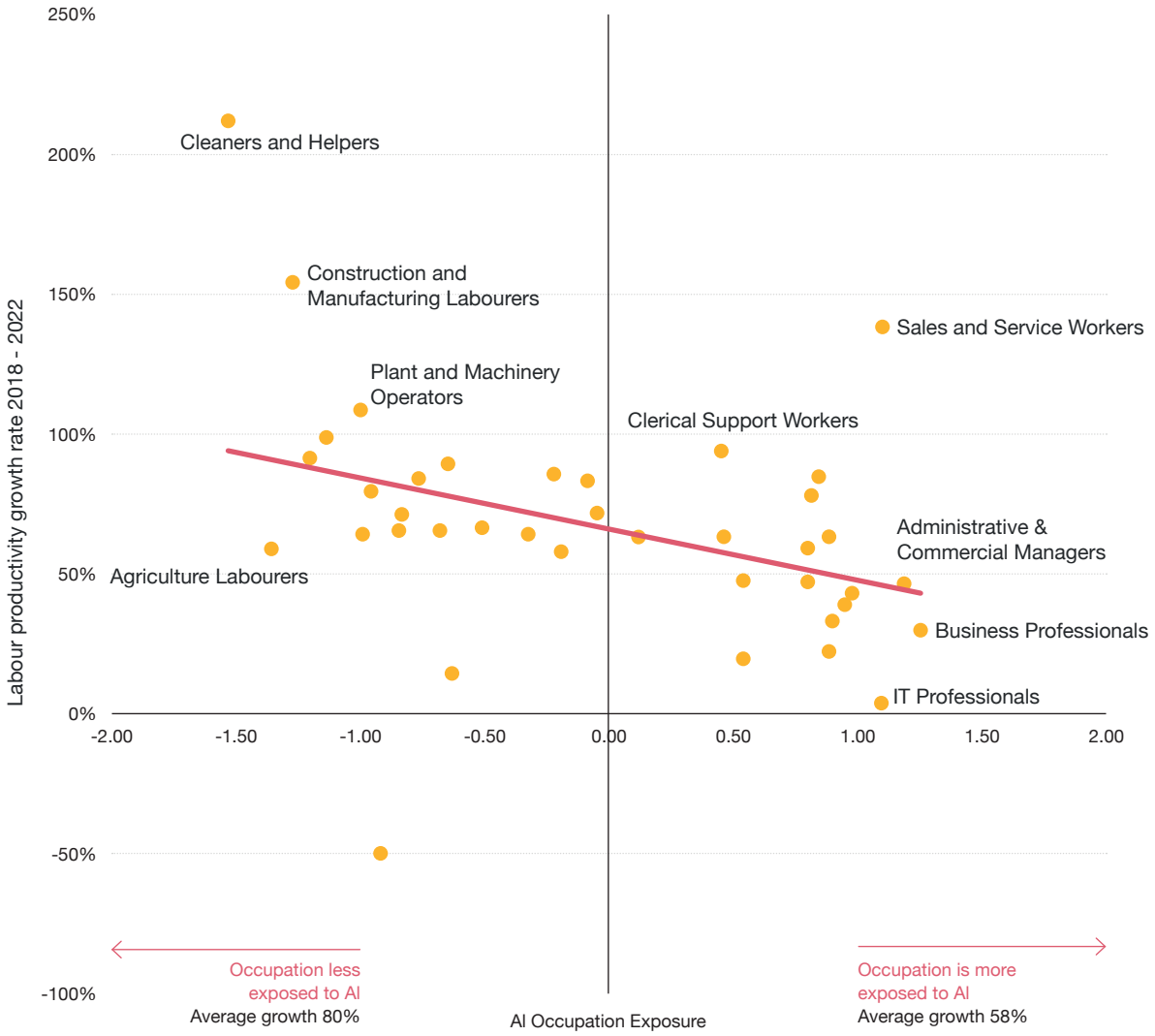
This could be good news for many nations facing shrinking working age populations and vast unmet needs for labour in many sectors. AI can help to ensure that the labour supply is available for the economy to reach its full potential.

27%

Lower job growth in AI-exposed occupations

(though jobs still growing overall)

Job openings are still growing in AI-exposed occupations, but more slowly



Sources: PwC analysis of Lightcast data, ISCO-08 Occupation Codes (2-digit level) and Felten et.al AI Occupation Exposure. The cross-country comparison on the right hand side considers the difference in the growth in job postings between the occupations most exposed to AI and those least exposed to AI.

It is important to emphasise that job numbers in AI-exposed occupations are *still growing*. The data suggests that AI does not herald an era of job losses but rather more gradual jobs growth, helping to enable companies to find the workers they need.

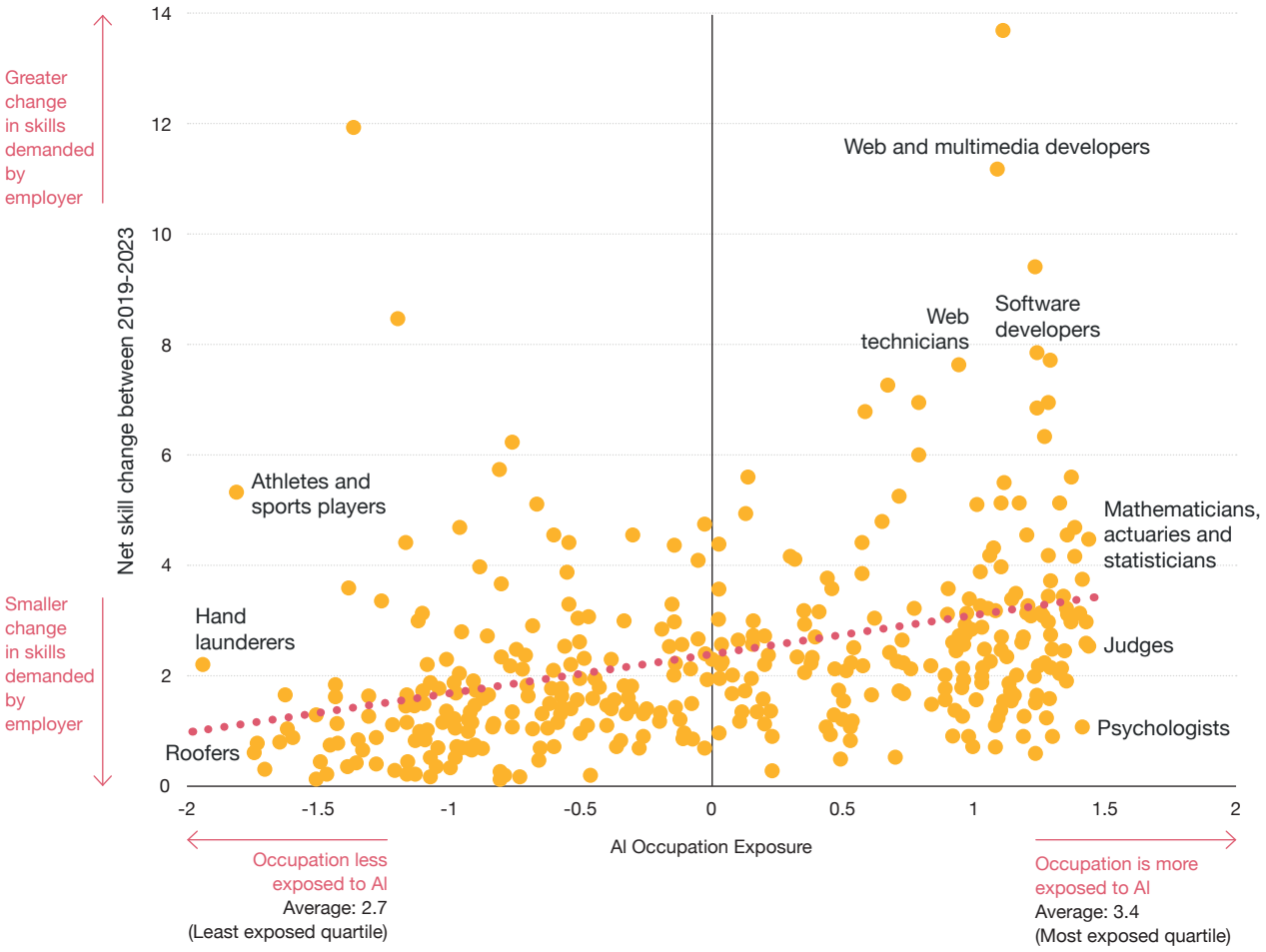
What this means for workers: Build skills for an AI age

The skills required by employers in AI-exposed occupations are changing fast. Old skills are disappearing from job ads - and new skills are appearing - 25% faster than in roles less exposed to AI.

25%

higher skills change in AI-exposed occupations

Change in skills demanded by employers for occupations more (and less) exposed to AI

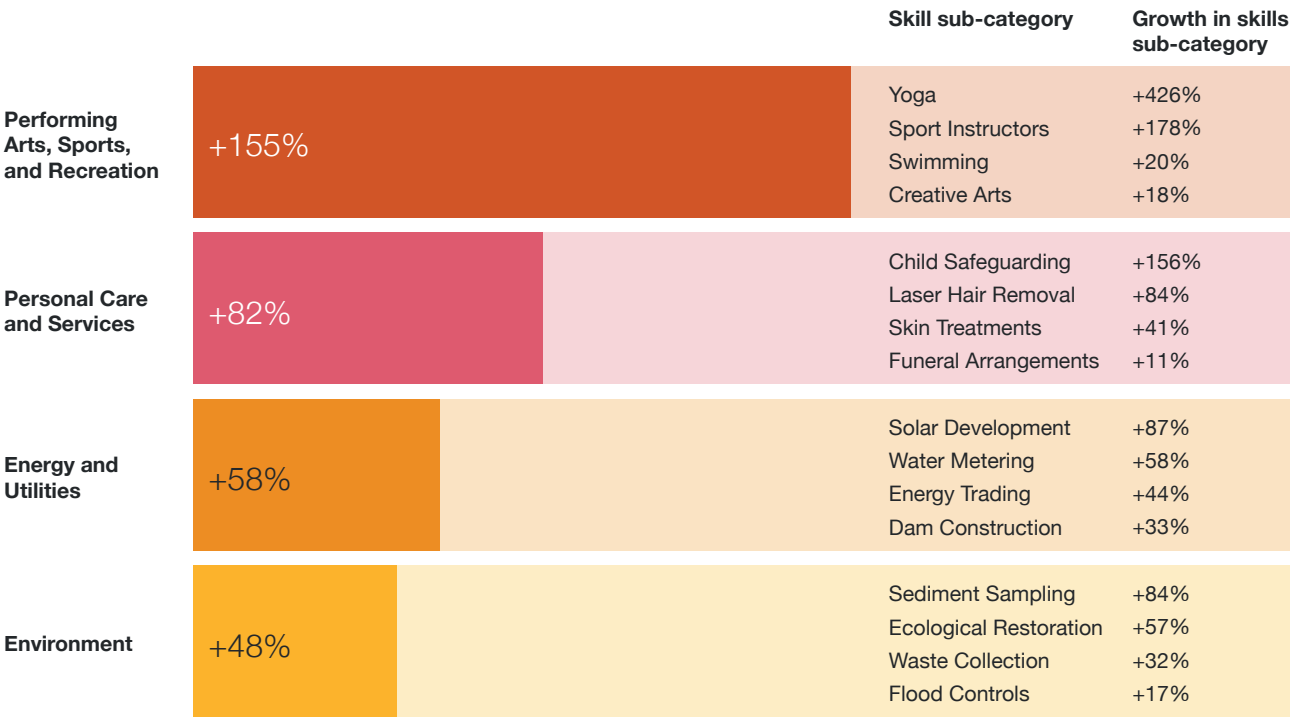


Sources: PwC analysis of Lightcast data, ISCO-08 Occupation Codes (2-digit level), Felten et al. (2018, 2019). The net skill change is based on Deming and Noray (2020) and is calculated by using the difference between 2019-2023 in the total number of skills required by job occupations using the ISCO-08 4-digit occupational codes. The AI Occupation Exposure is from Felten et al's (2018, 2019) and measures the degree to which occupations rely on abilities in which AI has made the most progress in recent years, meaning AI can more readily be used for some tasks. The correlation coefficient is .31 and is the statistical measure that quantifies the strength and direction of a linear relationship between net skill change and AI Exposure. To calculate the average net skill changes for the most and least exposed occupations to AI,an average of the net skill change of the top and bottom quartile of occupations is taken based on their exposure to AI. See Appendix Two for formula.

Workers in AI-exposed roles may need to demonstrate or acquire new skills to stay relevant in a jobs market that is fast-evolving. PwC's 2024 Global CEO Survey makes it clear that 69% of CEOs anticipate that generative AI will require most of their workforce to develop new skills, rising to 87% of CEOs who have already deployed generative AI. Workers need to take ownership of their learning, rapidly developing the skills to remain relevant and to embrace the opportunity AI brings.

There are clues to which skills workers may want to build to prosper in an AI age. Some of the skills rising fastest in demand are those which cannot easily be performed by AI. Below are four of the skills categories rising fastest in demand, and for each category a few examples are provided of specific skills with growing demand. From dam construction to sports instruction, some skills with booming demand are relatively hard for AI to perform.

FASTEST growing skill categories



Sources: PwC analysis of Lightcast data. Data based on 2019-2023. The overall growth in skill categories is calculated as the change in the average share of the skill category for all countries between 2019 and 2023.

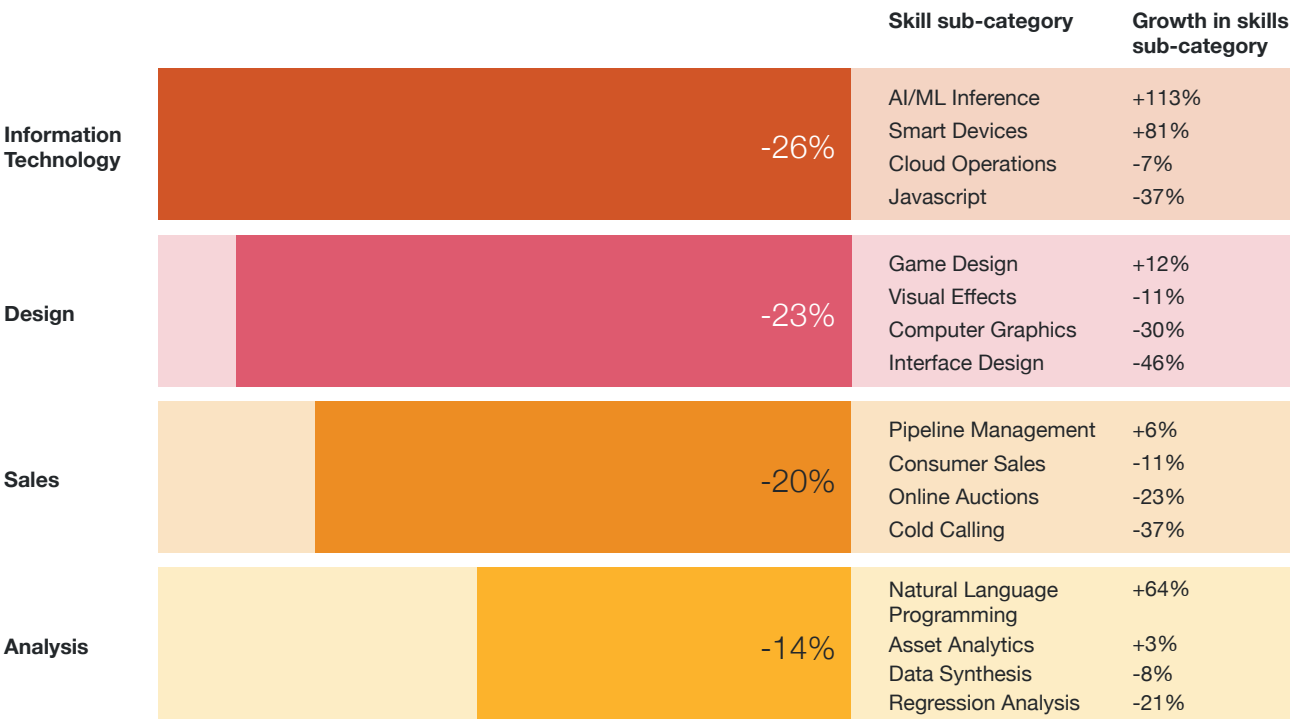
On the other hand, what skills are declining in demand? Below are four skills categories with the steepest declines in employer demand, with a few illustrative examples of specific skills with falling (or rising) demand within each category.

The AI transformation is clear to see in categories like Information Technology where demand for AI-related skills like 'AI/Machine Learning Inference'[6] is flourishing, while

6 AI/Machine Learning Inference means applying a machine learning model to a dataset to generate an output, insight, or prediction.

demand for some skills that may be more readily replaced by AI (such as coding in Javascript) is falling. The Analysis category shows a similar pattern with soaring demand for Natural Language Programming (an AI skill) and declining demand for Regression Analysis, a type of analysis AI can help to perform.

SLOWEST growing skill categories



Within the slowest growing skills categories, some sub-categories buck the trend and are growing fast. Some of these (like AI/ML Inference) are AI skills.

Sources: PwC analysis of Lightcast data. Data based on 2019-2023. The overall growth in skill categories is calculated as the change in the average share of the skill category for all countries between 2019 and 2023.

No going back to yesterday's jobs market - but vast opportunities await those who adapt to an AI age

AI is redefining what it means to be a financial analyst, a software coder, a customer service agent (and many more roles), opening up whole new possibilities for workers to deliver impact. Workers who learn to harness AI are likely to have bright futures in which they can generate greater value and could consequently have greater bargaining power for wages - all within a context of rising societal prosperity.

Workers agree. PwC's 2023 Global Workforce Hopes and Fears Survey shows workers expect mostly positive benefits from AI with 31% expecting AI to increase their productivity/efficiency and 21% expecting AI to create new job opportunities.

Many who predict AI will cause a sharp decline in job numbers are asking the wrong question. Those who predict AI will have a negative impact on total job numbers often look backward, asking whether AI can perform some tasks in the same way as they have been done in the past. The answer is yes. But the right question to ask is this: How will AI give us the power to do entirely new things, generating new roles and even new industries?

> AI makes human labour more relevant and valuable, opening up new opportunities for people to develop new skills and enter new roles. AI will create new jobs for people that we haven't yet begun to imagine. Many of the fastest-growing jobs of today - from cloud engineer to digital interface designer - didn't exist 10 or 20 years ago and have been generated by technology. Like a spreadsheet or a saw, AI is a tool that makes people more powerful and capable. Workers who build the skills to harness AI will be more valuable than ever.

Pete Brown, Global Workforce Leader, PwC UK

AI often performs best in partnership with people. Without oversight, AI can miss context and nuance or give poorer quality output. Only humans can fully appreciate and navigate the people, processes, and context of individual organisations and situations.

> As technology gets better at being technology, humans can get better at being humans. There is clear evidence that AI often delivers the best outcomes when used in partnership with people. The AI era requires a new style of leadership, an openness to bold transformation and inventive thinking about how AI and people together can create new forms of value.

Carol Stubbings, Global Markets and TLS Leader, PwC UK

Our analysis (particularly the finding about AI's potential impact on productivity) suggests that AI's effect on jobs may be similar to that of the internal combustion engine in the 20th century which reduced numbers of some jobs (such as horse trader) while at the same time creating far more jobs than it displaced (from truck driver to road engineer to traffic police).

> AI provides much more than efficiency gains. AI offers fundamentally new ways of creating value. In our work with clients, we see companies are using AI to amplify the value their people can deliver. We don't have enough software developers, doctors, or scientists to deliver all the code, healthcare, and scientific breakthroughs the world needs. There is a nearly limitless demand for many things if we can improve our ability to deliver them.
>
> **Scott Likens, Global AI and Innovation Technology Leader, PwC US**

Far from heralding the end of jobs, AI signals the start of a new era in which workers can be more productive and valuable than ever.

Instead of focusing only on how AI can take on some tasks formerly done by people, we should think inventively about how to make the most of AI to create new industries and new roles for people. Embracing AI in this way is one way to bring about continued positive outcomes for workers. Economist Eric Brynjolfsson observed, 'If AI is used mainly to mimic humans, to replace humans with machines, it is likely to lead to lower wages and more concentration of wealth. If we use AI mainly to augment our skills, to do new things, then it is likely to lead to widely shared prosperity and higher wages.'[7]

7 *The Second Machine Age,* Eric Brynjolfsson

Next steps for companies, workers, policymakers

There is no going back to yesterday's jobs market, but - if carefully managed - the AI revolution could bring a bright future for workers and companies. Below are steps that companies, workers, and policymakers can take to help realise AI's promise to grow productivity and fuel rising shared prosperity.

Here is what companies can do. Business leaders can embrace, experiment, and create new uses of AI. They can think beyond using AI to do things the way they have been done in the past and instead use AI to generate new ways to create value. While AI can help to make existing processes more efficient, companies can realise even more benefit from AI by using it to reinvent business models or pioneer new product lines. Thinking inventively about how to use AI helps the company to be the disruptor rather than the disrupted, and it helps to create new opportunities for people.

Business leaders should view AI as a complement to people that is best used with human oversight. Leaders should track the ever-shifting 'jagged frontier'[8] which marks where AI performs brilliantly versus where AI lacks capabilities or works best with human assistance. Companies can support employees to make the most of AI by offering training and helping them see how AI empowers them (and can even make their jobs more enjoyable by freeing them to work more autonomously and be more confident in their roles)[9].

Firms can consider hiring on the basis of candidates' skills rather than focusing solely on their degrees, job history, or previous job titles. This helps firms find the workers they need, and it helps workers more readily adapt to a fast-changing jobs market. A study by PwC and the World Economic Forum conducted across 18 economies shows that a skills first approach has the potential to expand the talent pool by 100 million people. Companies can take a skills first approach for existing employees too, treating workers as people with sets of skills and talents that can be fluidly applied across the organisation.[10] These 'skills based organisations' can more flexibly deploy workers, helping both companies and workers adapt to the AI transformation while opening up broader talent pools, developing more resilient talent pipelines for the jobs of tomorrow, and achieving enhanced levels of employee motivation, satisfaction, performance, and retention.[11, 12]

Workers, for their part, should embrace AI, experimenting with it and seeking ways it can complement and enable them in their work.[13] Workers should build the skills to be sought after in an AI age (for example, skills that either complement AI or are hard for AI to do). Some workers may need to adapt more than others to succeed in an AI era; for example, some workers may need only a little training to adopt AI tools while other workers may need to move to new occupations which require more extensive retraining or upskilling. Workers, companies, and policymakers share responsibility for helping all workers adapt to an AI era.

8 'Navigating the Jagged Technological Frontier: Field Experimental Evidence of the Effects of AI on Knowledge Worker Productivity and Quality,' Fabrizio Dell'Acqua et al, Harvard Business School working paper

9 MIT Sloan Management Review: 'Achieving Individual - and Organisational - value with AI,' 2022.

10 Skills based organisations are integrating skills throughout the talent management lifecycle by implementing skills-based training programs for upskilling and reskilling, as well as establishing skills-based career pathways for redeployment.

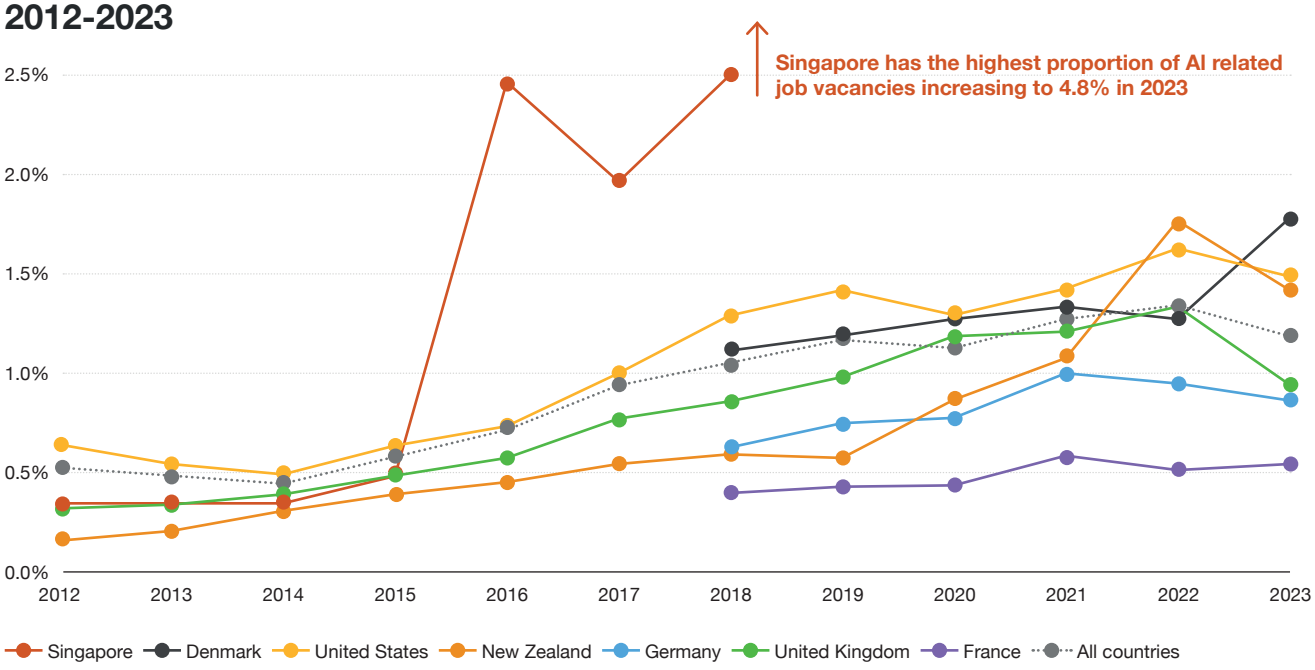
11 Skills-based sourcing & hiring playbook, Rework America Alliance, 2022

12 AI can help with skills based hiring by, for example, automatically generating and updating skills profiles and working out adjacent skills people are likely to have or could readily learn.

13 Workers whose companies do not offer AI tools can experiment with public AI tools like ChatGPT. Workers should not use proprietary company data on public tools, but public tools still provide a wealth of opportunities to get to know AI's power.

Policymakers can encourage the use of AI to grow productivity and prosperity, for example by building the supportive policy environment, digital infrastructure, and skilled workforce to help realise AI's potential. Countries with the strongest growth in jobs that demand AI skills (an indicator of AI usage and penetration) offer lessons for policymakers in how to create an environment conducive to making the most of AI. The three countries in this study with the highest proportion of jobs that require AI skills are Singapore, Denmark, and the US. These are the same three countries that top the IMF's AI Preparedness Index ranking which measures areas such as digital infrastructure, human-capital and labor-market policies, innovation and economic integration, and regulation and ethics. Policymakers who would like their people to benefit from the AI revolution should take note.

Proportion of total job vacancies requiring AI related skills by country, 2012-2023



Sources: The IMF's AI Preparedness Index ranks countries' preparedness to adopt AI based on four pillars: Digital Infrastructure, Innovation & Integration, Human Capital & Policies and Regulation & Ethics.

Policymakers can support workers with training/retraining and safety nets, and shape the education system to help prepare workers for an AI age in which critical thinking, creativity, and adaptability are likely to be key skills. Finally, policymakers can strive to make sure that growing prosperity from AI adoption is widely shared.

Key areas for action

Policymakers

- Encourage the use of AI to grow productivity and prosperity
- Ensure growing prosperity from AI adoption is widely shared
- Support the use of AI to augment rather than replace workers
- Support workers with training/retraining, worker protections, and safety nets
- Shape the education system to help prepare workers for an AI age
- Ensure the responsible use of AI with PwC's Responsible AI framework

Businesses

- Embrace, experiment, and pioneer new uses of AI. Think beyond using AI to do existing tasks. Instead, pioneer new ways to create value.
- Build a climate of confidence and trust in using AI so people are more likely to welcome trying it.
- Use AI to complement people. Figure out where AI is best used in partnership with people.
- Hire on the basis of skills rather than only degrees or work history.
- Upskill workers to make the most of AI
- Use AI responsibly with PwC's Responsible AI framework

Workers

- Embrace and experiment. Seek ways to make the most of AI to complement and empower you
- Build skills to be sought after in an AI-driven jobs market (e.g. skills that complement AI or are difficult for AI to do)

In conclusion

PwC's analysis of over half a billion job ads worldwide suggests that AI may help make workers more productive, opening the door to rising prosperity for workers and nations. Like past technological revolutions from electricity to internal combustion engines, AI is changing what it takes for workers to succeed - and those who adapt may enjoy vast new opportunities.

Acknowledgements

Partner Sponsors

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Appendix one: AI skills list

'AI jobs' are defined here as jobs that require one or more technical AI skills. Here is the complete list of AI skills used:

mlpack (C++ Library)
Nvidia Jetson
Watson Conversation
Robotic Systems
IPSoft Amelia
Apache MADlib
Loss Functions
Dask (Software)
Pydata
Advanced Robotics
Seq2Seq
Watson Studio
Vowpal Wabbit
Matrix Factorization
Kaldi
Google Cloud ML Engine
Semi-Supervised Learning
Dlib (C++ Library)
Robotic Liquid Handling Systems
Lexalytics
Amazon Comprehend
Semantic Parsing
Automated Machine Learning
Dialogflow (Google Service)
Word Embedding
AWS SageMaker
Amazon Textract
Natural Language Generation
Machine Learning Methods
Voice User Interface
Test Datasets
Cyber-Physical Systems
Part-of-Speech Tagging
Image Segmentation
Convolutional Neural Networks
Deep Learning Methods
Feature Learning
Autonomous Vehicles
Azure Machine Learning
Relationship Extraction
Word-Sense Disambiguation
Cognitive Automation
Programmatic Media Buying
Transfer Learning
Long Short-Term Memory (LSTM)
Amazon Lex
Caffe2
Conversational AI
Kernel Methods
Adversarial Machine Learning
Unmanned Aerial Systems (UAS)
Amazon Polly
Language Identification
Guidance Navigation And Control Systems
Natural Language Understanding
Fast.ai
Ensemble Methods
Training Datasets
Meta Learning
Speech Synthesis
Autoencoders
Pose Estimation
Intelligent Virtual Assistant
Voice Assistant Technology
Gradient Boosting
Apache SINGA
Oracle Autonomous Database
Microsoft LUIS
Apache MXNet
Open Neural Network Exchange (ONNX)
Azure Cognitive Services
Cognitive Computing
Bot Framework
Torch (Machine Learning)
Gesture Recognition
3D Reconstruction
Autonomous Cruise Control Systems
Advanced Driver Assistance Systems
Multi-Agent Systems
Artificial Intelligence
Applications Of Artificial Intelligence
Artificial Intelligence Markup Language (AIML)
Amazon Alexa
ANTLR
Optical Character Recognition (OCR)
Artificial General Intelligence
Artificial Intelligence Systems
Artificial Neural Networks
Computer Vision
Association Rule Learning
Autonomic Computing
Autonomous System
Naive Bayes Classifier
Classification And Regression Tree (CART)
CHi-Squared Automatic Interaction Detection (CHAID)
Decision Tree Learning
Cluster Analysis
Computational Intelligence
Computational Linguistics
Image Analysis
Decision Models
Dialog Systems
Digital Image Processing
Dimensionality Reduction
Expectation Maximization Algorithm
Embedded Intelligence
Evolutionary Acquisition Of Neural Topologies
Evolutionary Programming
Expert Systems
Fuzzy Logic
Gaussian Process
Genetic Algorithm
General-Purpose Computing On Graphics Processing Units
Hyperparameter Optimization
Handwriting Recognition
Hidden Markov Model
Contextual Image Classification
Image Matching
Inference Engine
Information Extraction
Intelligent Agent
Intelligent Control
Cognitive Robotics
Intelligent Systems
Interactive Kiosk
Knowledge Engineering
Knowledge-Based Systems

Language Model
Machine Learning Algorithms
LIBSVM
Machine Learning
Reasoning Systems
Machine Translation
Machine Vision
Markov Chain
Motion Analysis
Motion Planning
Natural Language Processing
Natural Language Programming
Natural Language Toolkits
Natural Language User Interface
Nearest Neighbour Algorithm
Named Entity Recognition
Natural Language Processing Systems
NLTK (NLP Analysis)
OmniPage
OpenCV
Apache OpenNLP
Sorting Algorithm
Knowledge-Based Configuration
Question Answering
Recommender Systems
Eye Tracking
TensorFlow
Object Recognition
Voice Technology
Path Finding
Remote Sensing
Robot Framework
Robot Operating Systems
Robotic Automation Software
Screen Reader
Semantic Search
Sentiment Analysis
Servomotor
Semantic Interpretation For Speech Recognition
Soft Computing
Speech Enhancement
Speech Processing
Speech Recognition Software
Speech Technology
Statistical Language Acquisition
Supervised Learning
Support Vector Machine
Swarm Intelligence
Text Mining
Tokenization
Feature Selection
Image Sensor
Speech Recognition
Weka
Reinforcement Learning
Shogun
Robotic Programming
Sirikit
Path Analysis
Semantic Analysis
SLAM Algorithms (Simultaneous Localization And Mapping)
Data Classification
Facial Recognition
Feature Engineering
Chatbot
Collaborative Filtering
Voice Interaction
Predictionio
N Gram
Random Forest Algorithm
Apache Spark
Text Classification
Realsense
Caffe
Deep Learning
Face Detection
Latent Dirichlet Allocation
AdaBoost (Adaptive Boosting)
Theano (Software)
Keras (Neural Network Library)
Cortana
Disambiguation
Deeplearning4j
Chainer (Deep Learning Framework)
Scikit-Learn (Python Package)
Perceptron
Pybrain
Word2Vec Models
Xgboost
Mnist
Objective Function
Cudnn
Microsoft Cognitive Toolkit (CNTK)
Recurrent Neural Network (RNN)
Boosting
Baidu
Game Ai
Dbscan
Feature Extraction
Imagenet
Apache Mahout
Lemmatization
Light Detection And Ranging (LiDAR)
PyTorch (Machine Learning Library)
Confusion Matrix
K-Means Clustering
Unsupervised Learning
Activity Recognition
Artificial Intelligence Development
MLflow
PaddlePaddle
Google AutoML
H2O.ai
Hugging Face (NLP Framework)
Hugging Face Transformers
DeepSpeech
Image Recognition
OpenVINO
MLOps (Machine Learning Operations)
BERT (NLP Model)
fastText
OpenAI Gym
Kubeflow
AIOps (Artificial Intelligence For IT Operations)
Text-To-Speech
GPT-3 (NLP Model)
Sphinx Speech Recognition
Explainable AI (XAI)
Generative Adversarial Networks
AI/ML Inference
Machine Learning Model Monitoring And Evaluation
Machine Learning Model Training
Transformer (Machine Learning Model)
Variational Autoencoders
ChatGPT
Deck.gl
Large Language Modeling
PyTorch Lightning
Attention Mechanisms
Boltzmann Machine
Generative Artificial Intelligence
Nuance Mix
Prompt Engineering
ModelOps
Operationalizing AI

Appendix two: Calculating net skill change

Here is how the turnover in skills required by employers (net skill change) is calculated.

How net skill change is calculated

The net skill change is a measure of the change in the frequency of skills required by employers for a particular occupation. This metric and its associated methodology to be calculated was developed by Harvard economists, David Deming and Kadeem Noray (2020).

Below we present the formula and walk through an example.

In short, the net skill change takes the absolute value of each skill change for an occupation and sums them. As it measures the absolute value the value is always positive. It is capturing skill changes be they positive or negative and adding them. The more changes in skills demanded by an employer be they demanded more or less (positive or negative), the higher this net skill change value.

Formula:

$$Net\ Skill\ Change_{o,t2,t1} = \sum_{s=1}^{S} Abs[(\frac{Skills^{s}_{o,t2}}{JobAds_{o,t2}}) - (\frac{Skills^{s}_{o,t1}}{JobAds_{0,t1}})]$$

Example:

If skill A is mentioned 50 times in 2019 and then 65 times in 2023 (and we assume job postings remained constant in both time periods at 100 for example). The skill change would be 65/100 - 50/100 = 15/100 = **+0.15.**

If skill B is mentioned 30 times in 2019 and then 25 in 2023 (in 100 postings in both periods), the skill change would be 25/100 - 30/100 = -5/100 = **-0.05.**

The net skill change the sum of the absolute values:
Net skill change for job X = 0.15 + 0.05 = **0.20.**

PwC's 2024 AI Jobs Barometer

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