

## We analysed job ads from data provider Lightcast

Country Name	Number of observations
United States	406,046,340
United Kingdom	114,033,805
Germany	74,453,370
France	50,085,742
Canada	21,708,544
Mexico	18,358,437
Brazil	16,824,532
Italy	15,323,940
Netherlands	15,122,502
Singapore	14,188,461
Belgium	14,031,387
Australia	13,785,544
Poland	13,183,592
Spain	12,389,469
Sweden	10,280,912
Switzerland	7,258,722
Malaysia	5,909,311

Country Name	Number of observations
Denmark	4,598,335
Ireland	3,860,132
South Africa	3,406,455
New Zealand	3,367,391
Hong Kong, SAR	3,029,620
United Arab Emirates	2,095,148
Norway	1,825,464

#### **Total observations**

841,389,319

# Lightcast's updated data methodology

## Changes stem from improved deduplication, sectoral mapping, AI taxonomy, and data standardisation

1

#### Noise Reduction & Improved Skill Detection

The deduplication model has been enhanced, leading to a reduction in data duplication.

2

#### **More Accurate Deduplication Model**

Previously, deduplication used ISCO (436 occupations); now, it relies on Lightcast Occupations (1,900 levels) and Job Titles (>70,000).

3

#### Standardisation of Non-English-Speaking Countries' Data

The format for non-English-speaking countries' data shifted, improving sectoral allocations through more accurate mapping mechanisms.

4

#### Refined AI Skills Taxonomy

The AI skills taxonomy has been expanded, leading to a rise in the number of jobs classified as 'AI jobs'. Additionally, AI skill libraries have been fine-tuned, incorporating additional tools and skills. This results in a larger AI taxonomy compared to last year.

## We use the IMF's classification for augmentable vs automatable jobs

#### We introduce the IMF's complementarity variable

AI Exposure Index: The augment and automate analysis includes only the occupations for which the AI exposure is greater than 0.5 on a scale of 0 to 1 (the top half of all observations).

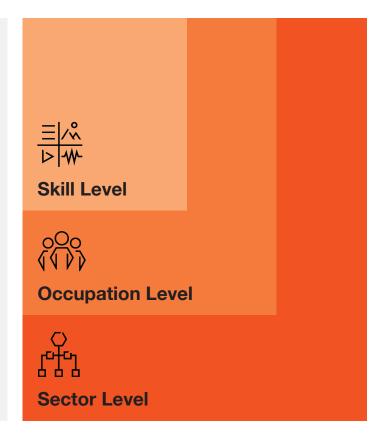
**IMF Complementarity Index:** Extends Felten's work to assess AI's potential to automate or augment key tasks for occupations.

We re-base the complementarity variable so that all occupations are between 0 and 1.

Augmented jobs: high AI exposure (greater than 0.5) and high complementarity (greater than 0.5) are poised for augmentation with AI enhancing productivity and wages (e.g., surgeons, judges).

Automated jobs: high AI exposure (greater than 0.5) and low complementarity (less than 0.5) are poised for automation as AI replaces tasks, reducing demand (e.g., clerical workers, telemarketers).

Levels of analysis we hope to include



- Metrics we include
  - Relative growth in Augment and Automate job postings, 2012 to 2024
  - Relative growth in Augment and Automate job postings, 2018 to 2024
  - Change in job demand for augmented and automated occupations, by country, 2019 to 2024
  - Net skill change for augmented and automated occupations, by country, 2019 to 2024

## Detailed methodology for key metrics

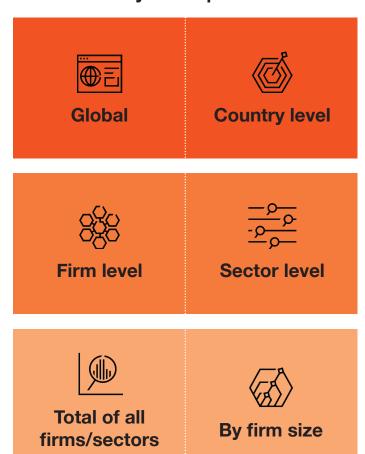
Metric	Data	Methodology	Levels
Relative growth in AI and all job postings, 2012/18 to 2024, globally	Lightcast: Share of AI jobs and All jobs	We take global Lightcast data for all job postings (global, including all nations listed on the previous slide) and compare the number of all jobs with the number of 'AI jobs'. We take a ratio for the relative number of all and AI jobs compared to 2012/18 levels.	Globally Occupation level
Proportion of total job posts requiring AI related skills, 2012 to 2024	Lightcast: Share of AI jobs	We take economy level Lightcast data for the number of job postings with an 'AI skill(s)' listed. We compare core countries over time to show the relative growth in the number of jobs listed with 'AI skills'.	Globally and by country Occupation level
Proportion of total job postings requiring AI related skills by sector, 2012 to 2024	Lightcast: Share of AI jobs	We take global Lightcast data for the number of job postings with an 'AI skill(s)' listed. We compare across different sectors over time to show the relative growth in the number of jobs listed with 'AI skills'.	Globally Occupation and sector level
Change in demand for all skills in all jobs against exposure to AI, 2019 to 2024	Lightcast: Change in demand for skills	We take global Lightcast data for demand for skills for each year by skill category on a global level. The demand (%) is the number of times a given skill category is mentioned (in a given year) over all skills.	Globally Occupation level
Number of job postings relative to 2012/18 by AI exposure	Lightcast: Change in demand for all jobs	We take Lightcast data on the difference in demand for jobs (grouped by occupation using ISCO codes). We split the demand for jobs into quartiles based on AIOE, with the top quartile being the most exposed to AI. For each quartile we take a ratio of growth from 2012 and compare the quartiles overtime.	Globally Occupation level
Average wage premium for jobs if listed with 'AI skills', 2024	Lightcast: Wage premium for AI jobs compared to all jobs	We take economy level Lightcast data for the difference in wages for a given occupation. We compare, for the same occupation, the difference in wage if the job is or is not listed with 'AI skills'. Thus we estimate the wage premium of 'AI jobs'.	By country Occupation level
The top 5 fastest and top 5 slowest growing skills by category, 2019 to 2024	Lightcast: Demand for skills Felten's AIOE	We take global Lightcast data for demand for skills for each year by skill category on a global level. The demand (%) is the number of times a given skill category is mentioned (in a given year) over all skills.	Globally Skill level

## Detailed methodology for key metrics

Metric	Data	Methodology	Levels
Relative growth in Augment and Automate job postings, 2012/18 to 2024	Lightcast: Total postings (with Occ. Code) Felten's AIOE IMF: Complementarity	We take global Lightcast data for all job postings and categorise each posting as either one of Augmented, Automated, or Neither based off their occupation code. We only include occupations for which the AIOE is greater than 0.5 (ie. we include the upper half of observations). We then use the IMF complementarity variable, where the upper half of occupations are considered augmented jobs, and the bottom half are considered automated jobs. We then take a ratio for the relative number of Augment and Automate jobs compared to 2012/18 levels.	Globally Augment and Automate
Change in demand by nation, 2019-2024, all jobs, augmented and automated	Lightcast: Change in demand for all jobs Felten's AIOE IMF: Complementarity	We take Lightcast data on the difference in demand for AI jobs (grouped by occupation using ISCO codes). We use AIOE to compare change in demand relative to AI exposure. We split this data further by augment and automate, using the complementarity variable. We observe the average positive and negative change in demand for skills for augmented and automated jobs.	Globally and by country Occupation level Augment and Automate
Average positive skill change and average negative skill change, for augmented and automated jobs, 2019-2024, globally	Lightcast: Positive and negative change in skills Felten's AIOE IMF: Complementarity	We take global Lightcast data for demand for skills for each year by skill category on a global level. We use both positive and negative change in demand data (2019 to 2024). We split this data further by augment and automate, using the complementarity variable. We observe the average positive and negative change in demand for skills for augmented and automated jobs.	Globally and by country Augment and Automate
The top 5 fastest and top 5 slowest growing skills by category, Augment and Automate Jobs, 2019 to 2024	Lightcast: Demand for skills Felten's AIOE IMF: Complementarity	We take global Lightcast data for demand for skills for each year by skill category on a global level. The demand (%) is the number of times a given skill category is mentioned (in a given year) over all skills. We only include occupations for which the AIOE is greater than 0.5 (ie. we include the upper half of observations). We then use the IMF complementarity variable, where the upper half of occupations are considered augmented jobs, and the bottom half are considered automated jobs.	Globally Skill level Augment and Automate

## In analysing the impact of AI Exposure on productivity levels, we adopt a methodology that focuses on three core metrics

#### Levels of analysis we provide



#### Metrics we include

For each level of analysis, we assess the following metrics:

- Change in productivity between 2018-2023 – turnover per employee (TPE) is calculated by dividing operational revenue by headcount
- Change in headcount between 2018-2023 – given as EMPL in the ORBIS dataset
- Change in wage per employee between 2018-2023 – wage per employee is calculated by dividing total staff costs by headcount

All three metrics are examined against AI Industry Exposure values sourced from Felten (2021). This ultimately allows us to assess the impact of AI exposure on productivity, headcount, and wages at both firm and sector level.

#### High level methodology

- We start by cleaning the raw Orbis dataset by removing outliers and checking for data completeness.
- We map AI Industry Exposure values sourced from Felten to the NAICS2017 sector codes tagged to the ORBIS data.
- We calculate turnover per employee (TPE) by dividing operational revenue by headcount.
- We calculate wage per employee by dividing total staff costs by headcount.
- We calculate the delta/percentage change for each of the three metrics using the 2018 and 2023 values as our inputs.
- We perform firm level analysis to determine correlation, regression and top quartile to bottom quartile ratios.
- We aggregate our results by 4-digit NAICS sector.
- We calculate weighted percentage changes for TPE, number of employees per company (EMPL) and WAGE using the 2018 and 2023 values as our inputs.
- We perform sector level analysis to determine correlation, regression and top quartile to bottom quartile ratios.
- We split firms into two groupings ('Large' and 'Super Large') taking an operating revenue in 2023 of \$1bn as the threshold.
- We perform the same firm and sector level analysis on the two different groupings of firms.
- We export our data tables into Excel to produce the final charts.

## Our productivity analysis includes a range of metrics and our methodology for each metric is outlined below

Metric	Data	Methodology	Level
AI exposure vs growth rate in productivity by sector	Felten: AIIE Orbis: Growth rate in TPE	TPE is calculated by dividing operational revenue by headcount. At sector level we calculate a weighted TPE by dividing the sum of operational revenue across all firms in a sector by the sum of employment across all firms in a sector. The percentage change across the 2018 and 2023 values is then taken as the growth rate.	Globally and by country By sector By firm
AI exposure vs growth rate in headcount by sector	Felten: AIIE Orbis: Growth rate in headcount	Headcount is directly provided in the Orbis data as 'EMPL'. At sector level we calculate a weighted headcount by taking the sum of employment across all firms in a sector. The percentage change across the 2018 and 2023 values is then taken as the growth rate.	Globally and by country By sector By firm
AI exposure vs growth rate in wage per employee by sector	Felten: AIIE Orbis: growth rate in wage per employee	Wage per employee is calculated by dividing total staff costs by headcount. At sector level we calculate a weighted wage per employee by dividing the sum of staff costs across all firms in a sector by the sum of employment across all firms in a sector. The percentage change across the 2018 and 2023 values is then taken as the growth rate.	Globally and by country By sector By firm
AI exposure vs growth rate in productivity by sector, by Large and Super Large firm size	Felten: AIIE Orbis: Growth rate in TPE	Follows methodology from (1) but firms with revenue greater than \$1bn are considered 'Super Large' while firms with revenue between \$50mn and \$1bn are considered 'Large'. The analysis is essentially run twice; once for 'Super Large' firms and once for 'Large' firms.	Globally and by country By sector By firm size By firm
AI exposure vs growth rate in headcount by sector, by Large and Super Large firm size	Felten: AIIE Orbis: Growth rate in headcount	Follows methodology from (2) but firms with revenue greater than \$1bn are considered 'Super Large' while firms with revenue between \$50mn and \$1bn are considered 'Large'. The analysis is essentially run twice; once for 'Super Large' firms and once for 'Large' firms.	Globally and by country By sector By firm size By firm
AI exposure vs growth rate in wage per employee by sector, by Large and Super Large firm size	Felten: AIIE Orbis: Growth rate in wage per employee	Follows methodology from (3) but firms with revenue greater than \$1bn are considered 'Super Large' while firms with revenue between \$50mn and \$1bn are considered 'Large'. The analysis is essentially run twice; once for 'Super Large' firms and once for 'Large' firms.	Globally and by country By sector By firm size By firm

## In arriving at our final datasets, we apply a series of assumptions and filters that directly impact the overall firm count

Filter	Rationale	Number of firms affected	Number of surviving firms
Orbis Raw Data (pre-filtered for firms with \$50mn+ OPRE)	This is the starting dataset	N/A	280,955
Removal of fewer than 4-digit NAICS/empty cells/missing values for either EMPL19/23 or OPRE19/23	We clean the Orbis dataset and remove any entries that are empty/NA as well as NAICS codes that are not 4 digits	221,740	59,215
Removal of firms from the Orbis dataset that have a 4-digit NAICS code with no direct match in the Felten AIIE paper	We are unable to tag these firms to a corresponding sector- specific AI exposure value	19,492	39,723
Removal of firms that do not have 10 or more employees in 2018 and 2023	We deem 10 employees to be a reasonable threshold for a firm to be considered 'normal'	1,210	38,513
Removal of firms that have 0 operational revenue in either 2018 or 2023	Operational revenue of 0 is unrealistic in the context of our analysis and we treat these entries as anomalies in the data	25	38,488
Removal of firms that are identified as outliers by the Rosner Outlier Test (where $k=100$ )	Rosner's Test is used to detect 'k' outliers in a dataset by iteratively removing the most extreme values. In our analysis we set the maximum number of outliers as 100, determined through an eye test of the distribution of the TPE growth data	100	38,388 (TPE/Headcount Table)
Removal of firms that have STAFF costs of 0/NA in either 2018 or 2023	Staff costs of 0 are unrealistic and would cause a calculation error when computing 'wage per employee'	8770	29,618
Removal of firms that have a 'wage per employee' value that falls outside of \$1000 - \$10,000,000	We filter out the possibility of negative wages and leave the upper bound relatively open, considering filter 4 is already in place	142	29,476 (Wage Table)

#### Other Filters (Sector Level and Size Level Analysis)

- For sector-based analysis we require a minimum of 5 firms to be included. For size-based sector analysis we reduce this requirement to 3 firms to maintain a sufficient sample size.
- For sector-based analysis we exclude any datapoints where the calculated growth in 'wage per employee' across 2018-2023 ('Wage\_Delta') exceeds 100%. We consider these sectors to be 'abnormal' and treat them as outliers relative to the rest of the dataset.

Notes: We apply the wage filters (6 and 7) last, as applying the wage filter before the productivity a nd headcount analysis results in a substantially smaller dataset for the productivity and headcount analysis. As such, we duplicate a parallel dataset to that used in the productivity and headcount analysis and apply the wage filter there. We use this parallel dataset for our wage analysis.

The Fearless Future: Global Al Jobs Barometer 2025 Methodology Appendix

# Our analysis considers workforce breakdowns, by national economy and gender

We leverage data from Felten, IMF, and ILOSTAT to produce analysis that breaks down country-specific workforces into quartile Al exposures, assess automation and augmentation potential and analyse gender-specific trends.



**Felten's AI Occupational Exposure Index (AIOE):** Evaluates the potential for AI to perform key job function, producing an AI exposure score by occupation.

**IMF Complementarity Index:** Extends Felten's work to assess AI's potential to automate or augment key tasks for occupations.

**ILOSTAT Workforce Data:** Comprehensive data which breaks down country-specific workforces by occupation and gender.

### List of 376 AI Skills used to identify 'jobs that require AI skills'

AI/ML Inference

AIOps (Artificial Intelligence For IT Operations)

Applications Of Artificial Intelligence

Artificial General Intelligence

Artificial Intelligence

Artificial Intelligence Development

Artificial Intelligence Markup Language (AIML)

Artificial Intelligence Systems

Azure Cognitive Services

Baidu

Cognitive Automation

Cognitive Computing

Computational Intelligence

Cortana Ethical AI

Expert Systems

Explainable AI (XAI)

Intelligent Control

Intelligent Systems

Interactive Kiosk

IPSoft Amelia

Knowledge Engineering

Knowledge-Based Configuration

Knowledge-Based Systems

Multi-Agent Systems

Open Neural Network Exchange (ONNX)

OpenAI Gym

Operationalizing AI

Reasoning Systems

Soft Computing

Swarm Intelligence

Watson Conversation

Watson Studio

Weka

Advanced Driver Assistance Systems

Autonomous Cruise Control Systems

Autonomous System

Autonomous Vehicles

Guidance Navigation And Control Systems

Light Detection And Ranging (LiDAR)

OpenCV

Path Analysis

Path Finding

Remote Sensing

Unmanned Aerial Systems (UAS)

AdaBoost (Adaptive Boosting)

Adversarial Machine Learning

Apache MADlib

Apache Mahout

Apache SINGA

Apache Spark

Association Rule Learning

Attention Mechanisms

Automated Machine Learning

**Autonomic Computing** 

AWS SageMaker

Azure Machine Learning

Boltzmann Machine

Boosting

Bot Framework

CHi-Squared Automatic Interaction Detection (CHAID)

Classification And Regression Tree (CART)

Cluster Analysis

Collaborative Filtering

Confusion Matrix

Cyber-Physical Systems

Dask (Software)

Data Classification

Dbscan

Decision Models

Decision Tree Learning

Dimensionality Reduction

Dlib (C++ Library)

Embedded Intelligence

Ensemble Methods

**Evolutionary Programming** 

Expectation Maximization Algorithm

Fast.ai

Feature Engineering

Feature Extraction

Feature Learning

Feature Selection

Game Ai

Gaussian Process

Genetic Algorithm

Google AutoML

Google Cloud ML Engine

Gradient Boosting

H2O.ai

Hidden Markov Model

Hyperparameter Optimization

Inference Engine

K-Means Clustering

Kernel Methods

Kubeflow

LIBSVM

Loss Functions

Machine Learning Machine Learning Algorithms Machine Learning Methods

Machine Learning Model Monitoring And Evaluation

Machine Learning Model Training

Markov Chain

Matrix Factorization

Meta Learning

Microsoft Cognitive Toolkit (CNTK)

MLOps (Machine Learning Operations)

mlpack (C++ Library)

ModelOps

Naive Bayes Classifier

Objective Function

Oracle Autonomous Database

Perceptron

Predictionio

Programmatic Media Buying

PyTorch (Machine Learning Library)

Random Forest Algorithm

Recommender Systems

Reinforcement Learning

Scikit-Learn (Python Package)

Semi-Supervised Learning

Sorting Algorithm

Supervised Learning

Support Vector Machine Test Datasets

Torch (Machine Learning)

Training Datasets

Transfer Learning

Unsupervised Learning

Variational Autoencoders

Vowpal Wabbit Speech Recognition Cognitive Robotics Object Tracking Xgboost Speech Recognition Software Motion Planning Adobe Sensei Amazon Alexa Speech Synthesis Nvidia Jetson Embedded AI

Amazon Textract Statistical Language Acquisition Robot Framework Deep Reinforcement Learning (DRL)

ANTI.R Text Mining Robot Operating Systems Vespa Apache OpenNLP Text-To-Speech Robotic Automation Software CrewAI

BERT (NLP Model) Theano (Software) Robotic Liquid Handling Systems Neuro-Symbolic AI Chatbot Tokenization Robotic Programming Incremental Learning

t-SNE (t-distributed Stochastic Neighbor Embedding) Computational Linguistics Voice Assistant Technology Robotic Systems

Voice Interaction DeepSpeech Servomotor Language Models

Dialog Systems Voice User Interface SLAM Algorithms (Simultaneous Localization And Mapping) Neural Ordinary Differential Equations

fastText Word Embedding 3D Reconstruction Image Super-Resolution

Word2Vec Models Fuzzy Logic Activity Recognition Sequence-to-Sequence Models (Seq2Seq)

Handwriting Recognition Apache MXNet Computer Vision Recurrent Neural Networks (RNNs)

Hugging Face (NLP Framework) Artificial Neural Networks Contextual Image Classification Bagging Techniques

Intelligent Agent Autoencoders Deck.gl Data Version Control (DVC)

Intelligent Virtual Assistant Caffe (Framework) Digital Image Processing Convolutional Neural Networks (CNN)

Kaldi Caffe2 Eve Tracking Topological Data Analysis (TDA)

Language Model Chainer (Deep Learning Framework) Face Detection Residual Networks (ResNet)

Latent Dirichlet Allocation Convolutional Neural Networks Facial Recognition Reinforcement Learning from Human Feedback (RLHF)

Lexalytics Cudnn General-Purpose Computing On Graphics Processing Units Variational Autoencoders (VAEs)

Machine Translation Deep Learning Gesture Recognition Scene Understanding

Microsoft LUIS Meta-Reinforcement Learning

Deep Learning Methods Image Analysis Natural Language Generation

Deeplearning4j Image Matching Reinforcement Learning (RL) Natural Language Processing (NLP) Evolutionary Acquisition Of Neural Topologies Image Recognition Concept Drift Detection

Natural Language Programming Generative Artificial Intelligence Image Segmentation Text to Speech (TTS)

Natural Language Toolkits ChatGPT Image Sensor Thermal Imaging Analysis

AI Skill (201-250) Natural Language Understanding Imagenet Image Captioning

Hugging Face Transformers Natural Language User Interface Machine Vision Meta-Learning Nearest Neighbour Algorithm Large Language Modelling Mnist Image Inpainting

Digital Twin Technology Nuance Mix Transformer (Machine Learning Model) Motion Analysis

Optical Character Recognition (OCR) Generative Adversarial Networks Object Recognition Semantic Kernel Prompt Engineering Keras (Neural Network Library) OmniPage Text Summarization

Screen Reader Long Short-Term Memory (LSTM) Pose Estimation Natural Language Understanding (NLU)

OpenVINO Realsense Natural Language Generation (NLG) Semantic Analysis Semantic Interpretation For Speech Recognition PaddlePaddle AI Copywriting Retrieval Augmented Generation

Conversational AI Semantic Parsing Pybrain Dynamic Routing

Semantic Search Predictive Modeling Multimodal Learning PyTorch Lightning Sentiment Analysis Recurrent Neural Network (RNN) Synthetic Data Generation Odrant

TensorFlow Sentence Transformers Seq2Seq OpenAI Gym Environments

Shogun Advanced Robotics Text Retrieval Systems Weaviate

#### The Fearless Future: Global Al Jobs Barometer 2025 Methodology Appendix

Data Sovereignty Microsoft Copilot

Automated Data Cleaning Neural Architecture Compression

Langgraph

Instance Segmentation

Distributed Machine Learning Summarization Methods Bayesian Belief Networks Small Language Model

AutoGen

Neural Architecture Search (NAS)

Graph Neural Networks (GNNs)

PineCone

Spiking Neural Networks

Multimodal Models

Gradient Boosting Machines (GBM)

AI Personalization

Knowledge Representation

Edge Intelligence Knowledge Distillation

Support Vector Machines (SVM)

Federated Learning

AI Security

Artificial Intelligence Risk

Agentic Systems AI Testing

Generative AI Agents
DALL-E Image Generator

Google Bard Stable Diffusion

Amazon Comprehend

Amazon Lex Amazon Polly

Dialogflow (Google Service)

Disambiguation GPT-3 (NLP Model) Information Extraction Language Identification

Lemmatization N Gram Named Entity Recognition NLTK (NLP Analysis)

Part-of-Speech Tagging
Question Answering
Relationship Extraction

Sirikit

Speech Enhancement Speech Processing Speech Technology

Sphinx Speech Recognition

Text Classification Voice Technology

Word-Sense Disambiguation K-Nearest Neighbors Algorithm

Artificial Consciousness

LightGBM

Intelligent Automation Nuance Nina Virtual Assistant

Azure OpenAI Azure AI Studio AWS Bedrock Google Assistant

Automated Planning And Scheduling

LangChain GitHub Copilot Human AI Interaction Few Shot Learning AI Research

AI Innovation AI Agents Agentic AI

Zero Shot Learning

AI Safety AI Alignment Graph Algorithms Time Series Text Processing PySpark

Databricks

Neural Machine Translation (NMT)



### How we calculate net skill change

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.

#### **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.

#### Formula:

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



#### 2025 Global AI Jobs Barometer

pwc.com/aijobsbarometer

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