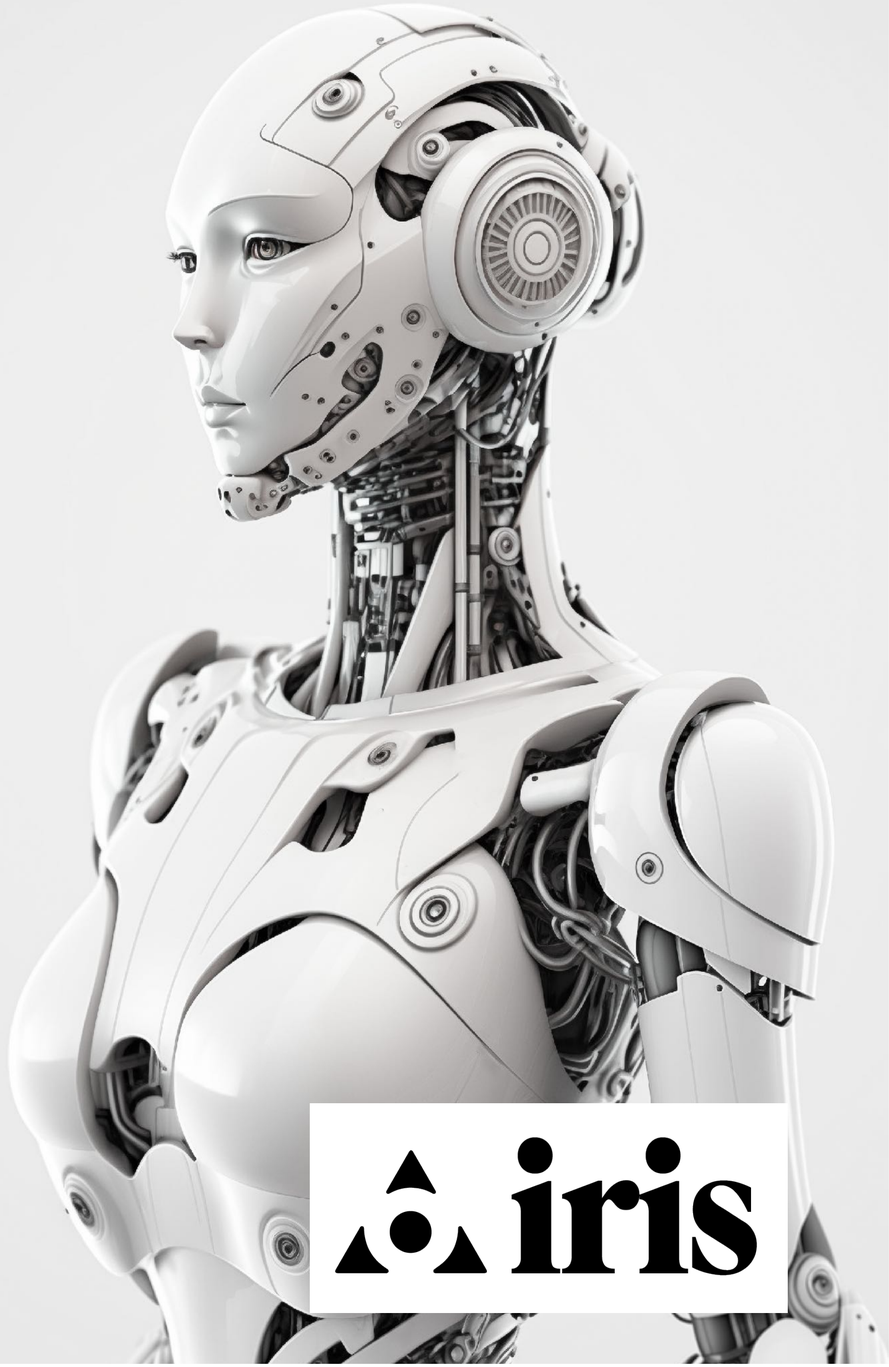
AI IN THE REAL WORLD



CHRISTY CARDENAS

APRIL 2024

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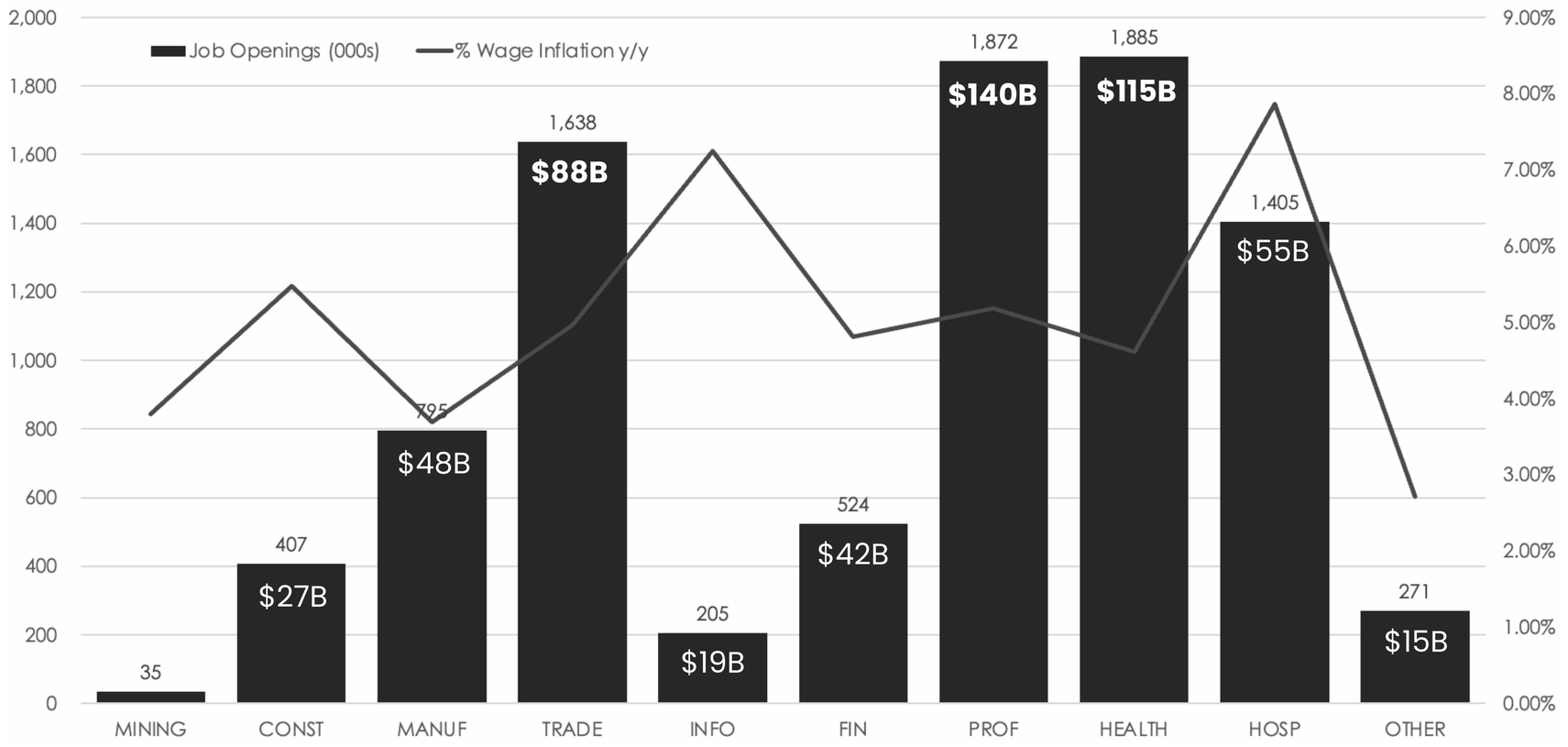
Labor is a challenge

LABOR MARKETS REMAIN IN SHORT SUPPLY [1]

Job Openings (000s) vs. Real Wage Inflation % y/y by Industry

Latest data available as of August 2022



INFLATION

DEMOGRAPHICS

EFFICIENCY

ARTIFICIAL INTELLIGENCE

Source: US Bureau of Labor Statistics, Peterson Institute for International Economics.

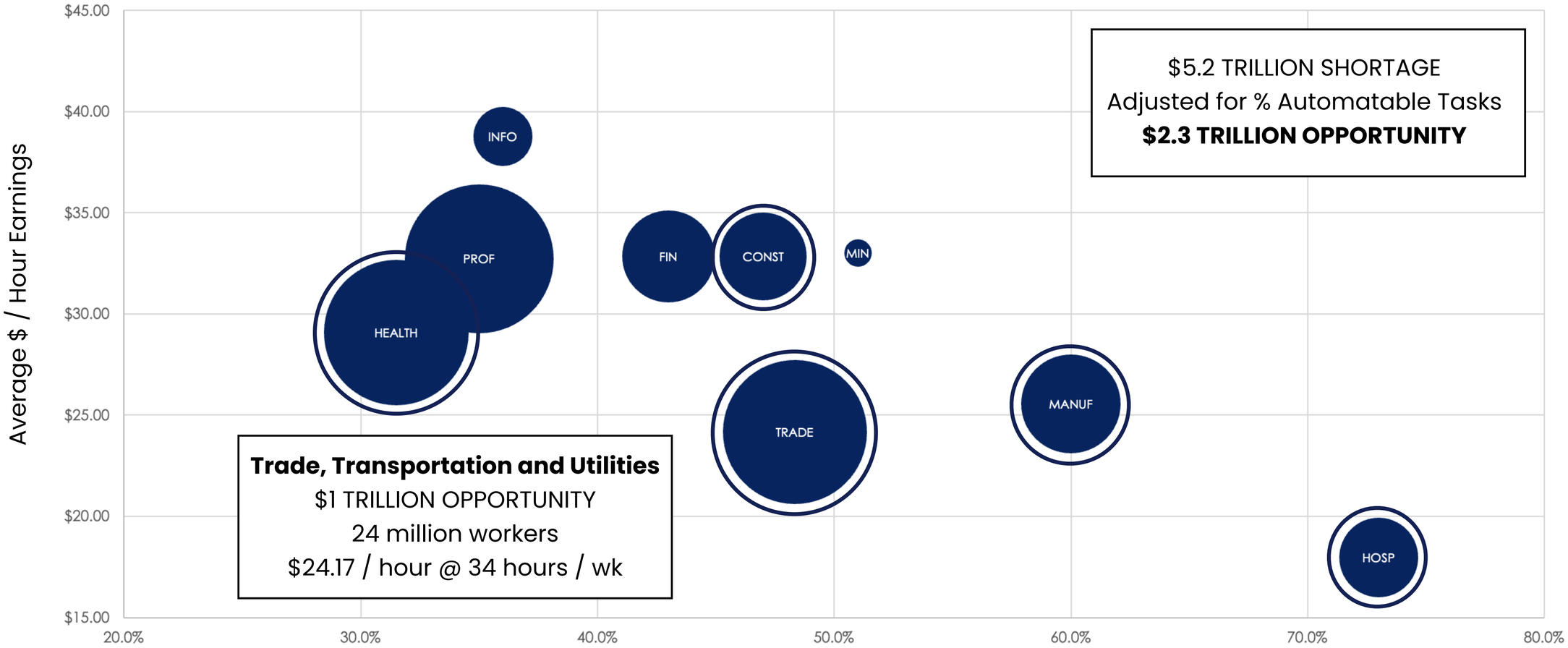
1 Assumes 40 hours per week, 50 weeks per year based on hourly wages by industry per US Bureau of Labor Statistics.

The opportunity is enormous

HUMAN LABOR: The Dull, Dirty and Dangerous

Nonsupervisory Labor: % of Automatable Tasks x Average Hourly Cost of Labor [1]

Bubbles scaled to Annual Size of Labor Market Opportunity [2]



Source: United States Bureau of Labor Statistics, information as of September 2022.

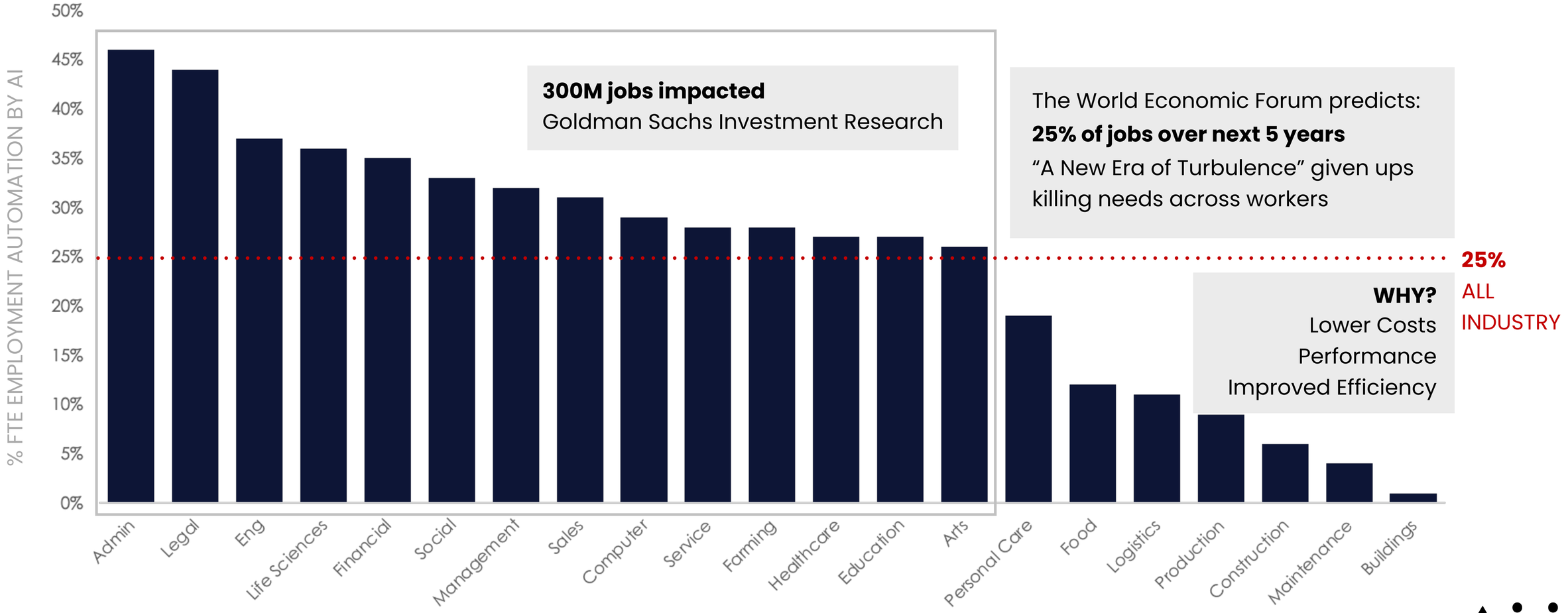
1 Portion of automatable tasks by Industry per McKinsey 2017 study.

2 Annual size of labor market opportunity based on average hourly earnings, average weekly hours worked, and a 52-week year on an industry basis.

AI drives big change

AI IS CHANGING THE GAME

Employment Automation by AI, % [1]

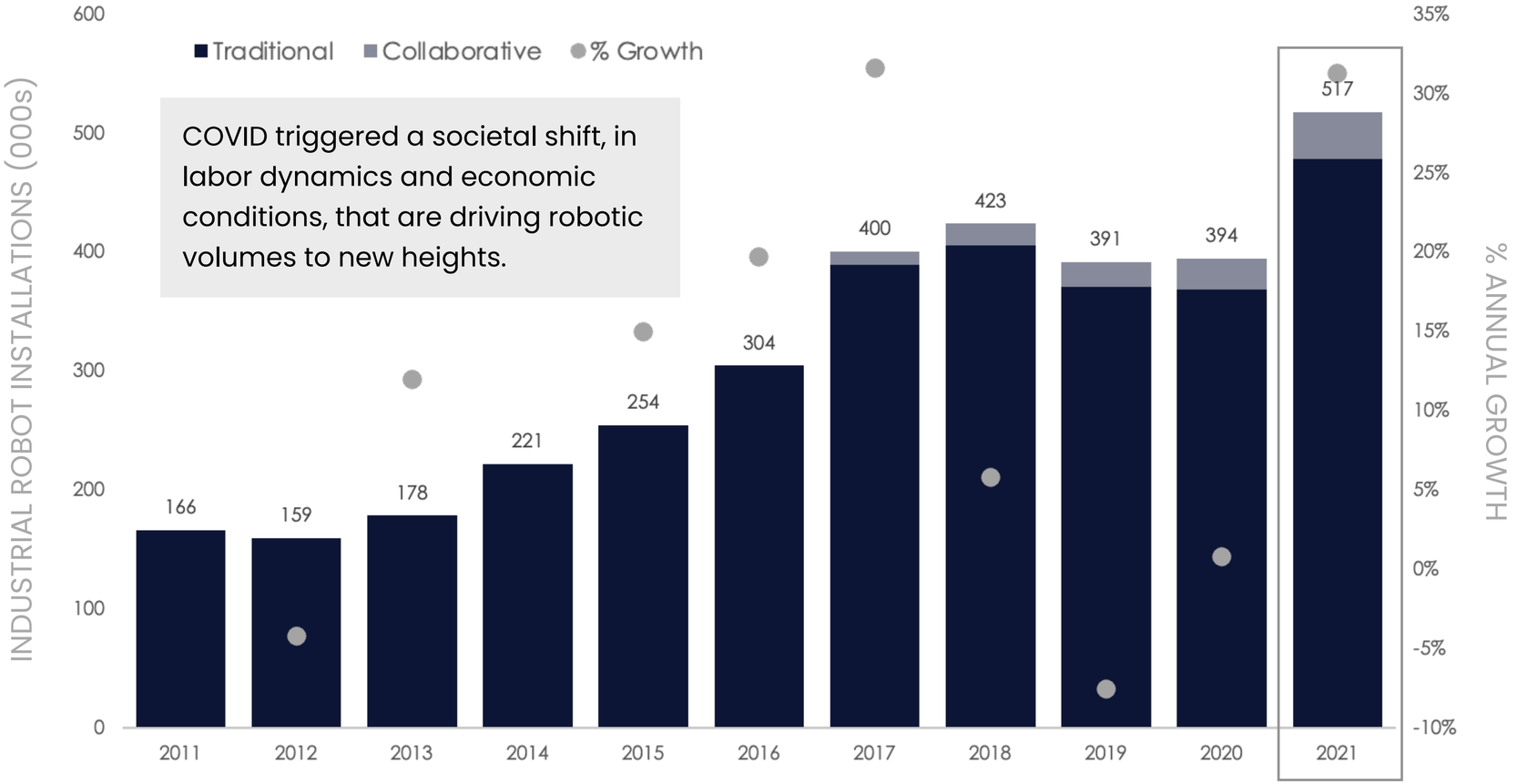


1 Goldman Sachs Global Investment Research, March 2023.

Here come the robots

ROBOTIC VOLUME GROWTH COMPOUNDS [1]

Annual Installations of Industrial Robots Worldwide (000 units)



COVID triggered a societal shift, in labor dynamics and economic conditions, that are driving robotic volumes to new heights.

Cost Reductions drive
Higher Volumes drive
Cost Reductions drive
Higher Volumes

2021: A BANNER YEAR

+ 517,000 Units

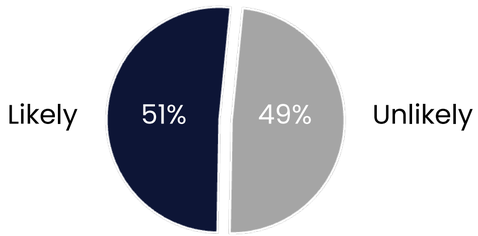
31% Growth

vs. 6% GDP Growth

Highest Growth Ever

MORE TO COME [2]

Technology Adoption, 2023-27

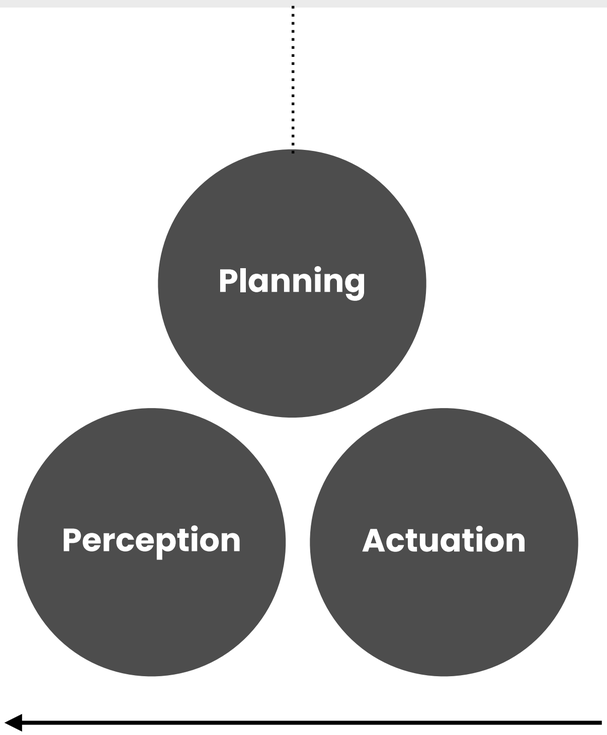


1 IFR World Robotics Report, 2022 (as of October 2022).
2 World Economic Forum, The Future of Jobs Report, 2023.

A new breed of bot

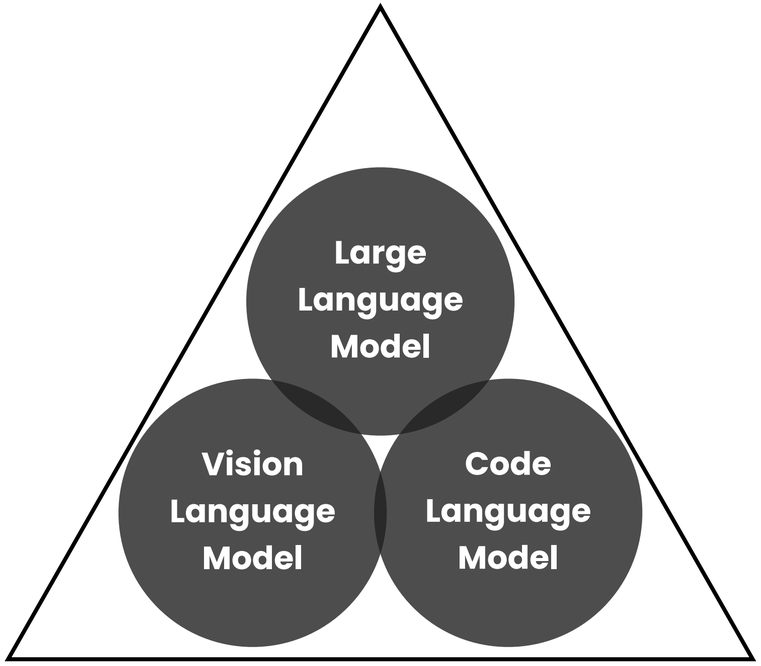
YESTERDAY

GOAL
Frequent iteration



TODAY

SOCRATIC MODELS
LLMs have an inner monologue, assess an environment, and reason



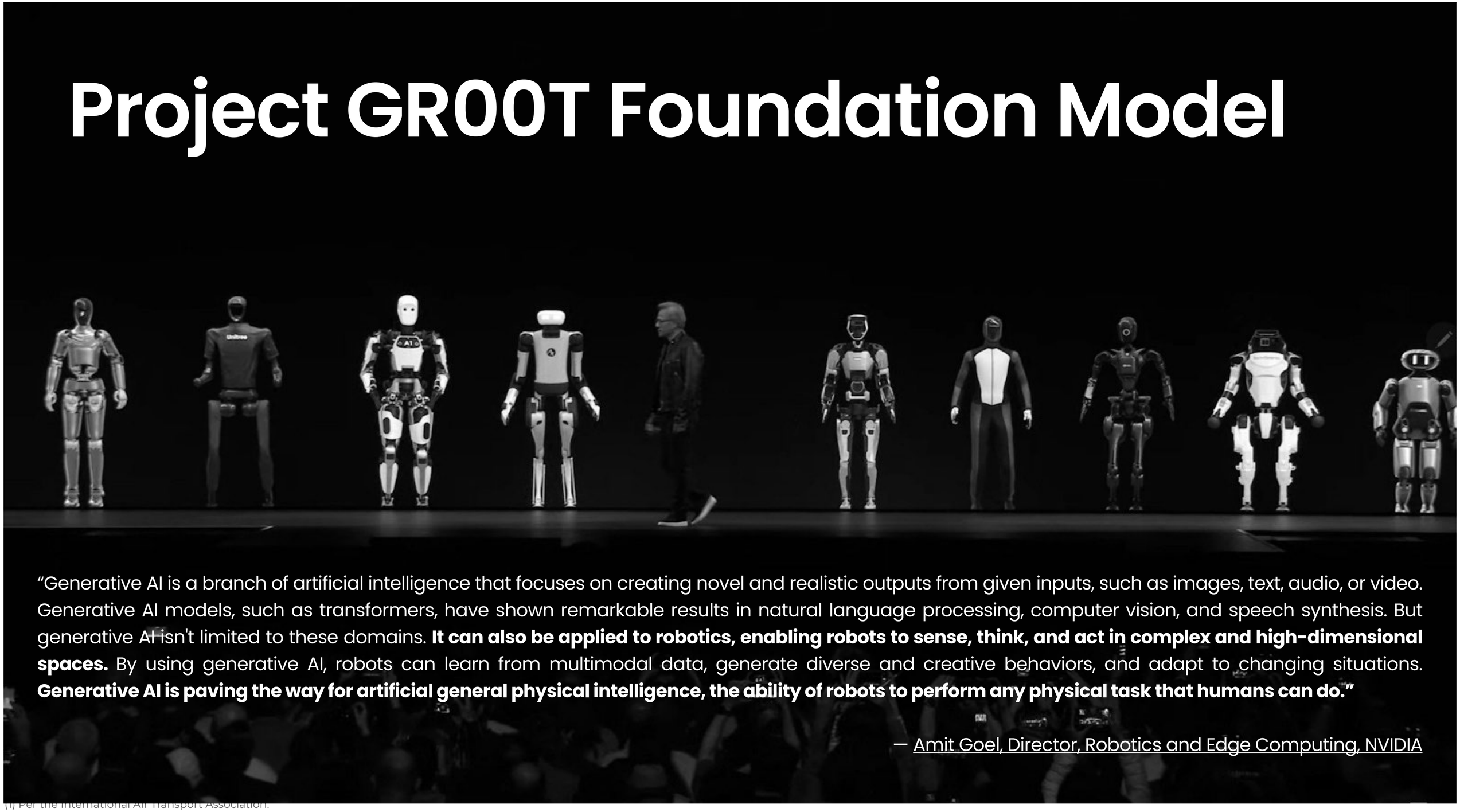
TOMORROW

Now, we will have robots that can ....

- Take instruction from anyone
- Assess their environments
- Communicate thought process
- Follow general safety principles
- **LEARN BETTER**

Source: Robotics in the Age of Generative AI with Vincent Vanhoucke, Google DeepMind, NVIDIA GTC 2024.

Project GR00T Foundation Model



“Generative AI is a branch of artificial intelligence that focuses on creating novel and realistic outputs from given inputs, such as images, text, audio, or video. Generative AI models, such as transformers, have shown remarkable results in natural language processing, computer vision, and speech synthesis. But generative AI isn't limited to these domains. **It can also be applied to robotics, enabling robots to sense, think, and act in complex and high-dimensional spaces.** By using generative AI, robots can learn from multimodal data, generate diverse and creative behaviors, and adapt to changing situations. **Generative AI is paving the way for artificial general physical intelligence, the ability of robots to perform any physical task that humans can do.”**

— Amit Goel, Director, Robotics and Edge Computing, NVIDIA

(1) Per the International Air Transport Association.

Challenges remain

TRAINING

There is no agreed upon recipe for training robotic systems today. No one knows how to develop skills over short and long term learning systems.

SIMULATION

Simulations <> Reality. This disconnect is another unsolved problem that researchers are attempting to reconcile.

DATA

The data being used to train large language and other models is imperfect, and produces imperfect results. Experts do not yet agree.

SCALING

Even if data is available, scaling up can be a challenge — translating from advanced models to the robotic stack and ultimately robotic actions.

ETHICS

Ethics and safety concerns are paramount, given the nature of unsupervised learning. This includes safety, supervision and other challenges.

COMPUTE POWER

ENERGY

“

EVERYTHING THAT MOVES IN THE FUTURE WILL BE ROBOTIC.

— Jensen Huang, CEO of NVIDIA regarding Project GR00T

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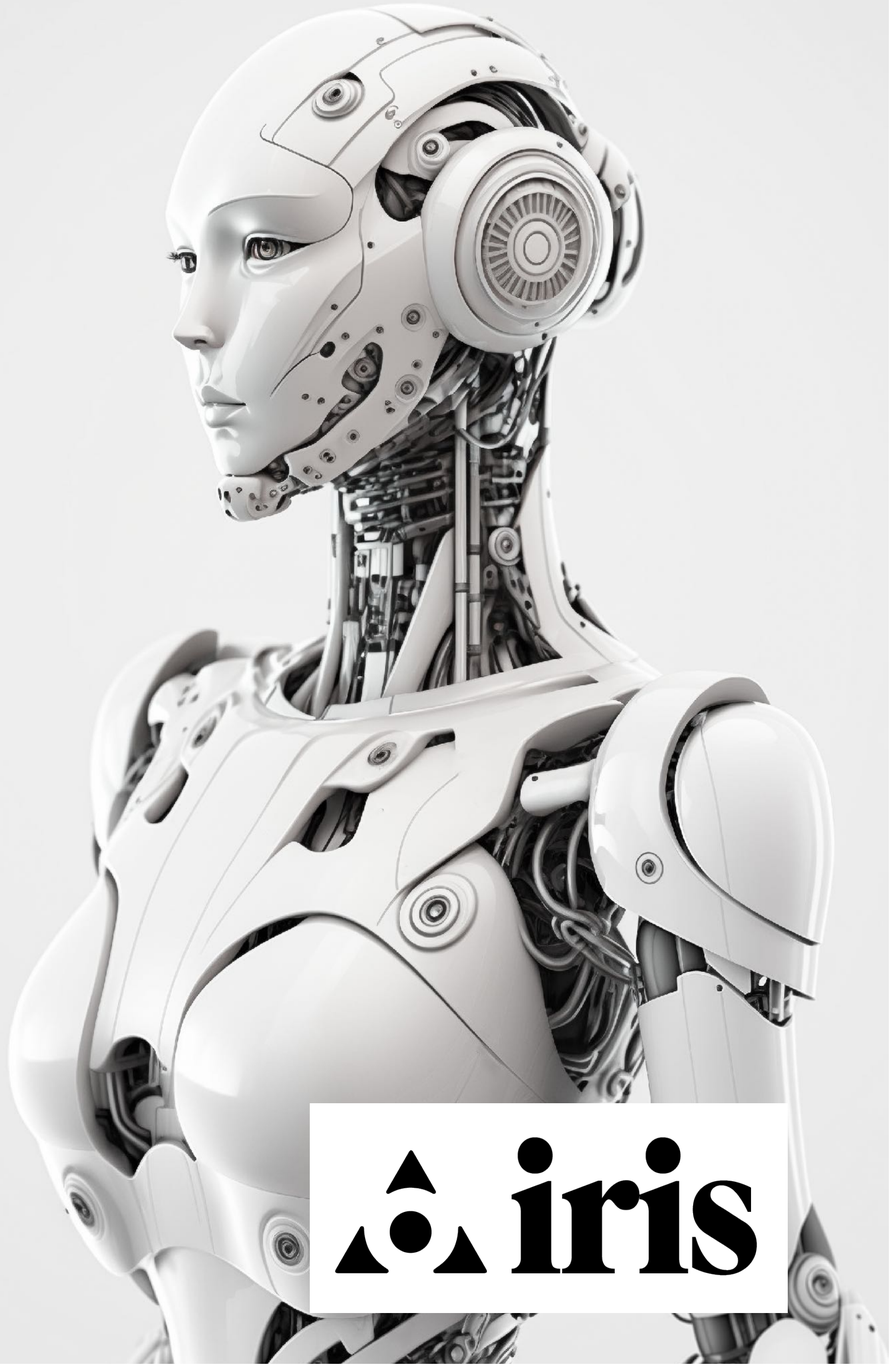

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