AI, Ethics and Workforce Transformation: Preparing Engineers for Digital Manufacturing Challenges

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Chemical, Materials and Biological Engineering

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17 October 2025

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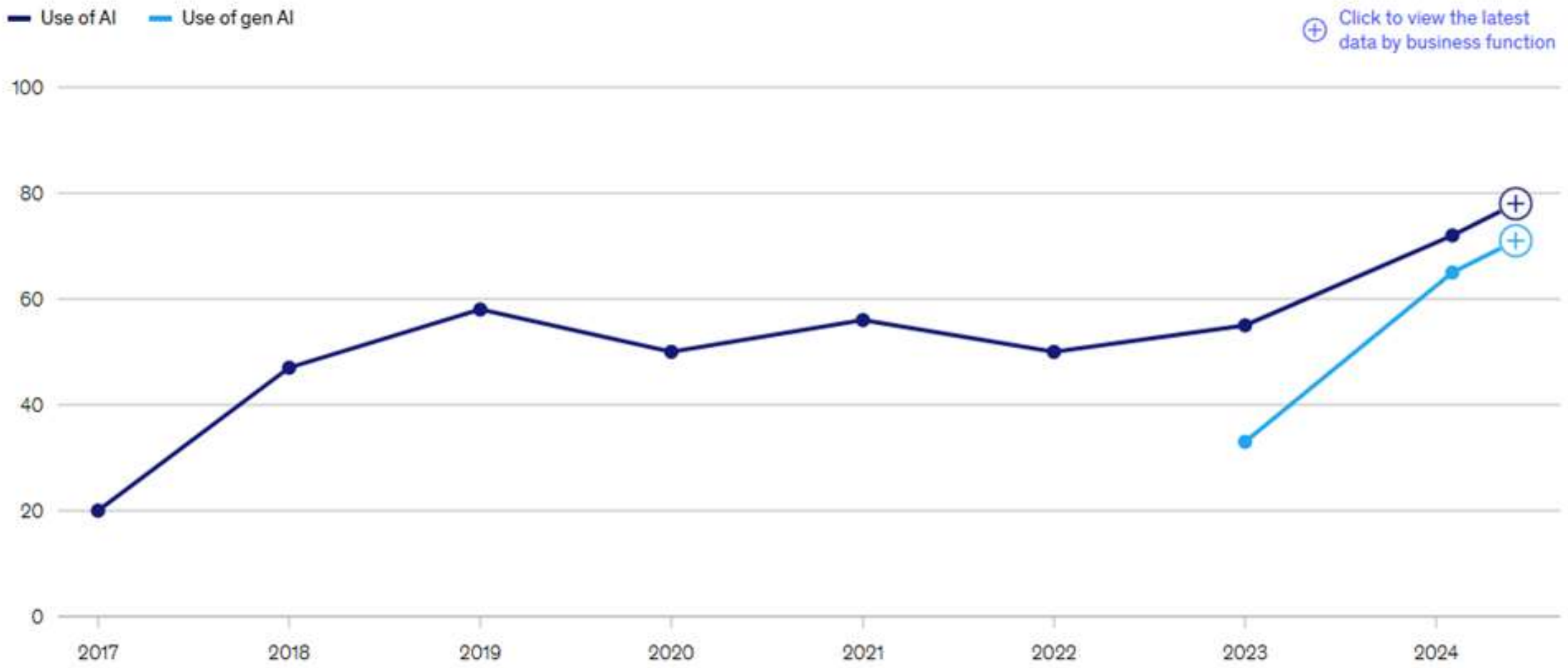
AI Positive World

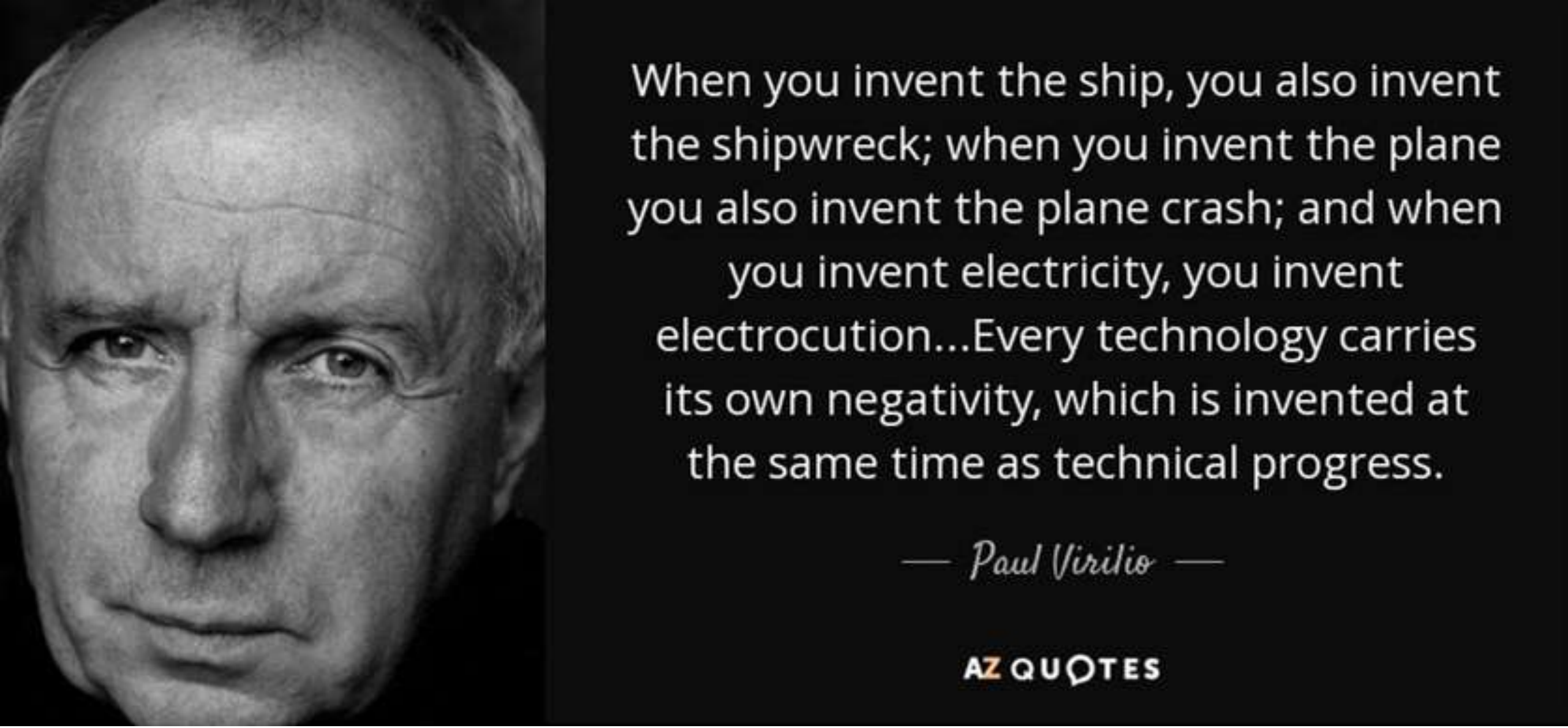


Source: McKinsey Global Surveys on the state of AI

AI in Manufacturing

Siemens CoPilot:
"*GenAI enhances human decision-making by providing context-aware support and making complex information accessible*"

Source: Generative and Agentic AI: Intelligent Manufacturing Evolves, June 2025


When you invent the ship, you also invent the shipwreck; when you invent the plane you also invent the plane crash; and when you invent electricity, you invent electrocution...Every technology carries its own negativity, which is invented at the same time as technical progress.
— Paul Virilio —
AZ QUOTES

Knowns and Unknowns of AI

	KNOWN	UNKNOWN
KNOWN	**Known knowns** - Misinformation and hallucination - Skills and reskilling	**Unknown knowns** - Effects of misinformation on us - Scaling bias - Fusion of AI into everything
UNKNOWN	**Known unknowns** - Redesigning education system - Environmental costs of AI systems - Deskilling decision-making to AI and losing agency – who is responsible?	**Unknown unknowns** - Superintelligent AI systems - Extreme catastrophic failures

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Good read: 5 strategies to activate your agency and stay relevant in the age of AI https://www.weforum.org/stories/2024/07/5-strategies-agency-relevant-age-of-ai/

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Is AI neutral?

How we answer it can help us to determine the **responsibilities** of anyone involved in creating or using AI technology?

And can help us to maximise its benefits and minimise its harms.

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AI is neutral…

Paul Daugherty, Chief Technology and Innovation Office at Accenture:

“So, I’d ask you to think a bout a simple question: Is technology and AI, good or bad?

The answer is Neither. Technology is neutral, AI is neutral. The way ‘we’ as humans, apply and use the technology is what defines if the impact is good or bad.”

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AI is neutral…

Demis Hassibis, the co-founder of DeepMind:

“I think AI is no different to any other powerful technology that was invented in the past. I think the technology itself is neutral. The question is how the society decided to deploy it.”

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AI isn't neutral…

Sir Tim Berners-Lee, WWW creator:

"As we're designing the system, we're designing society. Ethical rules that we choose to put into that design [impact society]....Nothing is self-evident. Everything has to be put out there as something that we think will be a good idea as a component of our society."

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A Double-Edged Sword: The Unseen Dangers of AI Enhancement

Geoffrey Hinton:

"I am scared that if you make the technology work better, you help the NSA misuse it more. I'd be more worried about that than about autonomous killer robots."

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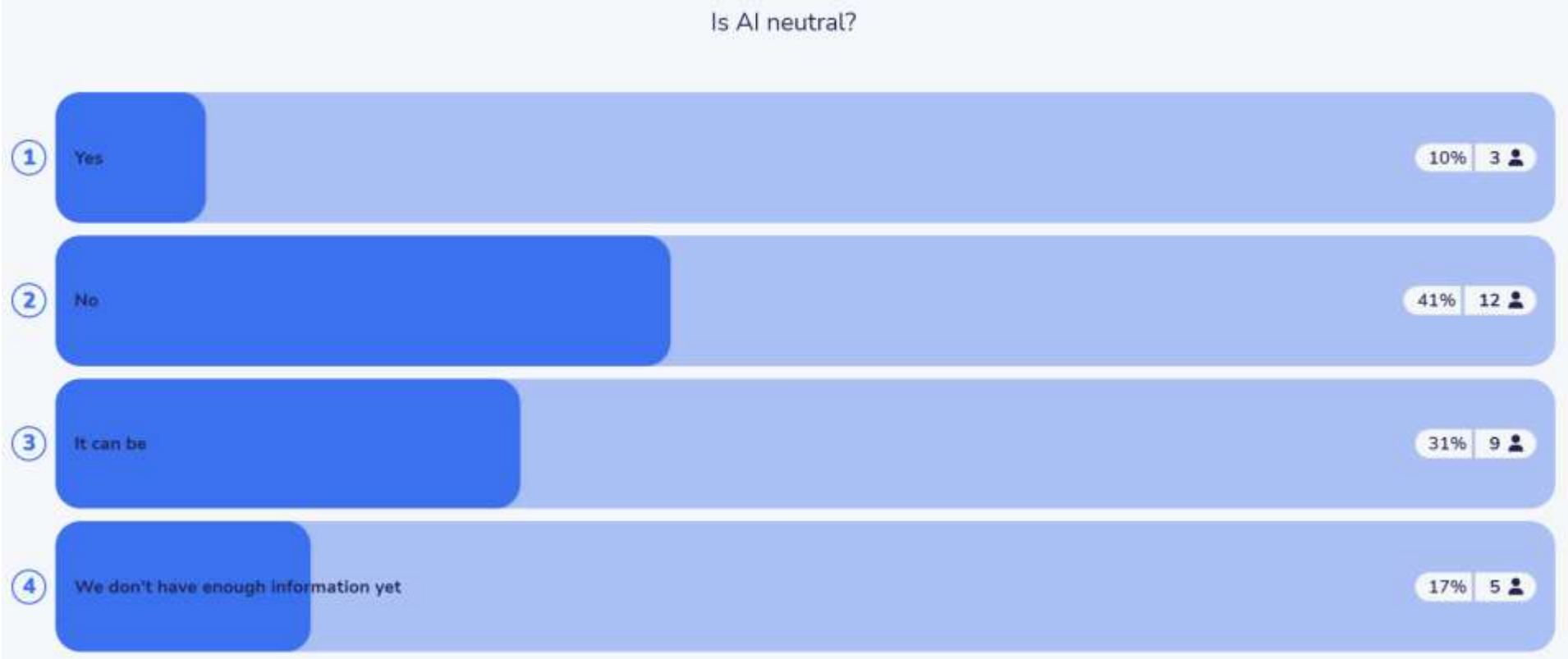
ChemEngDay UK – April 2025



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Ethics of AI - UNESCO

In no other field is the ethical compass more relevant than in artificial intelligence. These general-purpose technologies are re-shaping the way we work, interact, and live. The world is set to change at a pace not seen since the deployment of the printing press six centuries ago.

AI technology brings major benefits in many areas, but without the ethical guardrails, it risks reproducing real world biases and discrimination, fueling divisions and threatening fundamental human rights and freedoms.

Gabriela Ramos
Assistant Director-General for Social and Human Sciences of UNESCO

https://www.unesco.org/en/artificial-intelligence/recommendation-ethics

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Do we have an established universal framework to fully and ethically embrace and leverage AI in manufacturing today?

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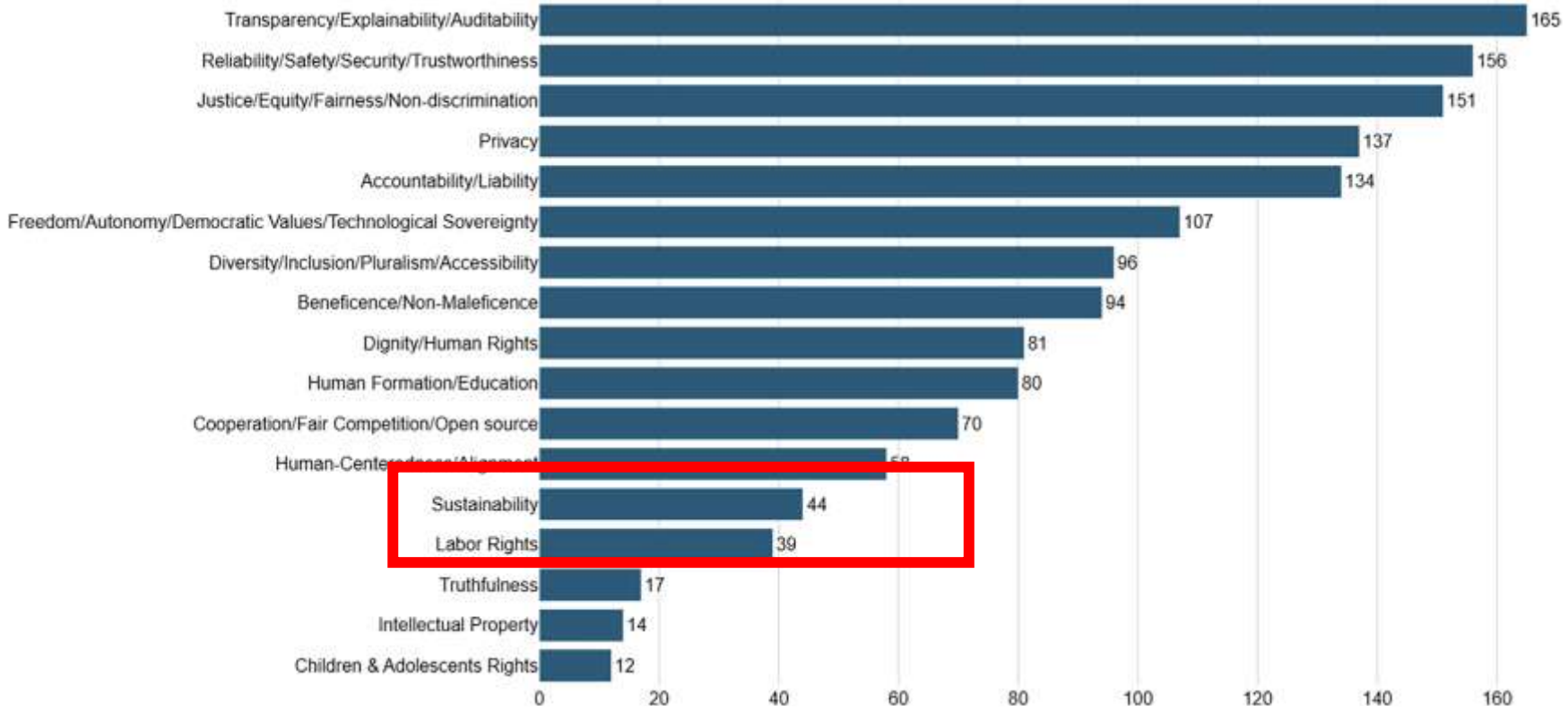
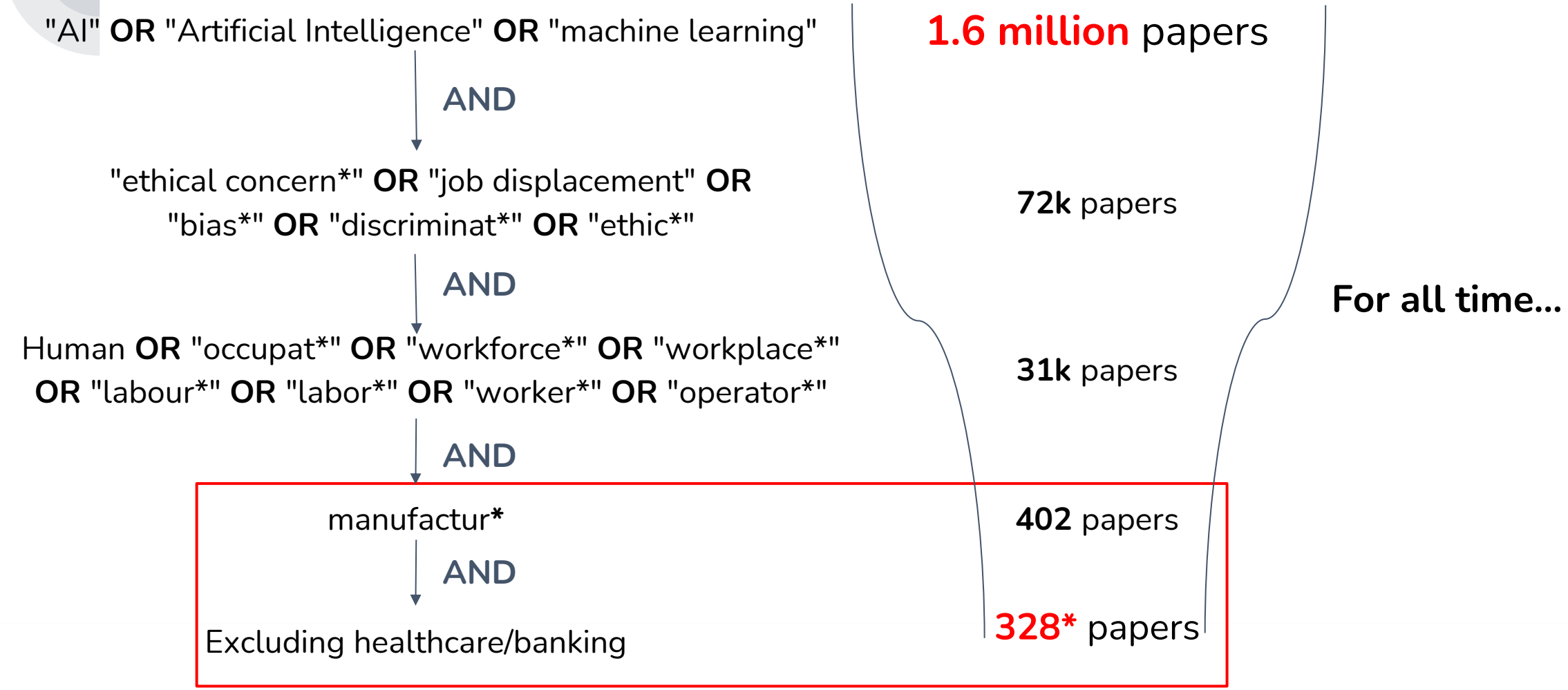
Worldwide AI Ethics



Number of times an aggregated principle was cited.

https://nkluge-correa.github.io/worldwide_AI-ethics/
Nicholas Kluge Correa et.al.

AI Ethics in Manufacturing



* Search updated in June 2025.

AI Policy Analyst

GSK
London N1C 4AG

- Engage with AIML engineers to guide governance and **ethics** components of project development.
- Collaborate with academic fellows in GSK and at partner...

Posted 8 days ago · More...

- View all GSK jobs - London jobs - Policy Analyst jobs in London
- Salary Search: AI Policy Analyst salaries in London
- See popular questions & answers about GSK

GenAI Solutions & Strategy

Morgan Stanley
London

Full-time

- Strong understanding of **artificial intelligence** concepts and technologies.
- The team is responsible for deploying advanced systems that utilize generative...

Posted 14 days ago · More...

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Data Privacy, AI & Ethics Lead

Greater London, England, United Kingdom · Reposted 5 days ago · Over 100 potential applicants

Hybrid · Full-time · Director

9 school alumni work here

Skills: Data Governance, Data Privacy, +8 more

MSD

Artificial Intelligence (AI) Ethics and Governance Specialist

Singapore, Singapore · Reposted 1 week ago · Over 100 potential applicants

Hybrid · Full-time

1 connection works here · 15 company alumni work here · 45 school alumni work here

Skills: Interpersonal Skills, Generative AI, +8 more

Ethics & Regulatory Compliance

Deloitte · 3.9 ★

London

Full-time

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WUN
WORLDWIDE UNIVERSITIES NETWORK

Empowering the Manufacturing Workforce for the Future: Democratisation of Digitalisation and Ethical Integration of AI

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Workshops

13 June 2024
University of Sheffield, **UK**

13 November 2024
University of Auckland, **New Zealand**

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Grand Challenge

Feature	**Traditional system**	**AI-powered system**
Functionality	Rigid, predefined	Dynamic, adaptive
Learning ability	Basic or None	Machine learning
Flexibility	Low	High
Data handling	Limited to structured data	Unlimited to structured and unstructured data
Decision-making	Based on predefined rules and logic	Based on data insights and patterns - no explicit rules
Complexity	Copmplicated, **deterministic**	Complex, **non-deterministic**
Human intervention	High	Low to very low
Behaviour	**Predictable**	**Unpredictable**

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Workshops takeaways

Concerns:

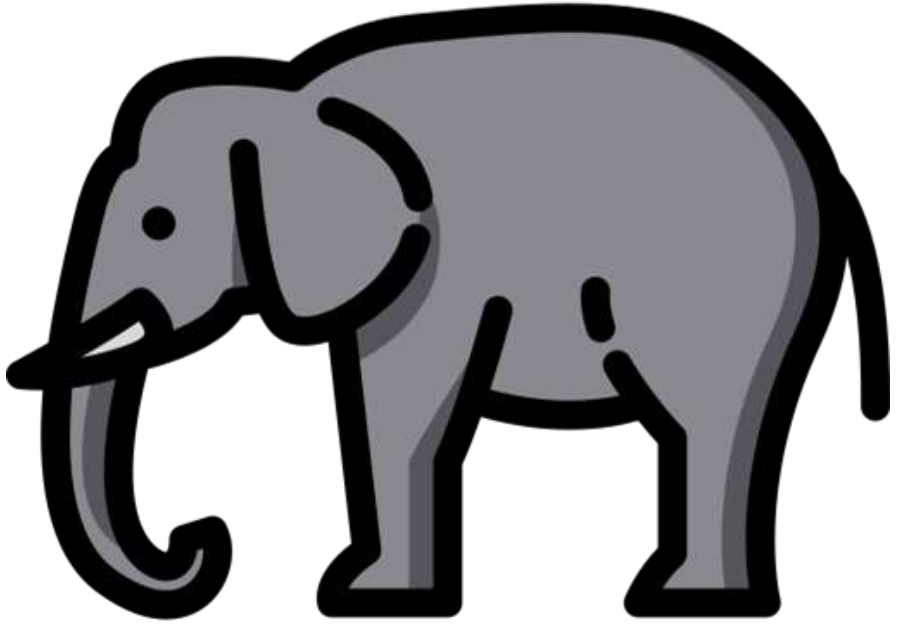
- **Data** in manufacturing is not always big data and sufficiently rich for model development: Industry still at industry 3.0.
- **Lack of** and difference in **understanding** by workforce and business on what AI is, what it can and can't do, and how it can assist.
- Human with AI replacing human without AI.
- Job displacement and replacement: Moving manufacturing (jobs) offshore.
- **Upskilling workforce requires skilled workforce**.

Five steps for adopting AI

- **Know your problem:** Do you need AI to solve your problem? Clearly define the specific problem you're trying to solve to avoid unintended consequences including its environmental cost.
- **Know your data:** Understand the origin, diversity, and limitations of your data, biased data produces biased outcomes! Treat data as an assest and not by-product.
- **Perform ethical & safety assessments:** Evaluate your AI system for potential ethical dilemmas and safety risks, ensuring transparency and accountability in their use. Who is responsible?
- **Trial in low-risk environments:** Deploy your AI solutions in controlled, lower-stakes scenarios to identify and mitigate potential problems before broader implementation.
- **Treat AI like an intern:** Supervise your AI closely, provide continuous feedback, and never rely entirely on AI decisions without human oversight.

Using GenAI is easier than asking my supervisor for support!

- 52% of PhD stduents had used GenAI within their doctoral research and/or writing.
- *“This is a tool, the same as Word, Excel, Google, WhatsApp, YouTube and others.”*



Do we prepare engineering students to think ethically?

How often do we encourage students to reflect on and discuss the societal trade-offs associated with technology?

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A rather stupid but always available brainstorming partner’: Use and understanding of Generative AI by UK postgraduate researchers https://doi.org/10.1080/14703297.2024.2446236

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"In medicine, you learn about ethics from day one. In mathematics [Engineering], it's a bolt-on at best. It has to be there from day one and at the forefront of your mind in every step you take."

Hannah Fry, Hello World: How to be human in the age of AI.

Good read: Technology is not neutral, a short guide to technology ethics, Stephanie Hare, 2022.

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Useful Resource

ISO/IEC TS 12791:2024 - Information technology — Artificial intelligence — Treatment of unwanted bias in classification and regression machine learning tasks

ISO/IEC 42001:2023 - Information technology — Artificial intelligence — Management system

UNESCO Ethical impact assessment: a tool of the Recommendation on the Ethics of Artificial Intelligence

Rolls Royce Aletheia Framework- Toolkit for ethics and trustworthiness in artificial intelligence

IChemE - Ethical Decision Making for Chemical Engineers - Basic knowledge to understand and make ethical decisions.

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AI Systems Definition

AI system:

Engineered system that **generates outputs** such as content, forecasts, recommendations or decisions for a given set of human-defined objectives.

Information technology — Artificial intelligence — Artificial intelligence concepts and terminology ISO/IEC 22989