

Artificial Intelligence

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1. More diversified access to large AI models

2. Changing dynamics in Responsible AI

3. Increase in co-evolution between hardware and AI

4. Collaboration between humans and AI

5. From large to small language models



Introduction

Over the past years, the full realisation of the transformer architecture (a digital neural network that can process vast amounts of data) has completely transformed the Artificial Intelligence (AI) landscape. Most AI research and development has pivoted towards Generative AI (GenAI), a subfield that employs computational models to generate text, images, video, and audio.

In many countries, government-funded organisations are developing large AI models for use in fields such as education, research, and healthcare. Unsurprisingly, many organisations are also integrating GenAI into their products and services in pursuit of profitability. Businesses are also seeking real-world applications in the name of efficiency, while also aligning with the responsible deployment of AI in those applications.

For example, there is an increase in the use of AI-Concierge, where AI can assist users (like hotel guests) with enquiries around the clock via popular messaging apps.

A key adoption bottleneck is the lack of knowledge that the general consumer, as well as many employees in organisations, have about prompt engineering for GenAI. Put simply, for any GenAI model to produce what a user wants, the user needs to know what type of instructions to provide the model with to get a desired result. This has pushed Agentic AI into the spotlight as an obvious solution for the novice AI user. In Agentic AI, the AI system serves the user by operating autonomously to perform pre-defined tasks with little or no human involvement or supervision.

Large-scale AI models (which are trained using enormous datasets) are becoming widely available and accessible, and applications built around them are increasingly being integrated into everyday life. The emergence of other new Human-Computer Interactions (HCI) powered by AI and concepts such as AI Love (where humans form intimate connections with AI) is also gaining traction.

A major consequence of the advancements in AI is that it is now a significant topic of geopolitical interest and controversy. In essence, AI is a key tool in the political world and as it now represents the greatest asset in the geopolitical game of AI supremacy. Governments are investing more in developing AI models and supporting infrastructure as they seek to establish themselves as AI superpowers to realise the full potential of

AI for broader society and national security. The unfortunate result of the race for AI dominance appears to come at the cost of a responsible or ethical AI based on principles such as trustworthiness, explainability, and human-centric AI.




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TREND #1

More diversified access to large AI models

Public Values

	Autonomy	Privacy Independency
	Justice	Transparency Trustworthiness Sustainability
	Humanity	Wellbeing

Maturity

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Drivers

Individualisation & empowerment; Mental health & well-being; Value of knowledge & skills; Automation & AI; Connectivity & interaction

Since ChatGPT became available and accessible for widescale use in 2022, large language models (LLMs) have gained massive worldwide traction. For example, ChatGPT reached 1 million users in just a few days after its launch, prompting more diversified access to LLMs and acted as the catalyst for AI to be increasingly part of many daily workflows. Access to AI is facilitated by browser-based tools (ChatGPT, Claude, and DeepSeek) as well as integrations in services and products from vendors like Google (e.g. Docs) and Microsoft (e.g. Copilot, Outlook).





Business models range from freemium tiers to pay-per-use APIs. Users now have the option to choose between cloud-based AI solutions or smaller, lightweight models running locally. Concurrently, open-source initiatives have contributed to the varied access to and democratisation of LLMs and tools. This development is reshaping how we write, code, research, and interact with AI, and even each other.




SIGNALS


Number of GPT users

Most students are using at least one of the available platforms to access a foundation model

- hepi.ac.uk 
- campustechnology.com 
- insidehighered.com 
- library.educause.edu 

OpenAI is now the most popular. Other options are Anthropic's Claude, Meta, Google options e.g. LM Notebook & Gemini (datastudios.org) 

As of late 2024-early 2025, DeepSeek has been getting quite some traction despite security risks (dig.watch) 

According to Semrush, OpenAI was the number five website in April 2025 (semrush.com) 

ChatGPT isn't the only chatbot that's gaining users (techcrunch.com) 






Gartner: why task-specific AI models will take over LLMs (aimagazine.com) 

Rapid rise of Generative AI: the leading companies (iot-analytics.com) 

Growing available models (& providers) on Huggingface (huggingface.co) 

Vatican: new Vatican document examines potential and risks of AI (vaticannews.va) 

European AI on the rise

- openeurollm.eu 
- swiss-ai.org 
- gpt-nl.nl 
- galaxus.nl 
- swiss-ai.org 

Is the search engine losing ground to AI chatbots?

- economictimes.indiatimes.com 
- mashable.com 

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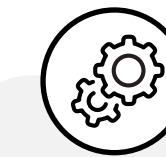
Education

- The diversified access to AI presents both opportunities and challenges for educators by automating mundane tasks, allowing them to focus on teaching and personal guidance, while necessitating adaptation to an AI-driven educational landscape.
- As students increasingly utilise AI chatbots for learning, productivity and general cognitive offloading, there may be significant implications for traditional tutoring roles and human skills such as critical thinking. Amongst students, the digital divide might widen due to variations in knowledge, access and permission to use.



Research

- In scientific research, AI can accelerate data analysis, enhance text interpretation, and support hypothesis generation. This serves to improve the speed and depth of scientific inquiry.
- Challenges include concerns over copyright and intellectual property, the risk of disinformation in generated content, and the danger of researchers becoming over-reliant on AI tools. More proposals and papers are produced which increases the reviewing burden.
- LLM's are increasingly being used as a research partner (research agents/co-scientists).






Operations

- Institutional processes are simplified by automating routine or repetitive tasks, enhancing information management, and enabling smarter workflows.
- Institutions have to navigate challenges such as potential copyright and data ownership issues, the risk of spreading disinformation, the reduction of human oversight, and concerns regarding the environmental sustainability of large-scale AI implementations.
- Services and products enabling AI lead to unauthorised data processing/contract breach and DPIAs.

TREND #2

Changing dynamics in Responsible AI

Public Values

	Autonomy	Privacy
	Justice	Integrity Equity Inclusion
	Humanity	Safety

Maturity

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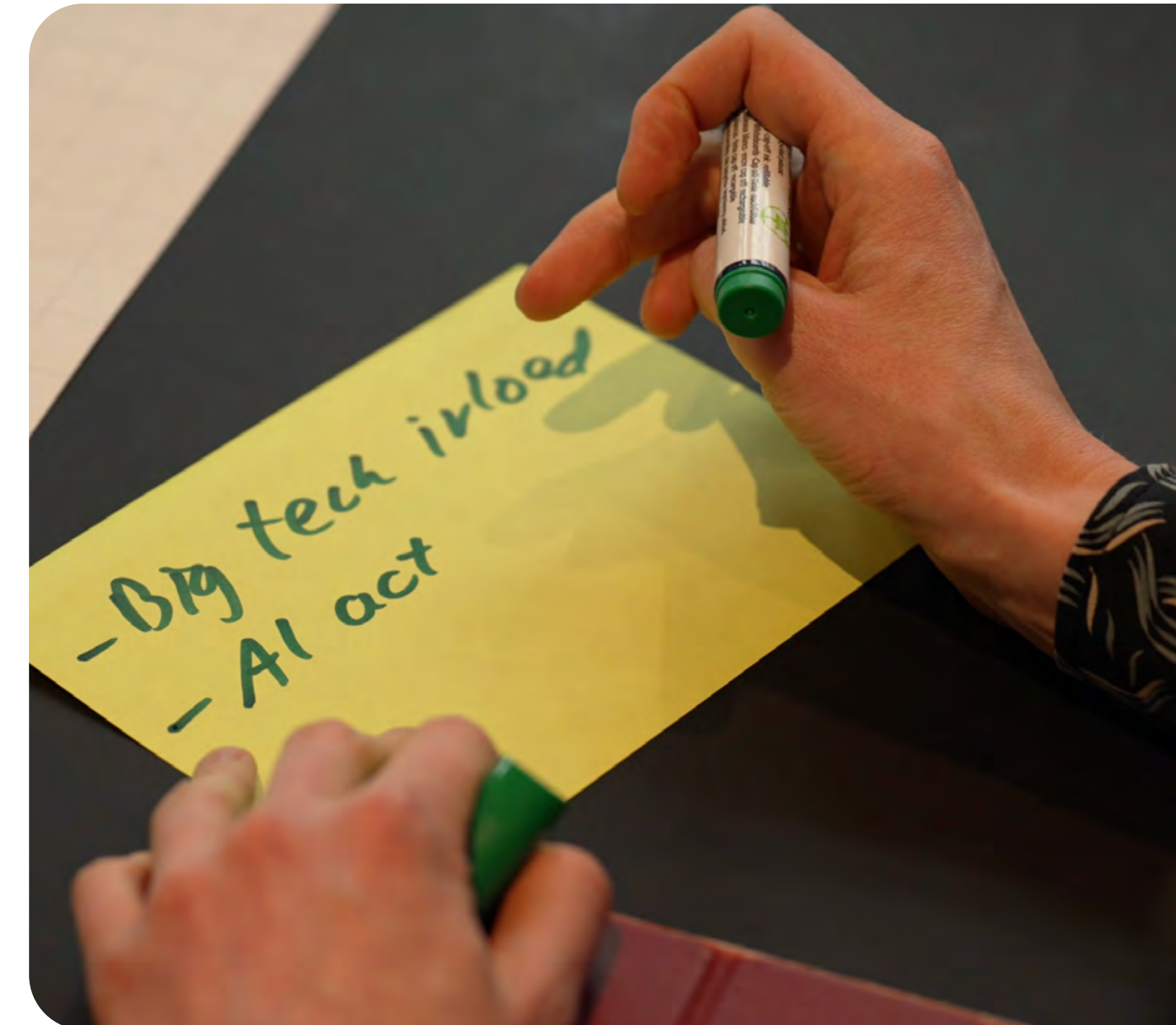
Drivers

Geopolitics & (digital) sovereignty; Concentration of wealth & economic inequality; Compliance & regulation

The EU is perceived as the global leader in regulation in comparison with the US. The AI Act, the world's first regulatory framework grounded on risk, transparency, and rights, demonstrates the EU as the defender of Responsible AI.

Despite this pioneering legislation, recent geopolitical events – mainly in the US - have shifted attention from ethics and human-centric AI towards national security and economic competition. Big tech companies are downsizing their Responsible AI commitments by laying off their ethics boards and prioritising competitiveness over transparency and responsible deployment.


However, there are signals that many businesses across the globe do want to implement Responsible AI, though they lack support or mechanisms to act upon it. Although generally small in scale, progress is being made to put Responsible AI programs in place. Nevertheless, the gap between intention, talk, and action on Responsible AI remains.



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Companies like Google and others are disbanding their ethics boards and firing ethics-aligned employees

- [wired.com](#) 
- [startupdaily.net](#) 
- [wired.com](#) 


Think twice before using DeepSeek: security and trust issues explained
([carleton.edu](#)) 


The UK has delayed plans to regulate AI as ministers seek to align with the Trump administration ([theguardian.com](#)) 

European Commission has withdrawn the proposed AI Liability Act (that would have made using copyrighted material for training models subject to copyright infringement)

- [openai.com](#) 
- [mayerbrown.com](#) 
- [musicbusinessworldwide.com](#) 

Harvard business review (HBR) research: how responsible AI protects the bottom line
([hbr.org](#)) 

Little more than half (52%) of companies actually have a responsible AI program in place, BCG data shows ([bcg.com](#)) 

87% of managers acknowledge the importance of responsible AI (RAI) - MIT Technology Review ([technologyreview.com](#)) 

“There is growing evidence that many big tech companies are backsliding on their commitments to responsible AI.”

- Virginia Dignum, Professor AI and Director of AI Policy Lab, Umeå University

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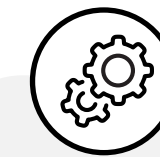
Education

- Copyright protection for teaching materials has been eroded, and there is a need to educate students in a more effective manner on how to use GenAI responsibly and safely.
- Students need to learn not to blindly trust GenAI models, and as Virginia Dignum says, educate them in navigating an industry culture that may be increasingly ambivalent towards responsible AI.



Research

- Copyright issues are impacting research involving GenAI models. Researchers require access to independently developed models, rather than just those derived from major tech companies, to avoid legal complications and foster responsible innovation.
- Industrial collaborations may be affected because of diverging policies on data management and processing.
- Independent research into AI's impact on society needs to be prioritised.




Operations


- Assessment methods should be reassessed due to a lack of measures from OpenAI to prevent coursework cheating.
- Clear guidelines for students and staff on using GenAI are needed.
- Offline models for educational use should be provided to end-users.
- Caution is required when using GenAI for administrative tasks, especially regarding data protection and ethical issues.


TREND #3

Increase in co-evolution between hardware and AI

Public Values

 Autonomy Interdependency

 Justice Equity

 Humanity

Maturity

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Drivers

Automation & AI; Engineering advances & computation;
Energy supply & power demand; Raw material scarcity

While hardware initially facilitates the computing for AI, it is now becoming the limiting factor, forcing AI developments to fit with computing infrastructure. The growing popularity and accessibility of AI models are driving a significant shift in hardware innovations. AI models are increasing in size and complexity faster than the advancements in general-purpose computing technologies for processing.

In the previous SURF Tech Trends Report 2023, the surge in specialised AI hardware was highlighted. In addition to this trend, more devices (phones, laptops, etc.) are being produced to support daily AI workflows. Another development driven by this mismatch is the design of AI models to use available computational resources more efficiently. With innovations such as low-precision models and AI-aware hardware implementations, AI is being reshaped, driven by the need to achieve ‘more with less’ in system capabilities.



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Nvidia's CES 2025 announcements promise a personal supercomputer

(nvidianews.nvidia.com) [↗](#)

Projected growth of AI chip market

(gcom.pdo.aws.gartner.com) [↗](#)

More AI hardware-focused companies coming into the market, e.g, Cerebras

- forbes.com [↗](#)
- axelera.ai [↗](#)

Many existing companies are pivoting towards making AI hardware

- digitaltrends.com [↗](#)
- gartner.com [↗](#)

There is an increase in hardware-aware model design (pytorch.org) [↗](#)

The pivot to focusing on AI solutions in most hardware marketing (gartner.com) [↗](#)

The AI revolution will require hardware resources with large energy requirements. This makes enterprise infrastructure a strategic differentiator once again

(deloitte.com) [↗](#)

"The gains in AI training performance since MLPerf benchmarks have dramatically outpaced Moore's Law."

- David Kanter, executive director of MLCommons (deloitte.com)

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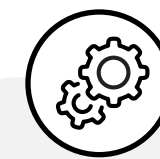
Education

- Personal AI workstations and increased attention for trusted compute architectures may help mitigate current privacy issues with big tech LLMs, as well as reducing data traffic across networks.
- High-performance compute for (HPC) for AI will offer students the possibility to handle more complex data tasks, however training may be required.



Research

- More accessible computer hardware with higher performance (personal supercomputers) means that there will be enhanced research capabilities for the research community.
- A dependency on a handful of vendors for AI-hardware exposes a risk of a potential scarcity of AI-devices as global supply chains come under pressure.






Operations

- Personal AI workstations and more efficient AI models, at lower cost, mean students and researchers are less likely to require large-scale high-performance computing (HPC) systems to experiment with cutting-edge AI. Unlike the computer science, data science, and AI communities who will still need to carry out internationally competitive research.
- Global demand for resources enabling AI specific chips, could limit hardware availability of edge devices supporting smart campus automation, research and education.

TREND #4

Collaboration between humans and AI

Public Values

	Autonomy	Freedom of choice Independency Privacy Diversity
	Justice	Inclusion
	Humanity	Safety Social cohesion

Maturity

WATCH

PLAN

ACT

Drivers

Individualisation & empowerment; Value of knowledge & skills; Automation & AI; Connectivity & interaction; Digital transformation; Concentration of wealth & economic inequality

Rather than taking over jobs, which is the way that AI is regularly framed, AI is becoming a partner at work and in our daily lives. In certain ways, AI is already taking over routine tasks to allow humans to focus on complex and creative work.

Next to routine tasks, AI is already considered a companion to turn to for therapy, identifying one's purpose, and resolving life issues. This AI partnership will be further strengthened by the growth of multi-agent systems.

Agentic AI, which has been in development since the late 1990s, promises to significantly enhance human-computer interaction through its natural language interfaces. Additionally, other interfaces are emerging in collaborative robots (cobots) and humanoid robots, enabling more human-like interactions.

Furthermore, AI is being integrated as ambient intelligence into various tools



and devices. Consider wearables with optics and microphones that can analyse the wearer's surroundings and assist in the same manner as a personal assistant or AI companion. A noticeable sentiment about this development relates to the use of LLMs from big tech companies for running the applications.

SIGNALS

Healthcare

AI assistants like PathAI are helping doctors analyse medical images (pathai.com) [↗](#)

Humanoid robots

Will be mass-produced in the US and China over the next three years

- tesla.com [↗](#)
- unitree.com [↗](#)

OpenAI's next big bet won't be a wearable:
Report (techcrunch.com) [↗](#)

Software development

Tools such as Github copilot in Character.AI are set to increase productivity and quality in the software development life cycle

- github.com [↗](#)
- character.ai [↗](#)

Your next AI wearable will listen to
everything all the time (wired.com) [↗](#)

Project Astra | Exploring the future of
learning with an AI tutor research prototype
(youtube.com) [↗](#)

More powerful AI is coming. Academia and
industry must oversee it – together (doi.org) [↗](#)

“Once AI becomes part of the background, it's no longer optional. It's invisible but irreversible.”

- Pieter Loman, Utrecht University

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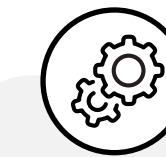
Education

- Changes are necessary in the curriculum to meet the new ways of collaborating with AI in professions, and all without compromising public values.
- Agentic AI may reduce teacher workload by automating assessments, feedback, and lesson planning – but raises questions about student agency, bias in feedback, and surveillance concerns.
- As workplace collaboration between humans and AI has a profound impact on jobs, students will need adaptability and a change in mindset as crucial skills for the future.
- Students, and teaching staff are becoming a data source for big tech, as the availability of AI tools become more widespread and accessible.



Research

- Researchers could benefit from AI agents to handle repetitive tasks (e.g., formatting, summarising, and literature scanning).
- Assuring reproducibility, data privacy, and authorship attribution are more complex for AI agents to handle.
- By streamlining data analysis, supporting experimental design, and managing laboratory tasks through robotic and predictive systems, AI promises increased automation and efficiency.
- Ownership of research data and associated questions are exposed with the use of publically available LLMs.






Operations

- AI can increase efficiency and productivity, but care needs to be taken with ethical judgements. Importantly, the main goal of education is not to lower costs, but to create a meaningful learning environment for students, as well as a safe and inspiring place to work for educational professionals.
- Institutions risk vendor lock-in and rising IT costs due to their reliance on embedded AI tools.
- AI-powered services could optimise scheduling, student support, and administration, lowering operational costs.
- Human-AI collaborative systems will be fed with huge amounts of physical and personal data, necessitating strict privacy regulations and ethical considerations to safeguard users and promote responsible AI practice.

TREND #5

From large to small language models

Public Values

	Autonomy	Privacy Diversity
	Justice	Transparency Inclusion Accountability
	Humanity	Safety Social cohesion

Maturity

WATCH

PLAN

ACT

Drivers

Individualisation & empowerment; Value of knowledge & skills; Connectivity & interaction; Cybersecurity & trust; Concentration of wealth & economic inequality; Energy supply & power demand; Climate change and global warming

After the revolutionary introduction of LLMs, there is growing interest in Small Language Models (SLMs). These are models with up to 10 billion parameters, in contrast with LLMs, which can have hundreds of billions or even trillions of parameters.

Training and using LLMs requires enormous amounts of computational resources. In contrast, SLMs are significantly smaller. Therefore, they are less intensive in terms of data processing, hardware, and training time requirements. SLMs also consume less energy, making them more suitable for applications on smaller devices.

SLMs are more accessible to users who want to train and run these models on consumer hardware at the edge of a network, especially for single-purpose devices (e.g. sensors). In addition, SLMs are particularly useful for specific tasks rather than for use as general-purpose tools.



SIGNALS

On-device deployment

Gemini Nano on Android: Building with on-device gen AI (io.google) [↗](#)

Qualcomm also enables the running of models like Meta's Llama 2 on smartphones using optimised, quantised versions (qualcomm.com) [↗](#)

Specialised hardware

European tech ecosystems focus on developing edge AI chips designed to deliver server-grade AI power on compact hardware

- axelera.ai [↗](#)
- edge-ai-tech.eu [↗](#)

Industry integration

EU-funded research programs (like AI-PRISM) explore embedding AI directly into manufacturing and industrial sectors to facilitate real-time analytics (aiprism.eu) [↗](#)

- AI-Powered human-centred Robot Interactions for Smart Manufacturing (cordis.europa.eu) [↗](#)
- Social industrial collaborative environments integrating AI, Big Data and Robotics for smart manufacturing (cordis.europa.eu) [↗](#)

Call for more environmentally friendly alternatives (nos.nl) [↗](#)

SLMs are well recognised for their lower energy consumption, providing a low-emission option for institutions looking to minimise their carbon footprint (unesco.org) [↗](#)

Why do researchers care about small language models? (quantamagazine.org) [↗](#)

The transformative potential of AI depends on energy (iea.org) [↗](#)

Privacy-preserving applications

AIPI pilot started in five Dutch hospitals (radiobotics.com) [↗](#)

IMPACT



Education

- SLMs and edge AI can enhance personalised learning experiences directly on students' devices, ensuring privacy and accessibility. However, institutions must manage infrastructure upgrades and maintain equitable access to avoid technology gaps. New skills in model compression and hardware optimisation will be needed.
- The affordability of SLM devices and enabling technology may increase the digital divide.



Research

- Researchers can benefit from local, real-time analytics, without extensive computational resources. This facilitates studies in resource-constrained environments.
- Local devices acting as sensors will be able to process data on the fly, offering greater possibilities for location independent research.



Operations

- Institutions can deploy SLMs and edge AI to enhance operational efficiency, such as automating administrative tasks, while reducing dependency on external cloud services and potentially lowering costs. However, device-level infrastructure and skill development investment are necessary to avoid vendor lock-in and maintain long-term flexibility.
- Institutions should proactively plan for necessary infrastructure upgrades and training programs to effectively leverage the benefits of edge AI and SLMs.

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