# Outlook 2025: Innovation's new golden age



- · Artificial intelligence progress continues, and software agents are put to work
- · Robotics and automation facilitate renewed reshoring efforts
- · Cyber risks to critical infrastructure rising on national security agenda

In 2025 the pace of innovation will continue to accelerate in key trends we follow including the application of Al across enterprise software, cybersecurity, and robotics, providing long term opportunities for agile investors.

#### Digital innovations drive global economic growth

Recent developments across AI, drug discovery, nuclear fusion, and quantum computing demonstrate the pace of innovation is accelerating. The nature of competitive markets, coupled with human ingenuity, results in an ongoing stream of invention and new ideas. From the gristmill of the agrarian age to the integrated circuit of the information age, humankind is continuously reshaping the world around us.

Dominating 2024, AI was the driving force behind technology advances and earnings growth. After taking home two Nobel Prizes last year, and passing a key benchmark test, AI development is not slowing down. Speaking at the World Economic Forum this month, Demis Hassabis, CEO of Google DeepMind said the company was on track to submit AI-designed drug candidates into clinical trials this year. More mundanely, but no less impactfully, AI agents are poised to shift from merely answering questions to taking action, as the technology seeks to fulfill its productivity enhancing promise.

We also delve into a renaissance in manufacturing, augmented by Al. Production bottlenecks, labor shortages, and geopolitical considerations have driven renewed interest in reshoring. Notably, in the US, investment in manufacturing facilities expanded by more than threefold over the last four years. This year, the country will see its first new leading-edge semiconductor plant begin mass production. In addition, industrial robots are not only getting more plentiful, they are getting smarter and more nimble too, as physical Al models come to the fore.

Finally, we consider cybersecurity, which has long been a top priority for governments and corporate leaders, but the stakes are even higher in 2025. Over the last four years, according to the IMF, cyberattacks have more than doubled and alarmingly risks to critical infrastructure including communication networks and power stations have come into sharper focus. While AI is already playing a role in detecting breaches and automating responses, the technology is a double-edged sword as adversaries also employ the tool. This cyber arms race provides ongoing investment opportunities.

#### **OUTLOOK JANUARY 2025**

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#### Al gets down to business

Of the two Al-related Nobel Prizes of 2024, the physics prize went to foundational research on the workings of artificial neural networks that underpin the current state of Al. The chemistry prize went to researchers for their work on computationally derived protein design, enabling calculations that previously took years to be completed in minutes. This research has spawned a wave of research and development in a diverse set of applications from drug discovery to materials science. While another Nobel prize seems unlikely this year, 2025 is shaping up to be formative year for the technology as Al models scale new heights, the infrastructure build-out boom continues, and Al software agents are put to work.

# "Venture capital investment in AI jumped to more than USD 100 billion in 2024

#### Building the foundation

Driven in large measure by Al investments in high-performance semiconductors and related data center infrastructure, capital spending by leading cloud computing service providers is expected to rise 36% in 2025 to USD 413 billion. Building upon those resources, Al models continue to improve. For instance, in December 2024, on a key testing benchmark for complex tasks, OpenAl's most recent model o3 scored 87.5% versus a previous model which scored just 5% earlier that year. Al has also driven an acceleration in venture activity, as funding to the sector jumped 79% in 2024 to more than USD 100 billion, according to CB Insights. As the technology shifts from the development phase to deployment, demand for computational resources is expected to rise further as Alenhanced applications gain wider scale adoption. That said, evidence from prior technology cycles suggests that a greater share of value creation from Al will accrue to those providing foundational technology and differentiated applications, and therefore we remain selective in our approach.1

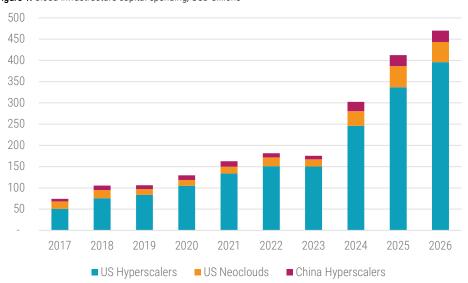


Figure 1: Cloud infrastructure capital spending, USD billions

Source: Morgan Stanley, June 2025 (chart updated August 2025 to reflect current trends)

#### Putting AI agents to work

The late economist Robert Solow famously quipped that 'you can see the computer age everywhere but in the productivity statistics.' After two years of significant investment and no small degree of hype, many are understandably looking for the technology to deliver on its promise. While we do not expect AI to generate a significant lift to the economy this soon in the development phase, we do expect the technology to build upon its early success to date.

<sup>&</sup>lt;sup>1</sup> Investing In AI: Everything, everywhere, and all at once, Robeco, May 2024



In particular, applications that enable AI to take action rather than merely answer questions are showing promise. These AI agents are working their way into existing software to automate tasks that often involve data entry or the manual process of integrating information from multiple applications. McKinsey estimates that AI could enable the automation of up to 70% of business activities. For example, ServiceNow, IT service software provider introduced several AI agents including for incident management, to categorize, prioritize and assign requests to appropriate resources. Similarly, software as a service (SaaS) pioneer Salesforce introduced its Agent Force platform that allows customers to build their own AI agents for company-specific tasks across sales, marketing and customer support functions. Barclays equity research estimates that AI agents represent a USD 110 billion opportunity for enterprise software vendors.

#### Power on

Although data center energy consumption has alarmed some, technology development has a demonstrated long-term track record of continuous efficiency gains. For instance, Alphabet reported a 90% drop in the cost per query since introducing Al summaries within Google search results last year. Similarly, Nvidia's recently released Blackwell GPU is up to 75% more power efficient in processing data than its predecessor. According to a study released last year by Ericsson and the ITU, while data consumption rose 40-fold since 2007, the technology sector's share of energy consumption remained constant at 4%. Therefore, even as data center build-out has accelerated to accommodate Al development, the International Energy Agency forecasted that the sector would account for only a small share of electricity demand growth through 2030. That said, the modernization of data center architecture has provided a lift in demand for power systems and management tools from providers like Emerson Electric, Siemens and Schneider Electric. Notably, with power efficiency in mind, the technology consultancy Omdia forecasts the share of liquid cooling within data centers will increase from 17% in 2024 to 33% by 2028.

# "US investment in technology manufacturing facilities rose 15-fold over four years

#### Build it here

Production bottlenecks, labor shortages, and security considerations have driven renewed interest in automation, shortening supply chains and reshoring manufacturing closer to home. In particular, geopolitical concerns have sparked heightened interest in diversifying semiconductor supply chains given a single country, Taiwan, accounts for 90% of leading-edge semiconductor production output. Further, a myriad of disruptions from the blocking of the Suez Canal in 2021 by a grounded container ship to the escalating attacks by Houthi militias on cargo ships in the Red Sea have impacted supply chains across the globe. While the desire to reinvigorate domestic manufacturing is not new, follow-through with significant investment spending has been less robust until recently.

Government policies in nearly all global regions increasingly seek to promote domestic manufacturing and modernize an aging capital stock. Notably, in the US, investment in manufacturing facilities expanded by more than threefold over the last four years and is on pace to have reached USD 235 billion in 2024. With a focus on semiconductors, investment in manufacturing facilities related to technology rose 15-fold over the last four years. According to the Peterson Institute for International Economics, the US invested more on technology manufacturing facilities in 2024 than it did in the prior 20 years combined. Importantly, those figures include only the structures and facilities, not the capital equipment used in production. Given the typical lag between construction and the outfitting of new sites with machinery and labor, the runway is now set for an acceleration in robotics, automation and capital equipment spending.

The jump in US manufacturing facility construction followed passage of three key fiscal policy initiatives directly aimed at revitalizing the US industry that combined provides more than USD 900 billion in funding. Although the incoming Trump administration has signaled a strong focus on import tariffs rather than fiscal policy to spur manufacturing, many of those investments are already well-underway. Notably, leading edge semiconductor

<sup>&</sup>lt;sup>2</sup> ICT sector electricity consumption and greenhouse gas emissions – 2020 outcome; February 2024, J. Malmodin, N Lovehagen

<sup>&</sup>lt;sup>3</sup> World Energy Outlook 2024, International Energy Agency, October 2024



manufacturing is set to return to the US this year with the scheduled opening of Taiwan Semiconductor Manufacturing's plant in Arizona.

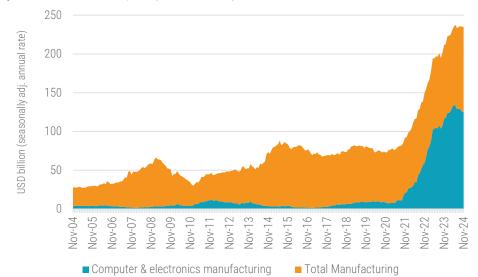


Figure 2: Private construction spending on manufacturing facilities in the US

Source: US Census Bureau, January 2025

#### Rise of smarter robots

These investments seek to not only bring on new capacity, but to also modernize the manufacturing process. In addition to providing margin improvements through increased efficiency, industrial automation systems address a critical issue – a shortfall of talent as the workforce ages. According to the consultancy Deloitte and The Manufacturing Institute, 1.9 million manufacturing jobs could go unfilled over the next ten years if talent challenges are not addressed. As a result, robotics have continued their steady advancement across the factory floor. Over the last five years, the globally installed base of industrial robots has expanded at an 11.3% CAGR reaching nearly 4.7 million in 2024. In the last seven years, global robot density in factories has doubled, reaching 162 per 10,000 employees. The most automated market in the world, South Korea, boasts a robot density of more than 1,000 robots per 10,000 employees.

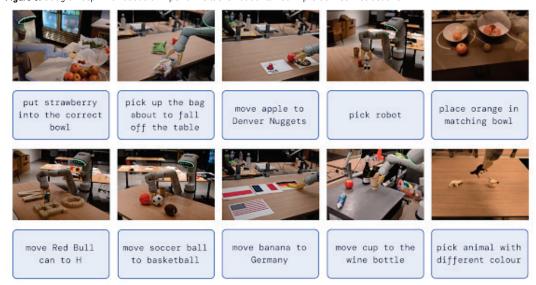
Robots are not only getting more plentiful; driven by AI they are getting smarter too. During a presentation in January 2025, Nvidia CEO Jensen Huang declared robotics a 'multi-trillion-dollar opportunity' as the company announced its Cosmos foundation model platform for what the company dubs 'physical AI.' AI coupled with advancements in mechanical engineering have also renewed hopes for developing humanoid robots which could be trained to work in numerous environments rather than fixed locations. CB Insights notes that the venture investment into industrial humanoid robotics tripled in 2024 to USD 1.2 billion.

# "Nvidia CEO Jensen Huang declared robotics a 'multi-trillion-dollar' opportunity

Currently robots are either human controlled or follow pre-defined programming to operate. More recently, autonomous and semi-autonomous robotics enable dynamic actions that factor circumstance and real-time conditions. By learning from human controls and taking input from sensors and cameras, robotic production is poised to become more efficient and more flexible. For instance, Google DeepMind's RT-2 model was trained on both robotic-specific data, as well as from the web. This system enables machine vision equipped robots to perform tasks that were not preprogrammed. Over time, generative AI and on-board computing may enable robots to not only learn how to perform a task, but to also implement improved methods for a given action.

<sup>&</sup>lt;sup>4</sup> Taking charge: Manufacturers support growth with active workforce strategies, Deloitte, April 2024

Figure 3: Google DeepMind robotic arm performs tasks not contained in pre-defined instructions



Source: Google DeepMind, 2024

#### Secure everything

Increased digitalization, fragmented systems, and rising geopolitical tensions have more than doubled cyberattacks over the last four years according to the International Monetary Fund (IMF). Alarmingly, cyberattacks have increasingly targeted government networks and critical infrastructure. Although digital transformation offers the potential for increased efficiency, connected systems are subject to an increasingly hostile cyber threat environment. While AI is also enabling more adaptive and efficient security systems, bad actors have also proven adept at incorporating the technology. Similarly, recent breakthroughs in quantum computing have sparked concern the technology could break existing cryptography algorithms. With cybersecurity concerns remaining a top priority, IDC forecasts global spending on the sector will accelerate modestly from 13% growth in 2024 to 14% in 2025 reaching USD 274 billion.

# "The cost of cybersecurity complacency is rising

The cost of complacency is also rising as cyberattacks inflict measurable damage. According to an analysis by Allianz, in cyber insurance claims exceeding EUR 1 million, the proportion of cases where data was stolen rose from 40% in 2019 to more than 77% in 2023. Over that time, the proportion of companies paying a ransom has increased from 10% to more than 50%. For instance, in 2024, United Healthcare paid a ransom to attackers in order to unlock data after one of its smaller affiliates was breached. The World Economic Forum estimates the total cost of cybercrime will rise from USD 6 trillion in 2021 to USD 10.5 trillion in 2025.

#### Infrastructure, a matter of national security

Cyber threats have also escalated on the national security agenda as state-sponsored actors appear to have been behind a myriad of recent attacks. For instance, according to the US Cybersecurity & Infrastructure Security Agency (CISA) in December 2024, state sponsored Chinese hackers breached the US Treasury Department's network, stole documents, and even accessed the computer of Treasury Secretary Janet Yellen. Governments around the world including Canada, Germany, Japan, and the UK have reported similar state-sponsored cyber breach incidents over the last year according to the Center for Strategic International Studies. With these threats in mind, in December 2024, the UN adopted by consensus its first Convention against Cybercrime. <sup>5</sup>

<sup>&</sup>lt;sup>5</sup> Inside the Cunning, Unprecedented Hack of Ukraine's Power Grid, Wired, March 2016



Concerningly, critical infrastructure has also come under attack. Unlike cybercrime motivated by profit, or espionage extracting state secrets, attacks on infrastructure portend debilitating disruption. At a time of increased geopolitical tension, experts warn cyber attacks on infrastructure could not only disrupt daily life, but also the ability to respond in the event of military conflict. In a sign of what could happen, and in the first such recorded attack, in December 2015 hackers turned off the power serving nearly a quarter of a million Ukrainians by remotely accessing the electrical grid control center. Along those lines, in January 2024, the US Federal Bureau of Investigations (FBI) announced the agency had extracted malware that the US says was planted within the networks of communications, transportation, and energy hubs. <sup>6</sup>

#### AI, a double-edged sword

Al is also playing an expanding role in security. In the early days of cybersecurity, software and hardware systems employed signature-based detection techniques to identify potential viruses and malware hidden within the code of software and data. As new threats were identified and marked within industry databases, security software required regular updating and patching to account for the new risks. Over time, as the rapid growth of new threats outpaced the ability to identify, catalog, and update signature databases, new techniques emerged. Today's cyber protection systems employ machine learning and behavioral analysis to detect threats based upon actions rather than signatures alone. Further, Al can not only better detect threats, but also automate the response. By learning from human professionals, Al-enabled cyber defense systems are able to learn not only what constitutes harm, but how such threats can be responded to.

Al is however a doubled-edged sword for cybersecurity as hackers weaponize the technology. After ChatGPT became available to users in late 2022, the number of posts on dark web forums about how to exploit the tool jumped from 120 in January 2023 to 870 in February 2023, according to software firm NordVPN. Just as professional software developers are already employing generative Al tools like Microsoft's Copilot to increase coding productivity, cyber criminals are using similar tools to write new malicious code. According to researchers at CyberArk, generative Al chatbots and programming tools can be manipulated to write malicious code that does not appear as malware, thereby evading detection. Further, the same tool that helps office employees write meeting summaries can also be used to create fake, but seemingly legitimate phishing messages from colleagues, suppliers, and customers.



<sup>6</sup> US Government Disrupts Botnet People's Republic of China Used to Conceal Hacking of Critical Infrastructure, FBI January 2024

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