Allianz Trade

No country for old robots: How can Europe leap over the robotics tech frontier?

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Executive Summary

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Europe has been a strong force in robotics but it is starting to fall behind China and the US. Robotics investment grew by almost +230% over 2019-2024 and the market is poised to outpace USD100bn by 2030. China has become the largest consumer of robots by far, accounting for 51% of total annual installations of industrial robots, and its robotic industry is growing steadily. The robotics industry in Europe is at risk of disruption from incumbents supported by strong industrial policies, and new players emerging from the tech ecosystem amid the AI frenzy. As robotics could deliver increased productivity, help to address Europe's demographic challenges and protect its industrial sovereignty, the region should act now to avoid following the fate of the auto industry, leaning on five levers:

1. Develop and implement a European robotics roadmap. Europe needs a strategic plan and a clear operational vision to ramp up its robotics sector. We suggest that such plan should focus on building robotics champions to first serve domestic sectors that are (i) less robotized, (ii) face productivity or recurrent labor shortage issues and are (iii) difficult to offshore and/or strategic. Namely, transportation and logistics, hospitality, agrifood, construction, healthcare, aerospace and defense. Europe should also avoid chasing robotics applications in which it is already falling behind too much (i.e. humanoids, autonomous vehicles).

2. Enhance access to capital for robotics start-ups. Europe should further develop a legal and business framework to increase the critical size of the venture capital market, whose funding capacities are complementary to public and private efforts. The capital-intensive nature of the robotics industry, which is even more pronounced for developing new AI-empowered smart robots, means that Europe cannot overlook any funding channel. The US currently attracts seven times more VC investments in AI compared to Europe, which could weigh on Europe's innovative capabilities and lead to a technology lag.

3. Scale up innovation from research to market. Europe's weakness lies in its market fragmentation and lack of cooperation to promote private investment. In this context, it needs to support the construction of regional champions and/or promote investment pooling to play a prominent role in the ongoing technology race for AI leadership. Increasing collaboration and business partnership via incubator programs between engineering schools and the private sector will help to develop an innovative ecosystem at reduced cost. At the public level, we recommend increasing the seven-year horizon budget for 2028-2034 by at least 5% (over EUR100bn) while setting up a minimal investment provision dedicated to the robotics industry (5-10%).

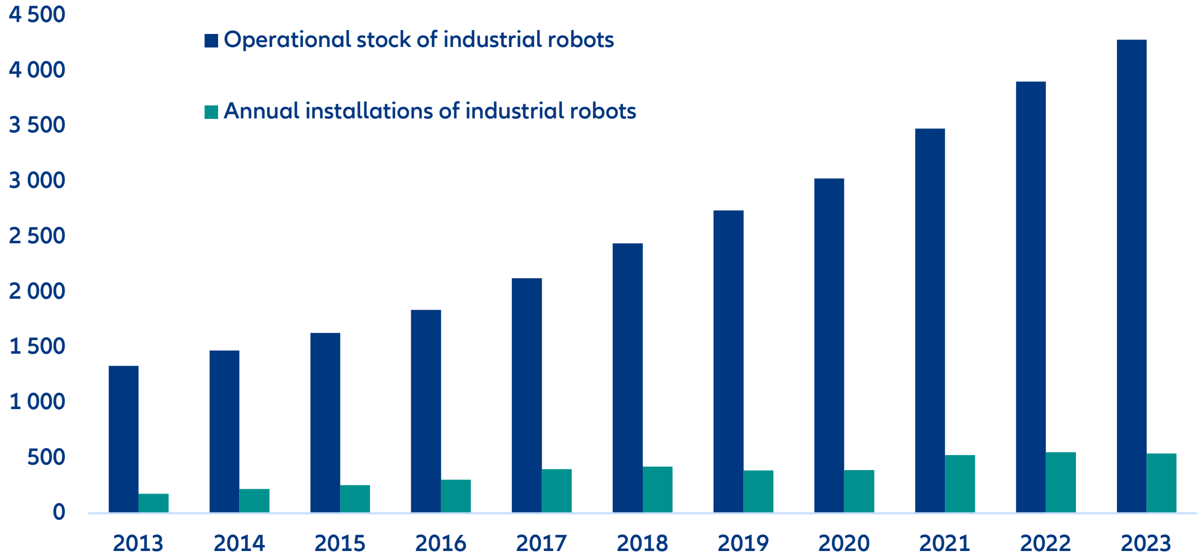
4. Invest in workforce upskilling and education. A significant number of EU firms report difficulties in finding employees with the necessary skills to implement digital technologies, including robotics. This shortage is particularly acute in industrial sectors, where the lack of technical operators, robotics technicians and systems integrators stalls the deployment of advanced technologies on factory floors. Compounding the issue, the share of EU enterprises providing training to their employees declined from 71% in 2015 to just 67% in 2020. A comprehensive upskilling agenda is essential. Frontline workers need training to operate collaborative robots safely, interpret interface feedback and perform basic maintenance. Technicians should be proficient in robot programming, PLC logic, sensor alignment and diagnostics. At the strategic level, engineers must be capable of planning robotic workflows and integrating systems with enterprise software. Expanding vocational training with updated curricula, incentivizing companies to invest in employee reskilling and establishing a unified "Robot Skills Framework" across the EU are critical steps to align the workforce with the demands of modern (automated) manufacturing.

5. Streamline regulatory frameworks to foster innovation and adoption. The EU must balance its leadership in AI regulation with the need to foster innovation, particularly in robotics. While the AI Act, effective since August 2024, sets a harmonized legal framework by categorizing AI systems by risk, its strict rules risk slowing innovation and deterring investment, especially for SMEs. Robotics, closely linked to AI, faces added regulatory complexity due to overlapping safety rules and dynamic risk classifications. To address this, the EU should harmonize regulations, create "regulatory sandboxes" for testing, promote international collaboration and adopt adaptive, risk-based approaches that evolve with technology and support sector-specific innovation.

Europe remains a solid player, but China is racing ahead too fast

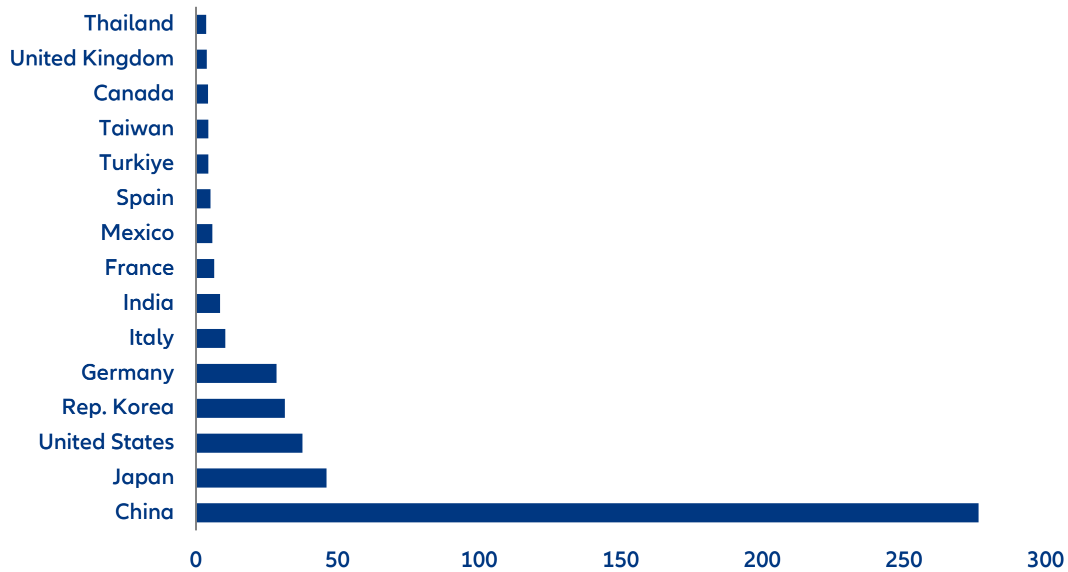
The global robotics industry has evolved into a key pillar of technological advancement, influencing sectors ranging from manufacturing and logistics to healthcare, agriculture and consumer electronics. The robotics sector has been witnessing robust global growth, with a volume of stock and installations that has almost quadrupled in the last decade (Figure 1), underpinned by advancements in AI, sensors, connectivity and computing power, setting the stage for its increasing influence across nearly all facets of the global economy. Historically, Japan has been a dominant force in the robotics space, particularly in the production of industrial robotics, with companies such as FANUC, Yaskawa and Kawasaki leading innovations. South Korea and the US have also played critical roles, the former with its highly automated manufacturing systems and the latter with strong leadership in artificial intelligence (AI) and robotics integration, particularly through companies like Boston Dynamics, NVIDIA and emerging startups. However, in recent years, China has rapidly emerged as a central player, driven by massive state investment, an expanding domestic market and aggressive acquisition of foreign robotics technology, rapidly scaling its capabilities in both hardware and AI-driven robotics. Indeed, besides its substantial role in production, China has become the largest consumer of robots by far, accounting for 51% of total annual installations of industrial robots (see Figure 2). China's surging role has made the APAC region account for 72% of annual installations of industrial robots in the world, followed by Europe (17%) and North America (11%).

Figure 1: Evolution of annual installations of industrial robots and operational stock of industrial robots globally (in thousands)



Sources: International Federation of Robotics (IFR), Allianz Research

Figure 2: Annual installations of industrial robots, 15 largest markets, in thousand units

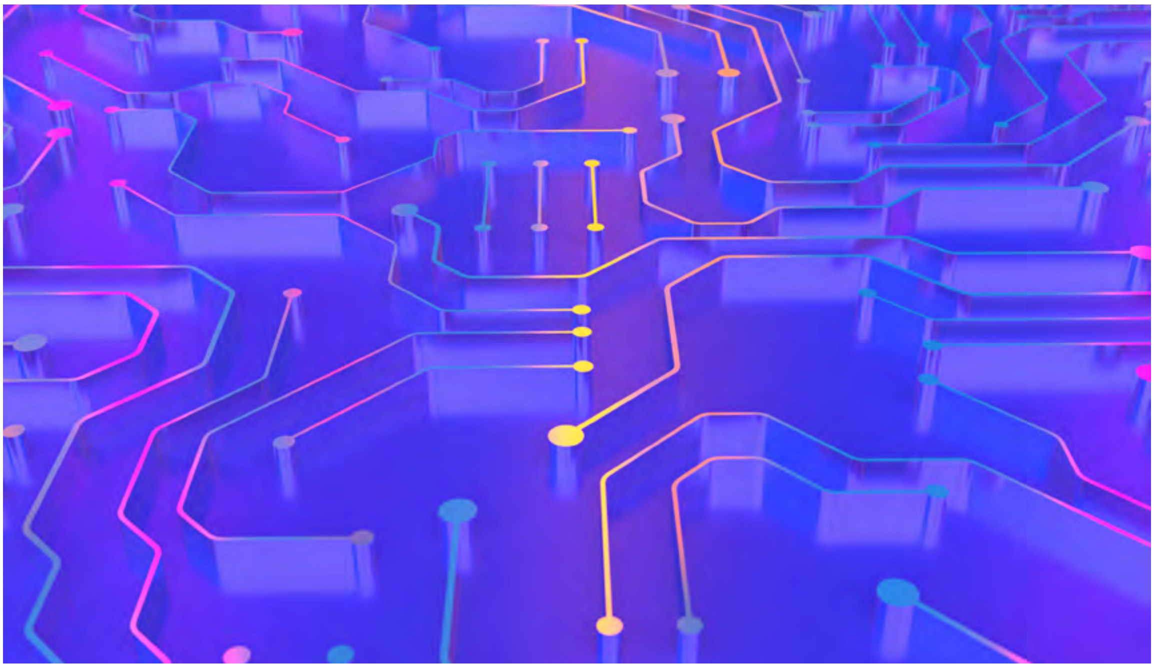


Sources: World Robotics 2024, International Federation of Robotics (IFR), Allianz Research

Europe maintains a convincing but more specialized position in the robotics industry. Countries like Germany, Switzerland and Sweden are home to some of the world's leading companies that produce precision engineering and automation, such as KUKA (now Chinese-owned), ABB Robotics (Switzerland) and Universal Robots (from Denmark, focused on collaborative robots). By demand or utilization, Germany, Italy and France are the leading countries in the region, with around 45,000 units installed last year. The European robotics market is characterized by high standards of safety, quality and integration, particularly in automotive, medical and service robotics. While Europe may not rival the scale of production seen in Asia, it continues to lead in advanced manufacturing and R&D-driven robotics applications.

In the past decade, China has emerged as the undisputed global leader in both the production and adoption of industrial robots. Backed by strong state-driven industrial policy, massive investments in automation and a clear strategic vision, China has rapidly scaled its robotics capabilities across sectors, particularly in electronics, automotive and logistics. The country is now not only the world's largest market for industrial robots but also a fast-growing manufacturing base for robotics technology itself, driven by a powerful combination of domestic demand and national self-reliance goals. Over the past two decades, China positioned industrial robotics at the core of its national development strategy. This deliberate integration of automation has not only enhanced productivity but also addressed demographic challenges and shifted the global manufacturing landscape. China's journey into industrial automation began earnestly in the early 2000s, coinciding with its rapid industrialization phase. Recognizing the potential of robotics to elevate manufacturing capabilities, the government launched policies to encourage automation adoption. The "Made in China 2025" initiative, launched in 2015, marked a significant milestone, aiming to upgrade the manufacturing sector by promoting advanced technologies, including robotics. This policy set clear targets for robot density and encouraged domestic production of key components to reduce reliance on foreign technology. Local governments complemented national efforts by offering subsidies and incentives to manufacturers adopting automation. For instance, the city of Dongguan launched the "Machine Replaces Human" program, investing billions to support companies transitioning to automated processes. Such initiatives facilitated the early and widespread integration of robots across various industries. China's robotics push was also motivated by its demographic shifts, characterized by a declining birth rate and an aging population, which posed significant challenges to its labor-intensive manufacturing model. The shrinking working-age population led to labor shortages and increased wages, and automation emerged as a strategic response to these issues. By deploying robots, China aimed to maintain high production levels. Industries such as electronics, automotive and textiles saw significant automation, reducing dependency on manual labor. This shift not only addressed labor shortages but also improved product quality, consistency and price competitivity amid rising wage costs – essential for competing in global markets.

Today's gap between China and Europe is not just about how many robots are deployed; it's about vision, momentum and long-term positioning in the global industrial landscape. When compared to China, Europe appears to be falling behind. While countries like Germany, Sweden and Italy have strong robotics traditions and advanced automation in specific industries, the continent as a whole lacks the unified, large-scale push seen in China. Fragmented markets, slower policy alignment and more cautious investment approaches have hindered the speed and scale of robotics adoption. Furthermore, European manufacturers tend to approach automation incrementally, often constrained by regulatory complexities and aging industrial infrastructure. As a result, Europe risks losing its technological edge, not because of a lack of innovation, but due to a lack of urgency and cohesive strategy. While China treats robotics as a pillar of its future economic model, Europe still tends to see it as a tool for incremental improvement. To avoid robotics following the fate of the automotive industry, Europe needs to act now. In the following sections, we outline the five levers for policymakers and business leaders to prioritize.



#1: Develop and implement a European robotics roadmap

With Europe continuing to fall behind the US and China in robotics and industrial automation, the need for a coordinated, forward-looking robotics roadmap has become increasingly urgent. Such a roadmap would serve not only as a strategic vision, but also as a practical framework to align stakeholders across research, industry and policy. By clearly identifying priority sectors, investment needs and innovation targets, Europe could focus its resources more effectively and accelerate the adoption of robotics technologies where they are most needed, particularly in labor-scarce industries like agriculture, construction and manufacturing. Without a unified direction, fragmented national initiatives and inconsistent support mechanisms risk undermining Europe's industrial competitiveness and technological sovereignty. A well-crafted roadmap would provide the long-term clarity and confidence needed to mobilize public and private investment, foster cross-border collaboration and ensure that Europe does not remain a follower in the next industrial revolution, but rather emerges as a proactive, innovative force.

Supporting the robotics sector is not only a matter of technological progress; it is a strategic necessity for maintaining Europe's economic competitiveness and social cohesion in the face of demographic decline. As Europe faces profound demographic challenges, marked by an aging population and increasingly fragmented migration policies that vary from one country to another, robotics and automation could offer a compelling and scalable solution to mitigate the growing workforce gap. Demographic dynamics are contributing to persistent and growing labor shortages in labor-intensive sectors such as agriculture, logistics, construction and elderly care.

By complementing human labor rather than replacing it, robotics can help sustain productivity levels, reduce dependence on volatile migration flows and support the long-term resilience of Europe's industrial base. Moreover, robotics could also help companies improve profitability, making them more competitive. In the agrifood sector, for example, personnel costs account for up to 60% of total fixed expenses. In this context, adopting automation would not only address labor shortages but also unlock significant cost savings, helping to preserve the economic viability of farming. Autonomous machines for farm-site inspection, precision planting, harvesting, livestock feeding and surveillance are becoming a reality, thanks to the incorporation of real-time perception tools and machine learning, especially in countries such as the Netherlands, Germany, Denmark, Sweden and Finland. However, the transition to fully autonomous machines is still far from complete. Similarly, in construction (which heavily relies on inbound migrant labor), robotic technologies could be adopted across almost the entire sector, helping to deliver measurable productivity gains. Retail, a sector with one of the lowest levels of margins, can also greatly benefit from robotics. By automating tasks like restocking, inventory checks and checkout, retailers can cut costs, boost efficiency and free up staff for higher-value roles, helping improve profitability in an increasingly competitive landscape.

The adoption of AI is essential to unlocking the next wave of cross-sector productivity gains through automation of tasks (see Figure 3). As AI continues to transform robotics from simple task performers into intelligent systems capable of adapting to dynamic environments, its integration becomes a strategic necessity, not just a technological upgrade. In other sectors like logistics, healthcare and hospitality where automation is still in early stages, AI-powered robotics offers the potential to dramatically streamline operations, reduce labor dependency and enhance decision-making. For instance, AI-enabled diagnostic tools and surgical robots can help address healthcare workforce shortages, while predictive algorithms and autonomous mobile robots could optimize supply chains in a volatile global market. Transportation, a sector that is vital for all other sectors, could also be transformed by AI and robotics, which can boost efficiency, reduce costs and improve safety. From autonomous vehicles and drones to smart logistics and traffic management, these technologies streamline operations and optimize how goods and people move, enhancing productivity across the industry.

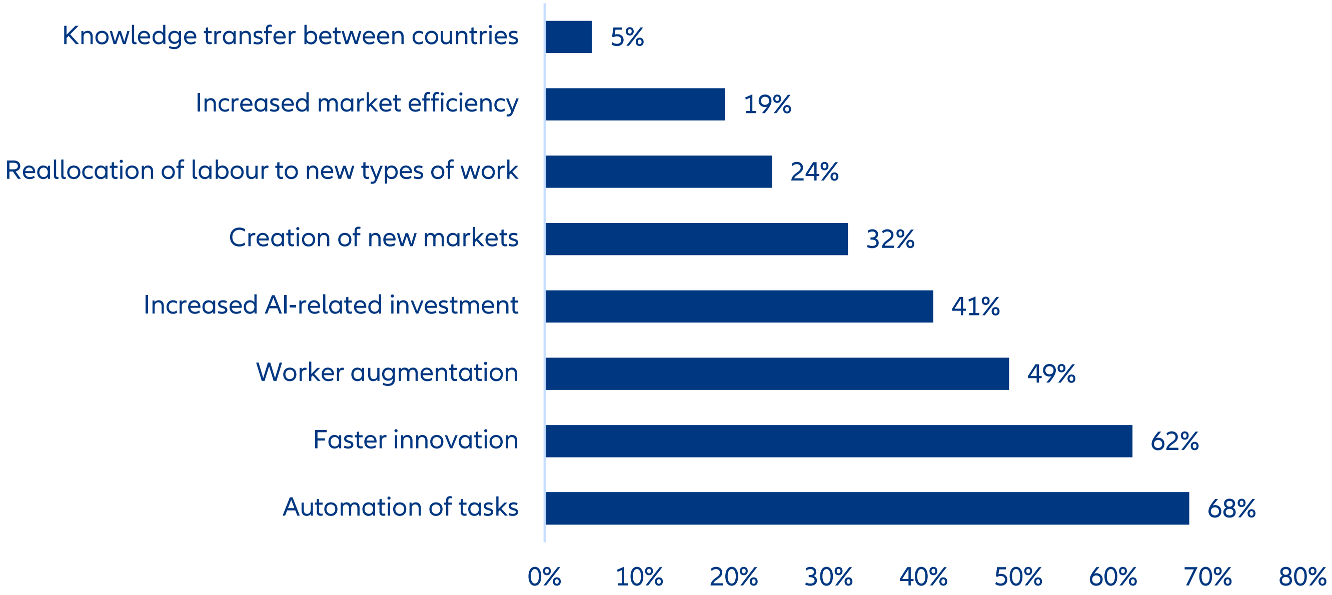
Table 1: Sectoral labor intensity* and its effect on profitability

	Labor intensity	Personnel cost as a % of fixed costs	LTM Avg EBITDA Margin (%)
Services	High		13.7
Construction	High		8.8
Retail	High		4.8
Textile	High		9.1
Agrifood	High		10.1
Transportation	Mid-high		11.8
Household Equipment	Mid-high		8.5
IT & Software	Medium		9.2
Computer & Telecom	Medium		8.6
Electronics	Medium		8.7
Phamaceuticals	Medium		17.1
Transport Equipment	Medium		9.5
Machinery	Mid-low		10.4
Pulp & Paper	Mid-low		6.1
Automotive	Mid-low		7.5
Metals & Mining	Low		11.8
Energy	Low		17.0
Chemicals	Low		10.1

Sources: LSEG Datastream, Allianz Research

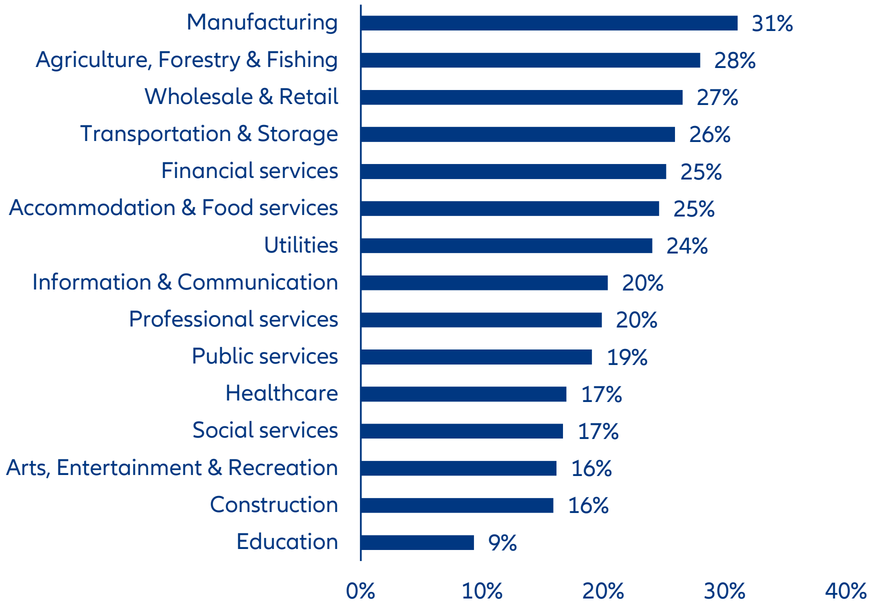
*Note: Low = capital and technology intensive, heavy machinery, automated / Mid-low = more capital-intensive, requiring fewer workers relative to output / Medium = balanced mix of labor and capital/technology / Mid-high = moderately labor-intensive but also relying on some machinery or automation / High = sectors requiring a large number of workers per unit of output, often involving manual or skilled labor.

Figure 3: AI growth impact channels – Through which channels do you expect AI to have the most significant positive impact on global GDP growth?



Sources: Chief Economists Survey (April 2025), Allianz Research

Figure 4: AI contribution to industry gross added-value by 2035

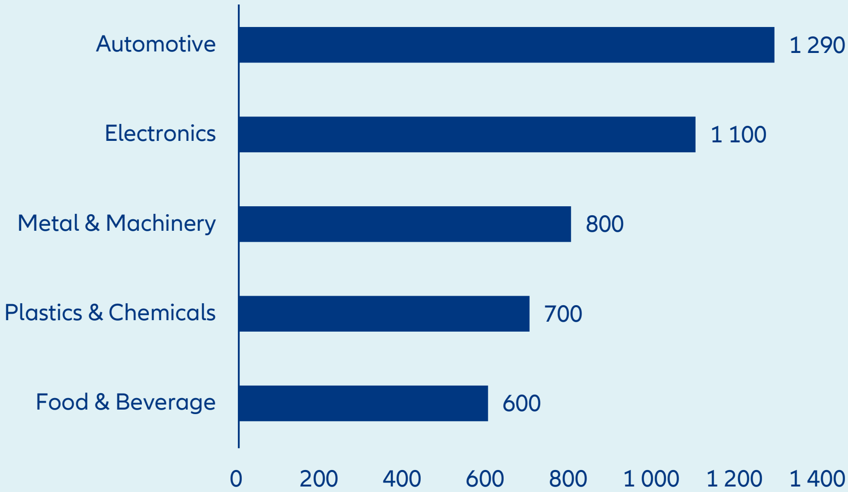


Sources: Accenture, Allianz Research

Auto – from automation to autonomy

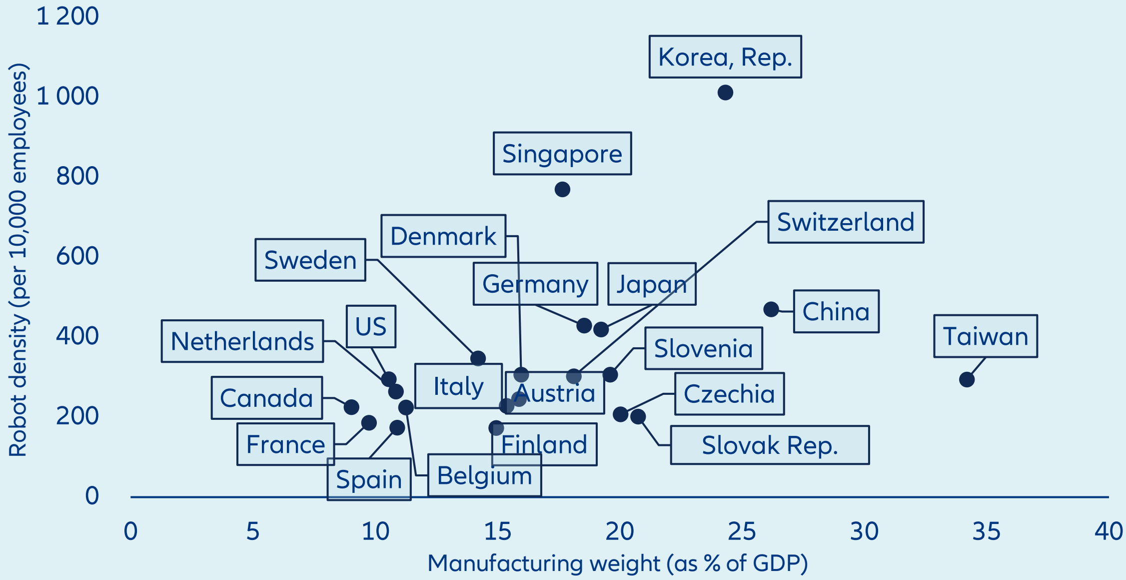
The automotive sector has been leading robotic investment for years. The automotive industry plays a pivotal role in driving global robot density, accounting for a significant share of industrial robot installations worldwide. As a highly automated sector, car manufacturing requires precision, efficiency and scale, making it a leading adopter of robotics. According to the International Federation of Robotics (IFR), the automotive sector is the most automatized sector amid manufacturing industries, ahead of electronics and machinery, and represented roughly a third of global industrial robot installations in the US and Europe, almost 60% in Canada and 70% in Mexico as of 2022. In Europe, this influence is especially pronounced. Countries like Germany – which has the highest robot density in Europe (429 per 10,000 employees in 2024) – but also Eastern Europe neighbors like Czech Republic, Hungary whose manufacturing industry and more specifically automotive has a prominent economic weight display the highest robotic density in Europe. Major automakers like Volkswagen, BMW and Mercedes-Benz heavily invest in robotics for welding, painting and assembly operations. The automotive sector's push for innovation, productivity and electric vehicle (EV) transformation continues to accelerate automation and boost Europe's robotics footprint.

Figure 5: Global robot density per industry breakdown (number of robots per 10,000 employees, 2023)



Sources: IFR (World Robotics Report 2024), Allianz Research

Figure 6: Robot density into manufacturing sector vs. manufacturing share of GDP



Sources: IFR, World bank, Allianz Research

A multi-faceted technology shift to apprehend and leverage. AI is infusing steadily into Europe's automotive sector. In recent years, specific technologies have been integrated into new models to enhance prediction and control systems. Amid new solutions, we can list AI-powered voice assistants enabling natural language control of in-car functions, but also conversational AI tools offering real-time voice interaction and smart navigation. The large diffusion of assistance system solutions (ADAS) and sensor cameras into new cars is also a direct consequence of the technology shift currently underway across the entire industry. These innovations allow OEMs to improve customer engagement and safety, AI providers to scale their models into embedded systems and users to benefit from more intuitive, adaptive mobility experiences. Europe's strong automotive base and growing AI ecosystem offer fertile ground for accelerating adoption, though challenges remain in regulation and infrastructure.

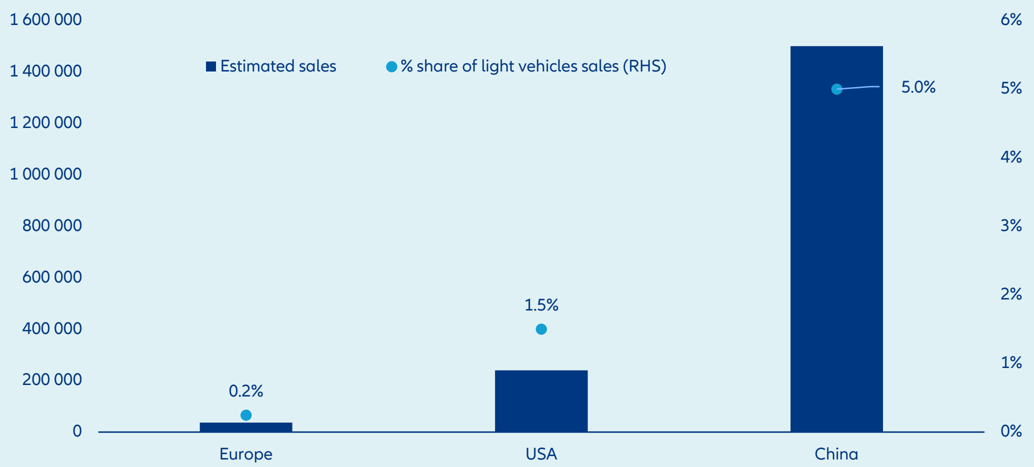
Table 2 : Global robot density per industry breakdown (number of robots per 10,000 employees, 2023)

AI Application Area	Description	ROI potential
Autonomous Driving	AI powers perception, decision-making, and control systems in self-driving vehicles.	New revenue stream
AI-Driven Design and Simulation	Digital support to speed up vehicle design	Conception time cutting
Smart Manufacturing (Industry 4.0)	Process optimization through production planning, defect detection and robotic automation solutions.	General cost cutting
Demand and Supply Chain Forecasting	Enhance inventory, logistics, and sourcing tasks.	General cost cutting
AI in Marketing and Sales	Targeted ads, pricing optimization, and predictive customer insights.	Profitability boost
Predictive Maintenance	Collecting data to predict/prevent vehicle/machine failures.	Improving sales conversion
In-Vehicle AI Assistants	Improving user experience via personalization solutions and permanent live client services	Improving brand loyaulty
Connected Vehicle Data Monetization	Monetization of real-time driving data.	New revenue stream

Source: Allianz Research

Looking ahead, the auto sector will need to be selective and smart in its industrial choices, favoring AI monetization over autonomous vehicles. Autonomous vehicles are expected to make only a slow entry into the global auto market, especially in Europe where market share is expected to remain less than 0.5% of new sales by the next decade. Amid multiple challenges, from a profitability squeeze to the looming ban on fossil-fueled vehicles in 2035, European OEMs have little incentive to focus on this segment, more so because of the high R&D cost and the wide technology gap with competitors in the US and China. However, AI-powered robots could help address the profitability issue by optimizing production and maintenance costs, reducing the lead times to launch new models, improving sales conversion rates and customer journeys. The dramatic increase of data collection by carmakers via their AI-embedded systems, in quantity but also in quality, also offers huge business opportunities, allowing carmakers to anticipate their clients' future needs. The Data Act that will be official in Europe next September will introduce a first regulatory step in terms of transfer and use of data generated by cars, clarifying the effective business framework for OEMs.

Figure 7: Estimated sales of autonomous vehicles by 2034

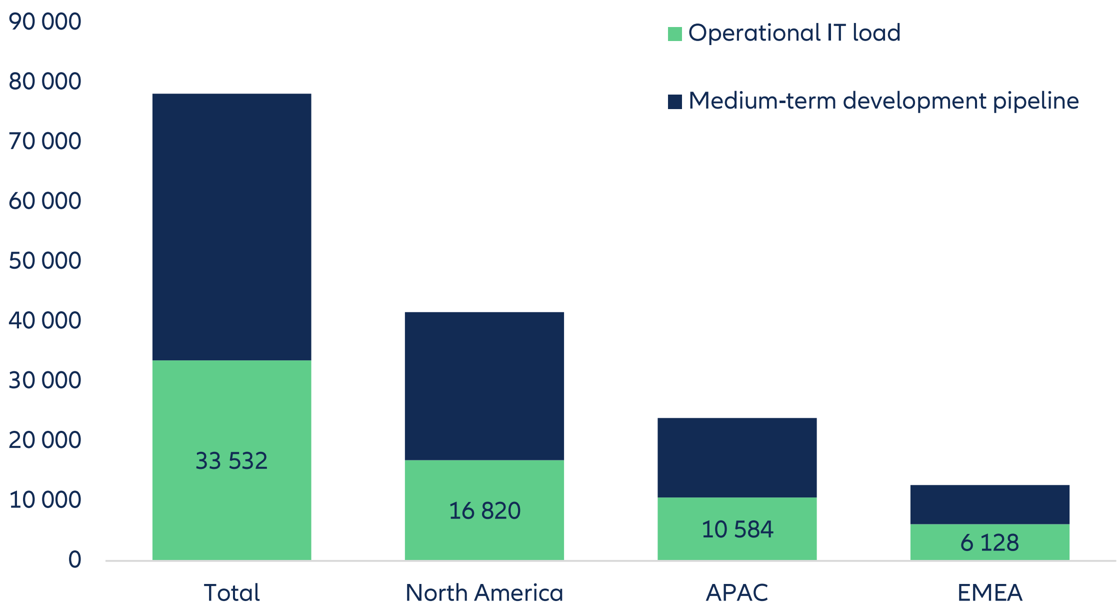


Sources: S&P Mobility, Allianz Research

#2: Enhance access to capital for robotics start-ups and research

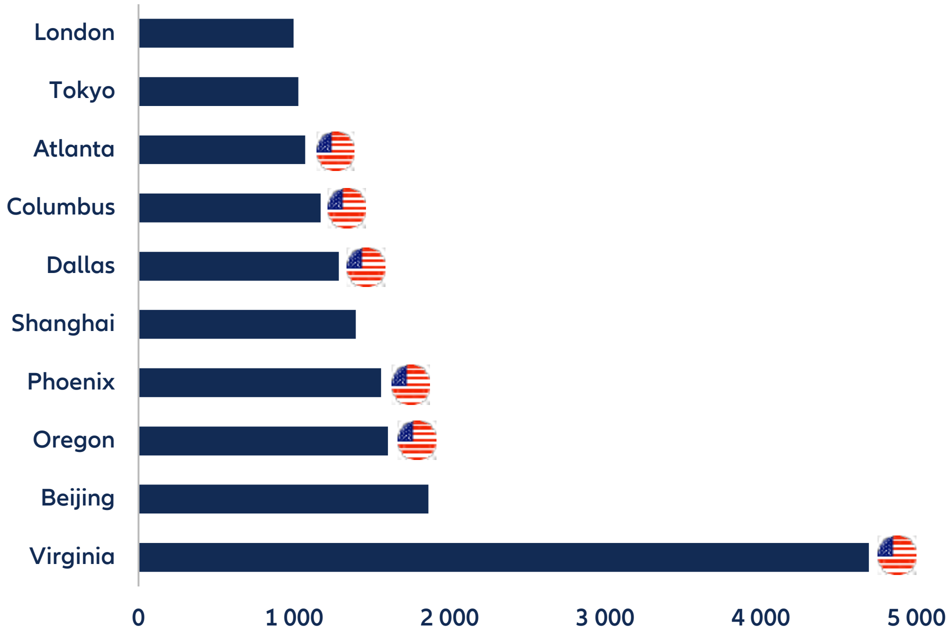
One of the most significant barriers to technological advancement, particularly in robotics and AI, is the sheer scale of investment required to drive innovation. Developing cutting-edge hardware, intelligent systems and machines and scalable applications demands sustained funding, world-class infrastructure and a high risk tolerance. This is one of the main reasons why Europe is falling behind global competitors like the US and China, which have made robotics a strategic priority backed by massive public and private investment. While European research institutions remain strong, the continent lacks the coordinated financial push needed to turn prototypes into commercial breakthroughs. Investments in data centers, for example, massively differ from one region to another (Figure 8). As of today, the US represents the epicenter of the digital infrastructure boom, with six of the 10 biggest data center hubs in the world (Figure 9). Virginia, often referred to as the "data-center alley", is the center of the global digital infrastructure market, with almost 5 GW of operational capacity (2.5x more than second-largest market, Beijing), while no EU city ranks in the list. Figure 8 also shows the mid-term development pipeline, which clearly suggests that although all regions plan to double their current capacity, the US is investing faster and further. Without a substantial increase in capital allocation, Europe risks ceding technological leadership to more aggressive, better-funded ecosystems.

Figure 8: Global data center capacity by region (in MW)



Sources: Bloomberg, Cushman & Wakefield, Allianz Research

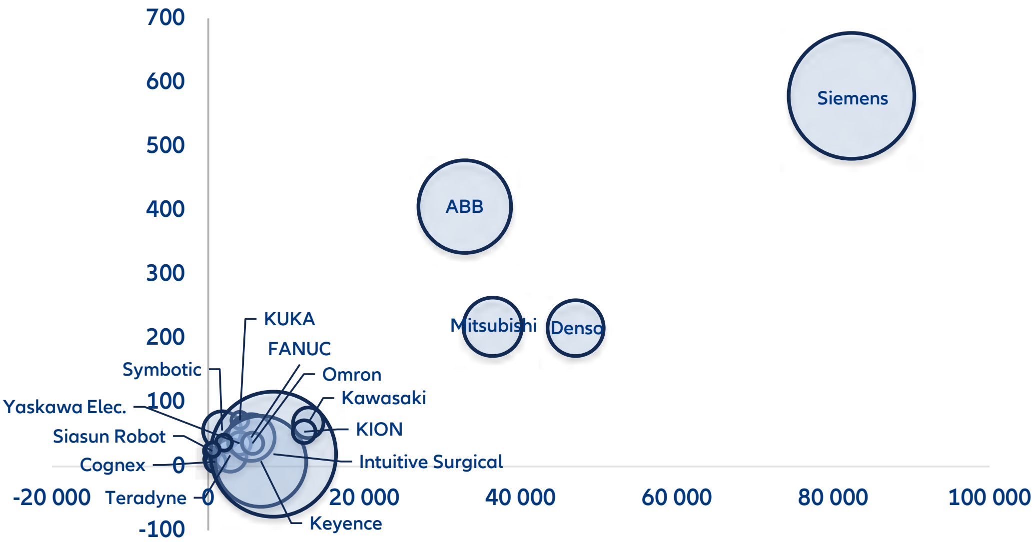
Figure 9: Top 10 data-center hubs globally (MW of capacity)



Sources: Bloomberg, Cushman & Wakefield, Allianz Research

In parallel, the robotics industry is made of a mix of diversified industrial giants, high-growth innovators and specialized automation leaders. Thus, beyond the high capital requirements inherent to the robotics sector, another major financial barrier lies in the structural imbalance between dominant, well-established players and smaller, emerging entrants. Large robotics companies benefit from deep capital reserves, stable cash flows and the ability to reinvest heavily in R&D, creating a cycle that reinforces their market dominance and accelerates innovation. In contrast, start-ups and smaller firms, despite often being the source of disruptive ideas and novel technologies, struggle to secure the funding needed to compete on equal footing. This asymmetry stifles diversity in innovation and slows the emergence of alternative approaches. As shown in Figure 10, European companies like Siemens (DE) and ABB (SE) dominate in terms of market capitalization, revenue and global footprint, reflecting their deep integration of robotics within broader industrial and automation ecosystems. These firms operate hundreds of facilities worldwide and leverage robotics as one component of vast product portfolios. In contrast, companies like Neura Robotics and Franka Emika in Germany, Moon Surgical in France and Milrem Robotics in Estonia are developing cutting-edge solutions (from cognitive collaborative robots to autonomous vehicles and surgical robotics), operating with far fewer resources than global giants. Their size limits access to large-scale funding, manufacturing capacity and market visibility, making it harder to scale or compete internationally. Yet, these agile players are essential for fueling breakthrough innovation in Europe.

Figure 10: Top 20 companies operating in the robotics sector globally. X-axis = Revenue size (USD million in 2024 FY), Y-axis = Number of facilities, bubble size = market capitalization

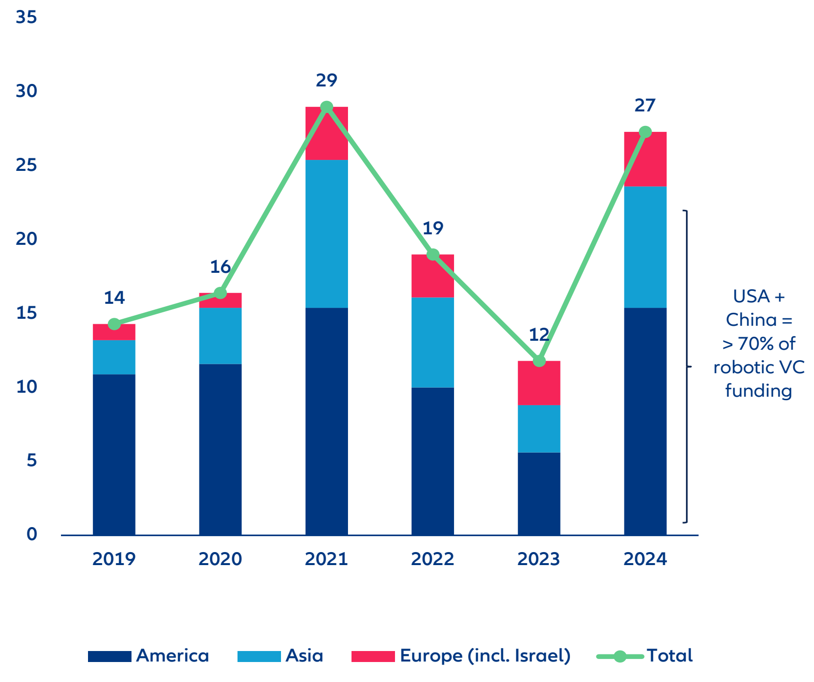


Sources: Bloomberg, Allianz Research

Boosting venture capital (VC) opportunities for small robotics firms in Europe is crucial to ensure that their ideas translate into industrial impact, foster innovation and maintain global competitiveness. Despite the continent's growing prominence in deep tech, including robotics, European startups face significant financial challenges. As seen in Figure 11, in 2024, European robotics startups raised approximately USD 3.7bn, substantially below the USD15.4bn and USD8.2bn raised in the US and Asia, respectively. This downturn underscores the ongoing "VC winter" affecting the sector. Notably, while large-scale investments continue to dominate, smaller firms often struggle to secure funding, hindering their ability to scale and compete. To bridge this gap, targeted VC initiatives are essential to support early-stage robotics companies, enabling them to transform innovative ideas into impactful technologies and ensure Europe's leadership in the global robotics landscape.

Seize opportunities to surf on the AI bonanza. Over the past two years, VC funding has flocked towards AI-related activities, with the share of AI in global funding more than doubling from 14% to 33%. The market share is also twice higher than it was in 2021 though the amount of capital invested remains similar at just over USD100bn. In a weak VC environment, hampered by elevated interest rates since 2022, this suggests that AI is among the few areas that generate investor interest. European robotic SMEs could seize opportunities of lower cross-industry competition amid private investment targets and lower scrutiny on AI valuation from investors (though this is already starting to change) to get fresh money. It is quite rare to witness a global consensus over one type of technology so Europe should seize the opportunity to connect the dots and ease connections between investors and corporates for mutual benefit.

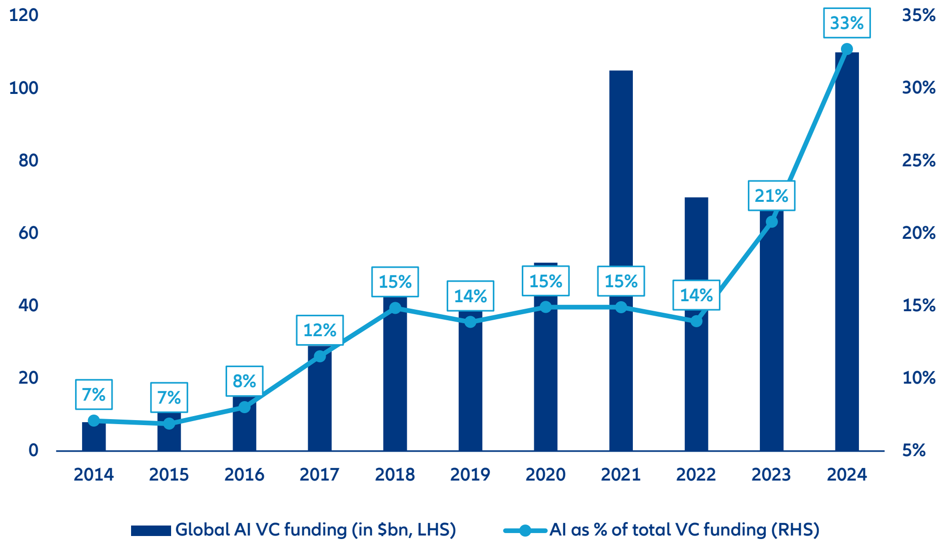
Figure 11: Global venture capital funding into robotic industry



Sources: Pitchbook, Crunchbase, Allianz Research

1 Our proprietary supply-chain complexity index considers shifts in trade flows, geographic distance, geopolitical alignment, our country risk ratings and infrastructure connectivity and quality. See our report here: The geoeconomic playbook of global trade

Figure 12: Global venture capital funding into AI

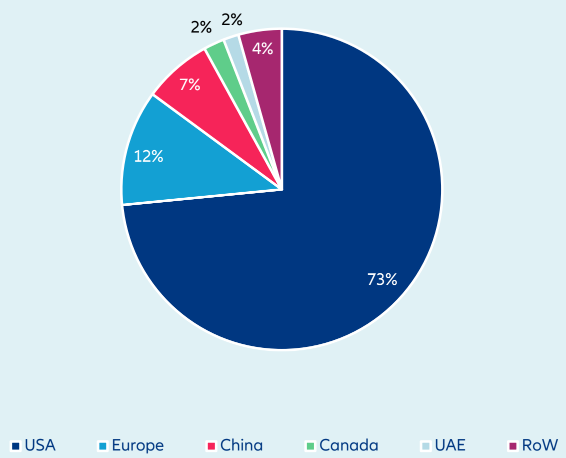


Sources: Pitchbook, Crunchbase, Allianz Research

Beware of the US AI frenzy

The star of the AI show. The US dominates global AI venture capital, absorbing around 75% of total funding last year (over USD80bn). Europe comes in second with almost USD13bn funding, of which over 70% went to three countries: the UK (USD4.3bn), France (USD2.7bn) and Germany (USD2.1bn). The difference of maturity and market depth between both regions explains part of gap but there are several other factors, including more business-friendly regulation favoring entrepreneurship and private investment, coupled with the US's leading research position, targeted migration policy for attracting foreign talent and a strong tech ecosystem composed of cash-rich blue chip companies with a strong R&D bias. The deregulation approach promoted by the US president Donald Trump and various corporate tax cuts implemented during his first term (2017-2020) turned out to be a significant catalyst for boosting VC activity, despite the uncertainties arising from trade conflicts. Against this backdrop, Europe could consider improving its business framework to promote VC investments that are complementary to broad national and European funding plans.

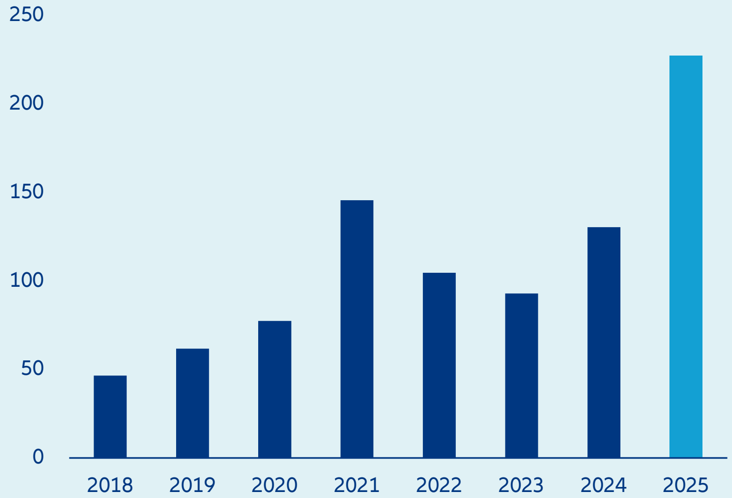
Figure 13: AI VC funding in 2024 per geography breakdown



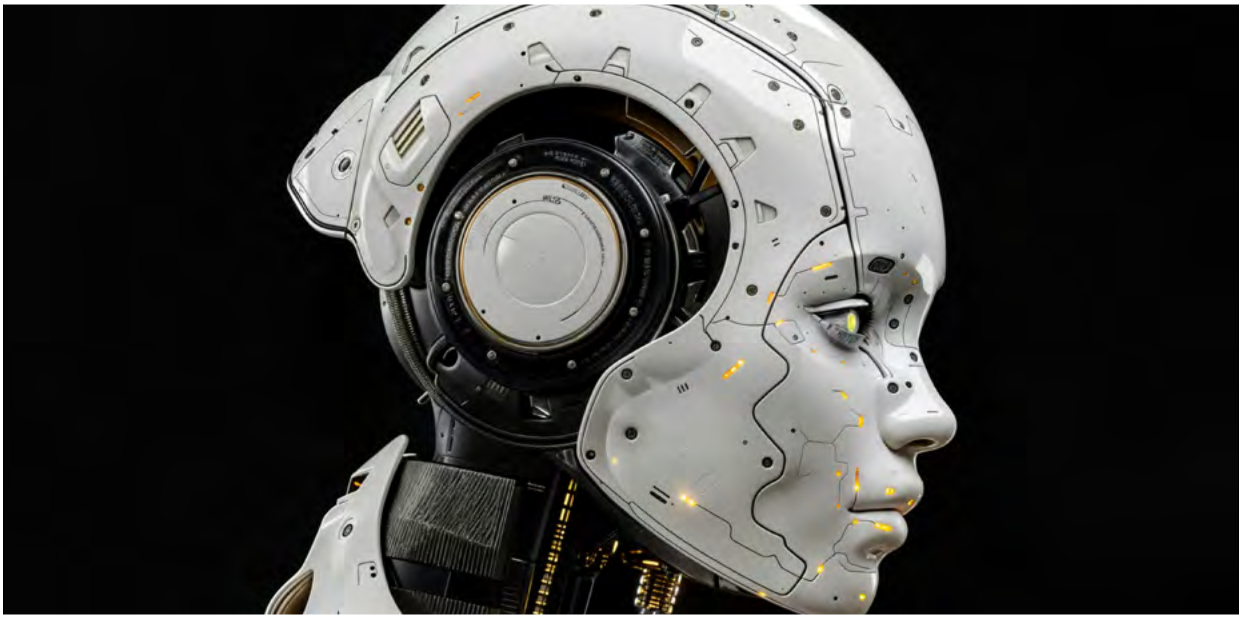
Sources: Pitchbook, Crunchbase, Allianz Research

US Big Tech corporations are significantly increasing capital expenditures (capex), driven by the rapid expansion of AI infrastructure. Companies like Alphabet, Microsoft and Meta are aggressively investing in AI-focused data centers and specialized hardware, pushing their capex to unprecedented levels. For example, Alphabet plans to spend USD75bn in capital expenditures in 2025, a +43% y/y increase, primarily fueled by AI initiatives. Similarly, Microsoft forecasts a +40% rise in capex for fiscal 2025 to USD80bn while Meta revised up its capex guidance with its Q1 earnings release from USD60-65bn to USD64-72bn, reflecting heavy investment in AI supercomputing capabilities but also rising costs due to a recent tightening of trade conditions under new US tariff policy. This inflation in capex is also partly due to soaring prices of cutting-edge GPU chips, which are a critical piece in the development and computation capacities of generative AI platforms, intensifying infrastructure costs as a result. Consequently, AI-driven capex inflation is reshaping the cost structure of Big Tech, signaling a new era of capital-intensive innovation.

Figure 14: Annual corporate private investment in AI and 2025 guidance from top three US hyper-scalers (Alphabet, Meta & Microsoft, in USD bn)



Source: AI Index Report (2025), Allianz Research. Note: In light blue the estimated capex from the top three US hyper scalers for 2025.

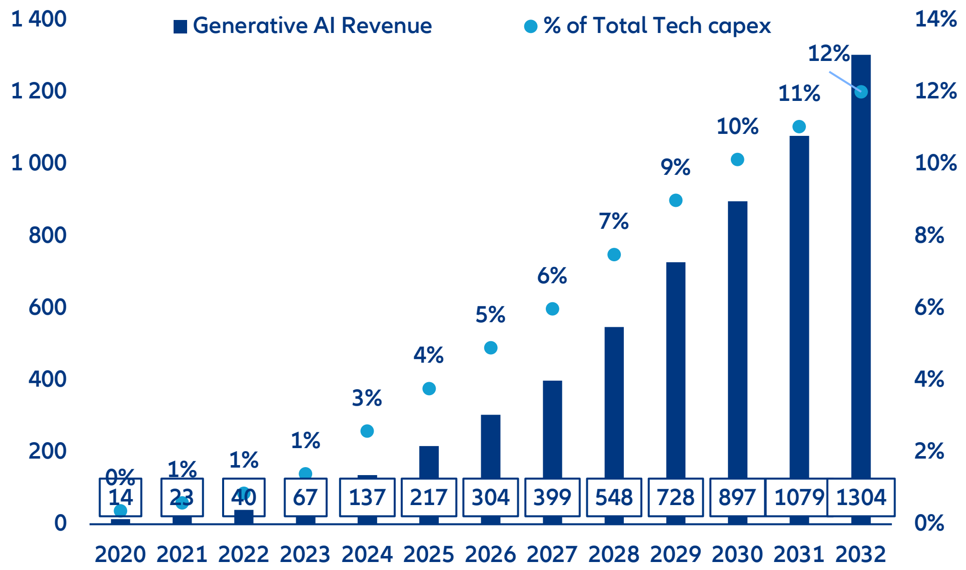


#3: Scale up innovation from research to market and integrate AI

High potential but a cash-intensive scale-up. The integration of AI technology into robotic solutions will mark a decisive shift for the industry, and the start of the era of smart robots that will integrate better precision, anticipation and optimization skills. However, as with any new technology at the early phase of its development, the scale-up phase requires massive investment, at both private and public levels, to unlock the revenue potential. In the case of the AI industry, whose revenue are expected to outpace USD1trn after 2030, the attractive reward justifies capital efforts, though it should take at least five additional years to reach a potential ROI of 10% on capital invested. The high level of investment required by AI-specific R&D looks quite elevated compared with the standard seen during the launch of the Internet in 1990s as at that time hyper-scalers among telecom companies used to spend between 15-20% of their revenue on capex compared to the 20-40% spent today by US tech giants. While high capital requirements look to be a heavy barrier for new actors, the success of DeepSeek's low-cost, open-source generative AI language tool in China is a great example of cost optimization, which European companies can take inspiration from. However, reducing scaling costs does not mean eliminating it as strong R&D is the key to build up a technological edge over international competition.

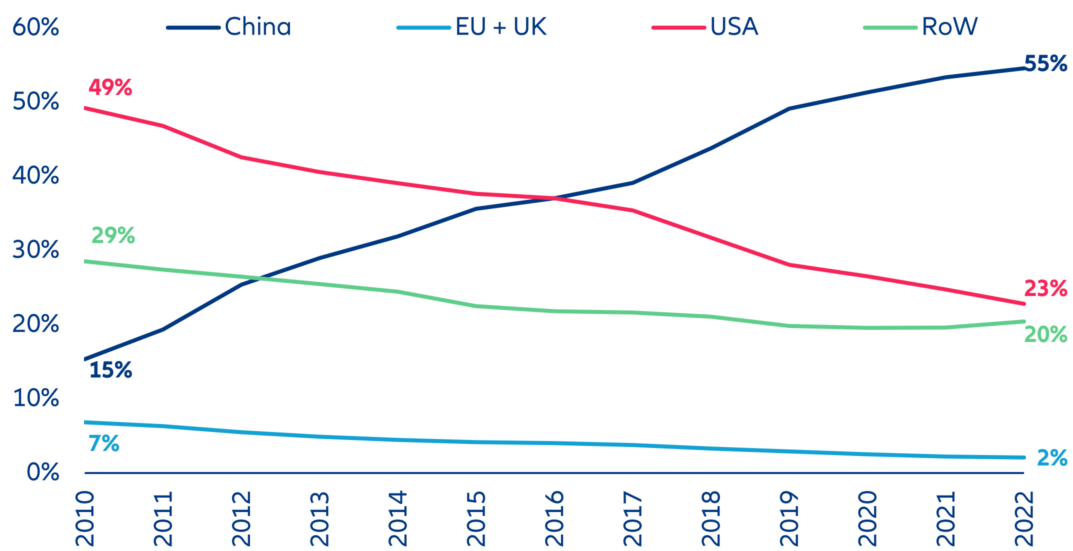
European R&D is too limited. In terms of R&D into advanced technology, Europe looks like a dwarf compared to the giants that are the US and China, which account for almost 80% of granted patents registered across the globe. The volume of patents is not imperatively a factor of success, but it nevertheless illustrates industrial efforts made to build up an innovative and operating ecosystem. European filings are minimal compared to those of China and the US, and also very heterogeneous as they are driven mostly by big economies like the UK, Germany and France. This gap is attributed to Europe's relatively conservative approach to AI research and development, characterized by fragmented efforts, limited investment capacities and an absence of a roadmap defining clear business targets and potential industrial synergies based on AI-related R&D. In the case of China, we observe that the advance into AI patents accelerated further along with the state's "New Generation Artificial Intelligence Development Plan" launched in 2017 that served as a blueprint for developing AI technology, including broad goals up to 2030. Another five-year plan launched by the Bank of China in early 2025 of over CNY 1trn is expected to bring additional support to the AI industry.

Figure 15: Estimate of generative AI revenue by 2030 (in nominal and in % of tech capital expenditure spent)



Sources: IDC, Bloomberg Intelligence, Allianz Research

Figure 16: Proportion of annual patents granted in the AI domain across the globe

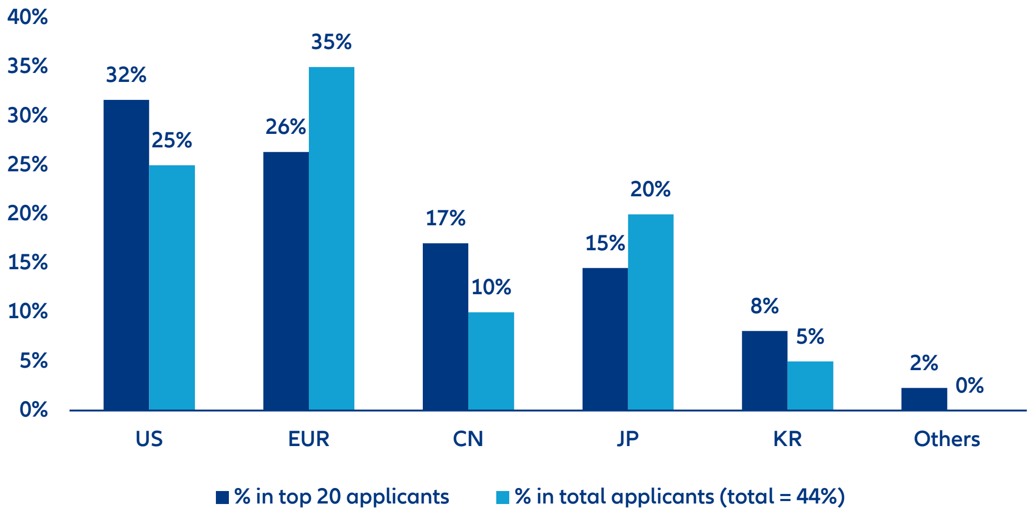


Sources: CSET, Allianz Research

Europe needs to fence its realm. Even on the European continent, domestic corporates are not the biggest contributor in term of AI-specific patents, with only seven representants in the top 20 for a ratio of roughly one-quarter of total granted patents. The difference of capital resources is part of the explanation but we the gap with other competitors is less wide than outside European borders, reflecting some local hurdles and/or reduced interest for foreign actors to implement R&D in Europe. The high level of bureaucracy in Europe coupled with a stringent legal framework on data privacy make the environment less flexible for investment. While this can be considered as a hurdle for innovation and a further development of capital risks industry,   these barriers could also be used as an asset for establishing an industrial protection policy in terms of R&D, deterring the easy offshoring of made-in-Europe intellectual property. European corporates can also rely on a large and well acknowledged network of universities and engineering talent to further develop technology incubator programs and leverage academic skills into business applications. Ultimately, consolidating its position locally is a mandatory step before Europe can play the international game.

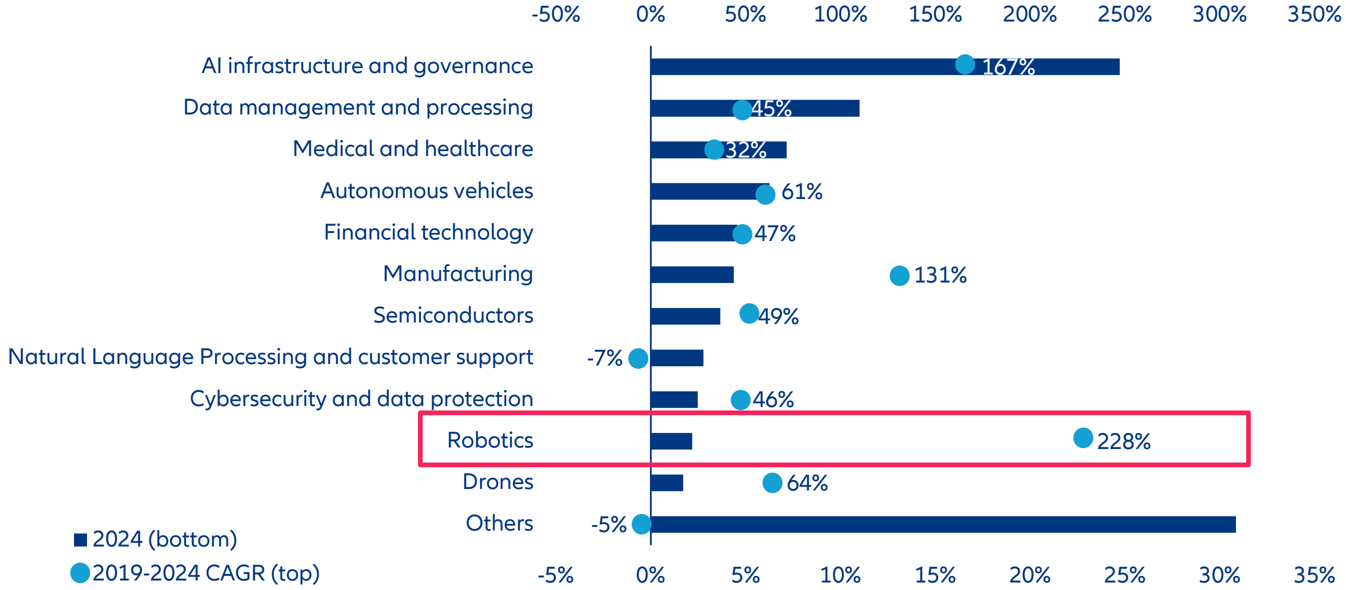
Robotic momentum. The implementation of AI solutions into the robot industry is just starting and is expected to intensify further over the next decade as this technology will reframe the industrial range of robots, extending their usage and area of activities. With around USD2.8bn of private funding registered in 2024, the robotic industry is ranked 10th in global AI funding, just behind cybersecurity, language processing and semiconductors, and well behind data centers. However, in terms of momentum, robotics is leading the way, with investment growth recording a compound annual growth rate (CAGR) of almost +230% over 2019-2024. This is a clear sign of rising industrial interest for further and more integrated implementation in the short and mid-run, setting the stage for the robotics market to outpace the USD100bn milestone by 2030, with a CAGR of at least 15%.

Figure 17: Localization of top 20 corporate applicants of AI patents in Europe



Sources: EPO, Allianz Research

Figure 18: Private investment into AI per industry affiliation breakdown (2024 ratio and 2019-2024 CAGR)



Sources: : AI Index report (2025), Allianz Research

Innovation attraction. Besides massive capital expenditure, some hyper scalers are also resorting to acquisition and/or capital participation to access innovation, plugging in to their existing business or investing into high-growth-potential activities for diversification. This is also an expensive approach, but it allows companies to minimize risks as capital is invested into well-advanced technology and processes. Despite a common pattern, we observe that some activities generate more attraction than others: In robotics, humanoids and autonomous vehicles gather the most interest, both in media and among companies, including some big tech and auto names. However, Europe has little incentive to focus on these two domains as there is no guarantee that it can close the financial and technology gap and get a substantial ROI at the end.

Table 3: Main corporate shareholders among top advanced robotic ETI

Name	Nationality	Robot type	Key shareholders
Boston Dynamics	USA	Mobility (Drone)	Hyundai Motor (JP)
Realtime Robotics	USA	Motion/Vision control	Mitsubishi Electric (JP)
Figure AI	USA	Humanoid	Nvidia, Microsoft, OpenAI, Amazon (US)
Apptronik	USA	Humanoid	Alphabet (US), Mercedes Benz (DE)
Agility Robotics	USA	Humanoid	Sony, Softbank (JP), Amazon (US), Schaeffler (DE)
Vecna Robotics	USA	Mobility	GM (US)
Fetch Robotics	USA	Mobility	Zebra Technology (US)
Comau	IT	Mobility	Stellantis (IT)
Techman Robot	TW	Cobot	Pegatron (TW)
Universal Robot	DK	Cobot	Teradyne (US)

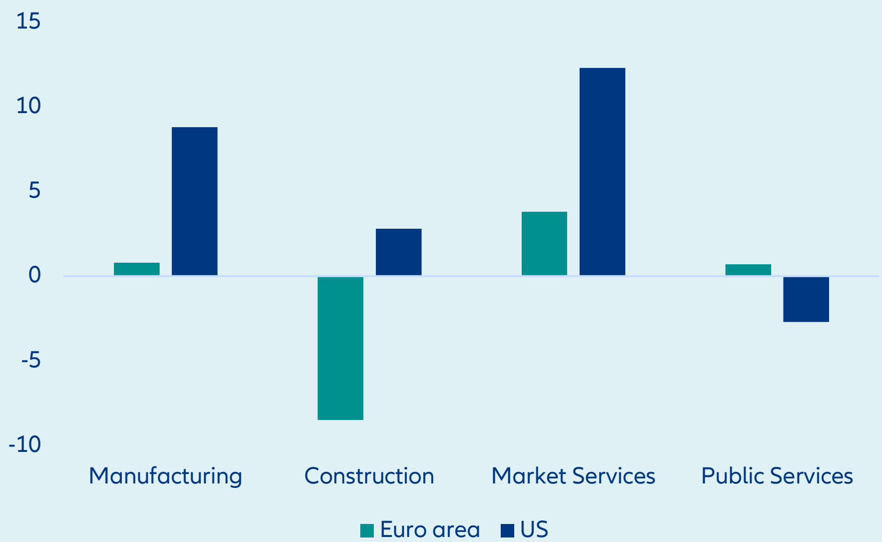
Sources : AI Index report (2025), Allianz Research

Why robots are Europe's best bet for a productivity revival

Europe's productivity engine is faltering, and this is especially visible in its manufacturing sector. Between Q4 2019 and Q1 2024, labor productivity in Eurozone industry rose by just +0.8%, while US industry improved its productivity by +8.8% over the same period (see Figure 19). This gap is not new, but it is now widening at an alarming pace. The divergence seems to be structural and a number of reasons have been put forward to explain it: (i) The digitalization lag: European firms, particularly SMEs, have been slower to adopt digital technologies that drive productivity. (ii) The investment gap: US companies have consistently invested more per worker, particularly in high-return areas like automation, while European investment remains skewed towards lower-productivity sectors. (iii) Firm demographics: The US economy features a higher share of dynamic, fast-growing firms – often tech-driven – whereas Europe's firm population is older, smaller and less prone to scale. Finally, (iv) labor market fragmentation: European labor markets remain more regulated and slower to reallocate workers to more productive firms, sectors or regions.

This is where robotics offers a clear, evidence-backed path forward. Industrial robots raise output, reduce rework and waste and allow for continuous operation without proportional increases in labor. Their productivity impact is quantifiable: It is estimated that robots contributed 5% of productivity growth in 17 OECD economies between 1993 and 2007. More recent firm-level studies also show productivity gains of about 10% within two years of robot deployment[1]. In Europe's own factories, the returns are increasingly well-documented. Importantly, these gains extend to SMEs. Adopting robots – even in low-tech sectors like plastics and wood processing – allows companies to gain marked improvements in labor productivity and product quality. Although all industries did not adopt robots to the same extent, the effects are visible at the industry level when deployed. In the automotive sector, one of the most robotized globally, robot use has been linked to labor productivity growth of up to 20% over a decade. In metal and machinery manufacturing – sectors with traditionally slower productivity growth – robot deployment has improved multi-factor productivity by 5-8% across Europe over five-year horizons. European food processors using robotic packaging, inspection and palletization systems achieved 10-15% increases in output per labor hour, particularly where labor shortages had previously constrained throughput. In logistics and warehousing, where service robots are being adopted for order picking and transport, labor productivity has increased significantly in leading pilot deployments across Germany and the Netherlands. What makes these achievements compelling is that productivity growth is occurring even in mature industries with relatively low digital intensity. Robots are not just tools for high-tech verticals – they are now viable for general manufacturing, thanks to falling unit costs and simplified integration. The resulting productivity payoff is no longer limited to factory giants: it is and will be more and more available to mid-sized firms and regional industrial clusters.

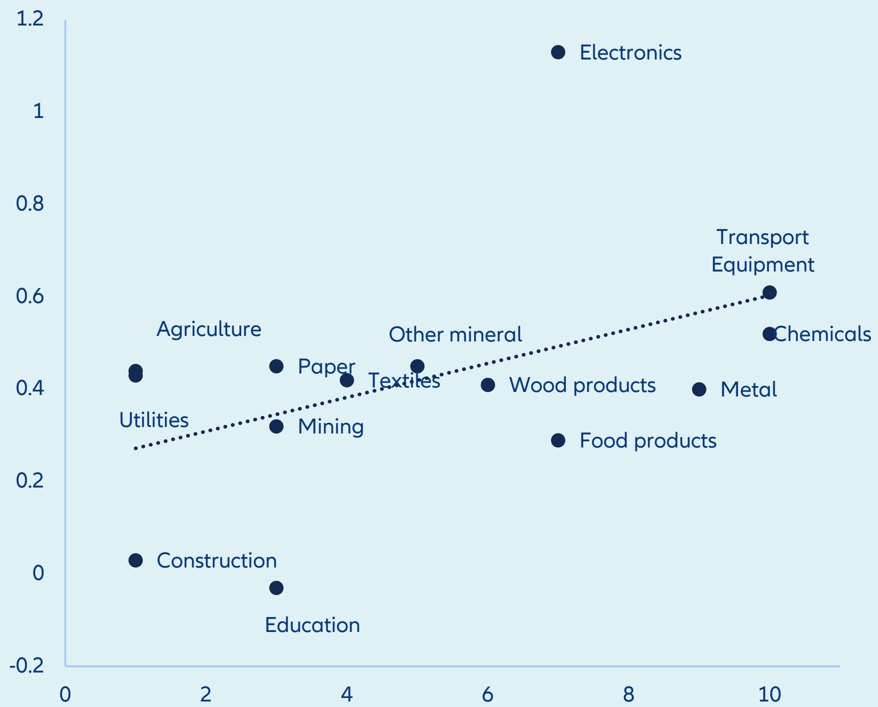
Figure 19: Productivity growth by industry (Q4 2019 – Q1 2024)



Sources: ECB, Allianz Research

1 Zhao et al. (2024), "Impact of industrial robot on labour productivity: Empirical study based on industry panel data", Innovation and Green Development 3(2).

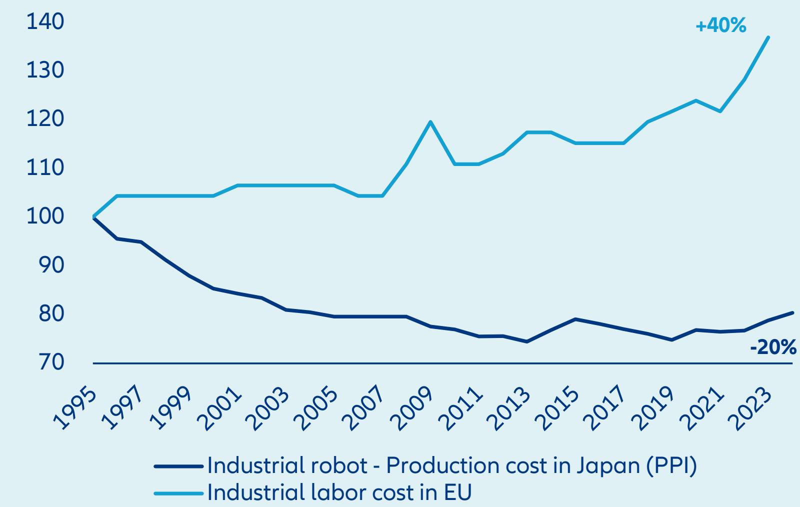
Figure 20: Productivity versus robotization (1993-2007)



Sources: Graetz & Michaels (2018), Allianz Research

As industrial robot technology becomes increasingly affordable, its widespread adoption across manufacturing sectors will become easier. The significant decline in robot costs (see Figure 21) is making automation more accessible to various industries, transforming global supply chains and operations. Historically, high upfront costs and the complexity of integrating robotic systems limited their use to large corporations. But the decreasing cost of industrial robots has now opened doors for SMEs to embrace automation. With the advent of collaborative robots (cobots) that are smaller, more affordable and easier to deploy, SMEs can now automate repetitive and physically demanding tasks, leading to increased efficiency and reduced labor costs. Moreover, the integration of artificial intelligence into robotics has enhanced the capabilities of these machines, enabling them to perform complex tasks with greater precision and adaptability. AI-powered robots can learn from their environments, adjust to new tasks and work safely alongside human workers, further expanding their applicability across various industries. Embracing robotics not only addresses current labor challenges but it could also position European companies to thrive in an increasingly competitive and automated global economy.

Figure 21: Industrial robot vs. labor cost



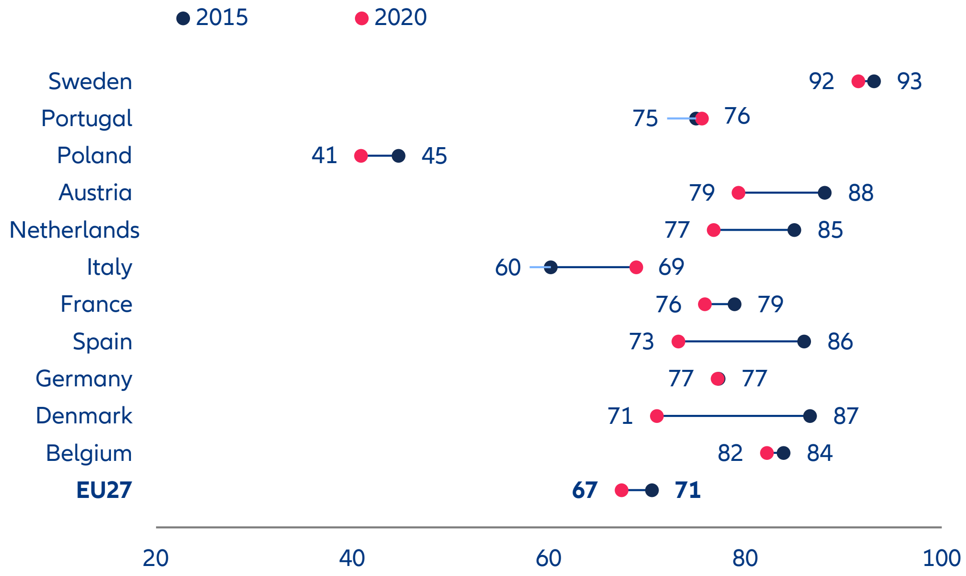
Sources: BOJ, ECB, Allianz Research

#4: Invest in workforce upskilling and education

A workforce that remains misaligned with automation. Europe's ambition to lead in advanced manufacturing could be undermined by a widening industrial skills gap. While the continent would like to ramp up automation and digital technologies, it has yet to broadly equip its workforce with the capabilities required to operate, integrate and maintain modern robotic systems. This misalignment is jeopardizing Europe's long-term goals. 76% of EU firms identify a shortage of relevant skills as a key barrier to investments. The gap is especially acute in industrial sectors, where a shortage of technical operators, robotics technicians and systems integrators is stalling the rollout of advanced technologies on the factory floor. Furthermore, between 2015 and 2020, the share of firms offering training to their employees decreased: On average in the EU, 67% of companies were offering training to their employees in 2020 compared to 71% in 2015. In Italy, only 60% of firms were offering training in 2020, while in Poland that number was as low as 41%. Even better positioned countries saw significant drops: for instance, while 79% of Austrian firms offered training in 2020, the share was 88% in 2015. Although these figures are from the pandemic era and probably encompass some bias, they still underline the progress that remains to be done.

Operation, technical and strategic skills must be developed. To prepare workers for the robotics transition, skills development must address three distinct areas. Frontline workers need to be able to safely operate and interact with collaborative robots (i.e. cobots), read interface feedback, manage faults and carry out first-line maintenance. These are skills that can be taught in vocational contexts but are rarely covered in standard industrial training curricula. At the intermediate level, technicians must be proficient in robot programming, PLC logic, sensor alignment, vision systems and diagnostics. These functions are critical to deploying robots at scale, particularly in SMEs that lack dedicated automation teams. However, demand for such technicians far outstrips supply across Europe as thousands of automation engineer positions were open as of June 2025. At the top end, Europe needs more engineers and integrators capable of planning entire robotic workflows, optimizing throughput with digital twins and linking robotic systems to enterprise software. These higher-order skills are essential to extract value from robotics in complex, digitally integrated environments such as pharmaceuticals, aerospace or precision electronics.

Figure 22: Share of firms offering training to their employees (%)



Sources: Eurostat, Allianz Research

A successful upskilling agenda must be both systemic and modular. Europe already has proven tools from dual training systems to sectoral education bodies but these need to be redirected toward automation readiness. The priority is to expand and update vocational training. Governments should push the integration of robotics modules into technical colleges and trade schools. This includes basic programming, safety protocols and robot-human interaction. Equipment funding is equally critical – many institutions still lack functioning industrial robots to train on. Public-private partnerships with OEMs like ABB, KUKA and Fanuc could help close this gap. Second, reskilling must be incentivized within firms. Governments could offer tax relief or subsidies to companies that invest in certified training for robotics and automation. Sectoral training funds, already active in many EU countries, could co-finance these initiatives. Spain and Finland have piloted digital vouchers to support workers enrolling in digital training – this model could be expanded to cover robotics-specific upskilling. Third, targeted programs are needed for displaced and at-risk workers. They could benefit from stackable certification, where each module counts toward a broader qualification. This would make it easier for mid-career workers to transition into automation-related roles. At the policy level, the EU should create a unified "Robot Skills Framework" modelled on the Digital Competence Framework. This would define core competencies, standardize certifications and help align curricula across member states. A shared taxonomy would also enable better matching of skilled candidates across borders.

#5: Streamline regulatory frameworks to foster innovation and adoption

The EU needs to balance regulation and innovation. While the EU has established itself as a global pioneer in regulating AI through the enactment of the AI Act, concerns have emerged regarding the potential of these regulations to inadvertently hinder innovation, particularly in the robotics sector. To harness the full potential of robotics and AI, Europe must refine its regulatory framework to foster innovation while safeguarding ethical standards and public trust. The EU's AI Act, which came into force on 1 August 2024, represents a landmark effort to create a harmonized legal framework for AI across member states. The Act categorizes AI systems based on risk levels – unacceptable, high, limited and minimal – and imposes corresponding obligations on developers and users. While the AI Act aims to ensure trustworthy AI, critics argue that its stringent provisions may stifle innovation. The EU's regulatory caution has, at times, left the union behind the innovation curve, potentially hampering the scale-up of AI start-ups and creating strategic dependencies on external technologies. Robotics, inherently intertwined with AI, faces unique challenges under the current regulatory regime. The integration of AI into physical systems introduces complexities related to safety, liability and ethical considerations. For instance, the EU Machinery Regulation, which governs the safety of machinery, now intersects with AI regulations, necessitating a cohesive approach to ensure that smart robots incorporating AI comply with both sets of rules. Moreover, the classification of AI systems based on risk levels may not adequately capture the nuances of robotics applications. Many robotic systems operate in dynamic environments and may transition between risk categories depending on their use cases. This fluidity poses challenges for compliance and may deter smaller enterprises from investing in robotic innovations due to regulatory uncertainties.

Regulation needs to be strategically adjusted. First, given the convergence of AI and robotics, it is imperative to harmonize regulations across these two sectors. Aligning the AI Act with existing machinery and product safety regulations is needed to provide clearer guidance to developers. Also, as we suggest Europe should focus its robotics efforts on some specific sectors, the EU could create "regulatory sandboxes". Such sandboxes provide controlled environments where companies can test specific innovative technologies under regulatory supervision. This approach allows regulators to observe emerging technologies in real-world settings, gather data, and refine regulations accordingly. The EU regulation should also support international collaboration, which is essential for setting standards and sharing best practices. The EU should actively engage in global forums and treaties, such as the Framework Convention on Artificial Intelligence adopted by the Council of Europe, to align its regulations with international norms and facilitate cross-border innovation. All of these regulatory efforts should be taken keeping in mind that regulation needs to be adaptative and risk-based: rules and standards should evolve with technological advancements. Thus, it can prevent obsolescence and encourage innovation. And risk-based regulation, which tailors requirements based on the potential impact of a technology, allows for more nuanced oversight. This approach ensures that high-risk applications receive appropriate scrutiny, while lower-risk innovations can proceed with fewer barriers.

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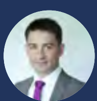

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