Fraunhofer IPT

White Paper

AI-Powered Robots in Industry – A Reality Check on the Status Quo

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Executive Summary

Automation has long been a key lever in industry to meet rising demands for efficiency and productivity as well as increasing labor costs. Conventional automation provides substantial value in complex and repetitive tasks performed within restricted environments. However, it reaches its limits when confronted with high variability, unstructured environments and close collaboration with employees. Skilled-worker shortages and rising labor costs lead to growing pressure on industrial companies, as hard-to-automate processes remain dependent on human reasoning and manual expertise.

AI-powered robots emerge as a potential technological response to address industrial tasks that currently remain hard-to-automate. They can perceive as well as reason about their environment and can translate this reasoning capability into physical action. However, the emerging market for AI-powered robotics is accompanied by considerable technology hype and inflated expectations. Ambitious commercial announcements often exceed demonstrated capabilities and call industrial readiness into question. The actual potential of AI-powered robots in industrial environments remains unclear.

In this study, the Fraunhofer Institute for Production Technology IPT addresses this lack of clarity by answering the question:

What is the industrial potential of AI-powered robots in the near term?

To do so, this study establishes a common understanding of AI-powered robots and their enabling capabilities, examines how the global market is evolving, and assesses the readiness of potential industrial solutions. The four-month study mapped more than 240 companies, including AI-powered robot manufacturers, software developers and component manufacturers across three key regions including Europe, North America and Asia. The identified AI-powered robots used in industrial environments especially include cobots and industrial robot arms, autonomous mobile manipulators (AMMs), bipedal and wheeled humanoids as well as quadrupeds.

This study uncovered key insights into regional strengths, industrial readiness in terms of use cases and production readiness as well as deployment opportunities for AI-powered robots. Against this background, three aspects are particularly noteworthy:

Three regions with distinct strengths in AI-powered robotics

- Alongside AI-powered robot startups, Europe combines an established automation ecosystem with advanced component development and strategic partnerships that may indicate early signs toward an AI-powered robotics supply chain.
- North America leads in robotic intelligence, supported by a strong computing technology ecosystem, renowned AI-powered robotics manufacturers and venture-backed development.
- Asia, particularly China, demonstrates a localized vertically integrated market with strong hardware and rapid industrialization capabilities.

Industrial value can emerge before general-purpose autonomy fully arrives

- With the increasing number of company announcements for AI-powered robot production, scaled production is not a question of if, but rather a question of when it will be achieved.
- Although current achievements remain far away from general-purpose autonomy enabled by a single robot form, task-specific AI solutions can already generate substantial industrial value.
- Diverse industrial use cases may favor specialized robot forms and application-specific deployments, questioning the need for a general-purpose robot form in industrial environments.

Established robot forms equipped with AI can pave the way for advanced robot forms

- Although humanoids offer long-term potential for flexible deployment in human-centric environments, their industrial validation is currently limited to pilot projects and demonstrations.
- AI-powered cobots or mobile manipulators that are, e.g., equipped with cameras, foundation models and innovative grippers such as robot hands, may offer low-risk near-term added value for industrial tasks. Their adoption can establish the technological and organizational foundation for deploying humanoids in the long term.
- Tasks where established robot forms are neither practical nor suitable can eventually be addressed by novel robot forms such as humanoids and quadrupeds.

All in all, manufacturing companies are encouraged to assess their readiness for AI-powered robots, investigate value-adding use cases and prepare near-term pilots with clear milestones for industrialization.

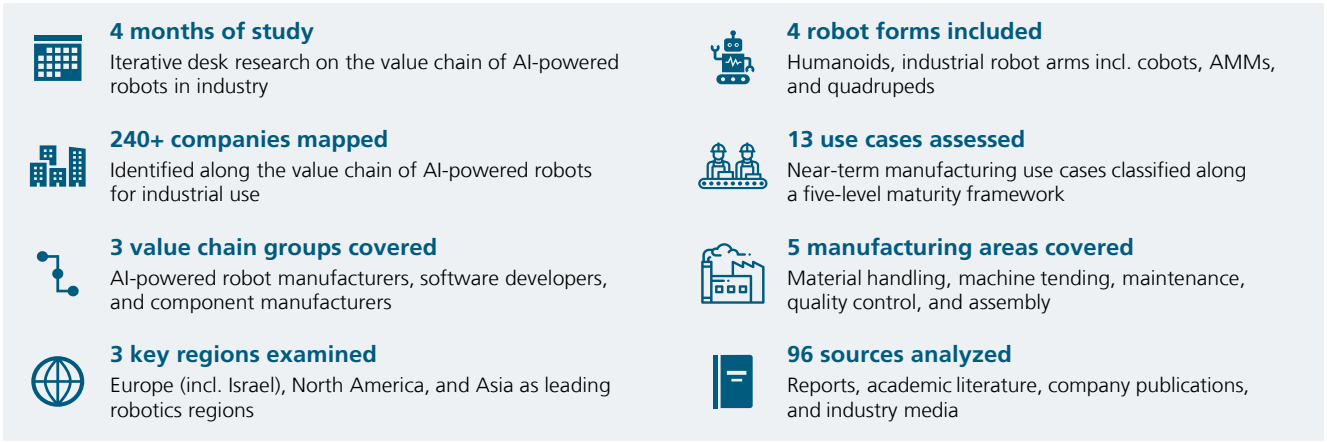


Figure 1: Key facts of the study at a glance

Motivation for AI-powered robots

Conventional automation has a structural ceiling

A robot can reliably weld, paint, or assemble components as long as the task is clearly defined. Current automation systems are primarily designed for high-volume serial manufacturing with standardized processes in structured environments. Existing industrial robot solutions are based on clearly defined and repeatable motion sequences that are programmed by experts in advance. As a result, conventional automation reaches its limits when faced, for example, with high product variety, variable processes, and assembly tasks that require complex manipulation. Moreover, existing automation solutions are not well suited to dynamic, unstructured production environments and changing tasks. Hence, many of the tasks that remain unautomated require a certain degree of flexibility and dexterity, which is often provided by a skilled workforce.

Demographic change reinforces the skilled labor shortage and the need for technological solutions

For many companies, automation is a key lever for addressing rising costs, increasing productivity demands, and the shortage of skilled labor. According to projections by the German Federal Statistical Office, one in four people in Germany will be 67 years or older by 2035, and between three and five million workers are expected to leave the labor force by the mid-2030s, with particular pressure on small and medium-sized enterprises (SMEs). [1] If this gap remains unaddressed, value chains and industrial ecosystems that depend on manual, skill-demanding work may encounter critical challenges. China, notably, faces a comparable demographic trajectory, for which the government has explicitly named the development of humanoid robots and AI as a strategic response, particularly in elderly care and services. [2] In that regard, AI-powered robotics tends to be one possible technological solution to compensate for a shrinking workforce and aging society.

Technological advances in AI-powered robotics triggered enormous market expectations

AI-powered robotics has undergone a maturity leap through advances in both software and hardware, potentially making future applications in real, unstructured environments increasingly realistic. This development is accompanied by enormous market expectations. Bank of America projects 300 million humanoid robots in operation by 2040 and up to three billion units by 2060 across service and industrial applications. [3] Morgan Stanley forecasts more than one billion units by 2050. [4] Individual forecasts have also been revised upward within short timeframes. Morgan Stanley, as reported by CNBC, for example, raised its shipment forecast for Chinese humanoid robots for 2026 from 28,000 to 50,000 units within the current year. [5] At the same time, the large spread between forecasts suggests an early market phase. Depending on scope, time horizon, and underlying assumptions, projections range from 38 billion US dollars by 2035 to several trillion US dollars by 2050. [4, 6] While this reflects high market momentum, the forecasts themselves are not yet evidence of industrial maturity or actual demand.

SMEs lack low-threshold access to AI-powered robotics

While large manufacturers are already conducting pilot projects, SMEs often lack the necessary expertise, infrastructure, time, risk appetite for pilot projects, and venture capital. Introducing AI-powered robotics is typically more complex than a simple technology procurement, as it affects not only the AI-powered robot itself but also processes, employees (including their acceptance), data, IT systems, and legal and safety issues. Companies therefore need structured and low-threshold ways to experience AI-powered robotics and test them in practice.

Expectations and verifiable evidence are drifting apart

Beyond market-size forecasts, public communication around AI-powered robotics, humanoids in particular, is currently largely shaped by demonstration videos, funding announcements, and shipment figures that reveal little about actual industrial usability. Many of the most widely cited forecasts originate from parties with a stake in the outcome, such as equity research informing investment decisions, consultancies offering transformation services, and manufacturers raising capital. Without dismissing these publications, this underlines the need for an independent assessment, as it has become genuinely difficult for industrial decision-makers to distinguish technological substance from marketing communication.

This white paper aims to provide a grounded, source-based overview of the status quo of AI-powered robotics, from the underlying technology and the market landscape to demonstrated use cases and actual production readiness. It focuses on: What exactly is AI-powered robotics? What does the current market landscape look like? And what can already be deployed today?

Companies tend to do flashy demos, but these demos don't correspond to the real world."

Rodney Brooks, Professor Emeritus at MIT and co-founder of iRobot

Introducing the technological foundation

"Physical AI elevates robots from rigid automation to true autonomy. Enabling them to sense, reason, and act in real time helps them perform with greater safety, precision, and adaptability in any environment." [7]

A third component turns automation into AI-powered robotics: "think"

Conventional automation solutions can be simplified to two basic components: "sense" and "act". Systems are pre-programmed by experts, execute fixed instructions, and achieve their strengths with regard to speed, process stability, and precision in repetitive tasks within static, structured environments. AI-powered robotics expands these two classical components by a third "think" component that sits between them. As the AI-driven "brain" of the robot, it enables the robot to autonomously orient itself in dynamic environments, perceive and understand its surroundings, and make decisions in real time. As a result, AI-powered robots can, within limits, react to new, previously unknown situations without an expert needing to reprogram them. This is possible because the underlying models do not simply execute a fixed skill but rather retain previously learned skills. Moreover, they can recombine them flexibly, applying what they already know to situations not encountered before. The practical consequence is that robots may work in more complex environments with less supervision, expanding their added value in task automation.

Vision-Language-Action models are the key enabler bridging perception and physical action

Key enablers of AI-powered robotics are, among others, advanced AI foundation models, especially Vision-Language-Action models (VLAs). [8] Previously, robotic perception, task understanding, and motion control were developed as separate systems that had to be engineered and integrated for each application. VLAs combine these capabilities in a single model: computer vision to perceive the environment, language understanding to process instructions and capture intent, and action generation to execute physical tasks. [9] This integration supports the transfer of learned capabilities across tasks and is regarded as one of the main drivers of the current momentum in the field. [8]

Natural language instructions could significantly lower the barrier to operating robots

Leveraging this language understanding, an AI-powered robot can capture the underlying intent behind an instruction. Operators would neither need to follow a rigid syntax nor rely on traditional programming interfaces. Instead, they could communicate robot instructions in natural language, while the robot brain, i.e., the "think" component, handles the translation into actionable machine commands. In the long term, this could considerably lower the expertise barrier for deploying and re-tasking robots, as tasks could be assigned, adjusted, or corrected without robotics specialists. Instead of being programmed by specialists, AI-powered robots can be trained and taught new tasks by the available workforce. However, this only describes the technological potential rather than today's industrial practice. Human-robot collaboration on the shop floor remains governed by functional safety standards and certification requirements. While the 2025 revision of ISO 10218 marked the first major update in 14 years and now integrates collaborative operation into the main standard, safety standards for dynamically stable industrial mobile robots such as legged humanoids are still under development; see ISO/CD 25785. [10, 11]

Two complementary training methods give AI-powered robots their skills

To gain the aforementioned capabilities, AI-powered robots are trained through two main approaches:

1. Learning through demonstration: Leveraging real demonstration data, AI-powered robots learn via imitation learning, whether from teleoperation, visual recordings, or humans performing the task with sensor-equipped wearables.
2. Learning from synthetic data: Virtual environments provide fast, scalable, and low-risk conditions for generating artificial training data and for refining learned behaviors, e.g., through reinforcement learning.

Usually, multiple training methods are combined in practice. For example, teleoperation and simulation-based pre-training are often followed by real-world fine-tuning. Advanced robot foundation models such as VLAs are trained through mixed pipelines that combine robot trajectories, language instructions, synthetic and real-world visual data as well as human demonstrations. A central challenge in this approach is the so-called sim-to-real gap, which needs to be addressed through fine-tuning of the foundation model with real-world applications. Since simulations are built on abstractions and approximations of reality, learned capabilities that perform reliably in simulation often degrade once transferred to physical robots due to real-world dynamics, system design, perception and sensing as well as actuation and control. [12]

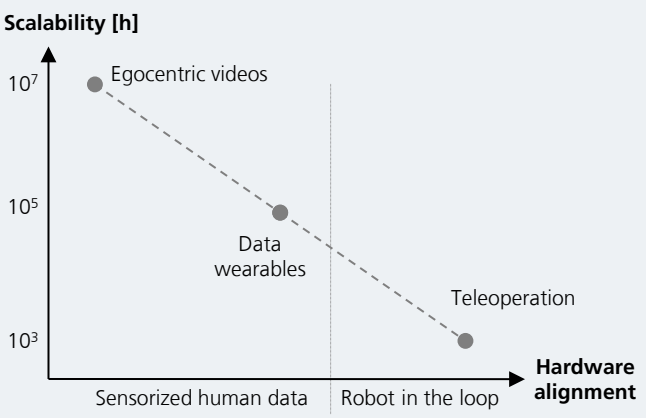


Figure 2: Scalability and hardware alignment of data sources for AI-powered robot learning (figure based on [14, 15])

Moreover, data collection for learning through demonstration faces a trade-off between scalability and hardware alignment. While teleoperation offers the highest hardware alignment, it is heavily limited by operator availability, specialized hardware requirements, and cost, with only one robot in the loop at a time. Sensor-equipped wearables close part of this gap, as they let a human collect motion data while keeping the robot out of the loop. Egocentric video appears to be by far the most scalable source. NVIDIA's EgoScale framework was trained on more than 20,000 hours of egocentric human video, over twenty times larger than prior efforts in transferring human demonstrations to robots. However, it requires retargeting to translate human hands and viewpoints into robot-executable actions. [13] Leading labs therefore increasingly blend all three sources rather than relying on only one.

The robot form factor alone does not define an AI-powered robot

The robot's form factor is not necessarily the defining criterion of AI-powered robotics, as AI-powered robots are primarily defined by their ability to act autonomously through embodied or physical AI. The form factor does, however, determine which tasks and environments a robot is suited for. Multiple form factors are already in use, as depicted in Figure 3.

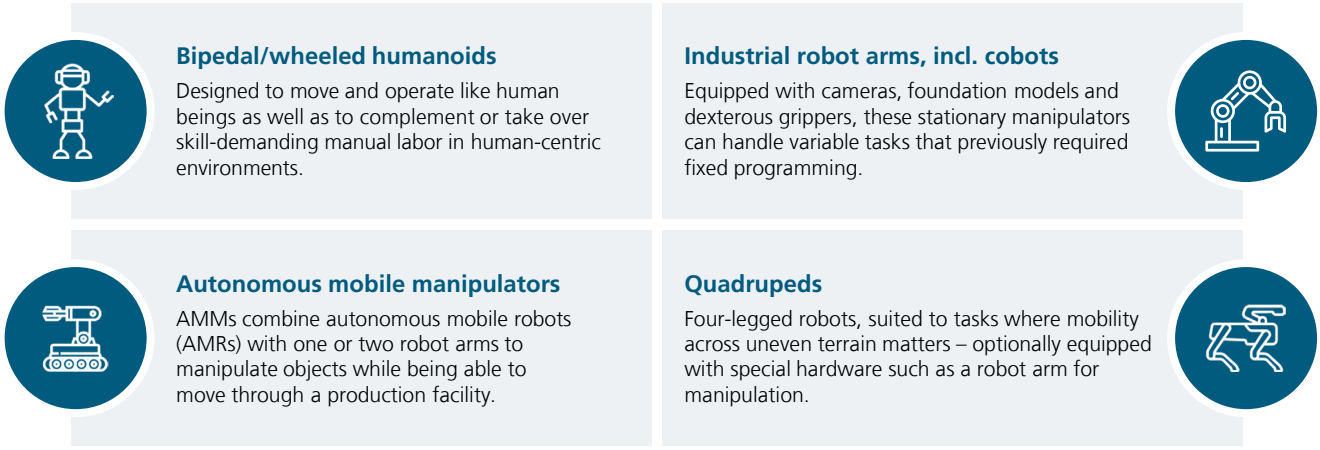


Figure 3: Typical form factors of AI-powered robots used in manufacturing environments

Across all form factors, the current momentum in AI-powered robotics is largely driven by software. However, AI-powered robots equally build on hardware advances in actuation, sensing, energy supply, and onboard computing. This includes, for example, the development of high-precision and force-sensitive gearboxes as well as high-performance, thermally managed drive systems in minimal space, and the integration of multi-sensory gripping technology. Moreover, the development of energy-dense batteries aims to enable mobile operation, and advances in onboard computing increasingly allow trained AI models to run directly on the robot.

From technological capability to industrial reality

In summary, AI-powered robotics is defined by a new technological capability: the ability to perceive, decide, and act in environments that were not explicitly programmed in advance. Whether this capability translates into industrial value, however, depends on factors such as technological advances and widespread availability of AI-powered robots, their operational reliability as well as their return on investment.

Mapping the market landscape

New companies continuously enter the market for AI-powered robots, established automation suppliers reposition themselves, and public attention concentrates on a few highly visible names. Consequently, most of the ecosystem remains largely unnoticed. To obtain a structured picture, Fraunhofer IPT conducted a desk study mapping more than 240 companies along the value chain. This chapter presents the results, highlighting a curated selection of stakeholders and the individual strengths of Europe (including Israel), North America and Asia. A more comprehensive overview of the identified companies and the regional AI-powered robotics ecosystem is available on our website [www.ipt.fraunhofer.de/nextgenrobotics].

Investments and strategic partnerships are gaining importance across the value chain

Investment in AI-powered robotics is currently increasing significantly. By mid-2026, robotics startups had raised 18.8 billion US dollars globally, already exceeding the 15 billion US dollars raised in the full year 2025 and the previous peak of around 14 billion US dollars in 2021. [16] Capital is flowing into the production and scaling of humanoid robots, foundational AI models for autonomous robotic systems, and performance-critical components such as actuators, gearboxes, grippers, and robotic hands. For example, the German robot manufacturer NEURA Robotics secured up to 1.4 billion US dollars in June 2026, whereas the US software developer Skild AI raised 1.4 billion US dollars in January 2026. [16] Moreover, targeted investments are made in innovative hardware components, for example in the Belgian start-up AILOS Robotics, which raised 3.5 million euros in December 2025 to industrialize a gearbox for human-centric robots. [17] Interest is thus no longer limited to individual robot manufacturers but increasingly extends across the entire value chain. As a result, a broader ecosystem is emerging that could accelerate the development, market readiness, and scaling of AI-powered robots.

In addition to investments, strategic partnerships are becoming increasingly important for the industrialization of AI-powered robots. Manufacturing companies can play a dual role in this context: as suppliers and as industrial users of robots. Schaeffler and NEURA Robotics, for example, illustrate such a partnership in practice. Schaeffler aims to develop and supply key components for humanoid robots, particularly innovative actuators, thereby contributing its technology and manufacturing expertise to the robotics value chains. At the same time, Schaeffler plans to deploy and test several thousand NEURA Robotics humanoids within its own global production network by 2035. [18] Thus, Schaeffler supports the development of future-relevant AI-powered robots while also refining and scaling them within its production environment. A similar approach is pursued by Mitsubishi Motors and Highlanders, which announced a Memorandum of Understanding in July 2026 to collaborate in the joint development of humanoid robots. [19] Whereas Mitsubishi aims to use and mass produce Highlanders' humanoid robots in one of its plants, Highlanders benefits from operational data, production know-how and practical use. These two selected examples indicate how manufacturing companies can use strategic partnerships as well as their existing technological expertise to enter the AI-powered robot market early and explore new business fields. In doing so, they not only create the baseline for new automation opportunities but actively shape the emerging value chain of AI-powered robots.

Nevertheless, strategic partnerships can also take a different form, in which, for example, machine builders integrate AI-powered robots into their offering. The strategic partnership between the printing press manufacturer Koenig & Bauer and the Munich-based robotics scale-up RobCo, announced in June 2026, exemplifies this. Their partnership addresses the peripheral and downstream process steps between printing and further processing, from material feeding to palletizing. According to the companies, robot systems are to be configured through a no-code interface so that they can be adapted to new tasks by the personnel on site, without specialist knowledge. In this way, Koenig & Bauer aims to extend its portfolio beyond the core technology and directly address the skilled labor shortage of its customers. [20]

AI-powered robotics companies cluster into three groups

In general, three overarching groups can be distinguished: AI-powered robot manufacturers, software developers, and component manufacturers. Figure 4 details the identified groups of the market landscape analysis.

In practice, the boundaries between these groups appear to be fluid. While some companies build on strategic partnerships, as outlined above, other robot manufacturers currently tend to rely on vertical integration across software and hardware. They develop critical performance-related capabilities in-house to potentially gain greater control over system design and improve iteration speed. This, in turn, may result in an overlap between the three focus groups. A robot manufacturer, for example, can develop and train advanced foundation models in-house, e.g., in data factories, as demonstrated by Sanctuary AI, Tutor Intelligence and Figure AI. [21-23] At the same time, robot manufacturers can also offer relevant hardware components commercially such as tactile sensors or dexterous hands, as seen with Huayan Robotics, PaXini, and Ti5 Robot Technology. [24-26] The classification logic used in this study is introduced in Methodology.

AI-powered robot manufacturers

These companies develop embodied robotic solutions such as humanoid robots, quadrupeds, autonomous mobile manipulators, or intelligent cobots. Depending on their internal capabilities, they typically develop components and/or foundation models in-house or in collaboration with selected technology partners.

Software developers

They provide the foundation for robotic intelligence, perception, motion planning, and manipulation. Some develop solutions to make high-quality industrial data available for training and for bridging the sim-to-real gap. The category includes developers of VLA and VLM models, robot operating systems, data collection engines and simulation platforms for synthetic data generation.

Component manufacturers

Companies in this group supply the hardware foundation of AI-powered robots at subsystem level, such as compact, high-performance rotary and linear actuators for movement, force-torque and tactile sensors, LiDAR and cameras for sensing and perception as well as grippers, anthropomorphic hands and custom end-effectors for dexterous, flexible object handling.

Figure 4: Overarching groups in the AI-powered robotics value chain

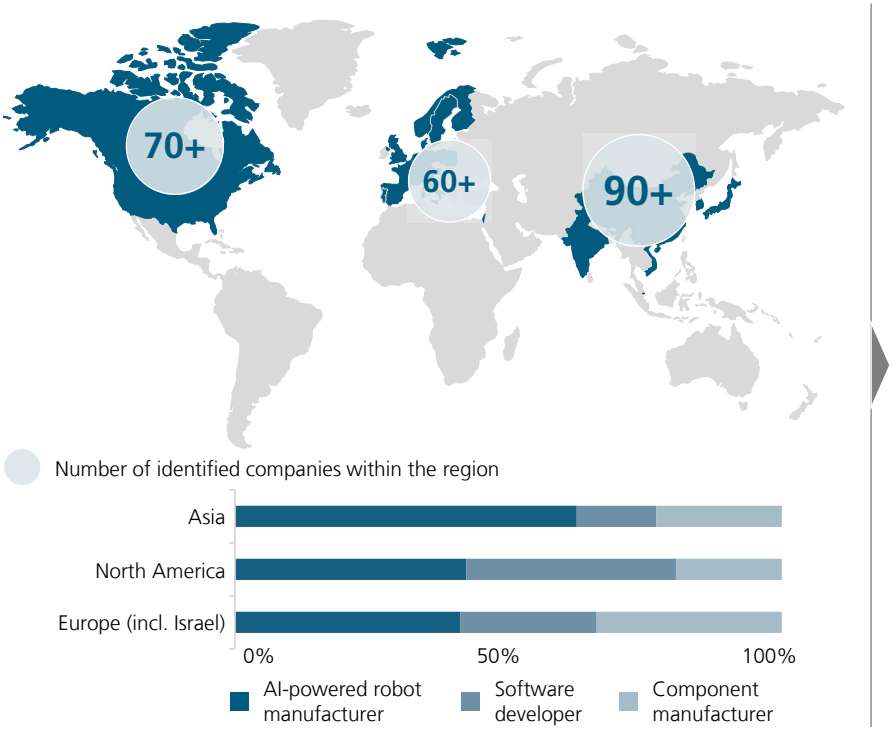
Three regions are playing a key role in the development of AI-powered robotics

As part of a structured desk research conducted by the Fraunhofer IPT, more than 240 companies in the field of AI-powered robotics were identified and mapped along the value chain. A look at the global landscape reveals three regions with distinct focus areas: Europe, including Israel, North America and Asia. Each region shows distinct strengths that are individually highlighted in more detail below.

Europe's strength lies in its established ecosystem of robotics, component, and software companies

Europe, including Israel, appears to have a more balanced ecosystem with a relatively equal distribution of companies among the three groups. The region can build on an established industrial automation industry. Hardware expertise, software development, industrial integration, and real-world application are closely intertwined. Europe therefore has a strong foundation for further developing AI-powered robotics across the entire value chain, see Figure 5. From the Middle East, Mentee Robotics from Israel stands out among other potentially relevant players. The company develops a vertically integrated, AI-powered humanoid platform that has demonstrated autonomous manipulation capabilities in warehouses. [27]

In addition to robot manufacturers such as NEURA, Agile Robots, and Humanoid, established component manufacturers including Bosch, Schaeffler, and Maxon are increasingly positioning themselves as strategic hardware partners for AI-powered robots. Bosch, for instance, became Humanoid's contract manufacturing partner for the European market in May 2026, with both companies already exploring deeper component integration into future robot iterations. [28] At the same time, the software ecosystem is growing, with



Key insights

- China plays a defining role for AI-powered robotics in Asia. As a major robotics hub, Shenzhen supports rapid prototyping, development, and industrialization.
- North America has renowned AI-powered robot manufacturers and stands out for software expertise, e.g., in foundation models and robotics simulation.
- Europe has an established automation network and tends to have a balanced ecosystem of AI-powered robotics, component, and software companies.
- Emerging value chains for AI-powered robots create opportunities to position as strategic partners for hardware, software, and integration.

Figure 5: AI-powered robotics companies by region and group

companies such as Wandelbots, Sereact, and Genesis AI being forerunners in the development of advanced software solutions for AI-powered robots. Here, a dynamic potentially similar to that of component manufacturers can be observed: AI-powered robot manufacturers may open their platforms to independent software developers, allowing them to integrate their intelligence solutions. Similarly, software developers aim to develop hardware- and vendor-agnostic software that can be deployed across a wide range of different robots. In that regard, both Inbolt's and Micropsi's advanced vision AI solutions, for example, can be deployed on Universal Robots (UR) cobots, adding the "think" component and enabling them to complete manufacturing tasks for varying products. Within Fraunhofer IPT's mapping, UR cobots appear to be a frequent choice for software developers focusing on intelligent robot arms when it comes to experimenting, testing, and demonstrating their robotic intelligence solutions. [29-31]

Research by Fraunhofer IPT also shows that several robotics hubs are emerging in Europe. Munich and Zurich in particular, as well as Odense and Paris, bring together research institutions, industrial companies, and start-up activity. In addition, Germany's large SME base can serve as a valuable testbed for piloting and further developing AI-powered robots, particularly in (flexible) production environments where certain processes remain difficult to automate.

North America stands out with renowned AI-powered robot companies and particular strengths in robot intelligence

North America is home to several renowned AI-powered robot manufacturers, such as Boston Dynamics, Figure AI and 1X Technologies, that have already successfully demonstrated pilot use cases in industrial environments.

In North America, component manufacturers also include companies that offer computing hardware, with established tech giants such as AMD and Qualcomm that are both heavily investing in new chip technology. [32, 33] However, the development of hardware components that enable movement and dexterous manipulation, such as actuators and advanced sensors, remains comparatively underrepresented. [34] Although some manufacturers of AI-powered robots currently work in-house on advances in robotic hand dexterity, there may be co-development opportunities for component manufacturers in the future. The robotics software sector in North America derives its strength from a diverse ecosystem ranging from companies developing foundation models such as Physical Intelligence and Skild AI, platform and tooling companies like Viam and Foxglove, to autonomy-focused providers such as Field AI. This is possibly due to the already well-established technology ecosystem, which is further reinforced by the presence of technology giants and a well-developed venture capital infrastructure. [35-37]

Across all three focus groups, NVIDIA appears to be a central stakeholder. The company not only develops relevant computing hardware for AI-powered robots, such as the Jetson Thor series, but also offers cutting-edge simulation, training, and development platforms such as Omniverse including Isaac Sim and Lab, and foundation models such as GR00T and Cosmos. Entering partnerships globally with established companies and startups alike, NVIDIA is actively pushing to bring AI and the relevant hardware into the robotics ecosystem. Examples include collaborations with KUKA, ABB, Fanuc, and Boston Dynamics, possibly enabling a pool of real-world production data for better training and validation. [38-40]

While the majority of North American AI-powered robot companies are headquartered in the US, Canada also contributes to the market and shows movement in each focus group. However, Canada tends to lag behind the US.

Asia's landscape is hardware- and manufacturer-driven, with China at its center

Asia, and China in particular, has the highest concentration of AI-powered robot manufacturers, which is also illustrated in the regional distribution of Figure 5. Within the region, a high level of vertical integration is assumed, as many software developers and component manufacturers have started to develop and commercialize AI-powered robots, and vice versa. For example, AI-powered robot manufacturers such as AgiBot, Galaxea, DexForce, and Galbot tend to put great effort in developing proprietary advanced robotic foundation models in-house. [41-44]

Shenzhen emerges as a major robotics hub, where robotics startups, electronics manufacturing, suppliers, and integrators are in the immediate vicinity. This dense ecosystem appears to enable rapid industrialization and commercial deployment of AI-powered robots. Unitree, for example, is one of the companies with the most deployments worldwide for AI-powered robots, having shipped around 35,000 humanoids and quadrupeds from 2022 to 2025. [45] The scaled production and great availability of Unitree humanoids may drive commercial deployment and decreasing unit costs. As a result, and as supported by Fraunhofer IPT's mapping, software developers specializing in humanoid intelligence currently tend to utilize Unitree's half-size humanoid robot G1 for development, testing, and skill demonstration. [46-48]

South Korea has established itself as a key player among all three groups. Holiday Robotics and Rainbow Robotics, for example, focus on novel robot forms for industrial and service applications, while start-ups like RLWRLD as well as established tech giants such as LG and Samsung develop VLA models for direct real-world actions and robot manipulation. [49-52] The adoption of AI-powered robots in Japan is primarily driven by well-established industrial automation companies. For example, Toyota and Kawasaki are investing in novel robot forms, while Fanuc and Yaskawa are incorporating physical AI through partnerships with NVIDIA. [53-55]

The market landscape reveals distinct strengths in different regions: AI-powered robot density and speed of industrialization in Asia; robotic intelligence and venture capital in North America; and a balanced automation ecosystem in Europe. It is also evident that large companies across all categories strive to shape and position themselves early in the emerging value chain, e.g., through strategic partnerships.

Assessing the industrial maturity

As previously detailed, AI-powered robots are becoming increasingly capable of performing activities that are currently performed manually. This extends automation into processes that were previously out of reach, either technically infeasible or economically unviable, particularly those involving high product variance or manipulation tasks that require a certain degree of dexterity.

Across different companies, the first wave of lighthouse projects is observable, in which manufacturing companies collaborate with AI-powered robotics manufacturers. For instance, BMW is already conducting its second test with Figure AI at its Spartanburg plant. Following an eleven-month pilot of Figure 02, which inserted sheet-metal parts for the welding process in the body shop and supported the production of more than 30,000 vehicles, Figure 03 is now being deployed for a more demanding sequencing task in logistics, picking unsorted components from containers and sorting them into sequencing trolleys for just-in-sequence delivery. [56] In another example, NEURA Robotics, BITZER, and SAP demonstrated a proof-of-concept in which the humanoid robot 4NE1 performed picking tasks autonomously, directly synchronized with the SAP warehouse management system. [57] These pilots demonstrate the potential of AI-powered robots under controlled or curated conditions, but not necessarily how reliably they perform in unstructured environments with close human-robot interaction. This raises the central question: where do AI-powered robots really stand today?

Robotic maturity is best measured by capability, not form factor

To answer this question, a structured assessment of capabilities is more useful than a focus on individual robot embodiments. BCG proposed a five-level framework for assessing the maturity of physical AI (see Figure 6). [58] This framework is not limited to manufacturing but covers all potential applications of AI-powered robots, including healthcare and home-related tasks. Each maturity level is defined by distinct characteristics and enables different exemplary use cases. By its nature, the framework shifts the focus away from a robot's form factor and toward the relevant underlying capabilities it possesses.

	Level 1	Level 2	Level 3	Level 4	Level 5
Maturity	Explicit programming	Visual perception	Dexterous manipulation	Workflow planning	Reasoning
Characteristics	▪ Tasks are explicitly programmed in advance in a domain-specific language ▪ Deterministic control behavior: Robot repeats static, predetermined sequence of motions/actions	▪ Tasks require adaptability due to varying object poses ▪ AI vision models enable six-dimensional pose estimation of arbitrary object geometries	▪ Handling tasks are too versatile and complex for explicit programming ▪ Task-specific behaviors are trained on human generated and synthetic data	▪ Tasks are converted into a sequence of actions following a purely probabilistic approach ▪ Robots can execute tasks in an unknown environment	▪ Able to reason on actions in advance through situational awareness and causal world models ▪ Learns new concepts by observing and autonomously executing tasks
Exemplary use-cases	▪ Arc-welding on the automotive assembly line ▪ Robotics used in fixed paths and processes in warehouses	▪ Bin picking ▪ Flexible goods-to-person systems for transporting inventory	▪ Contact-rich assembly ▪ Handling of soft bodies (e.g., imitating human-behavior for folding cloth)	▪ User asks robot to load dishwasher ▪ Robot delivers food in unfamiliar hospital environment	▪ General-purpose personal household assistant ▪ General-purpose professional hospital robotic assistant
	Manufacturing				Healthcare, Home

Figure 6: Five-level maturity framework for physical AI, based on BCG [58]

The five maturity levels describe a progression from rigid execution to general-purpose robots. A closer look at the exemplary use cases assigned by BCG reveals a pattern worth noting: level four (workflow planning) and level five (reasoning) tend to be populated by healthcare and home applications, whereas manufacturing applications such as contact-rich assembly reach level three (dexterous manipulation) at most. Consequently, the value of AI-powered robots in manufacturing may depend less on general-purpose autonomy than the current debate around humanoids suggests. As BCG illustrated only a few exemplary use cases per level, manufacturing was examined more closely by selecting the near-term use cases in which AI-powered robots are most likely to create value and positioning each of them against the five maturity levels. As depicted in Figure 7, all identified use cases across the five manufacturing areas fall within levels two and three. This reflects partly the near-term focus of the selected use cases and partly the limited maturity of levels four and five, which still require significant research and development.

	Illustrative near-term use-cases	Potential robot forms	Expected capability level
Material handling	▪ **Bin picking:** A robot grasps unsorted parts from a bin and places them in a predefined position and orientation to provide each part in the required pose for the next process step	Single-arm industrial robot, Single-arm AMM	Level 2/3
	▪ **Handover of totes:** A robot retrieves standardized totes from a stack and places them at a defined handover point to provide it in the required location for downstream handling	Humanoid, Dual-arm AMM	Level 2
	▪ **Line feeding:** A robot retrieves parts from a defined supply location and delivers them to line-side stations to maintain the required material availability at the point of use	Humanoid, Single- or dual-arm AMM	Level 2
	▪ **Packaging:** A robot picks finished parts and places them into packaging according to a defined orientation and packing pattern to achieve the required pack configuration	Humanoid, Single- or dual-arm industrial robot	Level 2
Machine tending	▪ **Machine load/unload:** A robot transfers parts between a buffer and a machine and loads/unloads the parts to maintain the machine's automated processing cycle	Humanoid, Single-arm AMM	Level 2
	▪ **Machine changeover:** A robot repositions clamping components inside the machine and operates the machine controls to configure the machine for the next product variant	Humanoid, Dual-arm AMM	Level 2/3
Maintenance	▪ **Facility inspection rounds:** A robot patrols predefined routes, captures visual data, and detects specified anomalies to identify facility conditions that deviate from the normal state	Quadruped	Level 2
	▪ **Gauge checks with simple adjustments:** A robot reads predefined gauges and actuates specified valves or switches to return the equipment to its defined operating range	Single-arm AMM, Quadruped (with manipulator)	Level 2
Quality control	▪ **Multi-station in-line inspection:** A robot inspects parts across multiple stations and sorts them based on the inspection result to separate non-conforming parts	Humanoid, Dual-arm AMM	Level 2
	▪ **Station-based surface inspection:** A robot grasps and reorients a part at an inspection station to expose all surfaces to the inspection system and separate non-conforming parts	Single- or dual-arm industrial robot	Level 2
Assembly	▪ **Rigid component assembly:** A robot aligns and joins rigid components using controlled contact and force feedback to achieve the specified fit and alignment	Humanoid, Dual-arm industrial robot	Level 3
	▪ **Wiring harness assembly:** A robot grasps and routes flexible cables, inserts them into clips and connectors, and verifies their placement to achieve the specified cable routing	Humanoid, Dual-arm industrial robot	Level 3
	▪ **Seal assembly:** A robot picks, aligns, and inserts a flexible seal into a predefined groove or onto a component to achieve the specified seal position and seating	Humanoid, Dual-arm industrial robot	Level 3

Figure 7: Classification of thirteen curated manufacturing use cases along BCG's maturity framework for physical AI

Near-term industrial value can emerge – even below the threshold of general-purpose autonomy

In detail, the thirteen use cases concentrate at the lower-to-middle end of the framework. Eight use cases are allocated to level two (visual perception) and three to level three (dexterous manipulation), while two use cases, bin picking and machine changeover, fall at the boundary between the two levels – depending on the complexity of the parts. Perception-driven applications such as handover of totes, line feeding, or autonomous inspection rounds are readily deployable at level two, whereas more demanding tasks such as rigid-component, wiring-harness, and seal assembly reach level three and are often still piloted in proof-of-concept settings. Taken together, these use cases suggest that near-term manufacturing applications currently sit at the transition from level two perception to level three dexterous manipulation.

The absence of level four and five use cases may reflect not only the lower technological maturity of these capabilities, but also the nature of manufacturing itself. Variability is often bounded by standard operating procedures and largely predefined processes, unlike the inherently more open-ended and human-driven environments of healthcare and home applications. Rather than requiring the robot to derive goals, constraints, and task structure from scratch, the more bounded nature of manufacturing often allows much of the required knowledge to be captured in process and task data, such as work instructions, process parameters, and cycle data, thereby limiting learning to well-defined sources of variability. Manufacturing may therefore serve as a proving ground for more general-purpose robots, from which capabilities could later transfer to healthcare and home applications. The relevant question for manufacturers is therefore not when general-purpose autonomy arrives, but how reliably robots can perform variable, dexterous manipulation tasks in production.

Capabilities alone do not ensure industrial readiness

Even where the required capabilities exist in principle, they must hold up under the conditions of a running factory. Against this backdrop, the analysis of deployed pilots in production environments reveals three key limitations:

1. Limited task complexity: Current applications focus on highly standardized and repetitive tasks in which robots need to respond to variations only to a limited extent. In addition, required cycle times are often significantly longer than during standard operation. Robustness is therefore achieved by maintaining a structured environment rather than through adaptive system capabilities.
2. Limited manipulation capabilities: The tasks performed so far require minimal force, a low degree of dexterity, and comparatively simple handling procedures, largely confined to grasping, transporting, and placing objects. More complex, contact-rich processes are being explored in pilots but are not yet reliably deployed in production.
3. Limited human-robot interaction: Many pilots are still implemented in restricted or clearly marked working areas, so direct collaboration between humans and robots rarely occurs. Consequently, these pilots do not yet fully represent the intended environments in which humans and robots are expected to work together.

Reaching full industrial readiness requires progress in five development areas

While AI-powered robots are advancing rapidly, several technological and operational gaps still limit their broad industrial deployment. In that regard, five overarching development areas can be identified based on the respective gaps in robotics research and industry practice – several of which build on the foundations introduced in the technological foundations chapter:

- Scale training data: To overcome the bottleneck in volume and quality of robot-usable data, including automated retargeting and quality assurance of human demonstrations.
- Improve generalization: To transfer learned skills across tasks, environments, and robot embodiments, with reliable spatial and contact reasoning under uncertainty.
- Advance dexterity: To handle variable, deformable, and contact-rich objects through better end-effectors, e.g., anthropomorphic hands, tactile and force sensing, and adaptive force control.
- Extend operational endurance: To sustain full industrial shifts through improved battery lifetime, charging, thermal management, and component durability, particularly for mobile robots.
- Establish safety and certification: To ensure predictable, controllable behavior for increasingly autonomous systems, where standards for dynamically stable robots such as legged humanoids are still developing.

Addressing these gaps lies primarily with technology providers and, for safety, with standardization bodies. Industrial users can instead focus on creating the conditions for future deployment.

Companies can prepare for deployment before AI-powered robots are fully production-ready

Even before deployment becomes viable, manufacturers can prepare along four lines. First, they can identify suitable use cases and monitor progress in robot learning, platforms, and suppliers continuously, so that previously infeasible applications are recognized as they become viable. Second, they can assess production sites early, so that charging infrastructure, maintenance areas, and wireless connectivity are planned in advance. Third, they can prepare the required data, evaluating which process and task data future applications will need, what already exists such as work instructions or video data, and what must still be captured, while involving operators to make tacit knowledge about handling, exceptions, and failure cases accessible for robot training. Fourth, they can define the interfaces to production IT, including MES. Beyond individual applications, AI-powered robotics should be anchored centrally and approached as a platform, in line with its promise of transferring capabilities across tasks, lines, and sites with limited re-engineering effort.

Returning to the initial question, the analysis suggests that AI-powered robots are currently at the transition from perceiving their environment (level two) to reliably manipulating it (level three), still well below the general-purpose autonomy that dominates public debate. The decisive factor is therefore no longer capability alone, but robustness under real production conditions, which is built on data from actual processes and actual robots. While broader deployment still requires technological progress, manufacturers do not need to wait for full maturity and can already prepare their organizations, factories, processes, and data environments for future applications.

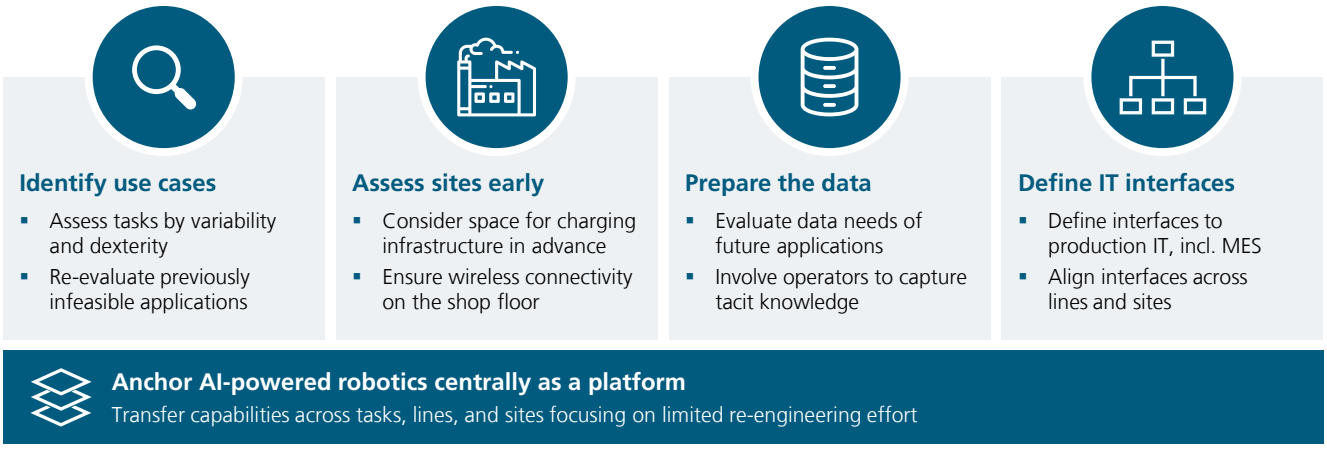


Figure 8: Four fields of action to prepare for AI-powered robots

Examining the production readiness

Across AI-powered robotics, industrial maturity differs significantly by robot form. Humanoids are entering a pilot-driven commercialization phase, but scalable production and repeatable industrial deployment in skill-demanding use cases remain largely unproven. Chinese manufacturers are scaling faster through strong supply chains, funding and policy support, while Western players generally follow a slower, demand-driven approach tied more closely to validated customer pilots.

Established cobot manufacturers are transitioning toward physical AI through AI vision, dexterous end-effectors and dual-arm platforms, creating a potentially low-risk and more practical near-term alternative to humanoids for many industrial manipulation tasks. Quadrupeds remain concentrated in inspection applications, where the form factor and specialized integration are likely to limit broader fleet adoption.

Near-term industrial maturity appears strongest where AI-powered capabilities build on established robot platforms or clearly validated use cases. Due to limited transparency regarding industry-specific deployment of AI-powered robots, production volumes alone should not be interpreted as evidence of industrial readiness.

Humanoid production accelerates globally, while quantity may not correlate to industrial maturity

Humanoids currently dominate investment activity, press coverage and industrial pilots in AI-powered robotics. Their form factor, especially the anthropomorphic hand, is closely linked to the use of human-generated training data and to the need to automate dynamic, skill-demanding tasks conventionally completed by human labor. [59] As the market matures, competition is increasingly shifting from demonstrations of AI capability and dexterity toward evidence of successful deployment, confirmed customer demand and the ability to scale production.

As for the latter, China currently leads the market in shipment volume and production ramp-up. This achievement is likely enabled by a localized robotics supply chain from material extraction to final hardware production, substantial private and government funding, and strategic policy support. [60, 61] More than 150 humanoid manufacturers are reported to operate in the country, and Chinese companies accounted for roughly 90% of global humanoid shipments in 2025. [62] In this dense and competitive market, manufacturers that can follow successful pilots with expanded production are positioned to emerge as global front-runners, such as AgiBot, Unitree, UBTECH and Leju. [63-66] This expansion also supports declining unit costs and makes Chinese humanoids increasingly accessible for research, education and demonstrations, thereby contributing to rapidly growing shipment as well as deployment numbers.

However, growing production and shipment volumes may not reflect industrial maturity and readiness. In 2025, only around 9% of Unitree humanoids reportedly entered industrial applications. [67] A 2026 Morgan Stanley survey indicated relatively low satisfaction among Chinese companies integrating industrial humanoids, with only 23% of respondents being satisfied with current products. [67, 68] In line with Fraunhofer IPT's findings, a China Tech Observatory report further found that current deployments remain concentrated in repetitive and narrowly defined tasks with low precision and dexterity, while market validation is still driven largely by domestic demonstrations rather than sustained industrial use. [69] These indicators suggest that China's humanoid production capacity is advancing faster than proven deployment in skill-intensive industrial applications. While there appears to be a certain availability of Chinese-manufactured humanoids, it does not necessarily mean that they are already readily deployable in production environments.

In the US and European markets, leading companies are proving demand through industrial pilots and deployment agreements, including projects by Figure AI at BMW, Apptronik at Mercedes-Benz, Boston Dynamics at Hyundai, and Hexagon Robotics and Humanoid AI at Schaeffler. [56, 70-73] Such pilots are increasingly followed by deployment commitments and additional funding from customers, which leads to new factory investments. This indicates a clearer link between planned production outlooks and their industrial relevance, with manufacturers scaling up production in response to validated customer demand. At the same time, however, scalable production in the West remains largely unproven. Companies including 1X, Boston Dynamics, Agility Robotics and Tesla have announced ambitious future production capacity investments for their bipedal humanoids, but confirmed output still lags behind these targets. [74-77] Figure AI currently stands out

through a more visible early ramp-up at its BotQ manufacturing factory, where the company achieved a 24-fold increase in production in less than two months of iteration time, raising output from one humanoid per day to one humanoid per hour. [78]

Due to their potential added value in the long term, humanoids tend to be a preferred robot form within the AI-powered robotics market. In that regard, leading AI-powered robot manufacturers are pursuing general-purpose autonomy applicable to various sectors, particularly addressing service applications in healthcare and household. However, within production environments, the near-term value generation of humanoids remains less proven than that of task-specific AI-powered robotics solutions. [79]

Single-arm and dual-arm manipulators may be practical near-term solutions for the industry

Manufacturers of cobots, AMMs and industrial robots are entering the field of AI-powered robotics through two paths. First, established platforms are being upgraded with AI-based vision and software to reduce the dependence on preprogrammed motions. Second, manufacturers are evolving hardware toward systems with higher degrees of freedom (DoF), including mobile dual-arm manipulators with dexterous, human-like end-effectors, i.e., anthropomorphic hands. Existing cobot platforms appear to provide a practical foundation for this transition, since stationary single-arm cobots are already successfully integrated into industrial production environments. Building on this form factor, two robot arms can be attached to a common body, supplemented by vertical lifting mechanisms, wheels or tracks for mobility and customizable end-effectors.

In 2025, AI-powered robot arm startups such as RobCo and Standard Bots reported deployments in the hundreds. [80, 81] Established cobot manufacturers, who are expanding their product fleets with AI-powered robot solutions, deployed fleets reaching tens of thousands of units. However, these figures likely refer to a mix of robot forms containing both conventional cobots and their AI-powered successors, without distinguishing between them. DOBOT Robotics reported more than 100,000 cumulative cobot shipments while expanding into humanoids and quadrupeds, and ROKAE surpassed 40,000 global deployments while broadening its portfolio toward mobile dual-arm manipulators. [82, 83] Similarly, UR confirmed deployments of 110,000 cobots in 2025. However, since UR cobots are primarily equipped with partner hardware and software for AI-enabled intelligence, conventional deployment figures reveal little about the adoption of physical AI within established companies. [84]

A similar transition is visible across renowned industrial automation companies. For example, ABB is at the forefront of adopting dual-arm manipulators and AI-powered cobot arms. Alongside KUKA, Fanuc and Yaskawa, ABB also aims to increasingly incorporate physical AI in its established robot fleet. [85-88] In parallel, these companies tend to expand their product portfolios also toward AMMs to further support human-machine collaboration on the shop floor. [89, 90] Their focus appears to remain closely linked to existing applications of industrial robot arms, however, with greater task flexibility.

In comparison to humanoid manufacturers, cobot and industrial robot arm manufacturers may follow a lower-risk, more scalable path toward AI-powered robots. Manufacturers tend to upgrade proven automation solutions with AI-powered vision systems, foundation models, and dexterous grippers, while gradually adopting novel robot forms such as dual-arm manipulators. However, since manufacturers are starting to transition their existing fleets toward AI-powered robots, their annual quantitative market data does not reflect the shift as clearly as it does for humanoid manufacturers.

In the near term, AI-powered single- or dual-arm manipulators may truly become a practical alternative to humanoids. In particular, autonomous mobile dual-arm manipulators can combine advanced grippers and autonomous movements while still benefiting from human-centric demonstration data for training purposes. This could allow them to be direct alternatives to humanoids in selected industrial use cases where manipulation capability matters more than the human form factor.

Quadrupeds gain traction in industrial inspection, while broader industry deployment remains selective

The quadruped robot form combines high mobility with flexibility to integrate additional equipment, including LiDAR, 3D cameras, and manipulator arms. Due to its robot form factor enabling mobile work in hard-to-reach areas, manufacturers often market these robots for inspection use cases including quality inspection, data collection and predictive maintenance. However, other task-specific applications are also possible, such as robot-assisted welding in mobile environments, which is enabled by an attached arm. [91] Quadrupeds may complement other robot forms instead of replacing them, driven by their unique robot form factor and different application scenarios.

By 2025, quadruped production had increased considerably. However, the confirmed industrial fleet deployments remain low in comparison to other robot forms. In more detail, Unitree produced more than 20,000 quadrupeds in 2025, with

approximately 26% of sales revenue attributed to industrial use cases. [45] Deep Robotics produced around 4,000 quadrupeds as well as wheeled-legged robots and reported only around 300 units (7.5%) deployed for industrial inspection. [92, 93] Boston Dynamics has deployed more than 1,500 Spot robots across various use cases with industrial inspection and data collection representing major applications. [94] On the one hand, these figures indicate a certain relevance of quadrupeds in commercial adoption. On the other hand, they also highlight a distinct gap between production volumes and confirmed deployments in relevant industrial environments.

Currently, quadrupeds appear to be most suitable for inspection and data collection scenarios. Since quadrupeds are designed to cover large areas over extended periods, integrators appear to be testing this robot form through selective deployments with long validation cycles in order to determine its process stability and return on investment. It is anticipated that the adoption of quadrupeds within manufacturing sites will be more selective and dependent on specific use cases than that of other robot forms.

	Humanoids	Single-arm and dual-arm manipulators	Quadrupeds
Observed situation	Leading manufacturers are pushing for general-purpose autonomy across multiple sectors, with a long-term focus on healthcare and households.	Mobile single- and dual-arm manipulators combine the ability to perform autonomous movements with dexterous manipulation using advanced grippers.	Quadrupeds are used primarily for autonomous coverage of large areas and safety-critical environments over extended periods of time.
Status in production	Within production environments, the near-term value generation remains less proven than that of task-specific AI-powered robotics solutions.	These robot forms offer a promising starting point for AI-powered robots due to their potential to perform manipulation tasks using real-world data.	Compared to other robot forms, quadrupeds are used rather selectively across manufacturing environments.
Potential relevance	Humanoids tend to be a promising robot form due to their long-term potential to perform tasks in any human-centric environment.	In manufacturing environments, AI-powered single- and/or dual-arm manipulators may become a practical near-term alternative to humanoids.	Quadrupeds appear to be best suited to use cases involving inspection, data collection and analysis, partially combined with basic manipulation.

Figure 9: Comparison of different robot forms and assessment of their potential relevance in manufacturing environments

Conclusion

Actuators have a significant impact on hardware costs and performance

The advanced manipulation ability of emerging AI-powered robot forms is primarily enabled by a combination of rotary and linear actuators. Both types of actuator contain gearboxes, control electronics, motors, mechanical components, reducers, and sensors and are repeatedly integrated into components ranging from robot joints to dexterous grippers. The latter may often integrate more than 50 actuators alone. [34] Industry forecasts from 2026 onwards suggest that actuators will account for around 40–60% of the bill of materials for humanoids and cobots in the near term. [3, 95, 96] While vision systems, computing and battery components are critical for AI-powered robots, their development is supported by established supply chains in adjacent industries such as electric vehicles, semiconductors, and consumer electronics. [34]

Actuators and advanced perception sensors enable core physical capabilities of AI-powered robots but are still associated with significant costs. However, their underlying technologies build on established engineering knowledge, so that further technological advances may drive down unit costs. Additionally, components such as motors, gears, and encoders already have a strong basis for scalable production to achieve economies of scale. As depicted in the market landscape, it may be beneficial to form strategic partnerships between AI-powered robot manufacturers and component manufacturers to co-develop critical hardware.

Relevance of general-purpose autonomy currently remains questionable for industrial applications

The pursuit of general-purpose autonomy seeks to enable autonomous workflow planning and reasoning in completely unknown environments without structured procedures. This level of intelligence currently remains a major research challenge, as depicted in Figure 6. However, the added value of this level of intelligence may also depend on the respective application.

In household and service applications, where tasks and environments mostly lack structure, the need for a general-purpose robot may appear justified. However, industrial processes are often clearly defined and supported by standard operating procedures, i.e., tasks are described by dedicated steps. Therefore, the industrial environment in which AI-powered robots are to be deployed may be semi-structured by nature. This raises the question of whether general-purpose autonomy is absolutely necessary for hard-to-automate processes in industrial environments, which can already benefit from task-specific AI-powered robotics solutions.

Increasing industrial deployment expected within three to five years

From Fraunhofer IPT's perspective, the current AI-powered robots – especially humanoids – are not yet ready for broad industrial adoption. As demonstrated by current pilot use cases, deployments remain limited to selected applications and mostly fail to generate a clear return on investment. However, the continuous development of critical hardware and robot intelligence as well as the intended expansion of production capacity could substantially advance industrial readiness within the next three to five years. This, in turn, may accelerate industrial adoption from 2030 onwards, particularly in areas that generate proven measurable added value on the shop floor.

In the short term, AI-powered cobots and AMMs equipped with a single- or dual-arm system can be a suitable solution for addressing hard-to-automate processes in industrial settings. These robot forms can leverage established hardware platforms and gain broader capabilities through advanced perception hardware, foundation models, and innovative, dexterous grippers. Moreover, advances in natural language processing may also fundamentally change how workers interact with AI-powered robots on the shop floor. Well-established robot forms can therefore serve as testbeds for AI-powered robotics in production, while preparing production companies for the seamless integration of novel robot forms, such as humanoids and quadrupeds.

Why companies should start exploring opportunities

The AI-powered robotics market is becoming increasingly relevant for manufacturing companies. Companies have the potential to participate not only as users, but also as technology partners within the emerging value chain. This creates three reasons why companies should explore AI-powered robotics today:

1. Investigate the automation potential of hard-to-automate processes: AI-powered robots enable the automation of hard-to-automate processes in unstructured, highly variable, and human-centered environments without the need to fundamentally redesign production processes.
2. Build integration capabilities early to ensure seamless deployment: Users of AI-powered robots can gain an advantage by building the data foundation, skills, employee acceptance, and integration roadmap to ensure seamless deployment early on.
3. Position early in the emerging value chain: Strategic partnerships are forming along the value chain, which may indicate a potential shift from vertical integration to supplier ecosystems. Industrialization competencies and vendor-agnostic interoperability across different robot forms appear to be beneficial boundary conditions.

> **The biggest bottleneck in Physical AI is no longer intelligence, it's experience."**
>
> **David Reger, CEO Neura Robotics**

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Methodology

Iterative search procedure

This study focuses on the value chain of AI-powered robots for skill-demanding manipulation tasks in dynamic industrial environments. To identify relevant companies within this field, a structured search was conducted. In that regard, the search for companies followed an iterative four-step approach over a period of four months from April to July 2026.

The specific steps included:

1. Identification and thematic clustering of keywords based on reports, academic literature, and industry publications related to AI-powered robotics.
2. Conducting broad desk research using defined keyword clusters such as Physical AI, embodied AI, advanced foundation models and dexterity.
3. Company-level screening and clustering of identified companies within the defined search scope.
4. Expansion of the search through industry media outlets, company databases, investment platforms, and professional social media platforms.

Company classification logic

Three groups of companies were identified based on the structured search. These included AI-powered robot manufacturers, software developers, and component manufacturers. To address the resulting overlap between the three groups and distinguish between them during company classification, the main added value of a robotics company has been taken into consideration: If a company commercially offers AI-powered robots as an end product, this activity is prioritized over the other two groups, and the company is classified as an AI-powered robot manufacturer. This is particularly evident in the Asian market, where component manufacturers have started developing and commercializing their own AI-powered robots. Accordingly, these companies were classified as AI-powered robot manufacturers.

Similarly, a software developer that specializes in vision AI for industrial robot arms and offers supplementary perception hardware is considered a software developer. Examples include Inbolt, Cambrian, and Pickit. Only selected industrial tech giants that operate within both the software developer and component manufacturer groups are classified accordingly, such as NVIDIA and Samsung.

Requirements for selected companies

The resulting list consists of more than 240 companies. It is not meant to provide an exhaustive representation of all stakeholders active in this field and is intended to be continuously updated.

Companies were considered for inclusion if they met the following criteria:

- Focus on industrial manufacturing: Robot manufacturers that target industrial environments, including those that develop humanoids, quadrupeds, robot arms/cobots, and AMMs.
- Verifiable efforts in AI-powered robotics: Companies that aim to develop or commercialize AI-powered robots through verifiable projects, partnerships, product developments, or public announcements.

Based on the defined search scope, companies were excluded if any of the following criteria applied:

- Robot manufacturers targeting applications in healthcare, households, services, concierge services, smart agriculture or heavy industry.
- Manufacturers without a verifiable focus on AI-powered robotics, including conventional automation providers and component suppliers.
- Companies without sufficient evidence of market maturity, lacking a commercial product or proof of concept despite public ambitions.
- Software companies that are outside the defined scope, including those involved in inter-robot communication, fleet management, trajectory planning, or warehouse management.
- Drone manufacturers that primarily address intelligent aerial transportation and delivery.

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