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INSIDER'S PERSPECTIVE

NEXT-GEN ROBOTICS

How cognitive robotics is reshaping productivity and cost structure of industrial companies

by Dr. Michael Müller

Key takeaways

- **Industrial automation is entering a new phase.** Physical Artificial Intelligence (AI) and next-generation cognitive robotics are expanding automation beyond fenced cells and narrow repetitive motion into more variable, human-centric workflows.

- **The increasing momentum of cognitive robotics is mainly driven by two factors:** first, fast advancing technology is fueled by AI now and second, economics become compelling with a payback that is increasingly attractive compared to labor costs.

- **Cost pressure is taking center stage in traditional industries.** Steadily increasing costs, low economic growth, geopolitical crises, and structural change – esp. in traditional sectors such as automotive and mechanical engineering – bring cost-saving opportunities through innovation and automation back into focus.

- **As-a-Service (aaS) models lower the adoption barrier.** By shifting investment from CAPEX to OPEX, and bundling support into a service model, industrial companies can scale automation fast and at low risk.

- **The strongest value cases go beyond labor substitution.** While labor substitution offers a direct way to reduce costs, additional potential arises from a combination of labor redeployment, reduced variability, lower downtime, higher process stability, and better safety and ergonomics.

Introduction

Robotics is moving rapidly from emerging technology theme to strategic industrial priority. Investor interest has accelerated sharply: humanoid robotics startups attracted just over $6 billion in funding in 2025, and Morgan Stanley estimates that more than 1 billion humanoids could be in use by 2050, with roughly 90% deployed in industrial and commercial settings. Beyond humanoids, next-generation (next-gen) robotics is increasingly shifting from prototypes to production: Artificial Intelligence (AI)-enabled, autonomous, cognitive robots working alongside humans in industrial environments. Two factors explain the increasing momentum behind cognitive robotics today: (1) technology fueled by AI is advancing fast, and (2) the economics are becoming compelling, with payback increasingly attractive relative to labor costs.

For high-wage economies such as Germany, this is not only a technology opportunity, but a competitiveness imperative.

> *"We predict that the impact of superhuman AI over the next decade will be enormous, exceeding that of the Industrial Revolution."*
>
> (***Daniel Kokotajlo*** *et al., AI Futures Project)*

Industrial companies have spent decades improving cost competitiveness through labor productivity, asset utilization, and automation. That logic still matters and is now being further exacerbated by difficult economic conditions and steadily increasing labor costs in Germany or Austria, low to moderate growth in the EU and international conflicts on a global level. In addition, many operations now face a different cost curve: repetitive manual work remains widespread, yet it increasingly sits in semi-structured environments (like machine tending in a high-mix production area) where labor shortages, rising service expectations, and variability make execution more difficult and more expensive. In that environment, cost is no longer only "rate x volume", but increasingly a function of availability, reliability, and flexibility.

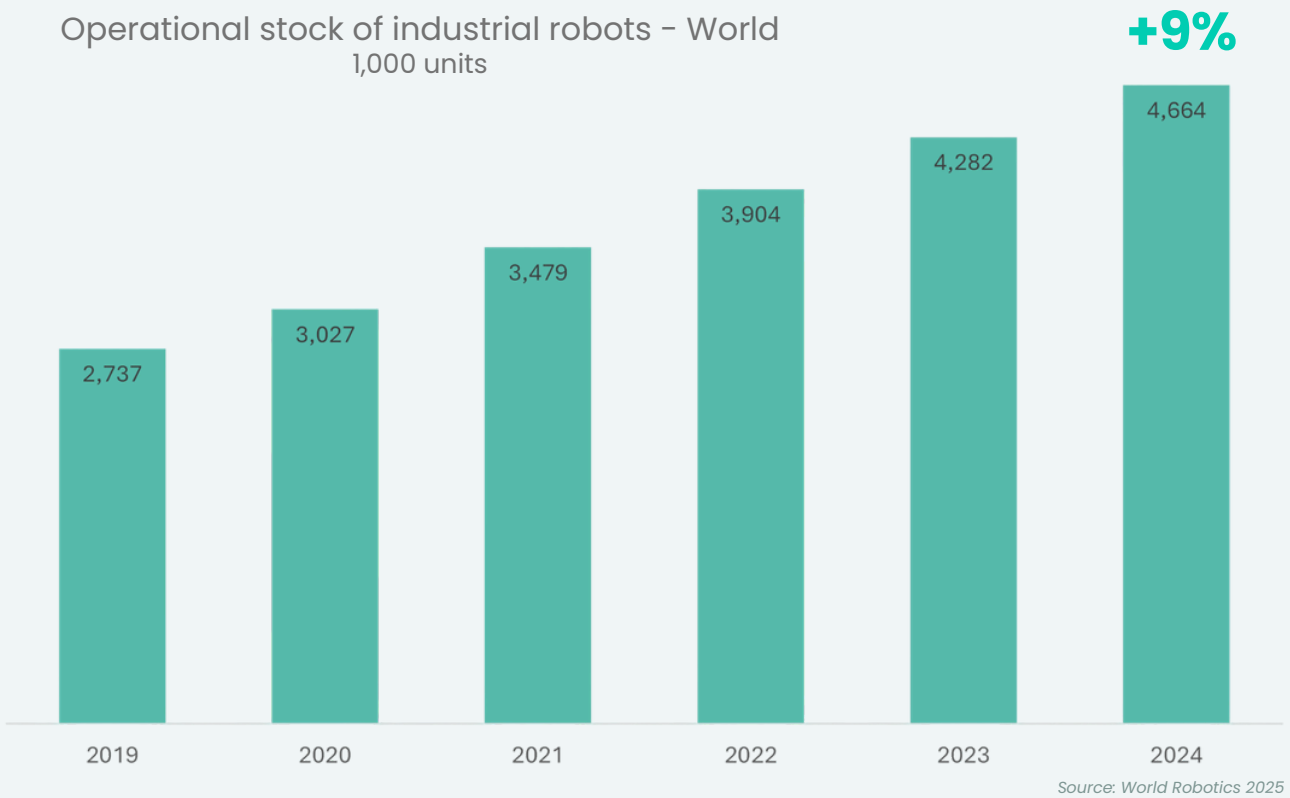
In this setup, next-gen robotics becomes strategically relevant. Conventional automation performs best in highly controlled settings. In contrast, the cognitive abilities of next-gen robotics extend automation into more dynamic operating environments. It combines perception, planning, and adaptive behavior with a digital-first software stack and a digital environment to develop, test, and optimize robot skills. The result is not simply new and more robots, but a different automation model – one that aims to reduce operational friction in workflows that have historically remained manual.

Trends indicate a structural shift for future efficiency initiatives

Labor availability is constrained, especially in repetitive, physically demanding, or low-attractiveness tasks such as internal logistics or simple support activities. Eurofound (2024) reports that 80% of employers in the EU struggle to recruit workers with the right skills, with many hiring under-skilled candidates to fill gaps. At the same time, automation continues to scale globally. The International Federation of Robotics (IFR) reports ~4.7 million industrial robots operating in factories worldwide, with annual installations exceeding 500,000 units for the fourth consecutive year, reaching the second highest count of new installations in history in 2024. Professional service robot sales are also rising rapidly to about 200,000 units in 2024, marking a 9% increase (Exhibit 1).

These trends reveal the potential to move automation beyond classic production cells and into operational service environments such as industry, warehouses, hospitals, and even retail. For industrial companies, that signals a structural shift: the next wave of cost takeout will not come only from faster lines, but from more stable execution across the “long tail” of manual, repetitive work.

EXHIBIT 1: Development of Industrial Robots 2019 - 2024



Source: World Robotics 2025

How next-gen robotics expands automation into a new field

This “long tail” sits outside of the controlled contexts where traditional industrial robots have their relevance. It can be described by fairly standardized, but cost-heavy activities like internal transport, staging, kitting, packing, simple assembly in high-mix areas, rework support, cleaning, sanitation, and line-side replenishment to only name a few. These tasks are repetitive enough to matter economically, but too variable for conventional automation concepts.

Cognitive robotics expands automation into these workflows by combining perception through vision and sensors, decision-making through Artificial Intelligence planning and policies, and adaptive behavior through learning and exception handling. Latest cognitive robotics models also place the digital twin at the center of development, training, and optimization. This allows reusable robot skills to be developed, validated, deployed across fleets, and improved over time.

Where conventional robotics reaches its limit and next-gen robotics take over

While conventional automation remains justified in their specific environments, structural limits are defined by higher variability, more frequent exceptions, and tighter operational interdependencies:

- Conventional industrial robotics remains highly effective where volume is stable, and the environment can be engineered around the machine. It delivers throughput, repeatability, and low unit labor cost, backed by mature safety and engineering standards. However, it often becomes difficult to justify conventional robotics in high-mix environments, in workflows with changing layouts beyond fenced cells or stock keeping units.

- Collaborative robots working alongside humans (in contrast to fully fenced-off cells of conventional robots) can lower the integration barrier, are more appropriate to a human-orientated environment, and fit ergonomic support use cases. However, many remain limited without advanced perception technology. Exception handling can become the hidden cost, with stoppages and operator interventions eroding the business case.

- Automated Guided Vehicles (AGVs), and other point solutions already create value in logistics or cleaning. Yet many deployments remain siloed, i.e. isolated from the broader operating model. When robots are not connected to planning, maintenance, and quality systems, they often improve one task locally but fail to unlock broader gains in prioritization, uptime, process stability, and scalable performance. Thus, the benefits often stagnate.

Accordingly, classic automation creates value mainly where tasks are stable, exceptions are limited, and the solution can be engineered or operated in relative isolation. Next-gen robotics reverses that dependency and expands the value pool by making automation more adaptive and more deeply integrated into the operating model.

As an emerging business case, humanoid robots (designed with a human-like body form) allow automation without any redesign of the plant. They are particularly suitable for brownfield sites built around human reach, aisles, doors, and tools. Their promise is real today, but economics still have to be proven in the future.

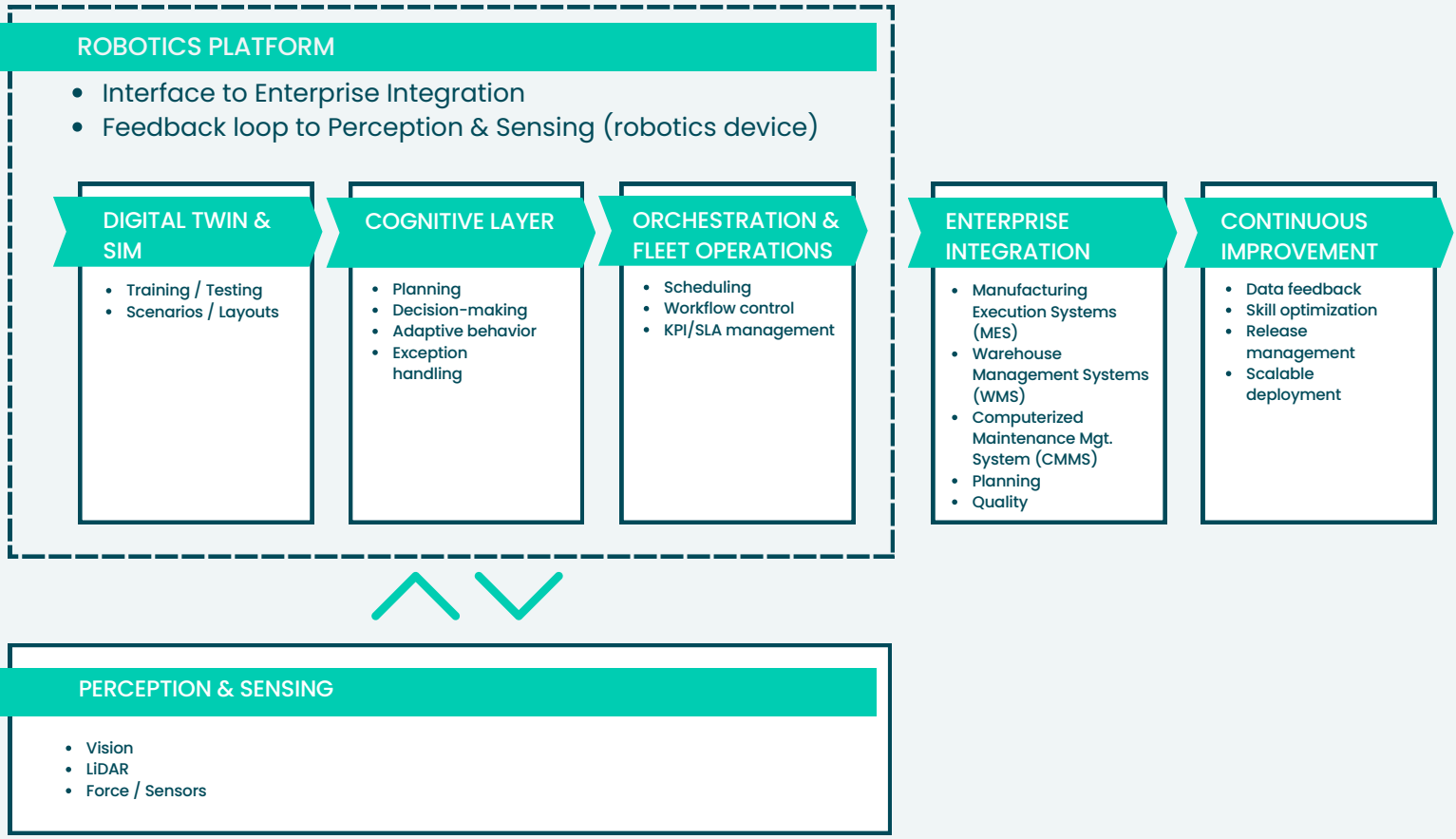
> *"Humanoids are not expected to replace the types of robots currently on the market in the future. Instead, they will complement and expand upon existing technology."*
>
> *(**Takayuki Ito**, President, International Federation of Robotics)*

Skills-based automation changes the equation

To facilitate adoption, next-gen robotics focuses on scalability models rather than on one-off projects. The core idea is to build reusable robot skills - for example pick and place, tray handling, wiping patterns, or inspection walks - that can be trained ideally in a digital twin, deployed across fleets, monitored through Key Performance Indicators (KPIs), and continuously improved through feedback loops.

The enabling architecture typically spans perception and sensing, a cognitive layer for planning and adaptation, orchestration linked to systems such as Manufacturing Execution Systems (MES), Warehouse Management Systems (WMS), and Computerized Maintenance Management Systems (CMMS), and a digital twin for testing, scenario simulation, and optimization (Exhibit 2). This is important not because it is technically elegant, but because it creates a repeatable operating model for value creation.

EXHIBIT 2: Reference Architecture

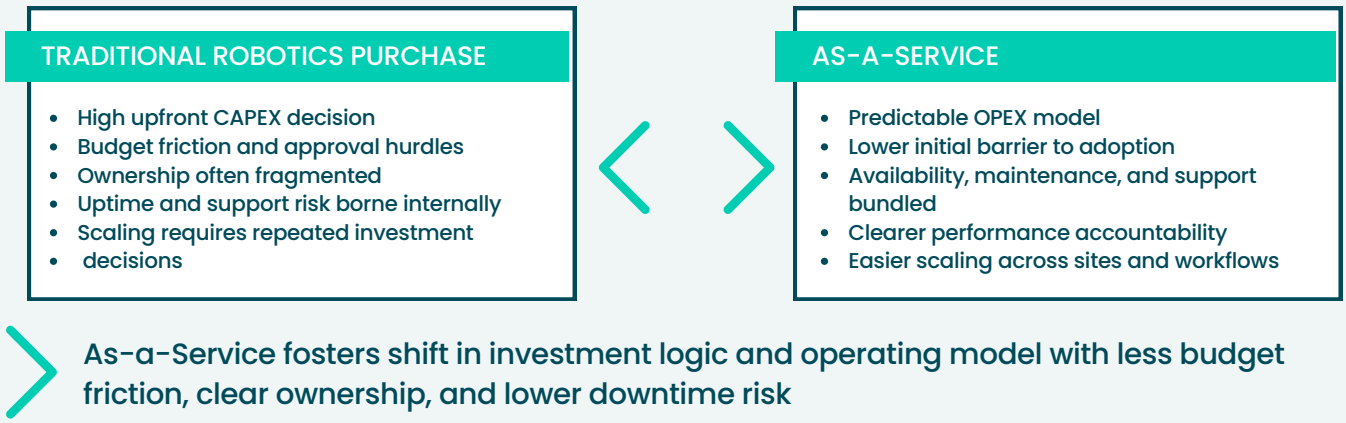


Delivery models tailored to meet customers' needs

Delivery models range from traditional upfront purchasing to subscription or pay-per-week models during peak seasons. Especially as-a-Service models convert robotics from a project purchase into an operating capability. Instead of requiring a large, six digits upfront Capital Expenditure (CAPEX) decision, it shifts adoption toward Operating Expenditure (OPEX), with more predictable rates and lower initial barriers. It also puts availability, maintenance, and support into a service construct, which can reduce operational risk and make scaling easier across sites and workflows.

That matters because the barrier to industrial robotics is often not technical feasibility alone. It is the combination of budget friction, unclear ownership, and uncertainty over uptime and support. A service model can reduce all three - provided it is tied to measurable performance and disciplined governance.

EXHIBIT 3: As-a-Service features



From use case to value case: next-gen robotics in industrial practice

Next-gen robotics is already in use and delivers tangible results. The following case studies highlight just three different examples of their applications and their impact on productivity and financial performance.

Case 1: Intralogistics automation with Autonomous Mobile Robots (AMRs)
A production company deployed AMRs to automate internal transport between warehouses and production facilities (incl. full WMS integration). The internal effort of this intralogistics service has been ~18 FTE over 3 shifts. After deployment of AMRs an automation level of ~80% was achieved and 10 FTEs could be redeployed to higher-value activities. In addition, the AMRs achieved ~20% faster dock handling and reduced peak labor dependency.

Case 2: Cleaning automation in facility solutions
A leading distributor of facility solutions switched from manual cleaning to scrubber-dryer AMRs and reallocated 14,000 human work hours at 23 locations from cleaning to customer-focused tasks. Technology reduced maintenance and labor costs by approximately 50%, with projected savings of $3.4 million over ten years.

Case 3: Machine tending in high-mix production
A machinery OEM enabled robot cells for CNC machine tending with AI, vision and MES integration. Based on the initial situation, tending the CNC machines required a workforce of about 12 FTE working in two shifts. After enablement, 8 FTEs could be redeployed, while machine utilization increased by 30% and idle time was reduced by more standardized and streamlined processes.

ROI: where are the savings coming from?

The strongest value cases for next-generation robotics go beyond direct labor substitution. Direct labor reduction will be an important option, but in many industrial settings labor redeployment is becoming a requested source of value: moving people from repetitive low-value work to higher-value or more critical activities. Additional savings come from reduced variability, fewer shortages, fewer missed tasks, fewer micro-stoppages, better quality stability, lower rework, and improved safety and ergonomics. CAPEX avoidance through as-a-Service adds another lever by reducing the financial hurdle and accelerating adoption.

Additional benefits come to hand: compared to new employees, next-gen robots do not incur any recruiting effort or costs and have almost no training period. The reallocation of next-gen robots due to e.g. a reorganization is simple – in an as-a-Service model the capacity can even be increased or decreased as needed. This is also an advantage during typical peak periods, such as in logistics warehouses, when volume peaks around seasonal high-sales days in retail. After the agreed service contract term ends, a renewal includes the latest generation of hardware – allowing companies to keep pace with state-of-the-art technology and increasingly shorter product lifecycles.

So what?

Next-generation robotics can reshape the cost structure of industrial companies by targeting the space between classic automation and manual work: repetitive, operationally important activities in semi-structured environments. This is where labor shortages, variability, and service pressure increasingly create hidden cost, and where conventional automation is often too rigid or too expensive to deploy.

The strongest business cases combine high utilization, measurable baselines, disciplined exception handling, and an operating model that treats robotics as a managed capability. By selecting the right use cases and processes, next-gen robotics typically pays back in less than 2 years while improving productivity, resilience, and cost competitiveness at the same time.

ROI in <2 years

Ultimately, industrial leaders should not ask whether robotics will continue to expand. The market already suggests that it will. The more relevant question is how systematically they intend to convert that trend into lower cost, greater resilience, and more scalable operations.

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