THE FUTURE OF INDUSTRIAL ROBOTICS

Humanoid Robot Hype vs. Impact

Thomas Katucki
Senior Research Associate

AGENDA

01 **Innovation drivers**

02 Cutting-edge innovations

03 Opportunities and outlook

MACRO-ECONOMIC PRESSURES

EFFICIENCY

COMPLEXITY

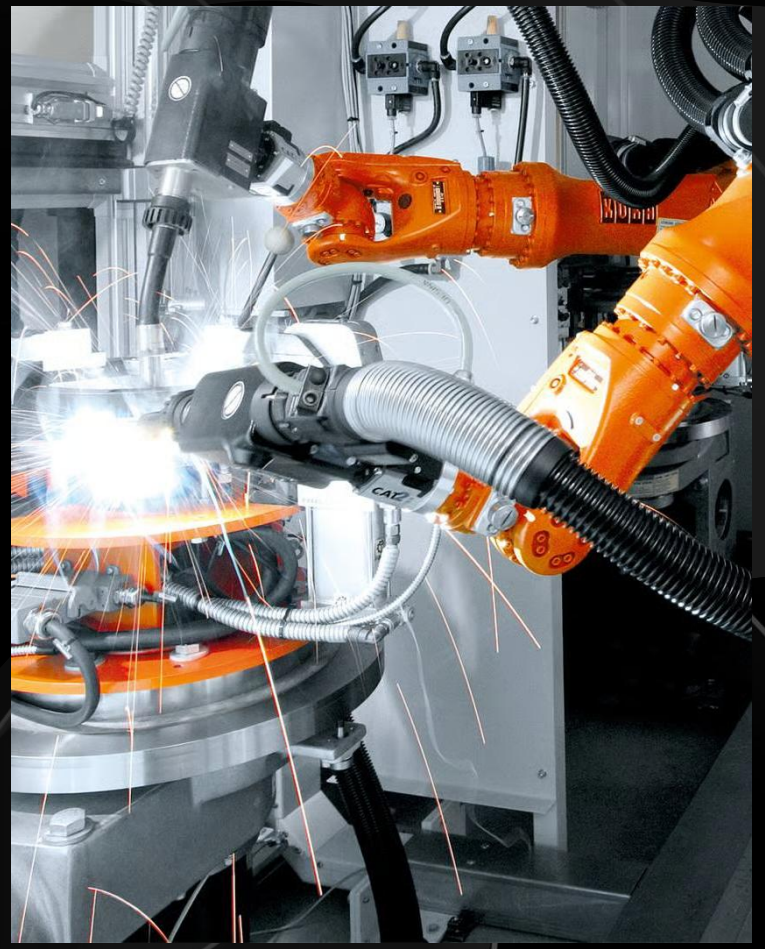

Image sources: ABB, Mecademic, and Kuka

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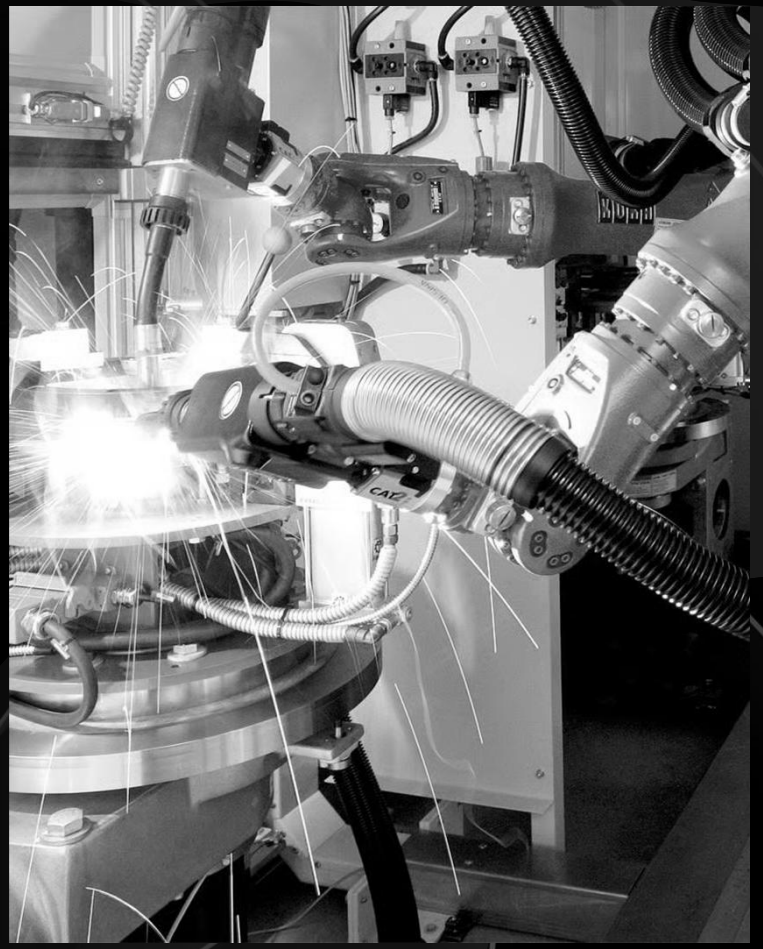
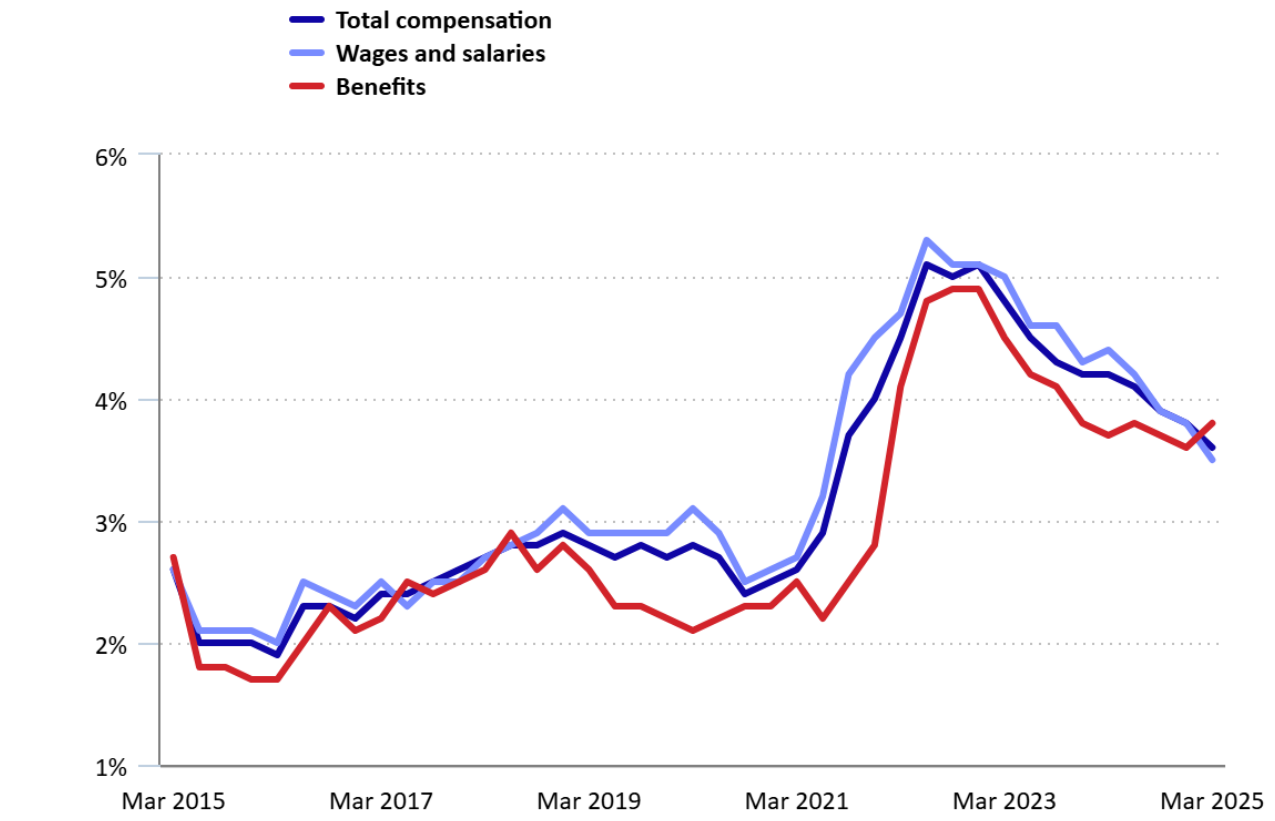


Image sources: ABB, Mecademic, and Kuka

HIGH TARIFFS AND HIGH WAGES

- Increasing labor costs, inflation, unfilled jobs, and economic uncertainty impact global operations.
- Proposed U.S. tariffs have led companies to seek labor alternatives or contemplate onshoring.

12-Month Changes in Wages, Salaries, and Benefits for U.S. Civilian Workers



Data are not seasonally adjusted.

Source: U.S. Bureau of Labor Statistics

MACRO-ECONOMIC PRESSURES

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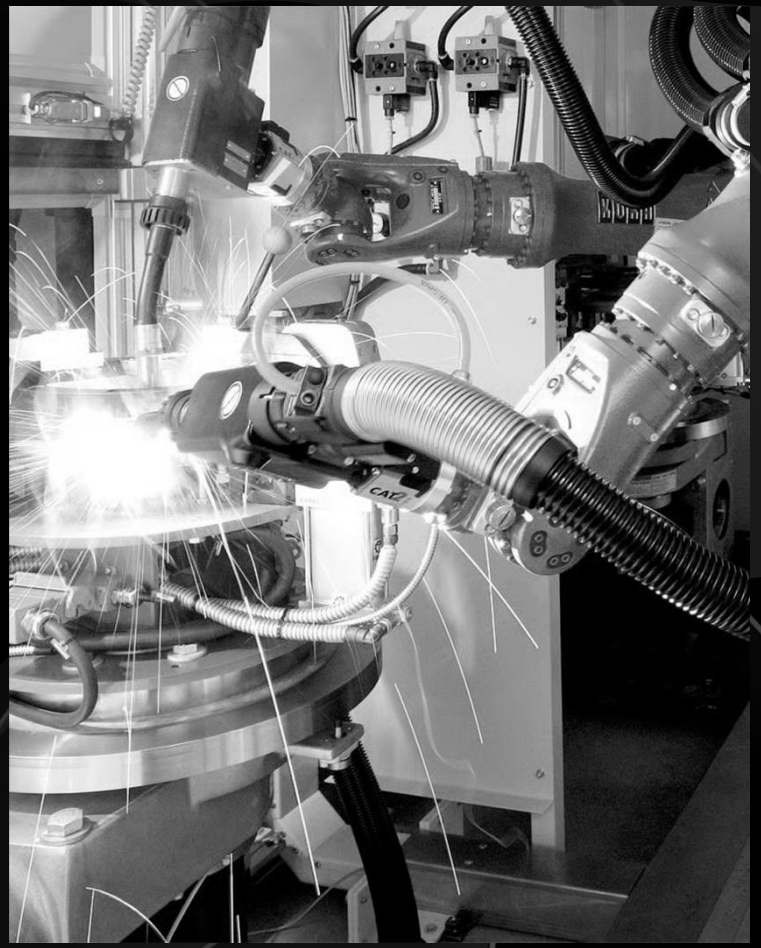
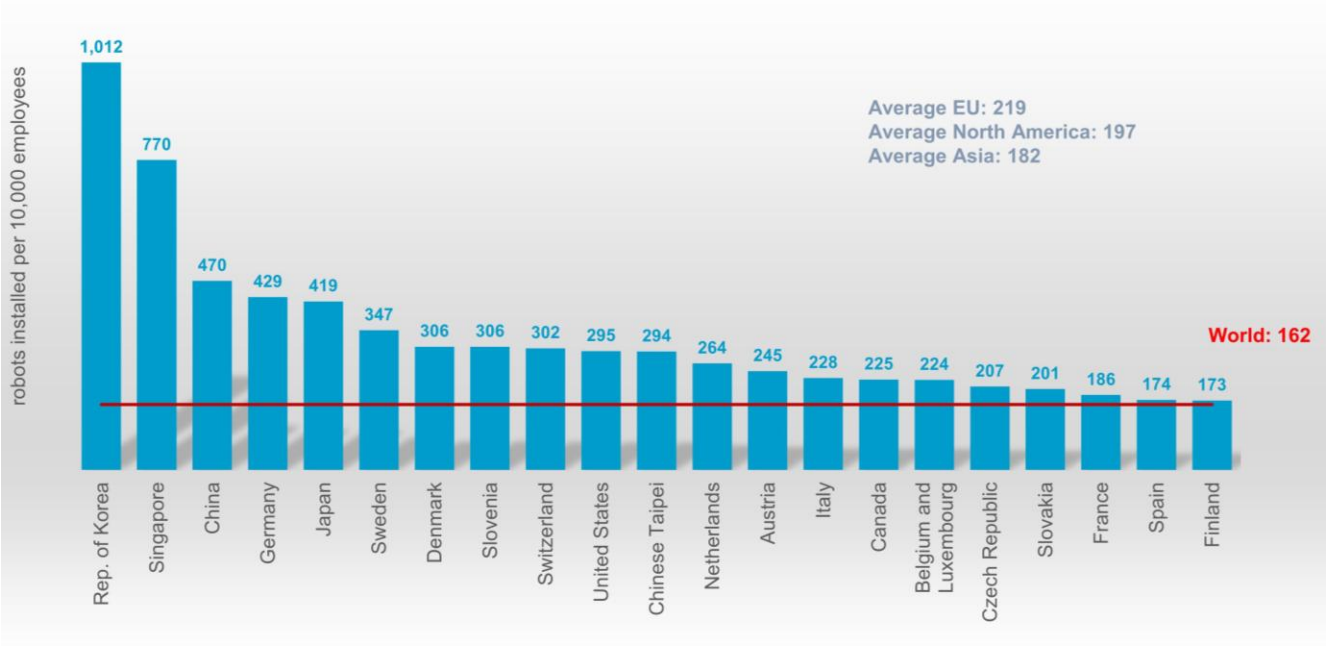


Image sources: ABB, Mecademic, and Kuka

AUTOMATION DELIVERS EFFICIENCY

- Industries are looking to expand the jobs that can be automated.
- Current robots don’t fit every job or non-repetitive tasks.
- Market demands are pushing robotics beyond mass production to handle variable and non-repetitive tasks.

Robot Density in Manufacturing, 2023



Source: International Federation of Robotics

MACRO-ECONOMIC PRESSURES

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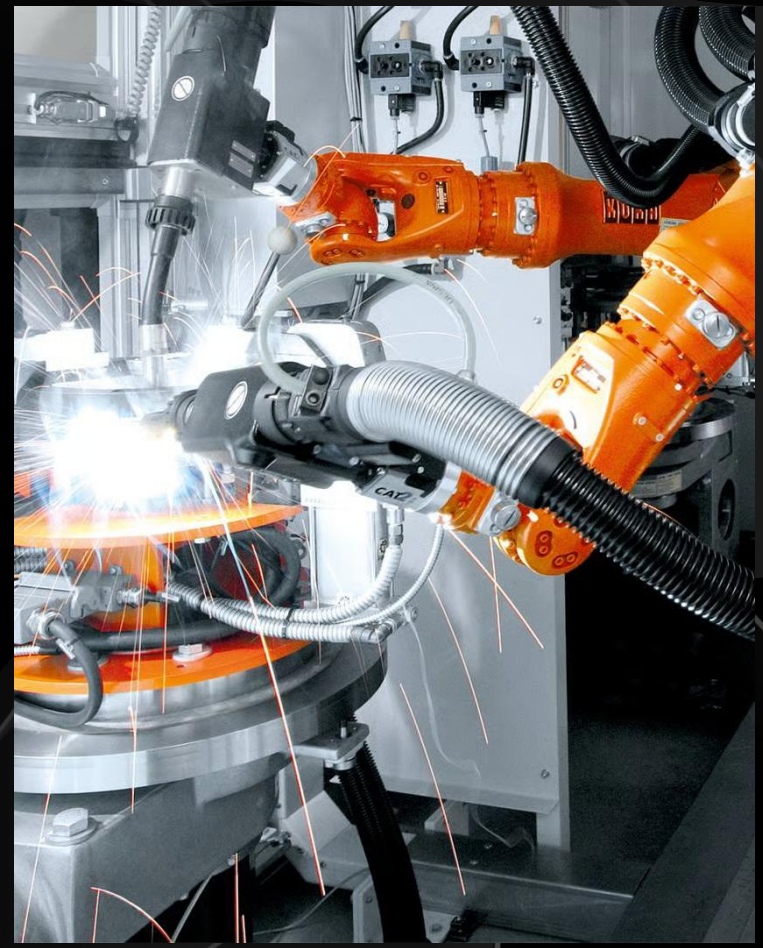
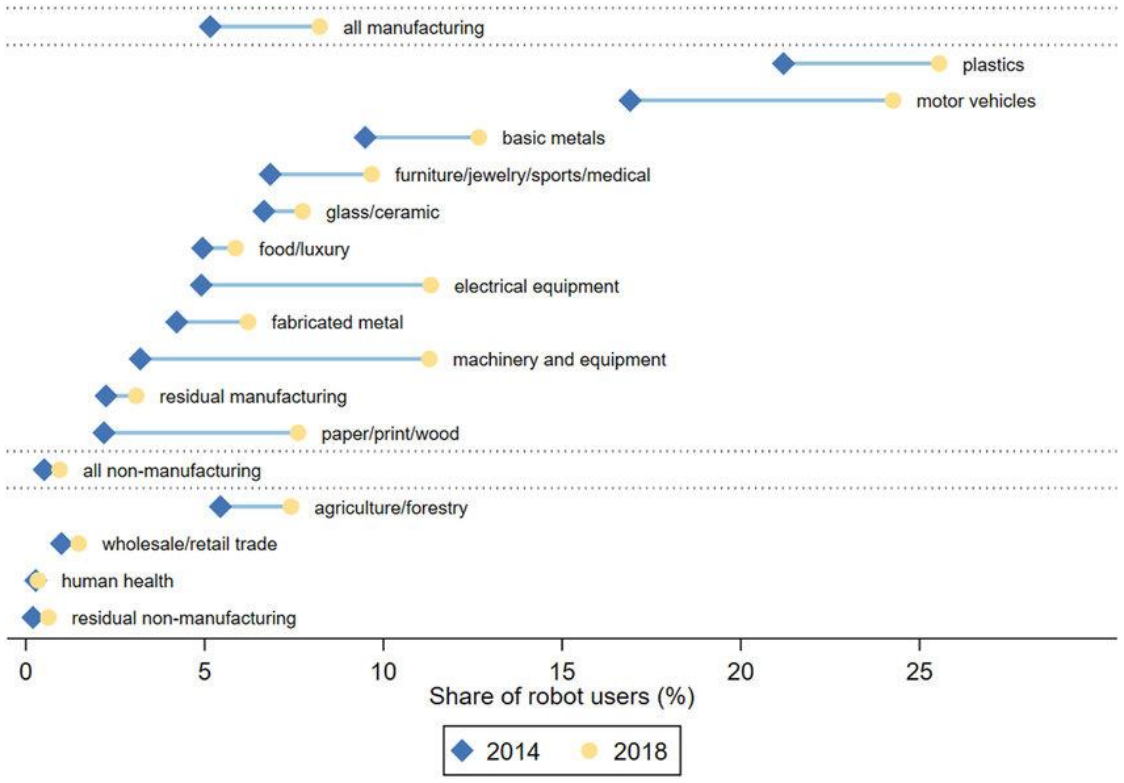


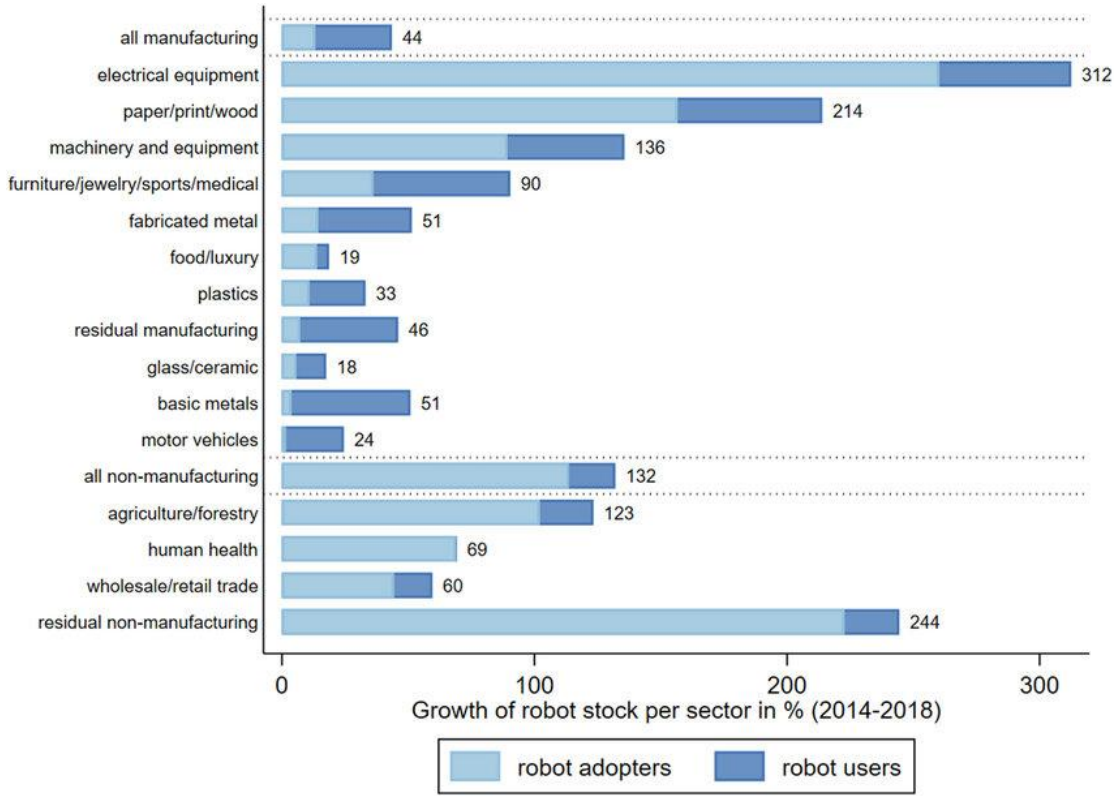
Image sources: ABB, Mecademic, and Kuka

EXPANDING REACH OF AUTOMATION

Growth of Robot Users



Growth of Robot Stock by Sector



Source: Centre for Economic Policy Research

MACRO-ECONOMIC PRESSURES

EFFICIENCY

COMPLEXITY

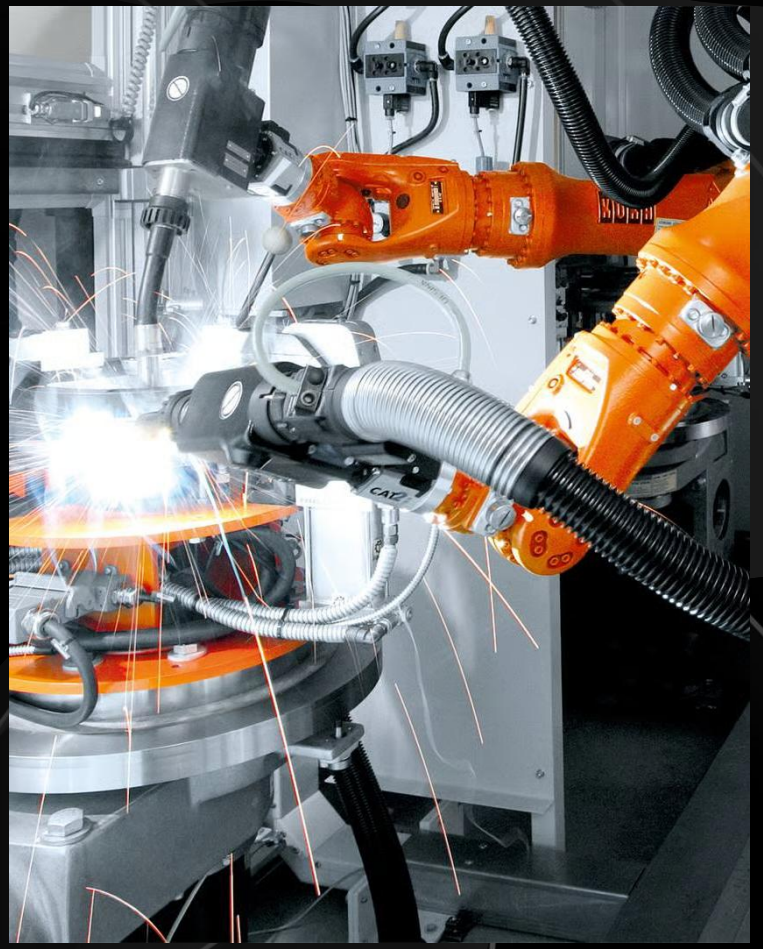


Image sources: ABB, Mecademic, and Kuka

TECHNOLOGY LANDSCAPE

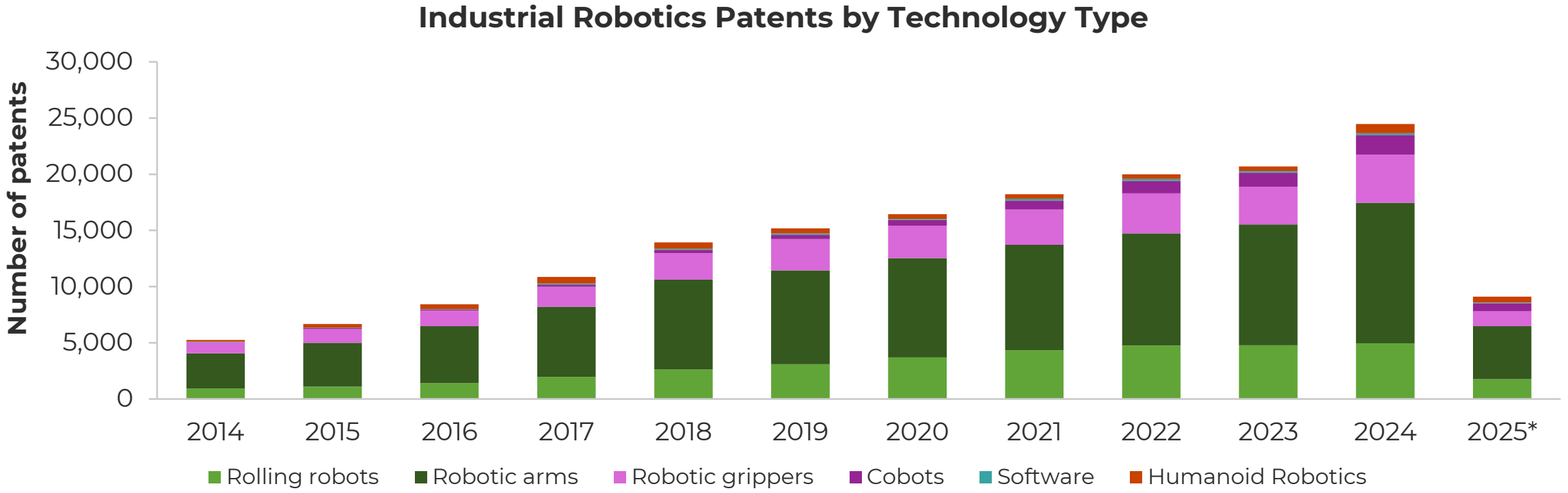
Six categories with distinct characteristics:

- Rolling robots
- Robotic arms
- Robotic grippers
- Collaborative robots (cobots)
- Software
- Humanoids

Source: Technology Landscape: Industrial robotics

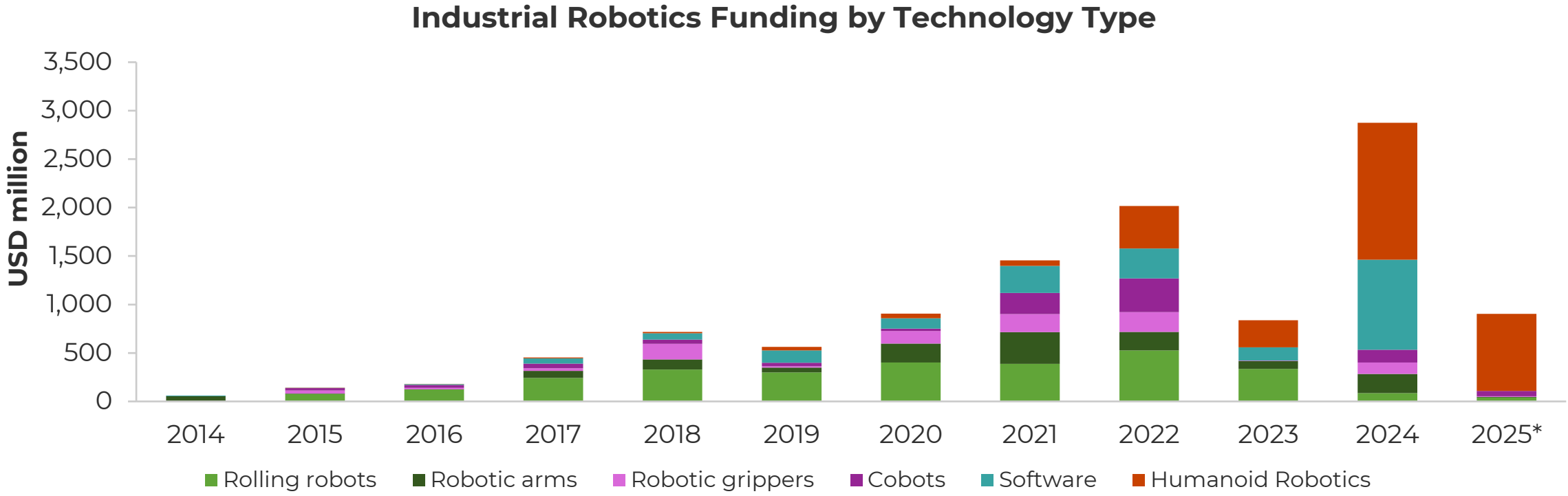
PATENT TRENDS

Innovations in industrial robotics are accelerating



INVESTMENT TRENDS

Investments in industrial robotics are accelerating



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HARDWARE ADVANCEMENTS

Image source: Universal Robots

EMERGING INNOVATIONS

- Robotic hardware (rolling robots, robotic arms, cobots, and robotic grippers) has mostly become commodified.
- Applications with more innovation include laboratory automation and field maintenance.

Image source: Kuka

INCREMENTAL GROWTH

- Hardware innovations are incremental.
- Existing players are entrenched and can provide solutions to most customers, while startups typically have better solutions but not as much staying power.
- Innovations either capitalize on minor gains or enable software applications.

Image source: Universal Robots

THIRA ROBOTICS

Novel rolling robot improves AMR mobility

- Thira Robotics' rolling robots are equipped with its hardware solution that enable movement over uneven ground and steep platform slopes as well as across wet and greasy floors.
- These innovations are specifically designed for food factories that have frequent cleaning with water.

LUX TAKE

Versatile hardware solutions are expanding automation opportunities for CPG and manufacturing organizations.

Image source: Thira Robotics

ROBOTIC SOFTWARE

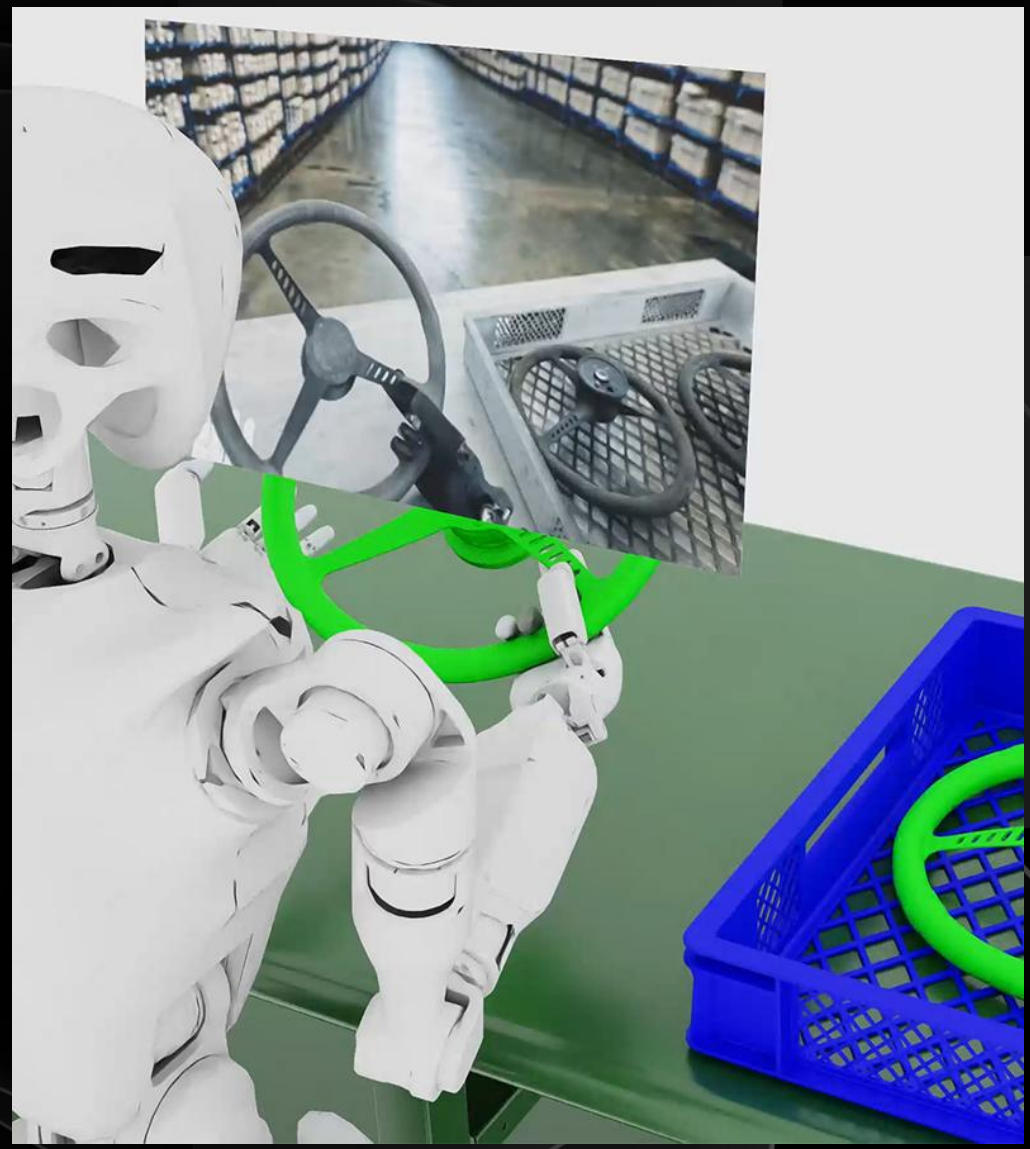

Image source: Thermtest Instruments

EMERGING INNOVATIONS

- Foundational models seek to create universal software for robotics.
- Innovators pair real-world and synthetic data, so robots can interact with environments they haven’t seen before.

FOCUSED APPLICATIONS

- Robotics software ranges from fleet management and cooperation support to control systems and application-oriented programming.
- Targeted software focuses on single use cases or a range of industry applications.

Image source: GrayMatter Robotics

WAREHOUSE EFFICIENCY

Amazon poaches Covariant to increase robotics and warehouse capabilities

- Covariant has been developing a multimodal, foundation model for robotics that increases the learning capabilities and dexterity of robots.
- Covariant entered into an agreement with Amazon to license its software, while some of Covariant's founders and team joined Amazon.

LUX TAKE

Covariant and similar software developers offer great opportunities for robotics to scale outside traditional environments through the development of foundation models.

covariant

Image source: Covariant

HUMANOID ROBOTICS

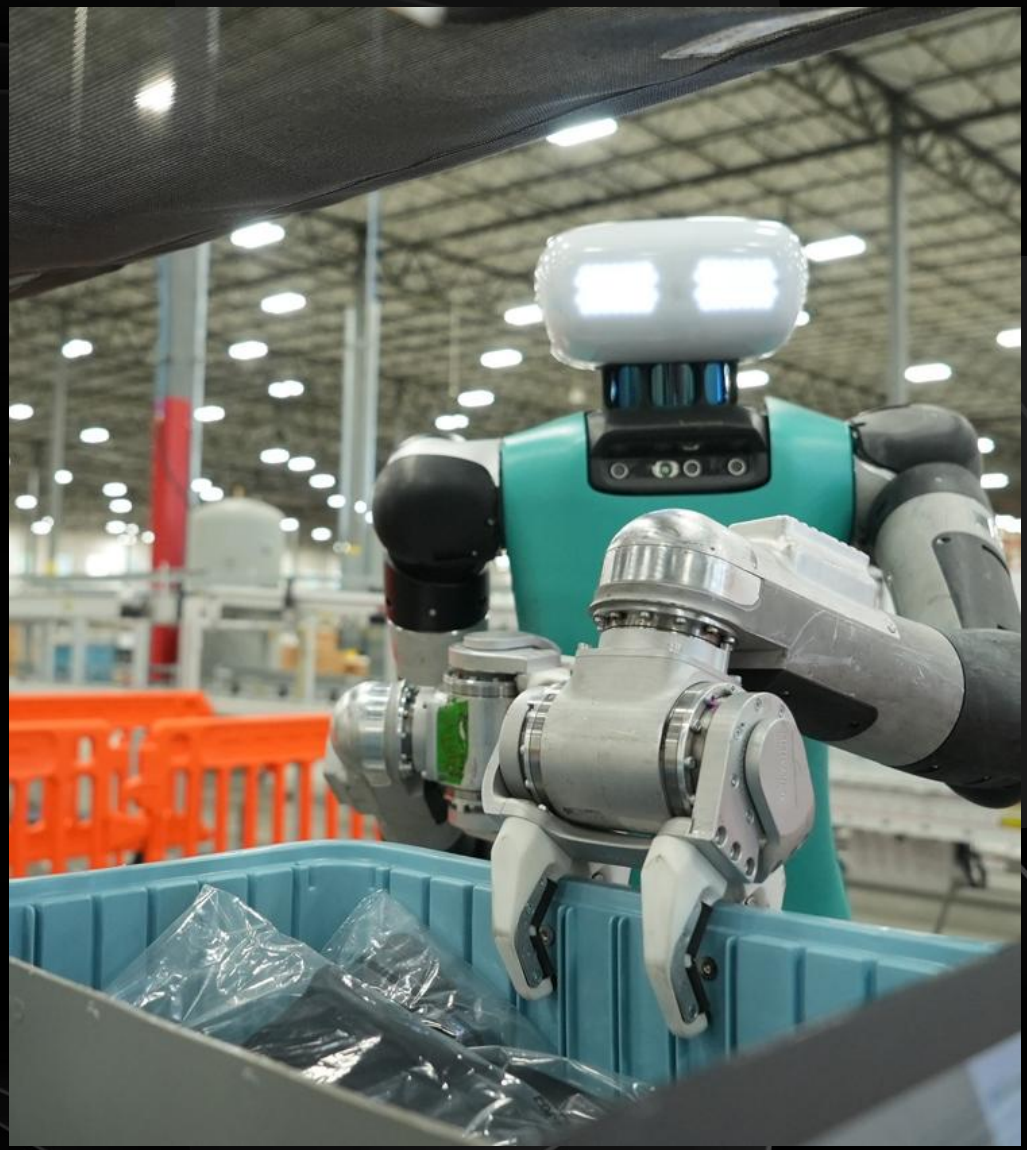

Image source: Agility Robotics

EMERGING INNOVATIONS

- Humanoid robots are equipped with legs, arms with swappable end-of-arm tools, a vision system, and a core processing unit.
- Initial developers target semi-structured environments including distribution centers, warehouses, and automotive factories.

Image source: NASA

GLOBAL IMPACT

- An increasing number of startups and corporate developers are from China and the U.S.
- Developers raised over USD 500 million in the last two years.
- China’s public/private partnership and robotics supply chain provide advantages.

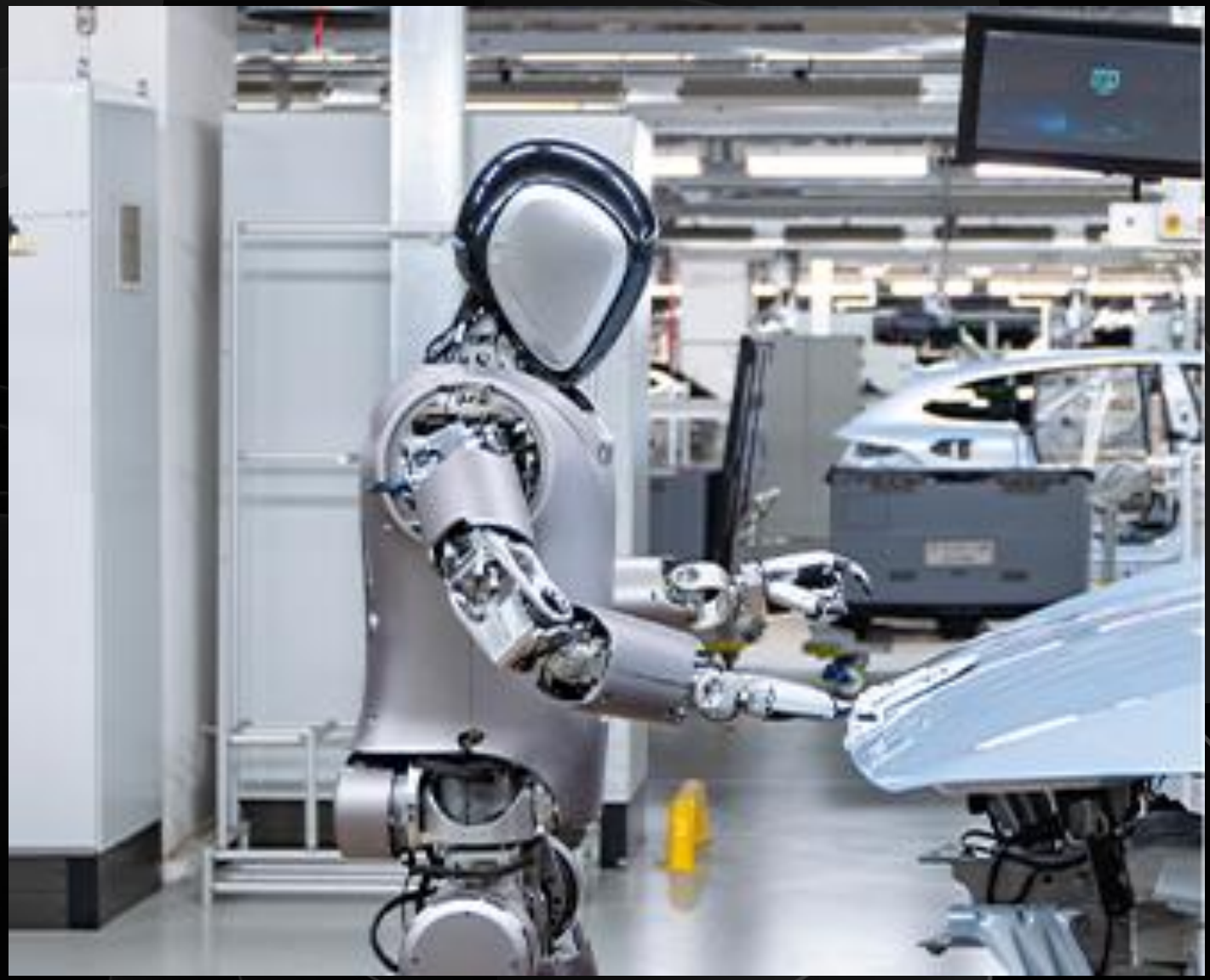

Image source: Ubtech

AUTOMOTIVE TRIALS

The automotive industry is an early adopter of humanoid robots

- Apptronik and other humanoid robot vendors have entered commercial agreements with automotive manufacturers that include Mercedes-Benz, BYD, BMW, and Nio.
- Partnerships are focused on identifying potential applications and training humanoid robots.

LUX TAKE

Early humanoid robot deployments are confined to R&D and the identification of future use-cases. Current capabilities are not competitive with existing industrial robots.

APPTRONIK

Image source: Apptronik

Will humanoid robots be the dominant platform for robotics in the future?

BETTER SOLUTIONS THAN LEGS EXIST

CHALLENGES IN ROBOTICS

- High capital expenses lead to longer payback timeframes.
- Integration and scalability issues exist in unstructured environments.
- Innovative startups are unable to match the demands of large customers.

	Rolling robots	Robotic arms	Robotic grippers	Collaborative robots	Robotic software	Humanoid robots
# Developers	H	H	H	H	H	M
Stage of development	Scale	Scale	Scale	Scale	Scale	Introduction
Precision and accuracy	M/H	H	M/H	H	M/H	M/L
Autonomy	M	M/H	N/A	M/H	N/A	M/L
Ease of use	M	M/L	N/A	M	M	L
Scalability	M	M/H	N/A	M	H	M/L
Versatility	M	H	M/L	H	M/H	M/H
Safety	M/H	M/L	M/H	M/H	N/A	M/H
Lux Recommendation	Engage	Engage	Engage	Engage	Engage	Monitor

Not Applicable	Low	Medium / Low	Medium	Medium / High	High

Source: Technology Outlook: Industrial Robotics

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KEY TAKEAWAYS

1

Humanoid robots will not solve current problems.

The estimated costs of humanoids are high, yet the initial focus will be on easily repeatable applications, creating value mismatch. Broader impact will happen in the 2030s or beyond.

2

Software, AI, and foundational models offer near-term value.

Software and AI create efficiency gains today. Companies should take advantage of software innovations to accelerate robotic deployments.

3

Innovations that deliver both short- and long-term payoffs are essential.

Companies can benefit from parallel hardware/software innovations from humanoid robots. Robust platforms with growth potential emerge from complementary software and hardware development.

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