

2025 HUMANOID ROBOT STUDY - Presentation of results

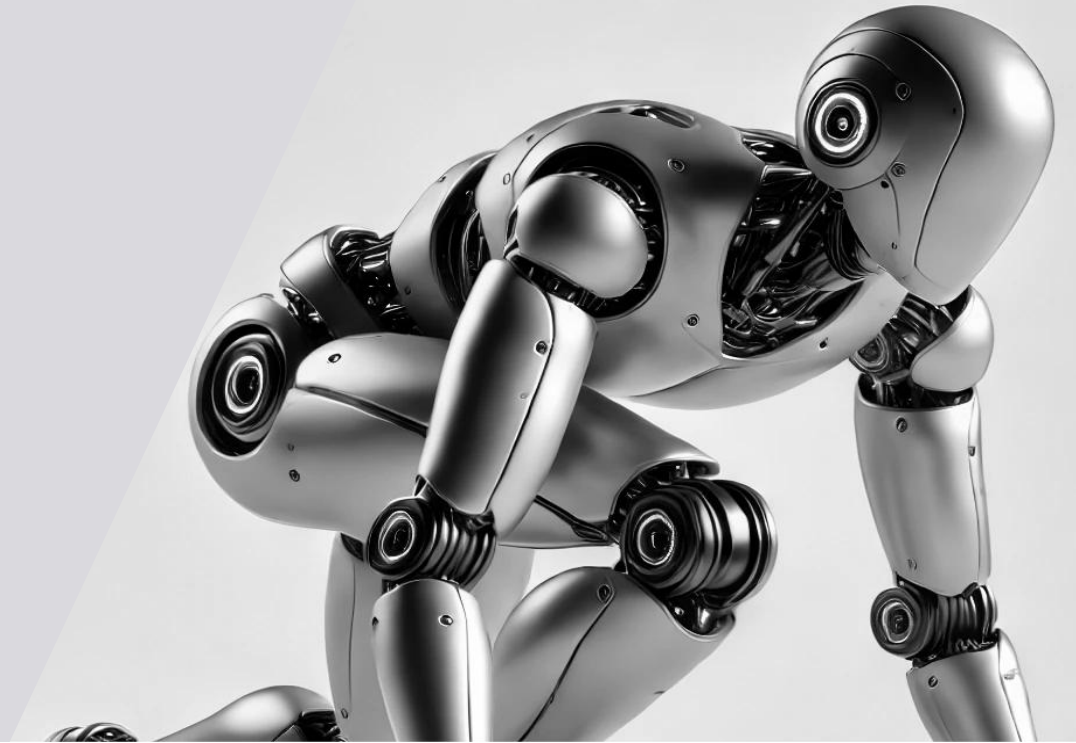
Market Development, Technological Maturity and Potential for Companies.

Tobias Bock | March 2025

// NEXERY.
NexusSphere Advisory

Content.

- 01 Management Summary
- 02 Market -Volume & -Development
- 03 Technological Maturity Level
- 04 Technology Costs
- 05 Potential for Companies
- 06 Way-Forward



2025 HUMANOID ROBOT STUDY

Market Development, Technological Maturity And Potential For Companies.



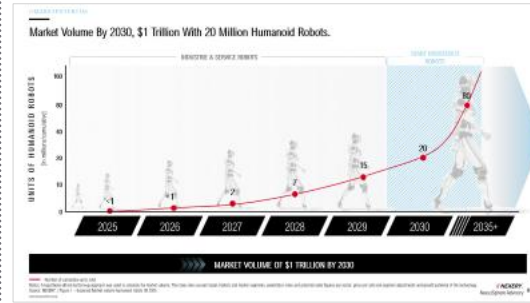
Foreword
Tobias Bock, 2025

The present study analyzes the rapid development of humanoid robots, their technological maturity and their growing importance for companies. It provides decision-makers with in-depth insights into market development and shows how humanoid robotics can unlock new potential for innovation and competitiveness.

Our goal is to create a basis for strategic decisions in a dynamic and forward-looking field of technology.

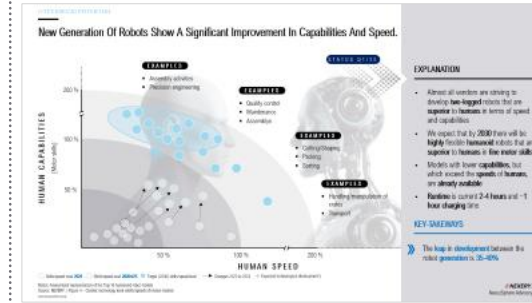
4 KEY-TAKEAWAYS

//01



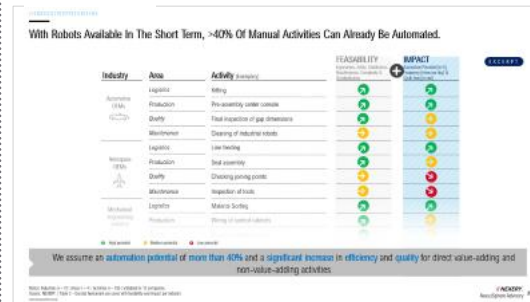
Expected **MARKET VOLUME** by 2030, \$1 trillion with 20 million humanoid robots

//02



Within the next **1.5 YEARS**, the first **HUMANOID ROBOTS** for **INDUSTRIAL USE** and **PRODUCTION-READY**, highly flexible robots will be launched on the market till 2030

//03



With robots available in the medium term, up to **>40% of MANUAL ACTIVITIES** in manufacturing companies can be **AUTOMATED**

//04



For the operation of the humanoid robots, we expect an **AMORTIZATION TIME** of less than **0.56 YEARS** and **SIGNIFICANT** effects in **EFFICIENCY** and **QUALITY**

In 2025, Humanoid Robots Will Push The Boundaries Of Automation.



MARKET DEVELOPMENT,
TECHNOLOGICAL MATURITY
AND POTENTIAL FOR
COMPANIES



20 Mio. \$ robots until 2030

Expected market volume by 2030, \$1 trillion with 20 million humanoid robots



>40% potential to replace manual tasks

Application example in the field of assembly/logistics in high industrialized industry



>35% increase in performance & 40% cost reduction

Exponential technical improvements and cost reductions in the last two years



2025 first market-ready solutions

5+ vendors aim for series production from 2025



<0,6 years return on investment

Skills growth of the humanoids leads to a drastic increase in ROI over the years

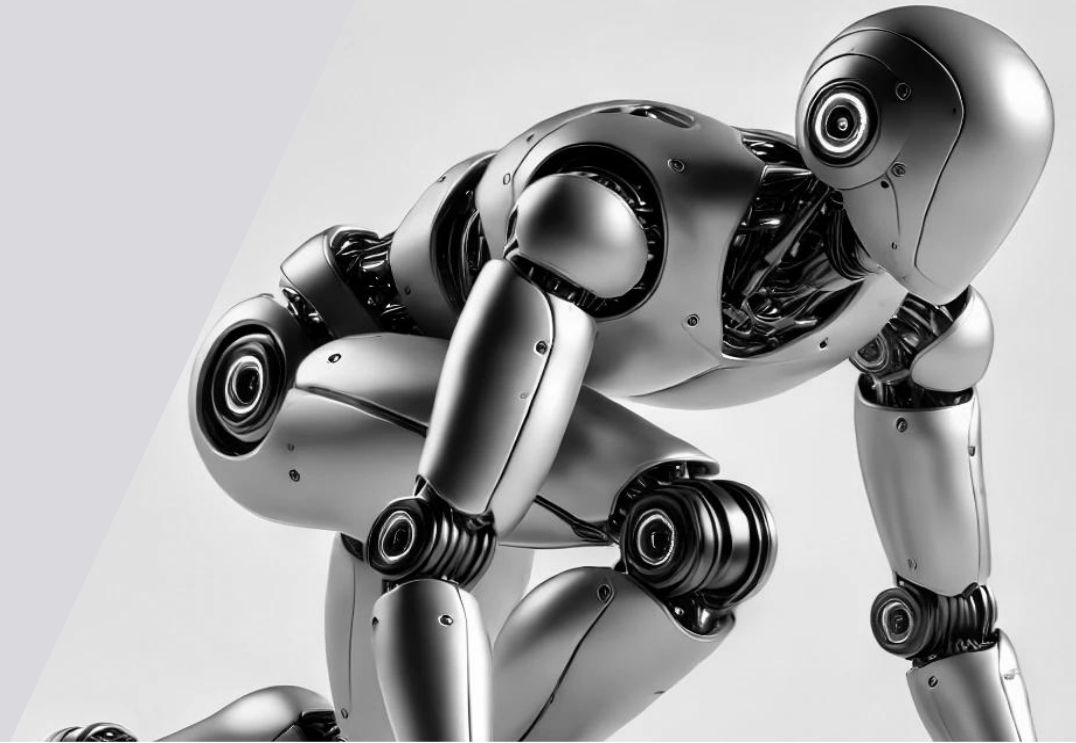


\$55,000 expected average price

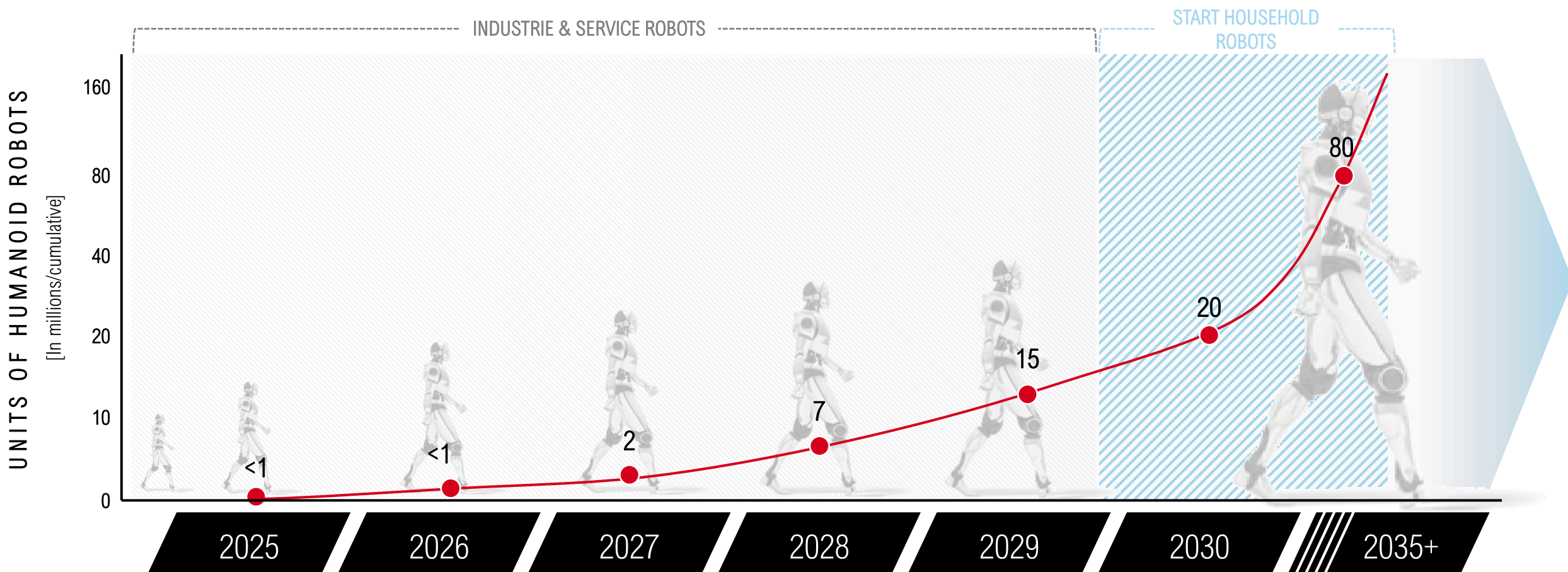
By 2030, prices for humanoids will fall significantly

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Market Volume By 2030, \$1 Trillion With 20 Million Humanoid Robots.



MARKET VOLUME OF \$1 TRILLION BY 2030

— Number of cumulative units sold

Notice: A hypothesis-driven bottom-up approach was used to calculate the market volume. This takes into account target markets and market segments, penetration rates and potential sales figures per sector, price per unit and segment adjustments and growth potential of the technology.

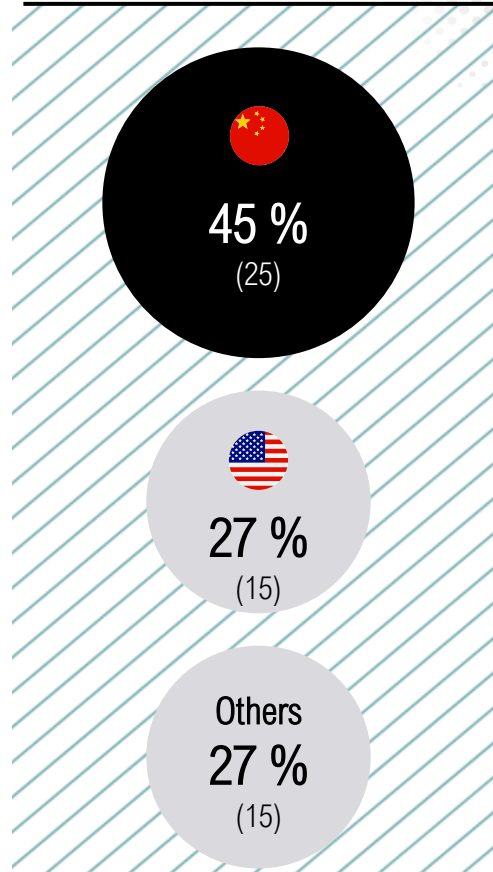
Source: NEXERY. | Figure 1 – Expected Market volume humanoid robots till 2035

2025 Humanoid Robot Study

Chinese And American Companies Already Dominate The Market.

VENDORS	HQ
XPENG Robotics	
Dreame	
Xiaomi	
Ubtech Robotics	
Unitree	
Kepler	
Fourier Intelligence	
AGIBot	
Apptronik	
Agility Robotics	
Boston Dynamics	
Figure	
Tesla Robots	
Sanctuary AI	
Neura Robotics	
1X Technologies	

COUNTRIES OF ORIGIN



n = 55 commercial vendors

EXCERPT

EXPLANATION

- There are currently around 100 **organizations** (55 commercial and 45 research) working on the **development of humanoid robots**
- A **large proportion** of the **non-commercial** developers of the technology come from **Europe** (mainly Germany) or **Japan**
- The **Chinese Ministry of Industry and Information Technology** has developed a **platform** that is available to Chinese companies **free of charge**

KEY-TAKEAWAYS

» As drivers in the development of the **technology**, the **USA** and **China** have a **dominant position**

Majority Of Current Vendors Have Mastered Prototype Construction, But No Large-scale Industrialization.



EXPLANATION

- Most vendors have **only limited capacities** for building prototypes
- Industrialization capability** (large quantities at an expected quality) has so far only been achieved by **corporate ventures**
- All of the **corporate ventures** plan to build robots for their **own use** but also as a **separate business model** (B2B and B2C). Some of them have announced a "humanoid first" strategy and are planning to enter the market on a large scale

KEY-TAKEAWAYS

» The most **promising companies** are those that not only have the ability to **develop** robots but also manage to **scale** them

Beneficiaries Of The Technology Are The Providers Of Software And Hardware.

EXCERPT

VENDORS	FINANCING	PARTNERSHIPS	FOUNDING (PROJECT START)
XPENG Robotics	~ \$100 mio.	NVIDIA XPENG	2018
Dreame			2017 (2023)
Xiaomi		XIAOMI	2010 (2022)
Ubtech Robotics		BaiDu NIO BYD Foxconn	2012
Unitree	~ \$139 mio.	NVIDIA	2013 (2023)
Kepler		NVIDIA	2023
Fourier Intelligence	~ \$88 mio.	NVIDIA	2015
AGIBot	~ \$85 mio.		2023
Apptronik	~ \$33 mio. & \$350 mio.	NVIDIA DeepMind Mercedes Benz NASA	2016
Agility Robotics	~ \$150 mio.	NVIDIA Amazon SCHAEFLER GXO	2016
Boston Dynamics		NVIDIA HYUNDAI TOYOTA res.	1992 (2016)
Figure	~ \$675 mio.	NVIDIA BMW	2022
Tesla Robots		NVIDIA Tesla	2003 (2021)
Sanctuary AI		NVIDIA MAGNA	2018 (2023)
Neura Robotics	€141 mio. & €120 mio.	NVIDIA	2016 (2021)
1X Technologies	~ \$125 mio.	NVIDIA	2014

EXPLANATION

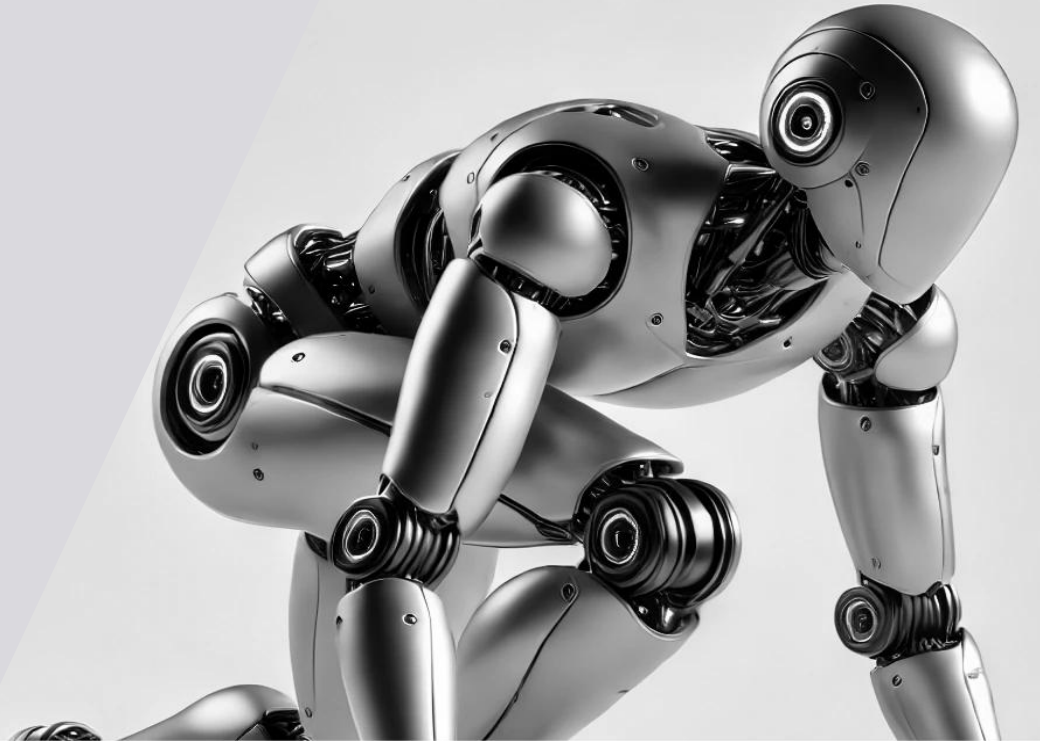
- Many of the **companies** and **projects** have been **set-up** in the last **3-4 years**
- Current **developments** and practical examples come mainly from the **automotive industry** and defense
- In **2024** alone, **billions were invested** in companies **researching** humanoid robots
- Among the leading vendors, **none** of the **established manufacturers** of **automation technology** or robotics is currently

KEY-TAKEWAYS

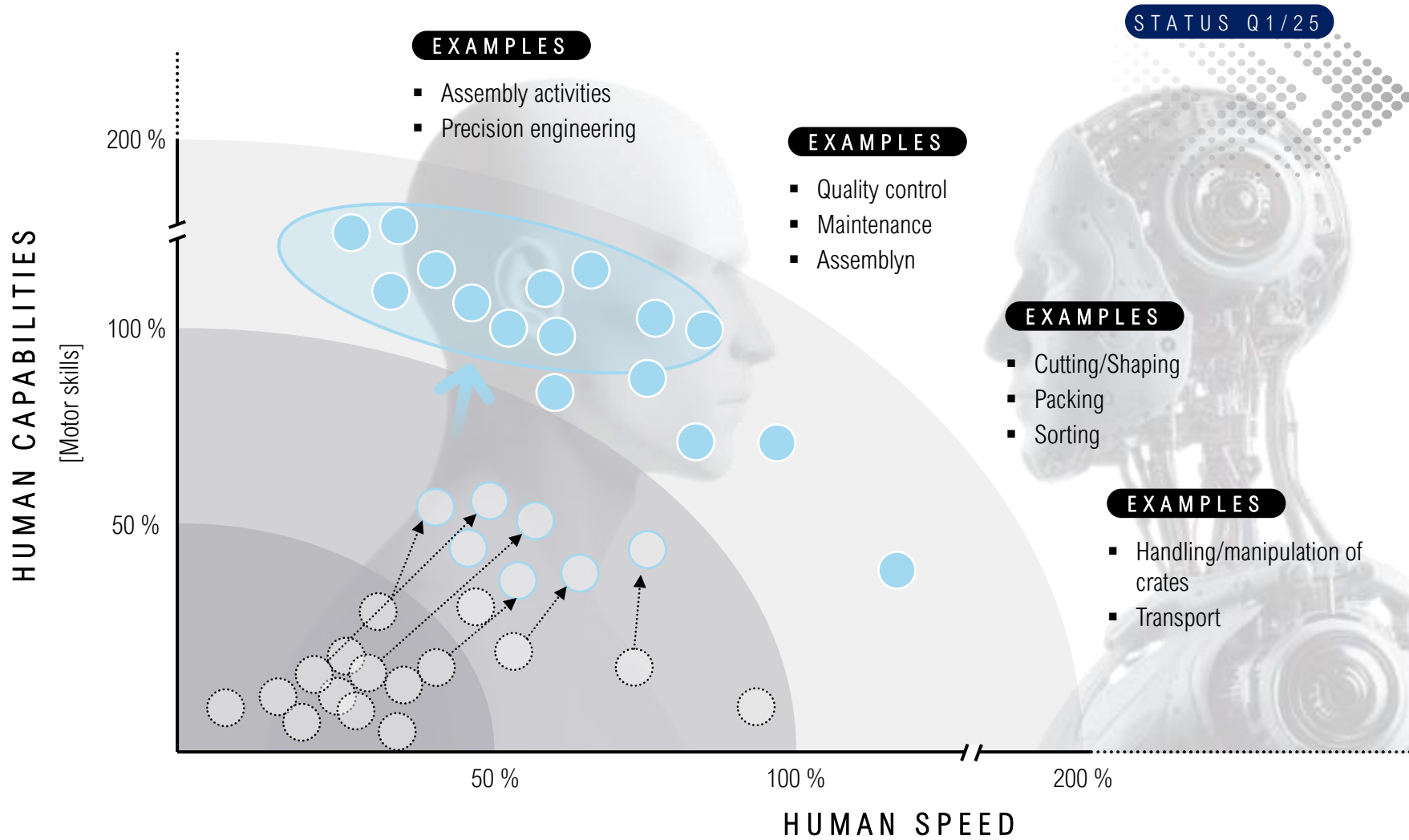
- » In addition to the companies that develop the hardware of the humanoid robots, **software companies** such as NVIDIA play a **significant role** in the **development** of the robots

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New Generation Of Robots Show A Significant Improvement In Capabilities And Speed.



EXPLANATION

- Almost all vendors are striving to develop **two-legged** robots that are **superior to humans** in terms of speed and capabilities
- We expect that by **2030** there will be **highly flexible humanoid** robots that are **superior to humans** in fine motor skills
- Models with lower **capabilities**, but which exceed the **speeds of humans**, are **already available**
- **Runtime** is current **2-4 hours** and **~1 hour** charging time

KEY-TAKEAWAYS

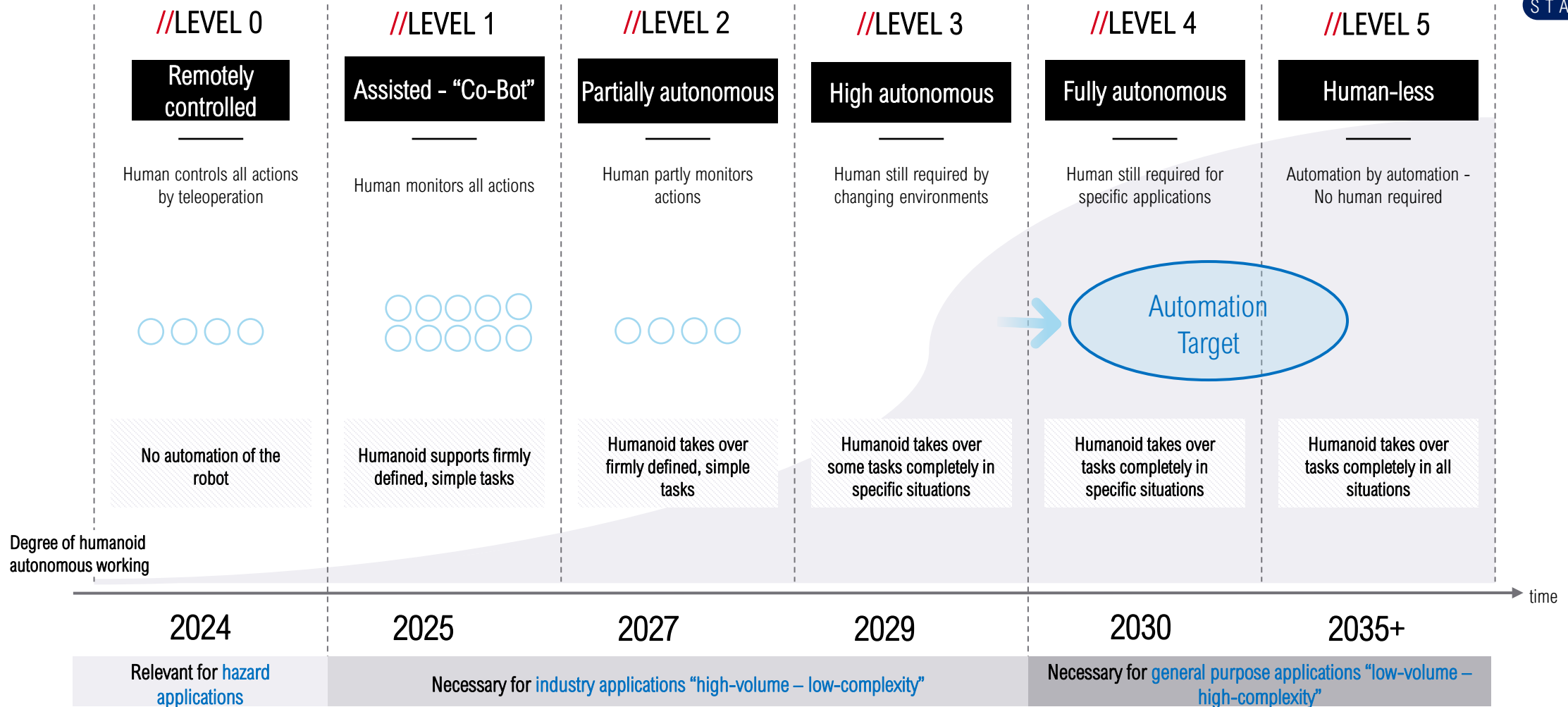
» The **leap in development** between the robot **generation** is **35-40%**

○ Skills/speed level 2024 ○ Skills/speed level 2020/25 ● Target (2030) skills/speed level ➔ Changes 2023 to 2024 ➔ Expected technological development's

Notice: Anonymized representation of the Top 16 humanoid robot models
 Source: NEXERY. | Figure 4 – Current technology level (skills/speed) of known models
 2025 Humanoid Robot Study

Fully Autonomous Humanoid Robots Are Not Expected Until 2030.

STATUS Q1/25



○ Automation level 2024/25 → Expected technological development's

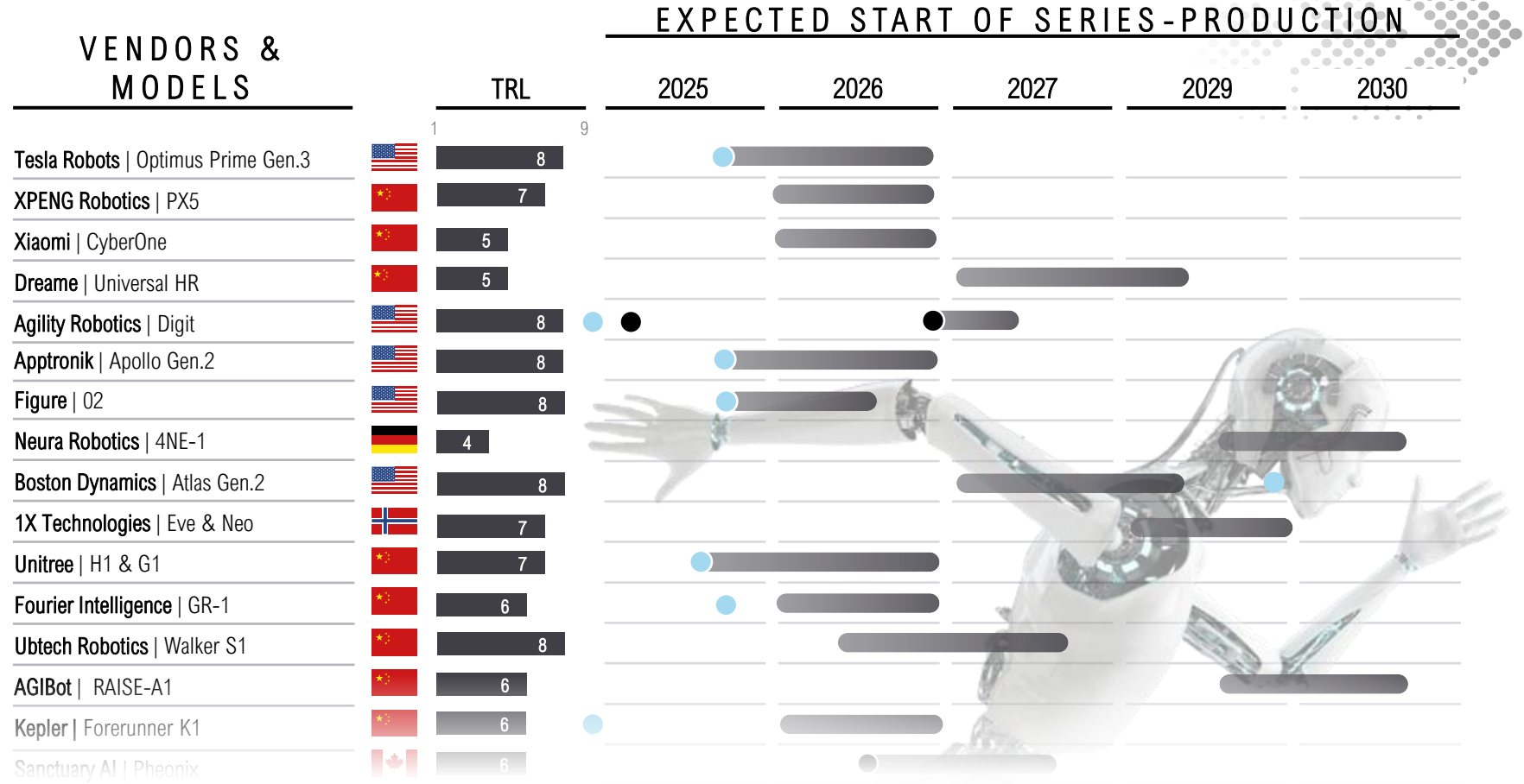
Notice: Anonymized representation of the Top 16 humanoid robot models

Source: NEXERY. | Figure 5 – Current automation level of Top 16 models

2025 Humanoid Robot Study

Fist Series Production For Industrial Usage Can Be Started In 2025.

STATUS Q1/25



EXPLANATION

- Most companies are very **secretive** about the **level of maturity**
- Humanoid robots leave the experimental setup in the **laboratory** and the **first pilot** projects in the industrial environment are **completed**
- Models available so far are **sold** as **prototypes** or **research robots**
- Many vendors plan to start their commercial production in the next **two to three years**

KEY-TAKEAWAYS

» We expect humanoid **robots** to be **series-produced** for **industrial** use by **2025**

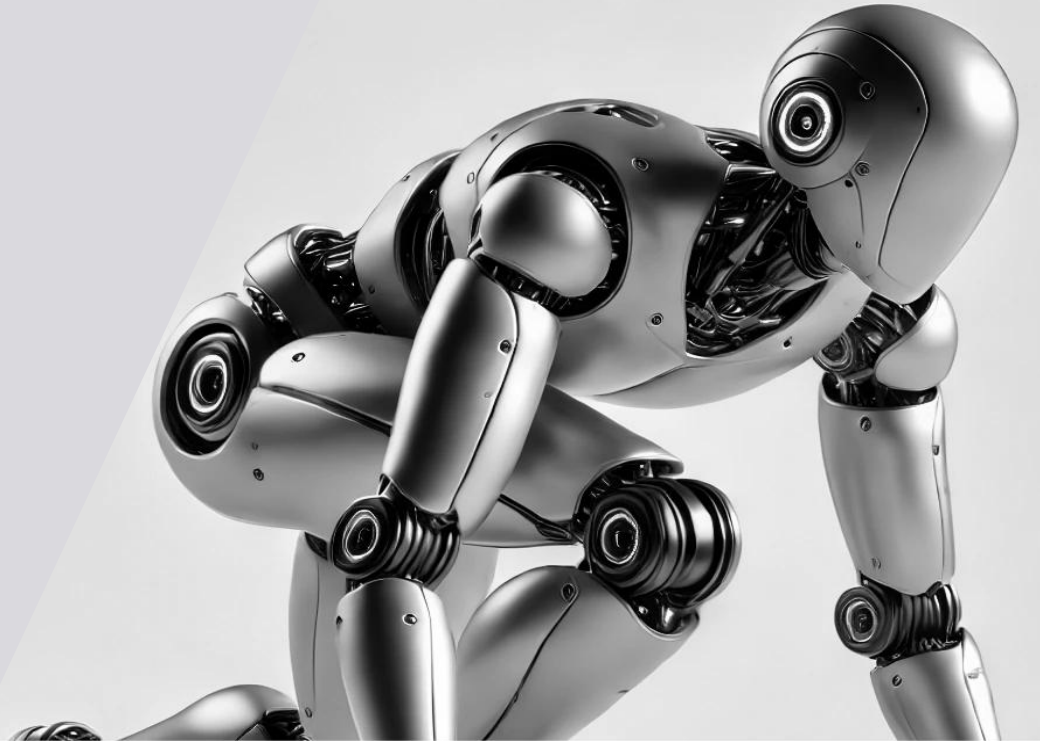
● Ready for series production according to the vendors ■ Ready for series production by maturity ● New generation

Notice: Representation of the Top 16 humanoid robot vendors | TRL = Technology Readiness Level (1–9) | Estimates based on interviews and information from the vendors

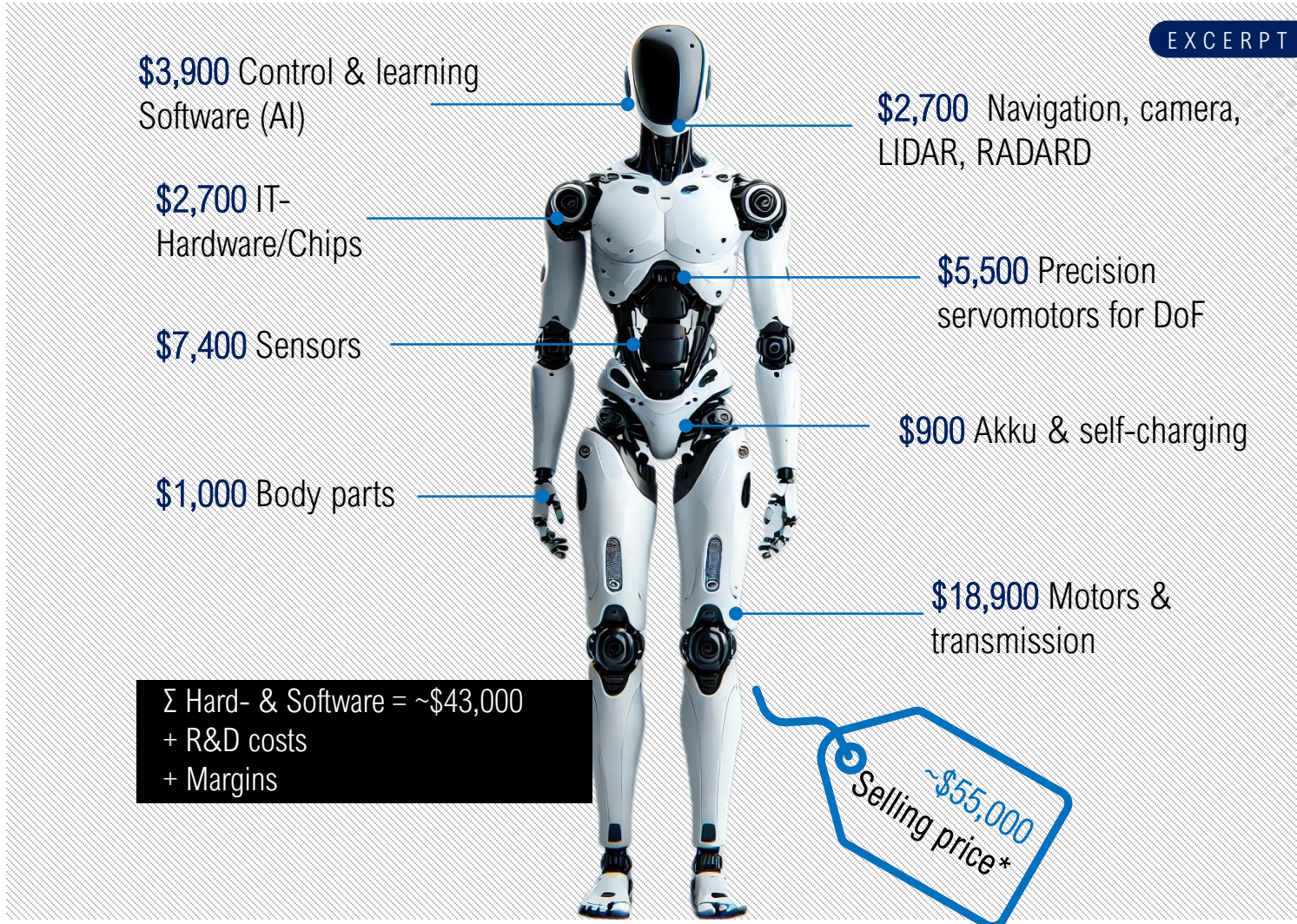
Source: NEXERY. | Figure 6 – Technology maturity of the humanoid vendors

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For An Industrialized Standard Robot In Series Production, We Expect Manufacturing Costs Of Around \$55,000.



EXPLANATION

- Costs for research robots and the first generations of robots for testing in "real-world condition" (Technological Maturity Level 7-8) are currently well into the **six-figure range**
- The **price** for procurement, similar to other industrial robots, is based on the **scope of the functionalities- general purpose or industrial usage**
- Additional functionalities** or modules such as 3 or 5 finger hands may incur **additional costs**

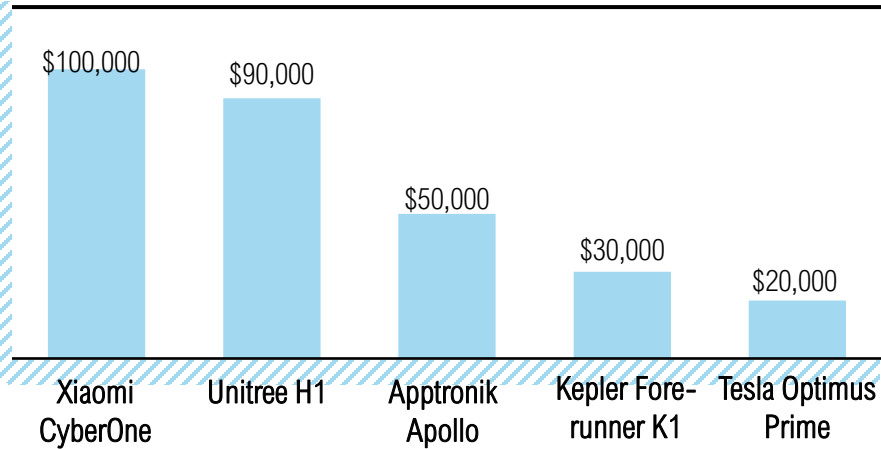
KEY-TAKEAWAYS

- » For a **standard robot** in series production, we expect manufacturing costs of around **\$55,000** in **2030**

Notice: *Not included: License costs, External maintenance contract, Integration costs

Source: NEXERY. | Figure 7 – Humanoid costs breakdown

Procurement Costs For Humanoids Are Continuously Falling.



EXCERPT

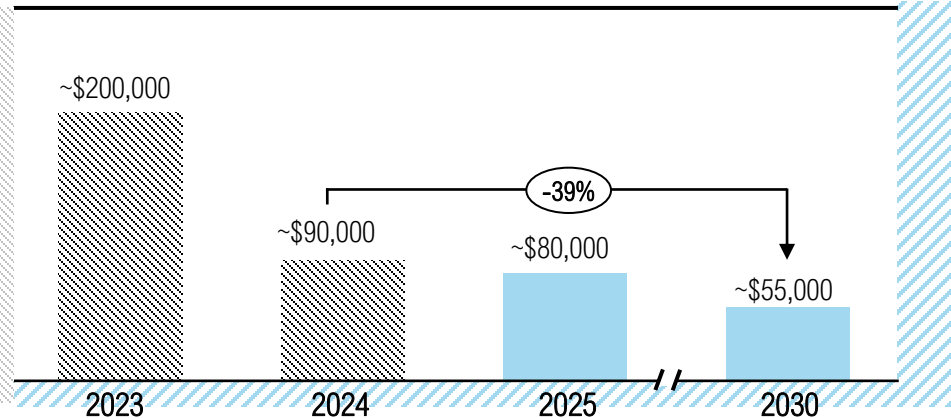
Figure 8
PROCUREMENT COSTS
ACCORDING TO THE
MANUFACTURER

EXPLANATION

- According to the vendors the procurement costs should be between \$20,000 and \$100,000
- As with other industrial robots, the price for procurement depends on the scope of functionalities
- For the market launch of the first humanoid robots, we expect an average procurement cost of \$80,000
- Some providers planning a 'pay by the hour' or 'pay by the day' remuneration model

EXCERPT

Figure 9
DEVELOPMENT OF
PROCUREMENT COSTS
Procurement costs, Ø in \$ by time



KEY-TAKEWAYS

» Procurement costs for humanoids are continuously falling by 2030

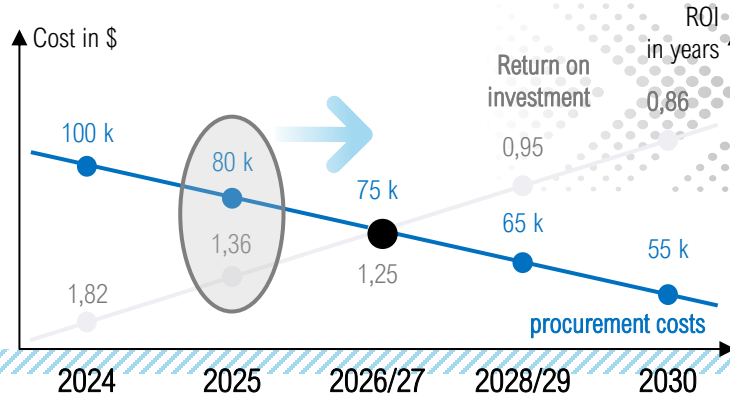
Expected Return On Investment Less Than 0.56 Years.

EXCERPT

DEVELOPMENT OF RETURN ON INVESTMENT

Scenario 1: With 50% performance and decreasing acquisition costs

Figure 10



EXPLANATION

- With the **current** average procurement costs of \$80,000 and **50% performance**, the payback period is **1.36 years**
- With a procurement price of around \$55,000 and a "Human Skill Level of 100 percent" we initially assume a **break-even point of <0.56 years**

KEY-TAKEAWAYS

- Contrary to the conservative ROI calculation, **initial pilot projects** in highly industrialized processes show a process **efficiency compared** to humans of more than **350%** and an **improvement in quality** of more than **90%**

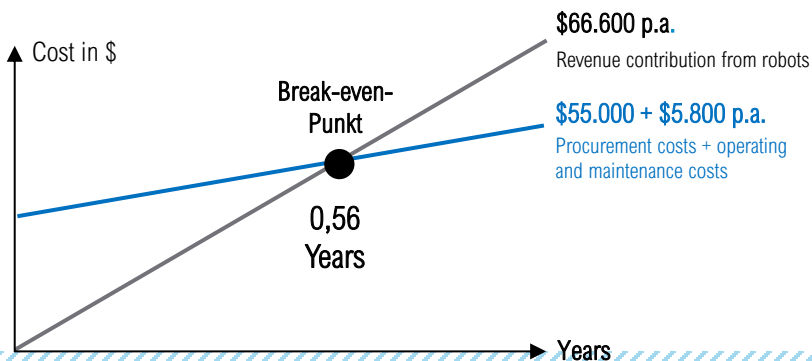


Figure 11

RETURN ON INVESTMENT

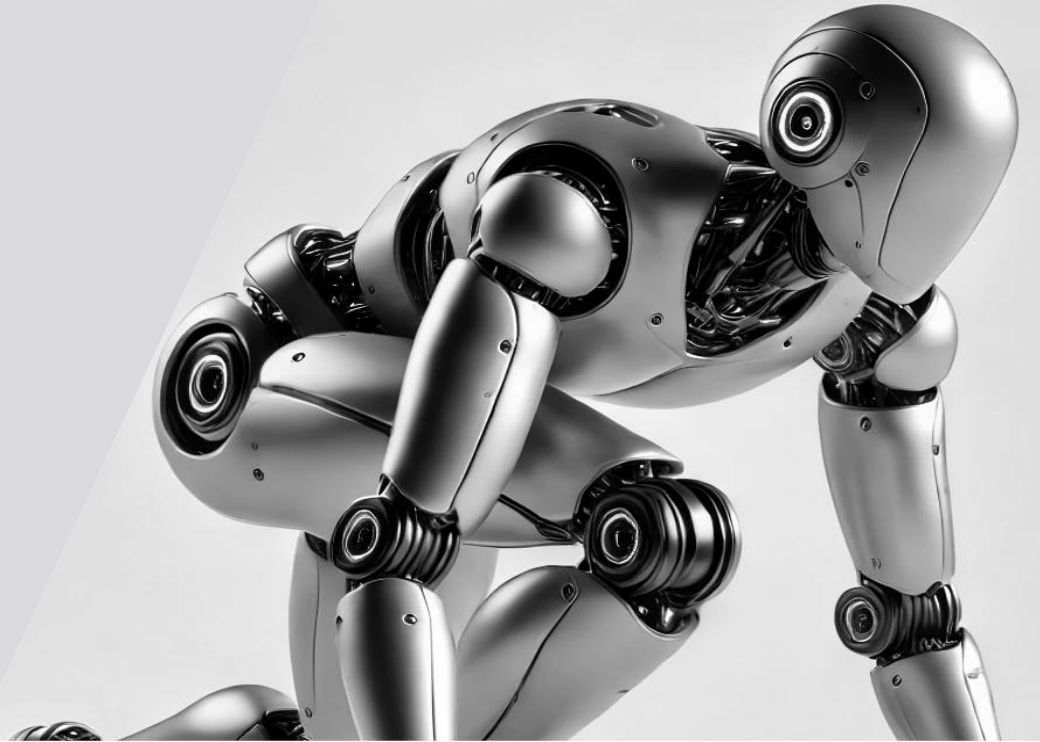
Scenario 2 – with 100% performance compared to a human

EXCERPT

Notice: 0.35-year payback period at 150% performance | 1.38 years payback period at 50% performance | → Expected technological development's Source: NEXERY. | Figure 10 - Return on investment with falling acquisition costs | Figure 11 - Profitability Investment in humanoid robots

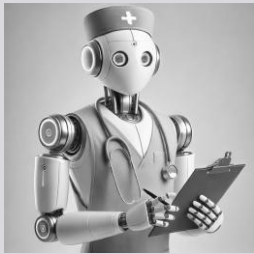
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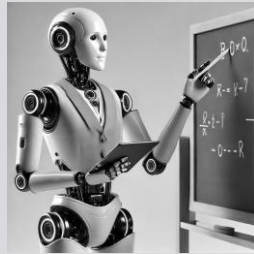
Additional To Specific Applications, Robots Should Also Cover General Purposes Such As Household Tasks.

HUMANOID APPLICATIONS



HEALTH CARE

- Assistant Caregivers
- Rehabilitation
- Surgical Assistance
- Geriatric care



EDUCATION

- Teaching and Learning
- Social interaction and communication



CUSTOMER SERVICE & HOSPITALITY

- Reception and interaction
- Service Robots



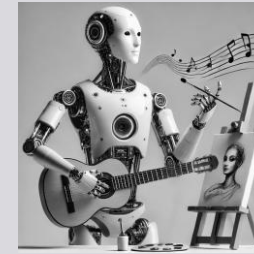
INDUSTRY & MANUFACTURING

- Production Assistance
- Cooperation with humans (cobots)



SAFETY & RESCUE

- Search and rescue operations
- Surveillance
- Defense



ENTERTAINMENT & ART

- Robotics in entertainment
- Interactive experiences



HOUSEHOLD & PERSONAL ASSISTANCE



- Assistance in the household
- Accompaniment and support for the elderly and kids



RESEARCH & DEVELOPMENT

- Study of human interaction
- Advances in Artificial Intelligence

With Robots Available In The Short Term, >40% Of Manual Activities Can Already Be Automated.

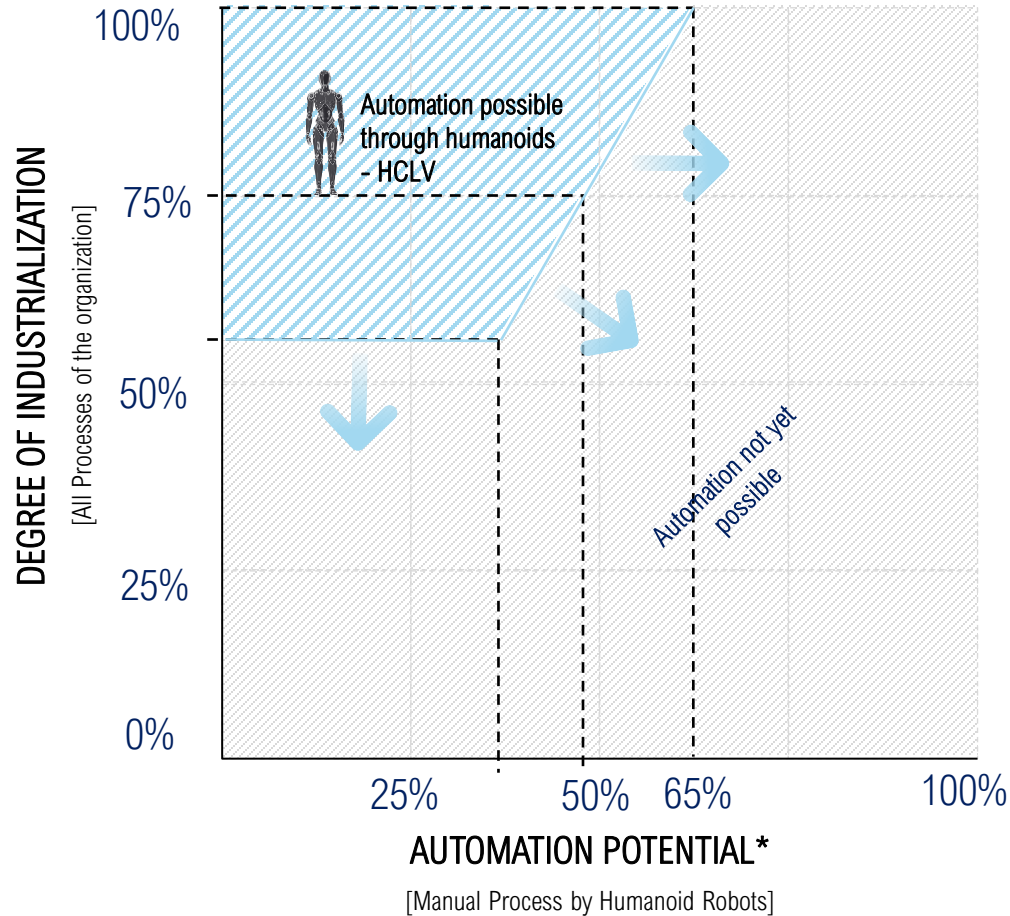
Industry	Area	Activity (Exemplary)	FEASABILITY	+	IMPACT
			Ergonomics, Safety, Stabilization, Repetitiveness, Complexity & Standardization	Automation Potential [in %], Frequency [times per day] & Cycle time [in min]	
Automotive OEMs 	Logistics	Kitting	High potential		High potential
	Production	Pre-assembly center console	High potential		High potential
	Quality	Final inspection of gap dimensions	High potential		Medium potential
	Maintenance	Cleaning of industrial robots	Medium potential		Medium potential
Aerospace OEMs 	Logistics	Line feeding	High potential		High potential
	Production	Seat assembly	High potential		Medium potential
	Quality	Checking joining points	Medium potential		Low potential
	Maintenance	Inspection of tools	Medium potential		Low potential
Mechanical engineering industry	Logistics	Material Sorting	High potential		High potential
	Production	Wiring of control cabinets	High potential		Medium potential
	Quality	Checking welding points	High potential		Medium potential

EXCERPT

We assume an automation potential of more than 40% and a significant increase in efficiency and quality for direct value-adding and non-value-adding activities

With A 100% Degree Of Industrialization, Automation Potentials Of Up To 65% Are Currently Possible.

STATUS Q1/25



EXPLANATION

- Currently the equation still applies: “the higher the **degree** of industrialization, the **more activities** can be taken over by **humanoids**”
- With the **increase** in automation, the automation potentials also **increase**
- Highly **industrialized processes** such as e.g. the **automotive industry** currently offers the **best conditions** for testing humanoid robots

KEY-TAKEWAYS

- » The use of humanoid robots currently still **requires** a degree of **industrialization (HVLC)** of the **processes** of more than **50%**

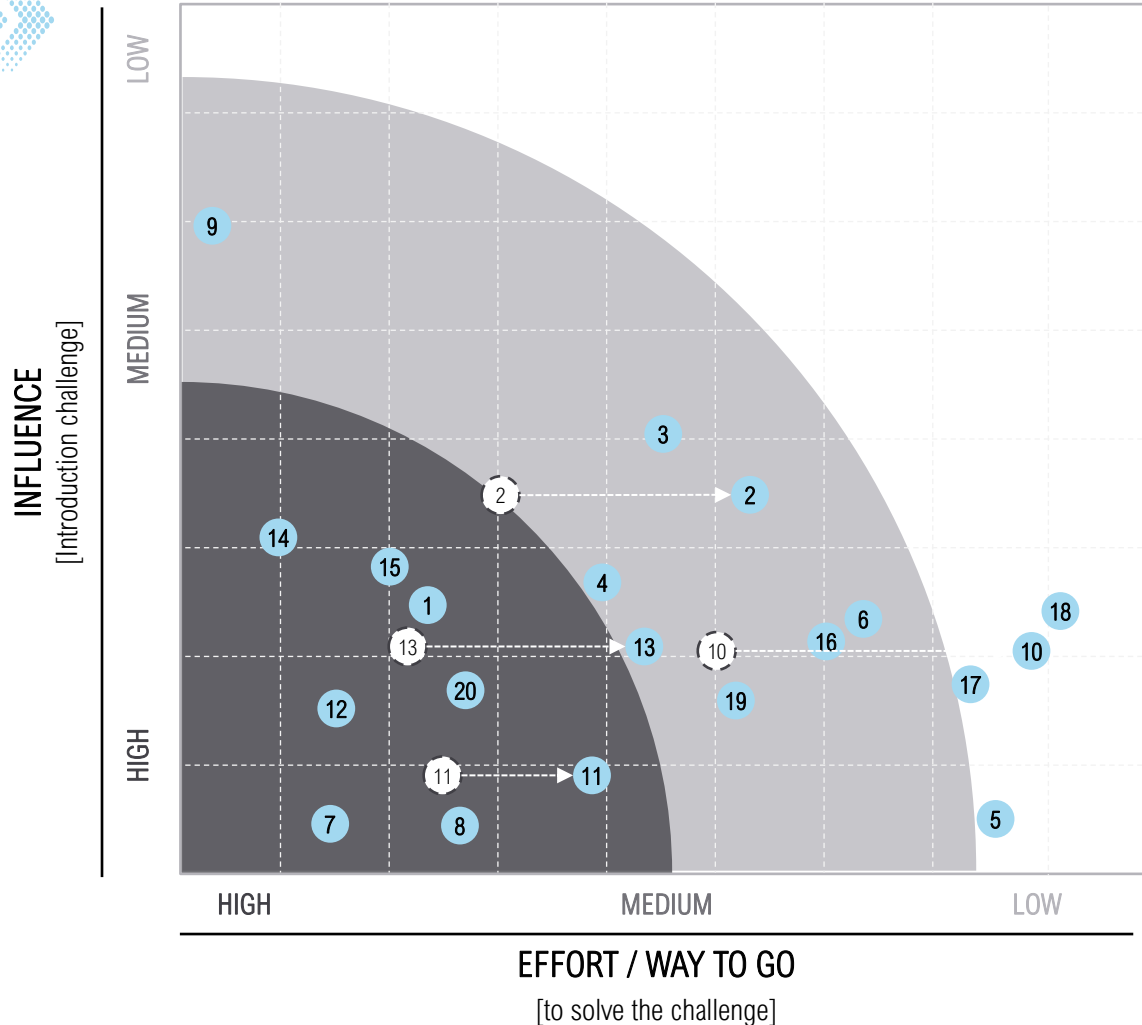
→ Expected technological development's

Notice: *Disclosures based on project experience | Influencing variables of the degree of industrialization = process stability + process complexity + automation technology | HCLV = High Volume – Low Complexity

Source: NEXERY. | Figure 13 – Automation potential in correlation to the degree of industrialization

It Can Be Observed That Mechanical Problems Have Become Significantly Less Challenging In The Past Year.

MAIN CHALLENGES OF THE VENDORS



//Technological challenges

Hardware

- 1 Motor control
- 2 Battery life
- 3 Modularity
- 4 Precise movements (fine motor skills)

Software

- 5 Compatibility of the systems
- 6 Detecting Objects
- 7 Autonomous operating (AI)
- 8 Autonomous learning (AI)
- 9 Complex problem solving
- 10 Getting around (walking <3 km/h)
- 11 Continuous operation
- 12 Safety in interacting with people
- 13 Flexibility in operation (Hardware)

//Organizational challenges

- 14 Legislation and standards
- 15 Ramp-up of series production
- 16 Manufacturing cost
- 17 Financing
- 18 Identification of use cases
- 19 Expertise (software & hardware)
- 20 Industrialization

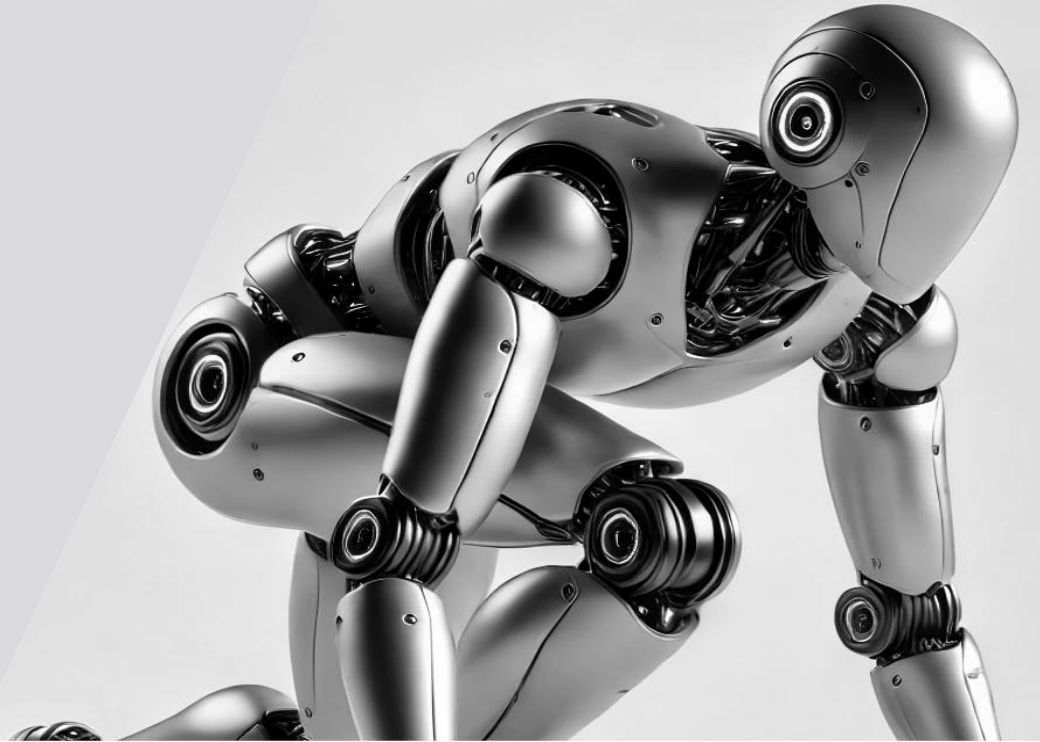
2023 ● 2024/25 ---> Changes 2023 to 2024

Disclaimer: Challenges can vary per vendor as well as per location (e.g., due to applicable legislation)

Source: NEXERY. | Figure 14 – Challenges of humanoid vendors

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Fields Of Action For Decision-makers.



#1

OBSERVE & ADAPT THE TECHNOLOGY

Stay **informed** about the latest **developments** in the field of humanoid robotics in order to identify **opportunities** and **challenges** in good time. **Pilot projects** or **collaborations** with technology providers can provide valuable insights.

#2

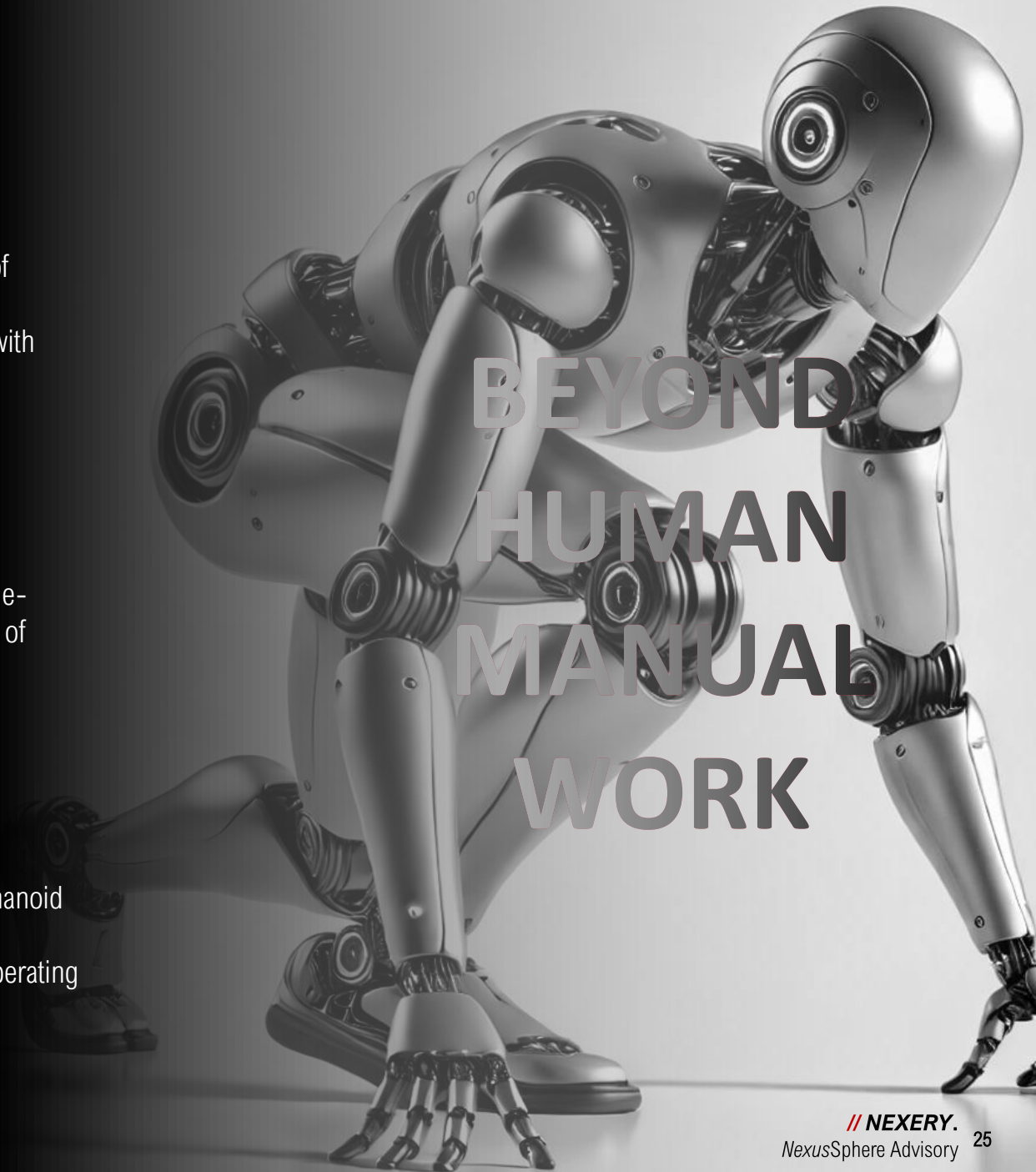
IDENTIFY AND EVALUATE FIELDS OF APPLICATION

Identify **fields of application** in value-adding and non-value-adding **activities** along the **value chain**. Evaluate the fields of application in terms of **feasibility** and **impact**.

#3

INTEGRATION IN THE OPERATING MODEL

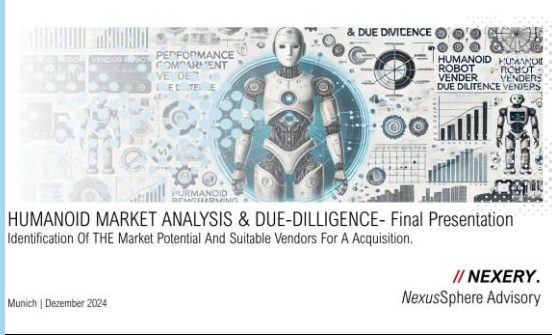
Build **knowledge**, **skills**, and **resources** for the use of humanoid robots. Start with a pilot project, then build a **Center of Excellence** for it and integrate the technology into your operating model.



Successful Humanoid Projects With Customer.

EXAMPLE #1

HUMANOID MARKET ANALYSIS.



50 VENDORS LONG- & 5 SHORT-LISTED

1 TECHNICAL DUE DILLIGENCE

CUSTOMER [Industry]



Private Equity

RESULT

As part of a **due diligence**, we analyzed the **market** for humanoid robots **vendors** on behalf of a private equity company. As a result, the **benchmarks** (Organizational & technology maturity) were compared with a **concrete acquisition candidate**.

EXAMPLE #2

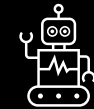
HUMANOID POTENTIAL ANALYSIS.



EFFICIENCY +350%

QUALITY +90%

CUSTOMER [Industry]



High-Tech products

&

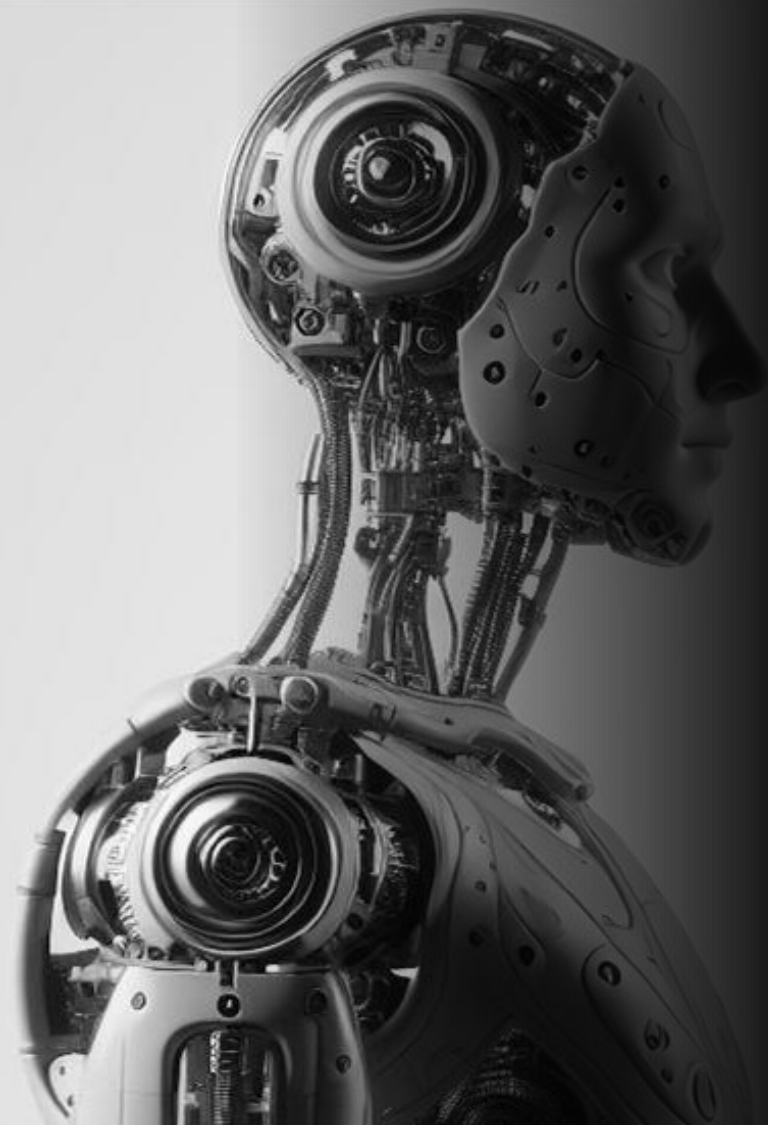


OEM

RESULT

In the context of several projects, we have been able to successfully support various customers in **determining the potential of humanoid robots** and **identifying fields of application** and suitable vendors.

Humanoids Will Disrupt Workforce In Operations And Enables Significant Savings.



ASSESSMENT

#01 BASELINE SETTING

Remote | Determination of the existing level of automation and manual activities



#02 TASK ANALYSIS

Onsite | Observation of all manual tasks and evaluation in the dimensions of ergonomics, stability, repetitiveness, complexity, standardisation & works-safety



#03 POTENTIAL VALIDATION

Remote | Determination of the tasks that can be automated by humanoids and derivation of the possible degree of automation



#04 WAY-FORWARD

Onsite | Identify the next steps for piloting and building the necessary knowledge for the use of humanoids



2 weeks per
Value
Stream

RESULT

CLATY OF TASKS IN WHICH HUMANIDS CAN BE USED ON SHORT- & LONG-TERM AND WHAT ADDED VALUE DOES IT BRING TO YOUR ORGANIZATION

Your Contact Person.



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// NEXERY.
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