Investing in Automation and Robotics: When Machines Learn to Work — How Investors Can Take Part in the Fifth Megatrend

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Abstract

In April 2026 a humanoid robot ran the Beijing half-marathon faster than the human world record — one year after half the machines in the same race had fallen or broken down. Hardly any image captures the pace of this megatrend better. This paper — the fifth of six on the great megatrends — examines automation and robotics from an investor's perspective: from the 542,000 industrial robots newly installed in 2024, through the merging of robotics with artificial intelligence, to the question of what labour market research actually knows about displacement and new employment.

The empirical picture: the stock of industrial robots has doubled within ten years to 4.7 million, China accounts for 54 per cent of new installations, and for the first time Chinese manufacturers supply more than half of their home market. At the same time, humanoid robots are taking their first steps into commercial use — carried by AI models that connect perception, language and movement, and by forecasts that range, depending on the house, from 38 billion to five trillion US dollars of market volume — a span that is itself a lesson.

For investors, the paper names listed companies across all stages of value creation — exclusively large- and mid-cap names with business idea and trading venue — and screens the ETF selection against a fixed checklist: physical replication, fund volume of at least 0.2 billion euros, costs, the currency question, issuer, UCITS status and exchange tradability. Four European funds pass. The structural news

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comes from the industry itself: ABB is selling its storied robotics division to SoftBank for 5.4 billion US dollars — the planned flotation became a takeover.

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JEL codes: G11, J23, L63, O33.

Non-Technical Summary

A good hundred years ago a Czech writer invented the word “robot” — for artificial workers who would take drudgery off human hands. Today 4.7 million industrial robots work in the world's factories, a good half a million are added every year, and machines have recently left the fence behind: they work beside people on the line, move containers in logistics centres, and in Beijing a humanoid robot ran the half-marathon in spring 2026 faster than any human ever has. Technology's oldest dream — the machine that works — is becoming a mass product.

This paper — the fifth of six on the great megatrends — explains what carries this shift: the union of robotics with artificial intelligence, which for the first time lets machines see, understand and relearn; the labour shortage of ageing societies, which turns automation from a rationalisation project into a necessity; and prices falling so fast that a Chinese maker now sells a humanoid robot for the price of a small car — and saw its August 2026 flotation rise more than 400 per cent on the first day of trading.

For investors, the paper describes who earns on all of it: the Japanese and European robot makers and their gear, sensor and machine vision suppliers; the software houses whose digital twins simulate entire factories; the warehouse automators of online retail; and the surgical robotics of medical technology. Roughly fifty large- and mid-cap stocks are presented with business and trading venue, plus the European robotics ETFs screened against a fixed checklist — four pass. And the paper takes seriously the worry that has accompanied the megatrend since Čapek: what do the best studies say about robots and jobs? The answer is more nuanced than either camp claims.

The most important warning comes last: robotics is a cyclical capital goods business with long waves — German industry revenue fell ten per cent in 2025 while humanoid euphoria multiplied valuations. Investors need both in view: the real, slow penetration of the factories and the fast expectation cycles of the exchange. Between the two lies the return — and occasionally a deep valley.

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1 Introduction

On 19 April 2026, at the Beijing half-marathon, a humanoid robot beat the human world record with a time of 50 minutes and 26 seconds — one year after the winner of the same city's first robot half-marathon had needed two hours forty, with much of the field falling, overheating or breaking down. A few months later the Chinese maker Unitree, whose smallest humanoid costs 5,900 US dollars, delivered the most remarkable flotation of the year: up 460 per cent on the first day of trading, valued at roughly 50 billion US dollars. And Amazon put its millionth warehouse robot into service in the summer of 2025 — against roughly one and a half million employees. Three news items, one message: the machine that works has moved from promise to mass phenomenon.[2]

Automation and robotics form the oldest of the great megatrends — and at the same time the youngest. The oldest, because the idea of the working machine has accompanied industry from its beginnings: in 1920 Karel Čapek invented the word "robot" for his play — from the Czech robota, forced labour — and in 1961 the Unimate, the first industrial robot in history, started work at General Motors. The youngest, because the field is reinventing itself: artificial intelligence, the subject of the second paper in this series (Rupprechter, 2026h), gives machines perception, language understanding and the ability to learn new things instead of repeating programmed ones. The blind tool behind the safety fence is becoming a system that sees, grasps and adapts — and so reaches fields of work that automation could not touch before.[3]

This paper continues the series of six studies on the major megatrends — after mobility (Rupprechter, 2026g), artificial intelligence (Rupprechter, 2026h), urbanisation (Rupprechter, 2026i) and water (Rupprechter, 2026j). Robotics is interwoven with all four: the autonomous vehicle is a robot on wheels, AI is its brain, the factories of the growing cities are its home, and even the water industry increasingly has machines inspect its networks. The paper is written for investors and pursues three goals: to understand what drives the robotics surge and how far it really is; to examine what research knows about the consequences for work and productivity; and to name concretely which stocks and funds capture the field — expressly without any buy or sell recommendation.

The structure: The first chapter serves as an introduction. Chapter 2 draws the numerical picture of the megatrend from the world robotics statistics — including an instructive statistical revision. Chapter 3 deals with the union of AI and robotics, chapter 4 with the rise of humanoid robots, chapter 5 with the connected factory and digital twins,

[2] Beijing half-marathon, 19 April 2026: robot "Lightning" in 50:26 against the 57:20 human world record (autonomous category); previous year, 19 April 2025: winning time 2:40 h; Unitree: first listing on Shanghai's STAR Market, 19 August 2026, day one +460 per cent, roughly 50 billion US dollars; Amazon: millionth robot July 2025.

[3] Čapek (1920): premiere of R.U.R. on 25 January 1921 in Prague; the word goes back to his brother Josef Čapek. Unimate: first industrial robot, General Motors, 1961.

chapter 6 with collaborative robots. Chapter 7 examines the drivers — demography, costs, Industry 5.0 —, chapter 8 the labour market research. Chapter 9 presents individual stocks, chapter 10 screens the ETFs, chapter 11 gathers the lessons, and chapter 12 closes with conclusions, an outlook and a look back across the five megatrends of the series.

2 The Megatrend in Numbers: Half a Million Robots a Year

2.1 Stock and additions

The field's most reliable source is the world robotics statistics of the International Federation of Robotics. Its latest edition counts roughly 542,000 newly installed industrial robots for 2024 — the second-highest figure in history and the fourth consecutive year above half a million (Figure 1). Within ten years the annual additions have more than doubled, and the global stock rose to 4.66 million machines. The steadiness deserves note: neither the pandemic nor the energy crisis broke demand for long — in 2020 additions fell by barely a tenth and reached new records the following year. Robots are bought when workers are scarce and costs press — and both hold in almost any state of the business cycle.[4]

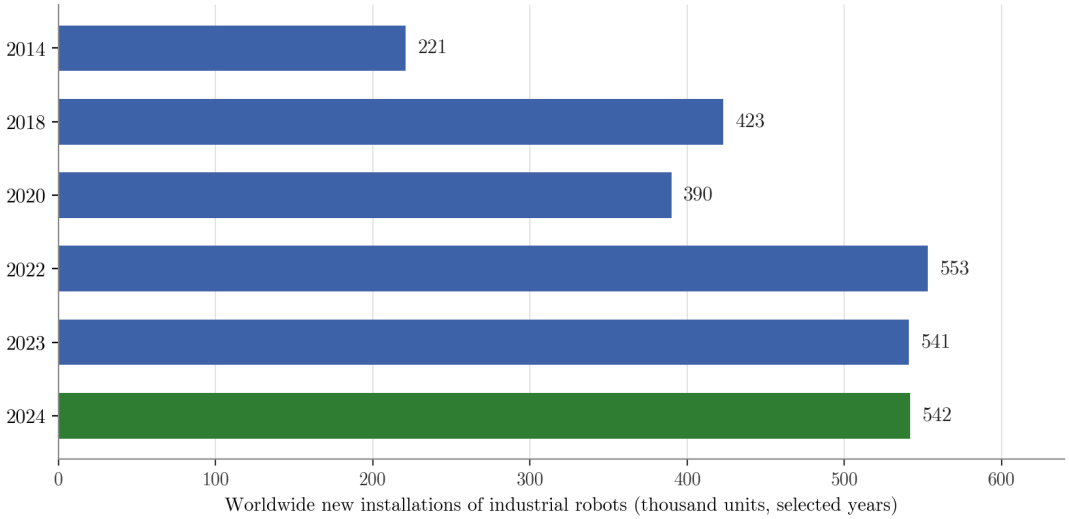

Figure 1: Worldwide new installations of industrial robots in thousand units, selected years 2014 to 2024. Source: IFR (2025a); own presentation.

The additions concentrate on one country to a degree no other megatrend in this series knows: China installed roughly 295,000 robots in 2024 — 54 per cent of the world — and holds a stock of over two million. New is the second figure behind it: for the first time, Chinese manufacturers supplied more than half of the robots installed in their own country — 57 per cent, after 47 the year before. What solar panels and electric cars have shown

[4] IFR (2025a), World Robotics: 542,076 installations in 2024 (minus 2 per cent against the revised 2023 record), stock 4.664 million (plus 9 per cent).

before is repeating in robotics: the world's largest market is building its own suppliers, and the established Japanese and European makers are losing share exactly where most is bought. For investors this is perhaps the most important competitive news for chapter 9.[5]

2.2 Robot density — and an instructive revision

How penetrated an economy is, robot density measures: machines per ten thousand manufacturing employees (Figure 2). South Korea leads by a wide margin with 1,220, ahead of Singapore with 818; Germany, at 449, narrowly leads the European field ahead of Japan, the USA follows with 307, and the world average stands at 132. China's figure of 166 stands out — and a lesson about statistics hangs on it that reaches beyond robotics: in the previous year's report the IFR had ranked China third in the world at 470. Between the two lies no de-automation but a revision — China's statistics office recounted manufacturing employment, the denominator grew, the density fell. Whoever compares indicators across countries and years should keep this case in mind: even the hardest number is only as stable as its definition.[6]

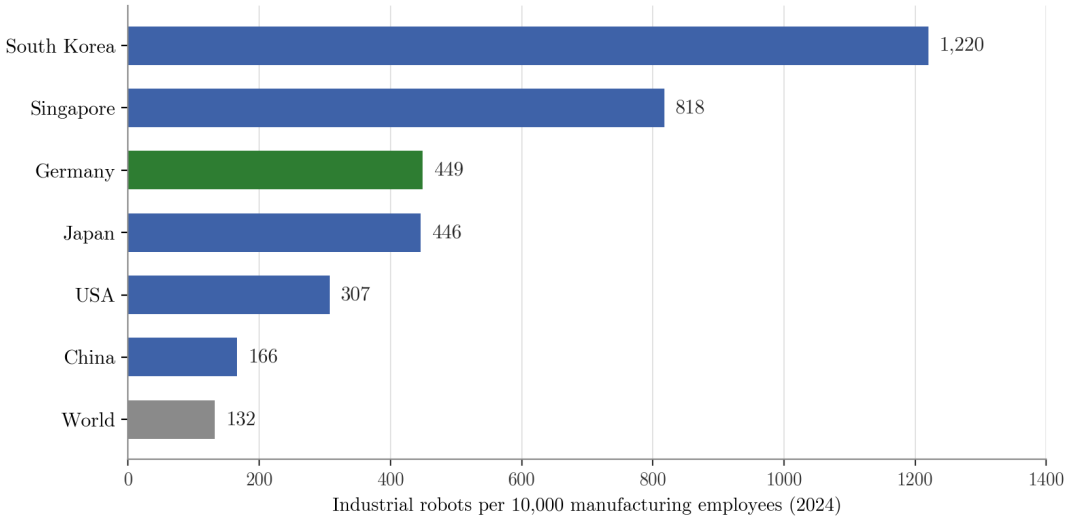

Figure 2: Robot density: industrial robots per 10,000 manufacturing employees, reference year 2024. China's figure is not comparable with earlier years owing to a revision of employment statistics. Source: IFR (2026); own presentation.

Behind the annual figures stands half a century of expansion in waves. The first wave belonged to the automobile: from the first Unimate at General Motors in 1961 into the 2000s, body shops were the robot's living room. The second wave carried electronics — Asia's factories building the world's phones and computers became the largest customer

[5] IFR (2025a): China 295,000 installations, 54 per cent world share; Chinese makers' home market share 57 per cent (2023: 47 per cent).

[6] IFR (2026, robot density release, April 2026): South Korea 1,220, Singapore 818, Germany 449, Japan 446, USA 307, China 166, world 132 per 10,000 employees (reference year 2024); previous report: China 470 — revision of the employment base by China's statistics office.

segment. The third wave rolled with online retail through warehouses and distribution centres. The fourth is beginning now and aims at the rest of the working world: workshops, laboratories, kitchens, care, construction sites — environments not built for machines, demanding perception, mobility and the ability to learn. Each wave has multiplied the market; the fourth is the first that in principle knows no industry boundary.

Europe plays a double role in this picture: technologically strong, falling behind in volume. The region installed roughly 85,000 robots in 2024 — 16 per cent of the world — just under 27,000 of them in Germany, by far the largest European market. At the same time the German industry association forecast a ten per cent revenue decline for 2025: the investment weakness of the car industry, for decades robotics' biggest customer, hits the makers directly. The contrast with Chinese additions could hardly be sharper — and it describes the strategic position of the European and Japanese suppliers: their strength lies in precision, components and software, while the volumes increasingly arise where demand sits. For the stock selection of chapter 9 this shift is the connecting thread.[7]

Beyond the factory, the field's second half is growing faster still: service robotics. The federation counted over 199,000 professional service robots sold in 2024 — transport and logistics machines in the lead — plus some 20 million consumer robots from vacuum to mower. Medicine grows steepest: sales of medical robots rose 91 per cent within a year — the surgical systems of the medtech groups listed in chapter 9 are the highest-margin single segment of all robotics. And robotics as a service is establishing itself as the business model: instead of buying machines, operators rent fleets with maintenance by subscription — lowering the entry barrier for smaller firms and giving providers recurring revenue.[8]

2.3 Five fields of action of the megatrend

For orientation, this paper divides the megatrend into five fields of action (Table 1) matching chapters 3 to 7: intelligent autonomy, in which AI models give robots perception and decision; the rise of humanoid robots in environments built for people; the connected factory, where operational and information technology merge and digital twins simulate entire plants; collaborative robots working beside people without fences; and the economic and social drivers from labour shortage through falling costs to Europe's Industry 5.0 vision. Across all fields one thing holds: the megatrend is investable at every stage — from the precision gear to the simulation software.[9]

[7] IFR (2025a): Europe 85,006 installations, Germany 26,982; VDMA Robotics + Automation (2025): 2025 revenue forecast minus 10 per cent to 14.5 billion euros.

[8] IFR (2025b), World Robotics Service Robots: over 199,000 professional units (plus 9 per cent), medical robots roughly 16,700 (plus 91 per cent), roughly 20.1 million consumer robots; robot-as-a-service fleets plus 31 per cent.

[9] Division of fields after this paper's brief; industry assignment own presentation.

Table 1: Five fields of action of automation and robotics and their investable industries

Field of action	Core topics	Investable industries (examples)
Intelligent autonomy through AI	Cognitive robotics, foundation models for machines, self-optimising production	AI chips and platforms, sensors, robot software
Humanoid robotics	Machines for human-made environments: logistics, manufacturing, later care	Humanoid makers, components (gears, actuators), platform groups
IT/OT convergence and digital twins	Merging of operational and information technology, virtual commissioning	Industrial software, plant control systems, simulation providers
Human-robot collaboration	Cobots without fences, sensor skin, simple operation for smaller firms	Cobot makers, safety sensors, machine vision
Economic and social drivers	Labour shortage, falling costs, Industry 5.0, robotics by subscription	Broad automation groups, warehouse automation, medical robotics

Sources: Own presentation; fields follow chapters 3 to 7.
Notes: No buy or sell recommendation; the chapters treat the fields in turn.

3 Intelligent Autonomy: When Artificial Intelligence Learns to Grasp

For decades the industrial robot was a blind precision tool: it repeated programmed movements a thousand times identically — and failed at every deviation. A slipped workpiece, different packaging, a new product: every change demanded engineers and downtime. Exactly this limit is falling. Multimodal AI models — trained on images, language and motion data — give machines a general perception for the first time: the robot recognises objects it has never seen, understands instructions in everyday language, and derives new movements from a few demonstrations. What the large language models were for text, these foundation models are to become for the physical world — the industry speaks of "physical AI".[10]

The tools come from the same groups that already carry the AI wave. In August 2025 NVIDIA launched Jetson Thor, a computer the size of a book that puts the power of a small data centre into the robot's body — Figure, Boston Dynamics, Agility and Amazon are among the first users, John Deere is evaluating it. Google DeepMind presented a robotics model in 2025 that runs entirely on the device, and extended it in July 2026 to whole-body control and teams of several robots — new two-armed systems, by the maker's account, learn from fewer than two hundred examples. For investors, a pattern from this

[10] On foundation model technology, Rupprechter (2026h), chapter 2; NVIDIA chief Huang (January 2025): "The ChatGPT moment for general robotics is just around the corner" (company statement).

series' AI paper repeats: the platform layer — chips, models, simulation tools — earns on the rise of every robot maker, whichever prevails.[11]

Why this was so hard, a paradox explains that the roboticist Hans Moravec described back in 1988: what people find hard — chess, calculus, file review — is easy for machines; what every child does effortlessly — grasping, walking, tying a shoe — is extremely hard for machines. Evolution invested millions of years in perception and motor skills, only millennia in abstract logic; the task of rebuilding them is distributed accordingly. Polanyi (1966) had framed the same core philosophically: "We know more than we can tell" — most human skill is tacit and cannot be written down as rules. Today's learning methods bypass exactly this hurdle, because they gain skill from examples rather than rules — which is why robotics is shifting its limit precisely now.[12]

With learning, what is scarce in the field shifts too. Classical robotics competed on mechanics — repeat accuracy, payload, cycle time. Learning robotics competes additionally on data: motion and grasp data from real operation are the raw material from which the models gain their skill, and whoever runs large fleets collects it in passing. Amazon learns from a million machines, Tesla from its factories and vehicles, the humanoid makers from every customer deployment — the same data flywheel logic this series' AI paper described for language models, now in the physical world. For the investor's competitive analysis this means: fleet size becomes a barrier to entry, and the head start of early operators can reinforce itself.[13]

One method accelerates this development out of sight: training in simulation. Instead of letting a robot practise for months in reality, its learning model runs through millions of simulated attempts in virtual worlds — falls cost nothing there — and is only then loaded onto the machine; practitioners speak of the path from simulation to reality. NVIDIA has built its own tool world around this idea, and Siemens connects its factory simulation to the same platforms — here the digital twins of chapter 5 and the learning robotics of this chapter touch. For investors this strengthens the platform thesis: whoever supplies simulation, training data and computing power sits at a narrow gate through which practically every robot development must pass.[14]

Intelligent autonomy first becomes visible where factories optimise themselves. In the most modern plants, machines exchange operating data in real time, reschedule job sequences when a line falters, and report wear before it becomes failure. Amazon shows the scale: the company reached its millionth warehouse robot in July 2025 and has since guided its fleets with its own AI system, which cut travel paths by a tenth; per employee, the

[11] NVIDIA (2025): Jetson Thor generally available since 25 August 2025, developer kit from 3,499 US dollars; Google DeepMind (2026): Gemini Robotics On-Device (June 2025) and Gemini Robotics 2 (July 2026), adaptation to new two-armed systems with under 200 examples (company statements).

[12] Moravec (1988), Mind Children; popularised by Pinker (1994); Polanyi (1966), The Tacit Dimension.

[13] On the flywheel logic of foundation models, Rupprechter (2026h), chapters 2 and 4.

[14] NVIDIA: Isaac simulation platform (company statements); Siemens: partnership with NVIDIA on industrial simulation since 2022 (company statements).

network moves more than twenty times the parcels of ten years ago. Such systems are no vision of the future but daily operations of the largest logistics firms — and the benchmark towards which the automation of smaller businesses will align in the coming years.[15]

4 Humanoid Robots: the Step into Application

The megatrend's most striking development is the rise of humanoid robots — machines in human form, built for environments designed for people. Their argument is economically compelling: factories, warehouses, stairs, door handles and tools exist billions of times over in human measure; a machine that can handle them needs no rebuilt world. For decades the form was technically out of reach — walking on two legs is Moravec's paradox in its purest form. Only the combination of learned motion control, lighter actuators and AI perception untied the knot; since 2024/25 the first humanoids have been working in regular businesses. Table 2 shows the state of the leading providers as of mid-2026.

Table 2: Humanoid robots: providers and status mid-2026

Provider (country)	Model	Status mid-2026	Price / valuation
Figure AI (USA)	Figure 03	Deployment at BMW Spartanburg (unit count not disclosed); predecessor helped build over 30,000 vehicles	private; ca. USD 39 bn
Tesla (USA)	Optimus	Series start repeatedly delayed; Fremont line converted, targets unmet	within group value
Unitree (China)	G1 / R1	Mass products; August 2026 flotation up 460 % on day one	G1 ca. 16,000, R1 ca. 5,900 USD
Agility (USA)	Digit	First commercial rental contract (GXO); over 100,000 containers moved	private; flotation announced
Boston Dynamics (Korea/USA)	Atlas	Electric successor; Hyundai plans plant deployment from 2028	Hyundai subsidiary
Apptronik (USA)	Apollo	Pilot programme with Mercedes-Benz	private; ca. USD 5.3 bn
1X (Norway/USA)	Neo	Home robot in pre-order	USD 20,000 or 499/month
UBTech (China)	Walker S2	Orders above 800 million yuan in 2025	listed (Hong Kong)

Sources: Company statements and press reports, end of August 2026; own compilation.
Notes: Figures on units and prices rest largely on maker statements; no buy or sell recommendation.

Behind the table stand very different levels of maturity — and an honesty that matters for investors. Real and documented is the logistics deployment: Agility's Digit works on a rental model at the logistics firm GXO and has moved more than a hundred thousand containers there; Figure's machines helped BMW over eleven months on more than 30,000 vehicles. Just as real is the Chinese cost offensive: Unitree sells its small humanoid for

[15] Amazon (2025): millionth robot, DeepFleet system with roughly 10 per cent shorter travel paths; parcels per employee from 175 to roughly 3,870 in ten years (company statements).

5,900 US dollars — the price of a used car. Unfulfilled, so far, are the biggest promises: Tesla had announced ten thousand Optimus units for 2025 and conceded in early 2026 that not one performs productive work — the production line was only converted in the summer of 2026. Whoever reads humanoid forecasts should separate maker statements from independent evidence, consistently.[16]

Worth noting is how the providers sell: increasingly not the machine but the working hour. Agility rents its Digits in fleet subscriptions with maintenance and software, 1X offers its home robot for 499 US dollars a month, and the industry speaks of robotics as a service. The model lowers the customer's entry barrier to zero upfront investment, shifts the technology risk to the provider — and, where it succeeds, converts cyclical machine sales into recurring revenue with plannable margins. It is the same pattern this series described for lifts, surgical robots and software: the durable business rarely arises at the sale, almost always in the installed base. Investors should therefore judge humanoid providers less by demonstration videos than by contract books and renewal rates — as soon as such figures exist.[17]

Nowhere is the humanoid build-up pursued as systematically as in China. Beijing staged the first World Humanoid Robot Games in 2025 — 280 teams, over 500 machines, 26 disciplines —, runs half-marathons for machines and supports the industry with the industrial policy playbook of solar and electric cars; behind Unitree, AgiBot is already pushing towards the exchange. The message of the events is double: they show, unvarnished, what does not yet work — in 2025 much of the marathon field failed — and they show the pace at which that changes, for one year later the human world record fell. Whoever wants to gauge the competitive landscape of the 2030s should not underestimate the seriousness of this state-backed effort.[18]

Academic honesty includes the counter-position. Critics object that the human form is simply the wrong design for most tasks: an arm at the line, a cart in the warehouse and a gripper on a gantry do their special task faster, cheaper and more robustly than any biped — the universal machine pays for its versatility with complexity, energy use and price. Logistics practice so far supports both sides: where environments are newly built anyway, specialised systems win; where machines move into existing human environments, the human form has its point. The likely outcome is therefore not replacement but division of labour — and for investors it follows that the humanoid theme should not be confused with the robotics theme: one is an option on the future, the other a documented business of the present.

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[16] Agility/GXO: over 100,000 containers moved, nine customer sites, over 65,000 operating hours; Figure/BMW: eleven months, over 90,000 parts; Tesla: 10,000-unit target for 2025 missed, statement January 2026, Fremont line conversion to summer 2026 — all company statements and press reports.

[17] Agility: fleet contracts including a 300-million-US-dollar multi-year order for 1,000 robots; 1X: 499 US dollars monthly (company statements).

[18] World Humanoid Robot Games, Beijing, August 2025: 280 teams, over 500 robots, 26 disciplines; AgiBot: Hong Kong flotation targeted for 2026 (press reports).

Accordingly, the forecasts diverge widely. Goldman Sachs puts the humanoid market of 2035 at 38 billion US dollars; Morgan Stanley considers over a billion humanoid robots and a market of five trillion US dollars possible by 2050, with unit costs falling from around 200,000 to 50,000 US dollars; Bank of America expects a million units sold annually from 2030. Between the smallest and the largest estimate lies more than a factor of one hundred — a span that says less about the future than about the present: the market barely exists yet, every figure is a model assumption. The investor lesson from this series' AI paper applies word for word: on such ranges one builds observation, not position sizes.[19]

For investors, access to the field is narrow: the pure humanoid pioneers — Figure, Apptronik, 1X, Agility — are private; Agility's announced flotation via a shell merger was not completed by end-August 2026, and Boston Dynamics belongs entirely to Hyundai. Listed exposure today runs mainly along four paths: the Chinese providers Unitree and UBTech — with valuations that after the Unitree debut reflect euphoria more than revenue —, Korea's Rainbow Robotics, in which Samsung holds 35 per cent, the platform and component layer from NVIDIA to the Japanese gear makers — and the patience to wait for the announced flotations instead of seeking detours through overpriced vehicles.[20]

5 The Connected Factory: Operational Meets Information Technology

Beneath the visible robots runs the quieter part of the megatrend: the operational technology of the factory floor — the systems that govern machines directly — is merging with the information technology of corporate IT. For decades the two worlds were separate: PLC technology at the line here, enterprise software and cloud there. Their union turns the factory into an end-to-end data-driven system: every order, machine and workpiece is digitally visible, and decisions fall where the data converge. This convergence is carried by the large industrial software and plant technology groups — Siemens, Rockwell, Schneider Electric, Emerson — which have been buying software houses for years: Schneider took Aveva, Emerson completed its takeover of Aspen Technology in 2025.[21]

The showcase of convergence is the digital twin: a virtual replica of machine, line or entire plant, fed with real-time data. New plants are commissioned virtually first, programs tested against the simulation, conversions planned without downtime — and increasingly the robots themselves train in simulation before entering the real hall. How large this

[19] Goldman Sachs (2025): 38 billion US dollars by 2035; Morgan Stanley (2025): 5 trillion US dollars and over 1 billion humanoids by 2050; Bank of America (2026): 1 million units a year from 2030, production costs from roughly 35,000 (2025) to roughly 17,000 US dollars (2030).

[20] Unitree: roughly 50 billion US dollars valuation after day one; Samsung/Rainbow Robotics: 35 per cent stake (not a majority); Agility: shell merger announced June 2026, completion open.

[21] Emerson: full takeover of Aspen Technology, completed March 2025; Schneider Electric: Aveva wholly owned since 2023.

market is, however, nobody knows precisely: analyst estimates for the early 2030s range from roughly 150 to over 570 billion US dollars — more than a factor of three apart, depending on what is counted in. This paper documents such spans deliberately: in the young part of the megatrend they are the rule, not the exception.[22]

The provider landscape of factory software is re-sorting meanwhile — three events of 2025/26 deserve investor attention. First, Honeywell became a pure automation group through the separation of specialty chemicals and aerospace — out of the conglomerate of old has come America's largest focused automator. Second, Synopsys took over the simulation specialist Ansys for 35 billion US dollars — chip design and physical simulation are growing together. Third, with Toyota Industries — parent of the warehouse automator Vanderlande — one of the big names left the exchange in June 2026 through a group buy-out. The sector is visibly consolidating towards fewer, larger platforms — with consequences for the selection in chapter 9.[23]

6 Cobots: Collaboration Instead of Fences

The idea of the collaborative robot is simple: a machine so safe that the fence can go. Force and torque sensors in every joint, pressure-sensitive skin and camera vision stop the cobot at the lightest touch; human and machine share the same workplace. The segment was invented by Denmark's Universal Robots — today part of the US test equipment group Teradyne and still the market leader — but the industry's giants have long built collaborative lines of their own, FANUC first among them, and from Korea the listed specialist Doosan Robotics pushes into the world market. A good one in ten newly installed industrial robots is now a cobot.[24]

Economically, cobots are above all automation for smaller firms. They cost a fraction of classical systems, need no rebuilding and can be taught without programming skills — the worker guides the arm through the movement once, the machine repeats it; the newest generation understands spoken instructions. This democratisation opens the industry's largest untapped market, for while the car industry has long been automated through, metal shops, joineries and food crafts are only beginning. The flip side is shown by the market leader itself: Teradyne's robotics unit went through a hard restructuring in 2025

[22] Digital twins, market estimates: roughly 36 billion US dollars (2025) with forecasts between roughly 150 (2030) and over 570 billion (2035) depending on the house — range documented.

[23] Honeywell: separation of Solstice (October 2025) and aerospace (June 2026), remaining company focused on automation; Synopsys/Ansys: completed July 2025, roughly 35 billion US dollars; Toyota Industries: delisted 1 June 2026.

[24] IFR: cobot share roughly 10.5 per cent of new installations (2023), rising; Universal Robots: market leader per industry analyses, part of Teradyne since 2015.

as industrial demand weakened — even the best tool sells cyclically when its buyers are cyclical.[25]

Where the journey leads, the providers' task lists show: machine loading and unloading, welding and grinding in workshops, laboratory automation in pharmaceutical research, camera-guided quality inspection, palletising in dispatch. These are the monotonous, ergonomically punishing or hazardous jobs for which staff can hardly be found anyway — so that the cobot rarely replaces a person economically, but fills an unfilled vacancy. Exactly this logic also carries the Industry 5.0 vision of the next chapter: the machine takes over what wears people down, and people keep what demands judgement. That this division of labour pays commercially is now well documented — whether it also holds socially, chapter 8 examines.

7 The Drivers: Demography, Costs, Industry 5.0

7.1 Labour shortage as a standing order

The megatrend's strongest driver appears in no technology press release but in the population statistics. Germany, by the calculations of its Institute for Employment Research, loses around seven million workers to demography by 2035 — a seventh of its labour market —, Japan and South Korea age faster still, and even China has passed the peak of its working-age population. It is no accident that the world's highest robot density is reached in the fastest-ageing industrial countries: where people are missing, the question “machine or human?” loses its opposition. Automation is changing from a rationalisation project that displaces workers into a capacity project that replaces missing labour — with correspondingly different political and workplace acceptance.[26]

East Asia shows the end stage of this logic. South Korea combines the world's lowest birth rate with its highest robot density — 1,220 machines per ten thousand manufacturing employees, almost ten times the world average — and Japan, whose working population has been shrinking since the 1990s, is at the same time the world's largest robot producer: close to half of all industrial robots built worldwide come from Japanese makers. The sequence is not chance but programme — where demography pinched first, the industry that answers it arose first. Europe and increasingly China follow the same curve one to two decades behind; the Japanese and Korean suppliers of chapter 9 are, in a sense, selling the rest of the world their demographic experience.[27]

[25] Teradyne: robotics revenue 293 million US dollars in 2024, restructuring 2025, first quarter above 100 million in Q2 2026.
[26] IAB (2022): around 7 million fewer workers in Germany by 2035 for demographic reasons.
[27] IFR (2026): robot density South Korea 1,220 per 10,000 employees; Japan: roughly half of world robot production per industry figures.

7.2 The cost curve

The second driver is price. As with batteries and solar cells, robotics follows the learning curve that Wright (1936) discovered in aircraft construction: with every doubling of cumulative output, costs fall by a stable percentage. Estimates of today's average industrial robot price diverge — the analyst span runs from a good ten thousand to over twenty thousand US dollars — but the direction is unambiguous and the humanoids accelerate it: Bank of America expects the production cost of a humanoid robot to fall from roughly 35,000 US dollars (2025) to about 17,000 (2030); Unitree already undercuts every Western forecast with its entry model. Falling prices shift the arithmetic of every automation project — and broaden the market into regions and firms for which robotics was unaffordable until now.[28]

Commercially, one simple calculation decides in the end: purchase and operation of the machine against the full cost of the working hour it replaces or supports. This calculation is tipping from both sides at once — machines are getting cheaper and more versatile while wages and, above all, the cost of unfilled positions rise: a shift that fails for lack of staff costs not an hourly wage but the margin of the whole line. That is why automation projects in high-wage countries often pay back within a few years, and why demand is far less cyclical than it looks: labour scarcity turns the optional investment into a necessary one. For valuing the makers this means that their order intake depends less on their customers' growth than on their customers' staffing gaps — an unusually stable demand base for capital goods stocks.

7.3 Industry 5.0 and the limits of the cycle

The European Commission gave the next chapter of automation a name in 2021: Industry 5.0 — human-centric, resilient, sustainable. After the pure efficiency logic of the connected factory, the vision moves people back to the centre: machines should relieve workers ergonomically rather than merely replace them, production should withstand shocks — from pandemic to trade policy —, and precise material use should cut scrap and resource consumption. One may see European programme prose in this; one may also soberly note that cobots, exoskeletons and quality sensors serve exactly this demand — and that resilience has been a budget-relevant procurement criterion since the supply disruptions of the early 2020s.[29]

The honest picture includes the cycle. Robotics is a capital goods business: bought when customers invest, cut when their utilisation falls. The German industry association expected revenue to fall ten per cent in 2025 to 14.5 billion euros — in the middle of the

[28] Wright (1936); price spans: diverging analyst estimates (documented); Bank of America (2026): roughly 35,000 to roughly 17,000 US dollars by 2030; Unitree R1: 5,900 US dollars.
[29] Breque, De Nul and Petridis (2021), the European Commission's Industry 5.0 concept.

greatest technology surge in the industry's history. Both at once is no contradiction but the field's nature: demand grows secularly and swings cyclically, and the exchange regularly overshoots in both directions. For investors follows perhaps the most useful single rule of thumb in this paper: robotics stocks are bought counter-cyclically in the investment trough — not at the peak of enthusiasm on which the humanoid valuations of 2026 stand.[30]

8 What Robots Do to Work: the State of Research

No question has accompanied the megatrend longer than the one about work — since Čapek's 1920 play about the machine revolt and Asimov's robot laws of 1950 it has been part of cultural history. Modern economics has made it measurable, and its answers are more nuanced than either camp — doom or cheer — claims. The pessimistic frame was set by Frey and Osborne (2017) with their much-quoted estimate that 47 per cent of American employment is technically automatable; the subsequent literature showed that occupations are rarely replaceable whole, mostly only in partial tasks — automatable means neither automated nor unemployed.[31]

The fear has a longer history than the robot itself. Keynes (1930) already coined the term “technological unemployment” — and predicted at the same time that the gain in prosperity would dissolve it in the long run; Wiener (1948), the founder of cybernetics, warned early of the social consequences of self-governing machines; Brynjolfsson and McAfee (2014) proclaimed the “second machine age”, and Baldwin (2019) extended the debate from the factory to service work. A century on, one can note soberly: employment in the world's most robotised economies — Japan, Korea, Germany — has not vanished but stands at historic highs; what shifted were tasks, industries and regions. Modern research therefore no longer asks WHETHER machines destroy work, but where, for whom and how fast work changes — and exactly there its answers become concrete for investors.[32]

Empirical measurement began with Graetz and Michaels (2018), who showed for seventeen countries: robots raised productivity growth appreciably — by roughly 0.36 percentage points a year — and lowered prices without reducing total employment; the losing group was above all the low-skilled. Acemoglu and Restrepo (2020) found the darker side for the USA: in regions with heavy robot use, employment rates and wages fell measurably — one additional robot per thousand workers cost jobs and pressed wages by almost half a per cent. Their theoretical frame (Acemoglu and Restrepo, 2019) explains

[30] VDMA Robotics + Automation (2025): 2025 forecast 14.5 billion euros of industry revenue, minus 10 per cent.
[31] Čapek (1920); Asimov (1950); Frey and Osborne (2017): 47 per cent of US employment in automatable occupations; on the task critique, Autor (2015).
[32] Keynes (1930), Economic Possibilities for our Grandchildren; Wiener (1948); Brynjolfsson and McAfee (2014); Baldwin (2019).

both at once: automation displaces tasks and creates new ones — what decides is which effect runs faster.[33]

Europe tells a third story. Dauth, Findeisen, Suedekum and Woessner (2021) examined Germany — the West's most robotised large country — and found no net loss of jobs: every industrial job lost was offset by new service jobs; incumbent workers stayed protected, and the adjustment was borne by labour market entrants, who found industrial work less often. And at firm level, Koch, Manuylov and Smolka (2021) turn the picture entirely: Spanish firms that adopted robots grew and hired — jobs were lost at the firms that did not. Automation thus shifts employment less from people to machines than from hesitant to automating firms — and from regions to regions.[34]

For investors this research has three practical consequences. First, it confirms the productivity core of the investment case: robots make economies measurably more productive — the source from which the sector's returns are ultimately fed. Second, it explains the political risk: where adjustment costs cluster regionally, robot tax debates and regulatory pressure arise — without consequence so far, but not a scenario to dismiss. Third, it supplies a selection criterion beyond the robot makers themselves: if adopting firms are the winners, the robotics case includes watching which user industries and companies deploy the technology most decisively — from logistics to surgery.[35]

Open remains the distribution question — and it concerns investors directly. When machines take over work steps, value creation moves from wage bills to capital income; the sector's equity returns are, in a sense, the flip side of the labour share. Historically, societies answered such shifts with education, redistribution and new fields of work — the move from farm to factory and on to services worked exactly that way for two centuries. Whether it must go faster this time, because machines now reach cognitive tasks too, is the open question this paper shares with the series' AI study. Investors need not answer it — but they should know that their portfolios assume an answer.[36]

9 Individual Stocks: Who Earns on the Working Machine

9.1 Selection principles

The following overviews group the listed field into three sets: the robot makers with their key components (Table 3), the factory software and plant technology groups (Table 4), and warehouse automation, medical robotics and large users (Table 5). Only large- and

[33] Graetz and Michaels (2018); Acemoglu and Restrepo (2020): minus 0.2 percentage points employment rate and minus 0.42 per cent wages per additional robot per 1,000 workers; Acemoglu and Restrepo (2019).

[34] Dauth, Findeisen, Suedekum and Woessner (2021); Koch, Manuylov and Smolka (2021): robot adopters plus roughly 10 per cent employment, non-adopters shrinking.

[35] On the division of gains between makers and users, again Teece (1986): whoever holds the scarce complementary assets — integration, data, process knowledge — earns along.

[36] On the parallel question for artificial intelligence, Rupprechter (2026h), chapter 10.

mid-cap names from roughly two billion US dollars are included; well-known smaller names — from a German camera specialist to a British online grocery automator that recently slipped just below the threshold — remain unnamed. Not investable, moreover, are the field's most prominent names themselves: KUKA belongs to China's Midea group, Universal Robots to Teradyne, Boston Dynamics entirely to Hyundai, and the humanoid pioneers are private. On the base statistics, once more Bessembinder (2018): a few names carry the entire excess return — selection does not replace diversification.[37]

9.2 Robot makers and key components

The industry's heart beats in Japan: FANUC and Yaskawa rank among the world's four large robot makers, Keyence rules sensors and machine vision with software-grade margins, and the quiet monopolies sit one level down — Nabtesco and Harmonic Drive build the precision gears that almost no robot joint in the world escapes, SMC the pneumatics, THK the linear guides. Europe's heavyweight ABB, by contrast, is taking leave of robotics: the flotation of the division announced in 2025 was dropped — instead ABB is selling the business to SoftBank for 5.4 billion US dollars; completion was still pending at the end of August 2026. And China's risers — Inovance, Estun, Siasun — have long been listed middleweights whose home market share grows year by year.[38]

[37] Bessembinder (2018), Journal of Financial Economics 129(3), pp. 440-457.

[38] ABB/SoftBank: sale of the robotics division for 5.375 billion US dollars enterprise value, announced October 2025, completion expected mid/late 2026; division: 2.3 billion US dollars revenue, roughly 7,000 employees.

Table 3: Robot makers and key components — large- and mid-cap names

Company	USD bn	Business idea in the megatrend	Traded on
Keyence	127	Sensors and machine vision — the eyes of automation	Tokyo
Mitsubishi Electric	71	Factory automation, robots, PLC technology	Tokyo
Teradyne	55	Semiconductor test; cobot leader Universal Robots and MiR	Nasdaq
FANUC	36	World's largest maker of industrial robots and CNC technology	Tokyo
SMC	28	World leader in pneumatics for automation	Tokyo
Hexagon	28	Metrology and manufacturing software	Stockholm
Inovance	25	China's largest automator: drives, PLCs, robots	Shenzhen
Kawasaki Heavy	14	Industrial robots and humanoid development	Tokyo
Cognex	10	Industrial machine vision	Nasdaq
Omron	8	Sensors, PLC technology, cobots	Tokyo
Yaskawa	8	Motoman robots and servo technology	Tokyo
Rainbow Robotics	7	Korean humanoid and cobot development; Samsung holds 35 %	KOSDAQ
Seiko Epson	6	SCARA assembly robots and precision technology	Tokyo
THK	5	Linear guides — the rails of every machine	Tokyo
UBTech	5	Chinese humanoid robots (Walker)	Hong Kong
Renishaw	5	Precision metrology and encoders	London
Estun	5	Chinese robot maker on the rise	Shenzhen
Nabtesco	4	Precision gears: in the joints of most large robots	Tokyo
Siasun	4	China's oldest robot maker, industrial and service robots	Shenzhen
Harmonic Drive	3	Strain wave gears for robot joints — a key humanoid technology	Tokyo
Doosan Robotics	3	Korean cobot specialist	KOSPI

Sources: Market capitalisations (rounded) end of August 2026; own compilation.
Notes: No buy or sell recommendation; selection without claim to completeness. ABB (USD 177 bn, Zurich) in the text: robotics division being sold to SoftBank.

9.3 Factory software and plant technology

The second group supplies the nervous system of the connected factory — and it is the field's highest-margin part, because software scales where metal cannot. Siemens is the European anchor with its industrial software portfolio, Schneider Electric and Rockwell dominate energy and manufacturing technology, and Honeywell enters for the first time as a pure automator after its break-up. Dassault Systèmes and PTC simulate products and production, Synopsys has absorbed physical simulation with Ansys, and from Taiwan Delta Electronics and Advantech grow as outfitters of Asia's factory digitisation. Whoever does

not want to bet on individual robot cycles finds the steadier business models in this layer — software subscriptions instead of machine orders.

Table 4: Factory software and plant technology — large- and mid-cap names

Company	USD bn	Business idea in the megatrend	Traded on
Siemens	259	Industrial software, digital twins, factory automation	Xetra
Schneider Electric	192	Energy and industrial automation; software arm Aveva	Euronext Paris
Delta Electronics	150	Power electronics and automation components	Taiwan
Emerson	86	Process automation; Aspen software wholly owned	NYSE
Synopsys	76	Chip design plus Ansys simulation	Nasdaq
Honeywell	69	Focused automation group after the break-up	Nasdaq
Autodesk	55	Design and manufacturing software	Nasdaq
Rockwell	48	America's largest pure factory automator	NYSE
Dassault Systèmes	35	3D design and production simulation (Delmia)	Euronext Paris
Advantech	19	Industrial computers and edge technology for the connected factory	Taiwan
Zebra	17	Data capture and mobile robots for logistics	Nasdaq
PTC	17	Industrial internet and product lifecycle software	Nasdaq
Trimble	14	Positioning for autonomous construction and farm machines	Nasdaq
Fuji Electric	13	Power electronics and factory automation	Tokyo
Yokogawa	8	Process technology for plants	Tokyo

Sources: Market capitalisations (rounded) end of August 2026; own compilation.
Notes: No buy or sell recommendation; selection without claim to completeness.

9.4 Warehouse automation, medical robotics and users

The third group shows where the machines go to work. In logistics, online retail has created the world's densest robotics landscape — Daifuku and KION/Dematic build the systems, Symbotic automates Walmart's distribution centres, AutoStore stacks in its cube warehouses, and GXO runs contract logistics as an automation pioneer including the first commercial humanoid deployment. In medicine, robotics has long been a precision business with recurring revenue: Intuitive Surgical dominates robot-assisted surgery, Stryker orthopaedic robotics — both earn per procedure on instruments and service, a textbook platform model. And the great users — from Amazon through Caterpillar with autonomous

mining trucks to Deere in the field — are the quiet robotics groups whose degree of automation appears in no industry statistic.[39]

Table 5: Warehouse automation, medical robotics and users — large- and mid-cap names

Company	USD bn	Business idea in the megatrend	Traded on
Amazon	2,873	World's largest robotics user: over 1 million warehouse robots	Nasdaq
Tesla	1,453	Highly automated manufacturing; Optimus programme (chapter 4)	Nasdaq
Caterpillar	368	Autonomous haul trucks and mine automation	NYSE
Deere	168	Autonomous tractors and precision farming	NYSE
Intuitive Surgical	133	Da Vinci surgical robotics; revenue per procedure	Nasdaq
Stryker	126	Mako robotics for orthopaedics	NYSE
Medtronic	116	Hugo surgical robotics in build-up	NYSE
Komatsu	39	Autonomous construction and mining machines	Tokyo
Symbotic	24	AI warehouse robotics; major Walmart orders	Nasdaq
Daifuku	15	World's largest material handling automation provider	Tokyo
Smith+Nephew	12	Cori robotics for joint surgery	London
KION	6	Forklifts and warehouse automation (Dematic)	Xetra
AutoStore	6	Cube storage robotics for retail	Oslo
GXO	5	Contract logistics as automation pioneer	NYSE
Kardex	2	Automated storage and retrieval systems	SIX Zurich

Sources: Market capitalisations (rounded) end of August 2026; own compilation.
Notes: No buy or sell recommendation; selection without claim to completeness. NVIDIA as platform supplier is treated at length in Rupprechter (2026h).

Across the three tables a clear geography of value creation shows: Japan holds the component and precision monopolies, America the software and medical robotics, Europe the factory and plant technology — and China the volumes, the home market and by now the humanoid euphoria. No portfolio captures that with two or three names. Whoever wants to hold the megatrend seriously combines the layers — components, makers, software, users — and the regions deliberately; or leaves that work to one of the broad funds of the next chapter and keeps as single names only what he understands better than the index does.

[39] Symbotic/Walmart, Agility/GXO, Caterpillar MineStar, Deere autonomy: company statements; medical robotics growth: IFR (2025b), plus 91 per cent.

10 ETFs on Automation and Robotics

10.1 The checklist and the offering

For fund selection, this series' fixed checklist applies: physical replication instead of swap contracts; fund volume of at least 0.2 billion euros as protection against closure; running costs (management fee and total expense ratio); the currency question; issuer; UCITS framework; continuous exchange trading. The robotics shelf is well stocked and saw strong inflows in the AI enthusiasm of 2025/26: four European funds pass the test (Table 6). The largest — the iShares fund — has grown within a short time to roughly four and a half billion euros; the oldest dates from 2014 and proves that a decade of fund history could be written with the theme. Hedged share classes are offered by no provider in the entire segment — investors carry the dollar and yen weight of the indices.[40]

Table 6: Robotics and automation ETFs under European law compared (UCITS)

ETF (short name)	Volume (EUR m)	Fee p. a.	Replication	SFDR	0.2 bn met?
iShares Automation & Robotics	ca. 4,540	0.40 %	physical	Art. 8	yes
L&G ROBO Global Robotics	ca. 1,490	0.80 %	physical	Art. 8	yes
Amundi MSCI Robotics & AI	ca. 1,140	0.40 %	physical	Art. 8	yes
ARK AI & Robotics (active)	ca. 280	0.75 %	physical, active	Art. 8	yes
WisdomTree Physical AI, Humanoids & Drones	ca. 175	0.45 %	physical	Art. 6	no
Global X Robotics & AI	ca. 124	0.50 %	physical	Art. 6	no
KraneShares Humanoid (KOID)	ca. 90	0.69 %	physical	n/a	no

Sources: Provider information and fund databases (justETF, extraETF), end of August 2026; volumes rounded.
Notes: No buy or sell recommendation. iShares with a distributing second class, the others accumulating; hedged classes not available in the segment. ARK fund actively managed (not an index fund).

10.2 What sits in the funds — and what to watch

Behind similar names stand very different funds. The iShares fund follows a broad index of well over a hundred names in near-equal weighting — much semiconductor and software technology besides robotics; its largest positions are currently the data house Snowflake, the chip tester Advantest and Keyence. The L&G fund is the robotics purist: roughly 85 names along the narrower automation world, at 0.80 per cent the group's most expensive.

[40] Fund databases (justETF, extraETF) and provider information, end of August 2026.

The Amundi fund carries robotics in its name but is 85 per cent a technology and cybersecurity fund — whoever seeks classical factory automation will hardly find it there. And the ARK fund is the only actively managed one, with Tesla as its largest position. The similarity of product names replaces no look into the holdings list — in the thematic segment the index decides, not the fund name.[41]

Two observations from the segment round off the picture. First, the new humanoid wave: since late 2025, a KraneShares and a WisdomTree product have brought the first funds with an explicit humanoid focus to market — both still below the volume threshold, both evidence of how quickly the fund industry pours stories into products. Ben-David, Franzoni, Kim and Moussawi (2023) showed how such theme-driven launches end on average: issued near the peak of enthusiasm, disappointing risk-adjusted thereafter. Second, the demarcation from AI: the large Xtrackers fund for artificial intelligence manages around seventy per cent more than the largest pure robotics fund — whoever holds both should know the overlaps. The ground rule stands: the thematic fund complements the world portfolio (Markowitz, 1952), it does not replace it.[42]

For practice, two points remain. First, the share classes: the iShares fund runs a distributing class beside the accumulating one — whoever wants running income finds it there; the other funds accumulate, and tax treatment follows, as always, the country of residence. Second, the view of history: the segment's oldest fund has carried its theme since 2014 through every cycle — the 2019 industrial recession, the pandemic slump and the rate turn — proving the theme suits a durable fund holding. The same history counsels patience: whoever entered near the 2021 peak of enthusiasm waited years for new highs. Entering in tranches, as this series recommends throughout, is worth most in the most cyclical of its six themes.

11 What Investors Can Learn from All This

First lesson: robotics is the megatrend with the longest record. For half a century the robot stock has grown through every crisis, the doubling within ten years is documented, and the productivity effect — unlike some younger themes — is solidly established by research. Whoever invests here buys no claim about the future but the continuation of a sixty-year development that is just receiving a new push.

Second lesson: separate what is documented from what is promised. The 542,000 robots installed in 2024 are statistics; the billion humanoids of 2050 are a scenario. In between lie

[41] Top positions per provider information, end of August 2026: iShares — Snowflake 3.7, Advantest 3.2, Keyence 3.1 per cent; L&G — Rockwell, Illumina, GEA each below 2 per cent (top 10 only around 18 per cent); Amundi — Palo Alto, CrowdStrike, AMD around 4 per cent; ARK — Tesla roughly 9 per cent.

[42] Ben-David, Franzoni, Kim and Moussawi (2023); Markowitz (1952); Xtrackers AI & Big Data roughly 7.8 billion euros against roughly 4.5 billion for the largest robotics fund (end of August 2026) — in substance an AI, not a robotics fund.

forecasts a hundredfold apart, flotations up 460 per cent in a day, and series starts postponed year after year. The discipline of this series — flag maker statements, document ranges, demand independent evidence — is nowhere as necessary as in the humanoid field.

Third lesson: the most reliable businesses sit one level beneath the spectacle. Who wins when humanoids arrive is open; that every one of them needs precision gears, sensors, machine vision, computing modules and simulation software is certain. The Japanese component monopolies, the sensor leaders and the industrial software are the megatrend's picks-and-shovels position — high-margin, broadly demanded and independent of which end provider prevails.

Fourth lesson: the cycle belongs to the business. Robotics is capital goods industry — German industry revenue fell ten per cent in 2025, Teradyne's cobot unit went through restructuring, while humanoid valuations celebrated records at the same time. Such divergence is no anomaly but the field's normal state. Counter-cyclical buying in the investment trough has historically paid better here than entering at the peak of the story.

Fifth lesson: China is market, competitor and risk at once. The country accounts for more than half of world demand, its makers now serve the majority of their own market for the first time, and its humanoid providers set the price benchmarks. Whoever holds Western and Japanese robotics stocks also holds the risk of Chinese competition — and whoever adds Chinese names, the political one. Deliberate geographic spread is no luxury in this megatrend but part of the investment case.

Sixth lesson: the labour question belongs in the risk picture, not the enemy picture. Research shows productivity gains, regional adjustment burdens and — in Europe — employment recomposition rather than employment decline. Politically the theme stays combustible nonetheless: robot taxes, conditions and industrial policy can shift returns. And Bessembinder (2018) holds here too: most stocks lag short-dated government paper over their lifetime — spreading across regions, stages of value creation and the funds of chapter 10 remains the most effective protection.[43]

Seventh lesson: the megatrends of this series overlap — and so do their funds. A robotics fund holds NVIDIA and Tesla, an AI fund likewise; the warehouse automators sit in logistics as well as robotics products, and whoever additionally holds single names from this series' tables buys some positions three times. Before every new thematic addition, the overlap check across the whole portfolio pays: concentration arises not only from bold bets but from the addition of seemingly different products. The six papers of this series are expressly written as one connected programme — their tables laid side by side show any investor within minutes where his themes double up.

[43] Bessembinder (2018).

12 Conclusion and Outlook — and a Look Back across Five Megatrends

Automation and robotics are a logical extension of this series of megatrends, as they bring together the first four megatrends: artificial intelligence gives the machines perception and the ability to learn, the mobility transition puts robots on wheels, the growing cities and their ageing societies create the labour shortage the machines are to fill, and even water is increasingly managed by sensors and machines. The sector itself stands at a double threshold: classical factory robotics grows steadily and cyclically at once, while humanoid robotics writes its first commercial chapter — with real deployments in logistics and manufacturing, but also with valuations and promises that run far ahead of reality.

The outlook: three questions decide the field's coming decade. First the technical one — whether the AI foundation models reach the reliability that turns impressive demonstrations into dependable workers; the answer falls in the logistics halls, not on trade fair stages. Second the industrial one — whether the Western and Japanese makers hold their component and software strength while China sets volumes and prices; the sale of ABB's robotics to Japan's SoftBank is a sign of the re-sorting. Third the social one — whether the transition succeeds so that automation stays accepted as the answer to labour shortage rather than fought as its cause. In all three, one thing holds: demand for working machines is the world economy's surest constant — contested is only who serves it.

And finally, the guiding principle: individual shares should only be held as part of a broad diversification across the value chain, or as a deliberately defined addition to a global portfolio in the form of an index fund.

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Preliminary note: Market, price and fund data without a separate reference are drawn from company statements, fund databases and the cited reports; as of end of August 2026. Figures on humanoid robots rest largely on maker statements and are flagged accordingly.

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