2025-2035 METATREND REPORT

THE RISE OF HUMANOID ROBOTS

Meet the Top 16 Humanoid Robots Shaping the Decade Ahead, and their Impact on Industries, Society and our Economy

"We will have 10 Billion Humanoid Robots on Earth by 2040."
– Elon Musk

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LEADERSHIP THOUGHTS

"If you've got a sentient humanoid robot that is able to navigate reality and do tasks at request, there is no meaningful limit to the size of the economy."

— Elon Musk, CEO, Tesla

"We are in the human-labor business, and today 50% of Global Domestic Product (GDP) is paying humans to do work every day, in other words human labor. That amounts to a marketplace of $40 trillion a year. It's 10 times bigger than all of transportation combined."

— Brett Adcock, CEO, Figure AI

"Humanoid robots will be as common as cars are today. 100 years from now, it's very clear, we'll have humanoid robots everywhere. They will likely be the largest volume mechanical system the world makes."

— Jensen Huang, CEO, NVIDIA

"By 2040 there could be a billion bipedal robots doing a wide range of tasks, freeing humans from the slavery of the bottom 50% of really undesirable jobs like assembly line and farm workers. This could be a larger industry than the auto industry."

— Vinod Khosla, Khosla Ventures

DASHBOARD

POTENTIAL MARKET SIZE

$38 billion
Goldman Sachs

$3 trillion
Macquarie Group

$24 trillion
Ark Invest

UNIT COST TODAY

$250,000
Morgan Stanley

UNIT COST PREDICTED

$20,000
Elon Musk

TOP 5 INDUSTRIES IMPACTED

- Agriculture
- Construction
- Eldercare
- Logistics
- Manufacturing

TOP 5 PLAYERS IN 2025

- Figure AI
- Tesla Optimus
- Agility Robotics
- Boston Dynamics
- Unitree

OPENING THOUGHTS

I was compelled to create this Metatrend report because the coming wave of humanoid robots will have a vast impact on society that is widely underappreciated. It will transform our lives at home and work.

How Many?: In my conversations with Elon Musk, Brett Adcock, Cathie Wood, and Vinod Khosla, the predictions on how many humanoid robots we will have working alongside us by 2040 is shocking at best. At the lowest bound, the number is 1 billion (which is more than the number of automobiles on Earth) and at the upper bound, proclaimed by Musk and Adcock, the number will exceed 10 billion.

How Much?: But equally impressive as the sheer number of robots is the price point, predicted to be between $20,000 to $30,000 which translates to a leased cost on the order of $300 per month, for a robot helper working 24 hours per day, 7 days per week.

Why Now?: The first question to ask is why now? Why are we seeing such an explosion of activity in the humanoid robot field now? Beyond any single technical advancement, the convergence of 5 major technological areas are super-charging this field: multimodal generative AI, high-torque actuators, increased compute power, enhanced battery life, cameras and tactile sensors. This, in combination with AI voice recognition, is transformative: As Brett Adcock recently told me, "We can literally talk to our robot and it can implement the tasks you request -- the end-state for this is you really want the default UI to be speech."

Impact on Jobs: Naturally, the prospect of billions of humanoid robots raises questions about their impact on jobs and society. According to Adcock: *"Our goal is to really be able to do a lot of the jobs that are not desirable by humans."* As of Q3 2024, there are nearly 8 million US job openings — jobs that people just don't want to do.

Creating a Future of Abundance: As Musk has commented regarding a future involving humanoid robots: *"This means a future of abundance, a future where there is no poverty, where people, you can have whatever you want, in terms of products and services. It really is a fundamental transformation of civilization as we know it."* Adcock echoes this vision, *"You can basically create a world where goods and services prices are trending to zero in the limit and GDP spikes to infinity … You basically can request anything you would want and it would be relatively affordable for everybody in the world."*

I hope you enjoy this Metatrend report, and are preparing for a future of Abundance (and an abundance of robots).

Best wishes,

Peter H. Diamandis, MD
Founder, Singularity, Abundance360, XPRIZE

7 KEY TAKEAWAYS ON HUMANOID ROBOTS

1 **Market Explosion:** The humanoid robots market is poised for exponential growth, with projections ranging from $38 billion by 2035 (Goldman Sachs) to a staggering $24 trillion (Ark Invest). In the U.S. alone, at the lower-bound, Morgan Stanley estimates 63 million humanoid robots could be deployed by 2050, potentially affecting 75% of occupations and 40% of employees. On the upper bounds, Brett Adcock and Elon Musk predict as many as 1 billion to 10 billion humanoid robots by 2040.

2 **Technological Convergence:** The rapid advancement of humanoid robots is driven by converging breakthroughs in AI, hardware components (actuators, sensors), and battery technology. Multimodal generative AI in particular is enhancing robots' adaptability and decision-making capabilities, while hardware costs are plummeting.

3 **Labor Shortage Solution:** Humanoid robots are emerging as a critical solution to global labor shortages, particularly in elderly care, manufacturing, and dangerous jobs. By 2030, the U.S. is projected to have a 25% "dependency ratio" of people over 70, driving demand for robotic assistance in healthcare and social care. In China and other parts of Asia and Europe, an aging population and lower birth rates make humanoid robotics critical for their economy.

4 **Cost Reduction Trends:** The cost of humanoid robots is plummeting rapidly, with high-end models dropping from $250,000 to $150,000 in just one year: a 40% decrease compared to the expected 15-20% annual decline. Ambitious targets, such as Tesla's goal of a $20,000 selling price for its Optimus robot, suggest mass adoption will become feasible across various sectors.

5 **Investment Opportunities:** The humanoid robot sector is attracting significant investment, exemplified by Figure AI's recent $675 million funding round at a $2.6 billion valuation. Morgan Stanley's "Humanoid 66" list provides a roadmap for investors interested in both robotics developers and potential beneficiaries across various industries.

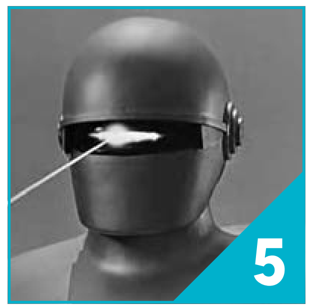
6 **Broad Societal Impact:** The widespread adoption of humanoid robots has the potential to usher in an era of unprecedented abundance, dramatically reducing the cost of goods and services while freeing humans to focus on creative and fulfilling pursuits. This transformation could reshape our concept of work and fundamentally alter the structure of our economy and society.

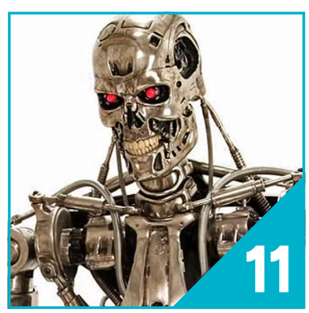
7 **Job Disruption:** The speed at which multimodal generative AI and humanoid robot development is progressing, paired with the lack of public discourse on this subject, indicates that there will be significant job disruption and societal upheaval. Mechanisms to address these concerns such as universal basic income (UBI), will need to be addressed. Some have proposed funding such UBI programs by taxing companies which utilize “robots and AIs” to displace previously human-filled jobs.

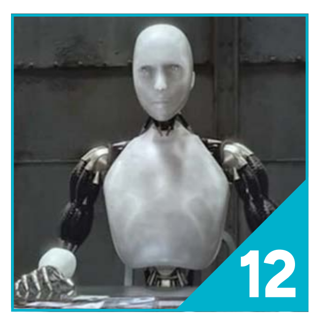
THE ROBOTS THAT SHAPED OUR VISION OF THE FUTURE

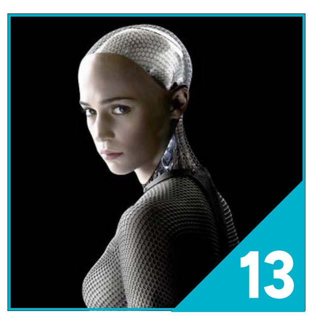
Over the course of the past 100 years, a number of iconic robots have shaped our vision of what a robot should look like, and how it should behave. Let's take a look at the top stars from film and TV:

1. **Maria**
(Metropolis, 1927)
2. **Robby**
(Forbidden Planet, 1956)
3. **The Robot**
(Lost in Space, 1965)
4. **HAL 9000**
(2001: A Space Odyssey, 1968)
5. **Gort**
(The Day the Earth Stood Still, 1951)
6. **R2-D2 and C-3PO**
(Star Wars, 1977)
7. **Ash and Bishop**
(Alien Series, 1979 and 1986)
8. **Roy Batty**
(Blade Runner, 1982)
9. **Johnny 5**
(Short Circuit, 1986)
10. **Data**
(Star Trek: The Next Generation, 1987)
11. **T-800**
(The Terminator, 1984 and 1991)
12. **Sonny**
(I, Robot, 2004)
13. **Ava**
(Ex Machina, 2014)
14. **Dolores and Maeve**
(Westworld, 2016)

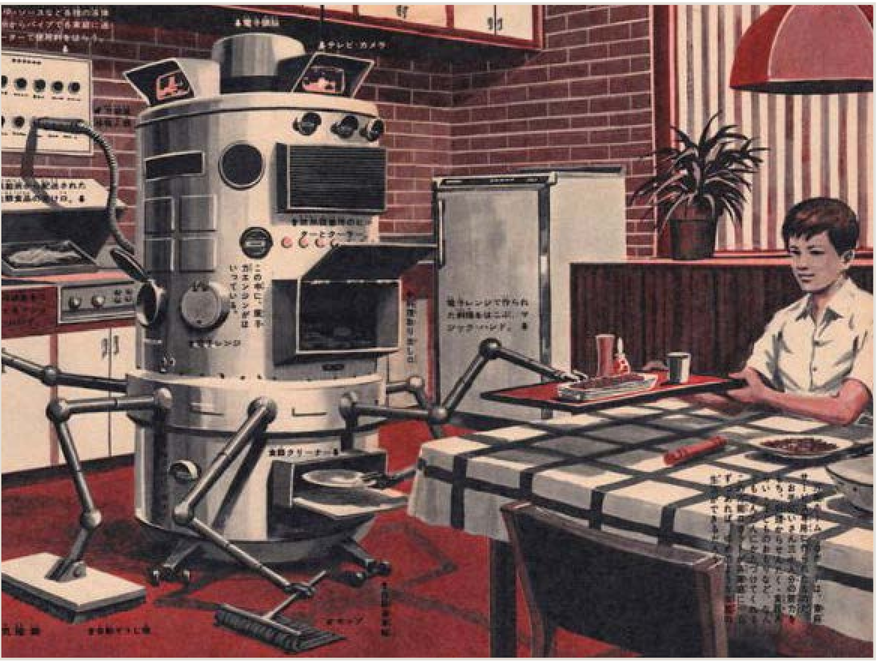






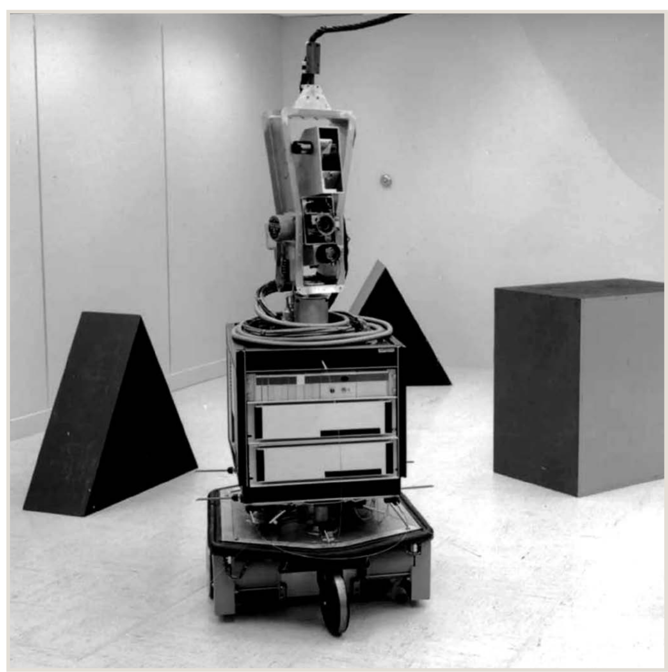


HUMANOID ROBOTS: HISTORICAL CONTEXT



The dream of humanoid robots has tantalized our imaginations for decades, promising a future where mechanical helpers seamlessly integrate into our daily lives. This vision, once confined to the realm of science fiction, is now rapidly materializing before our eyes. We stand on the precipice of a technological revolution that will fundamentally reshape our world, our work, and our understanding of what it means to be human.

In the 1960s, Silicon Valley-based SRI International unveiled "Shakey," a pioneering mobile robot that, despite its aptly chosen name, represented a quantum leap in robotics. Resembling a tall tower of electronics and cameras perched atop wheels, Shakey was the first of its kind to perceive and reason about its surroundings. *Life Magazine* hailed it as the "first electronic person" in 1970, a prescient title for a machine that would pave the way for generations of increasingly sophisticated robots.



Honda's ASIMO robot development (left to right) from 1986 to today.

Fast forward to October 2000, when Honda's charming ASIMO captured the world's imagination. Clad in what looked like a teenager's impression of a 1950s astronaut suit, ASIMO became an international celebrity. This charismatic robot rang the opening bell at the New York Stock Exchange, conducted the Detroit Symphony Orchestra, and even walked the red carpet at multiple movie premieres. The pinnacle of ASIMO's public appearances came in April 2014, during President Obama's visit to Japan. With impeccable politeness, ASIMO greeted the President in English: "Mr. President, I am ASIMO, a humanoid robot. It is a pleasure to meet you." The robot then proceeded to showcase its repertoire of impressive moves, including running, kicking a ball, and jumping.

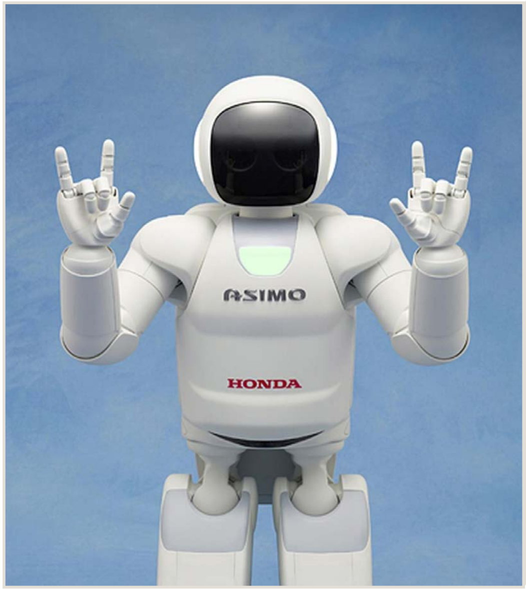


Photo credit: Paul Sancya / AP

Yet, for all their groundbreaking achievements, these early iterations of humanoid robots remained expensive curiosities, more suited to headlines than practical applications. It's only now, driven by technological convergence, that a generation of useful and affordable robots are within our grasp.

ENABLING TECHNOLOGIES:
THE PERFECT STORM OF INNOVATION

The rapid advancement of humanoid robots isn't the result of a single technological leap, but rather a remarkable convergence of multiple innovations across various fields.

AI Advances as a Market Driver: At the heart of this revolution lies the extraordinary progress in multimodal, generative artificial intelligence – for example OpenAI GPT-4o's ability to see, listen, and speak.

Tesla's in-house AI supercomputer

Today's humanoid robots are equipped with AI-enhanced vision systems, enabling activities like selecting, sorting and understanding. Using reinforcement learning, robotic AI systems can autonomously refine their operations for use in factories and homes, enabling self-improving decision-making algorithms, optimizing their actions.

According to a recent Morgan Stanley report, "The growth in AI drastically increases the potential for humanoids to manage complex and nuanced scenarios frequently encountered in the human workplace, and also increases the robots' ability to utilize the more complex arrangements of sensors/vision/actuators needed to make humanoids commercially viable."

"The growth in AI drastically increases the potential for humanoids to manage complex and nuanced scenarios frequently encountered in the human workplace"

Hardware Advances – The Physical Foundation of Progress: While AI provides the "brain" for humanoid robots, equally crucial are the advances in hardware that form their "body." In recent years, we've seen remarkable progress in actuators, sensors, and other physical components that are essential for creating robots that can move and interact with the world in human-like ways.

Morgan Stanley's research highlights how "developments to the physical humanoid 'body' (actuators, sensors, etc.), have and should continue to enable increasingly complex humanoid designs." New refinements in technologies such as planetary-roller screws, coreless motors, harmonic reducers, and six-axis force sensors have become commonplace in advanced humanoid designs.

A striking example of this progress can be seen in LiDAR (Light Detection and Ranging) sensors. A decade ago, a LiDAR unit cost about $100,000 and was the size of a coffee can. Today, thanks to innovations driven by the automotive industry, these crucial sensors have shrunk 1000-fold in size and 100-fold in cost. Companies like Luminar are now supplying LiDAR units to carmakers for just $1,000, with a goal of reaching $500 in the next few years. This dramatic reduction in size and cost of essential components is a key factor in making humanoid robots economically viable.

Battery Storage Technology – Powering the Robot Revolution: As humanoid robots become more sophisticated, with increased computing power and dexterity, they inevitably require more energy. Today's modern humanoids generally have battery lives of 1-3 hours when in operation. However, to make these robots commercially viable, we'll need to see significantly higher uptimes.

Fortunately, battery technology is advancing rapidly. As noted in Morgan Stanley's report "Will Moore's Law Apply to Batteries?", new battery developments over the past decade have gradually increased energy density by approximately 20% every two years. At this pace, we could see the commercialization of solid-state batteries—potentially the next major breakthrough for humanoid battery capacity—by 2028-30.

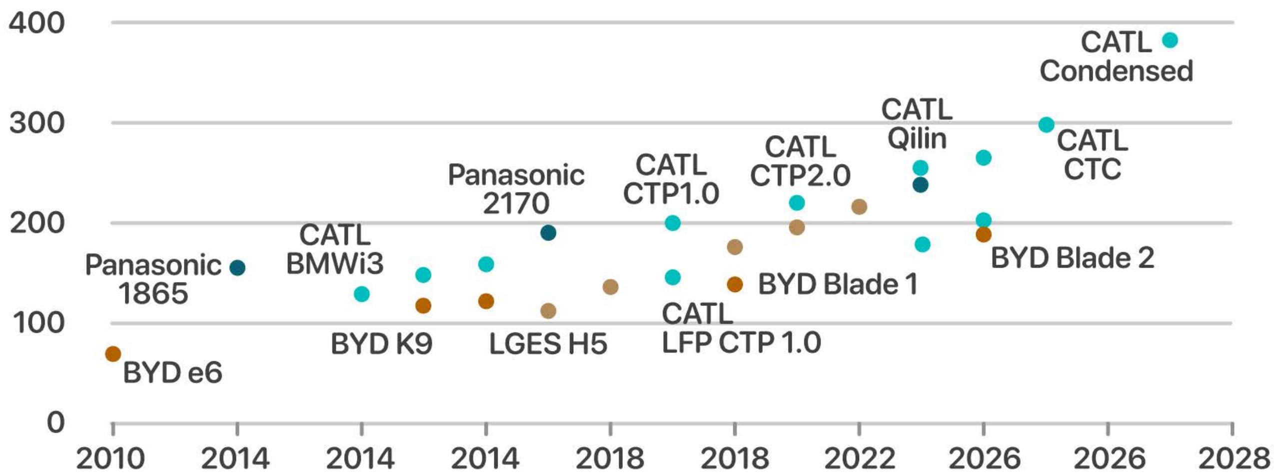
20%
average battery density increase every two years

Interestingly, there's a clear overlap between batteries designed for electric vehicles and those likely to be used in humanoids. Tesla's Optimus robot, for example, utilizes battery technology from the company's auto and energy businesses, allowing it to be produced using Tesla's existing supply chain and infrastructure.

$80
2030 projected cost per kWh

"Moore's Law" of Batteries?

Battery pack energy density increases by 20% about every two years.



Source: Morgan Stanley Research

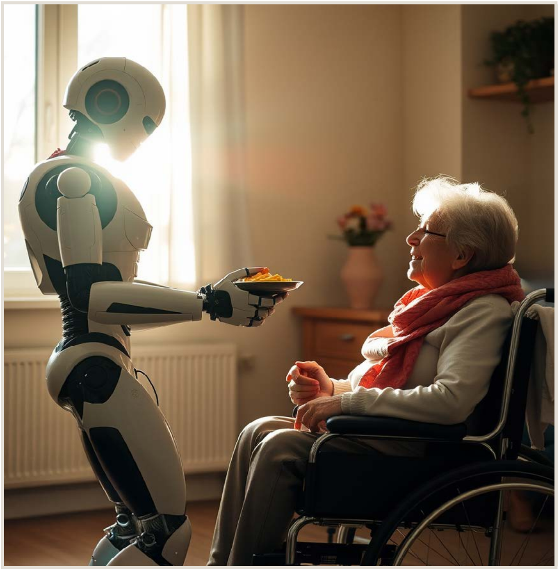
The economics of battery technology are equally promising. According to BloombergNEF's latest analysis, lithium-ion battery pack prices have reached a record low of $139/kWh in 2023—a 14% decrease from the previous year. This trajectory is expected to continue, with prices projected to reach $80/kWh by 2030, a price point that could dramatically improve the commercial viability of humanoid robots.

Beyond traditional lithium-ion batteries, the industry is exploring promising alternatives. Solid-state batteries offer higher energy density and enhanced safety through the elimination of liquid electrolytes, while hydrogen fuel cells present the possibility of extended operation times without frequent recharging. These advances, combined with sophisticated AI-powered battery management systems and thermal regulation, are creating a clear pathway toward humanoid robots capable of longer, more efficient operation—a crucial factor in their widespread commercial adoption.

ENABLING MARKET CONDITIONS

While technological advances have made humanoid robots possible, **it's the pressing need for labor in various sectors that's driving their adoption.**

The Elderly Care Crisis: One of the most pressing challenges facing many developed nations is the growing need for elderly care. A report from Morgan Stanley paints a stark picture: "By 2030, the United Nations forecasts a US population with 25 people aged over 70 for every 100 people aged 24-69 to look after them — a 'dependency ratio' of 25%. In Japan, it will be twice as acute, with 50 people over 70 years old per 100 people to care for them."



This demographic shift isn't limited to a few countries. Western Europe's dependency ratio is projected to be 35% by the end of the decade, while China's, currently at 20%, is expected to double by 2050. As the report notes, "Social care is arguably the world's largest TAM by the end of the century, but one that suffers from restrictive funding creating a lack of incentivization to recruit or re-skill workers."

In this context, humanoid robots emerge not just as a technological marvel, but as an increasingly necessary solution for a world facing immense longevity challenges.

*"By 2030, the United Nations forecasts a US population with 25 people aged over 70 for every 100 people aged 24-69 to look after them — **a 'dependency ratio' of 25%.**"*

35%
Dependency ratio in Europe by 2030

40%
Dependency ratio in China by 2040

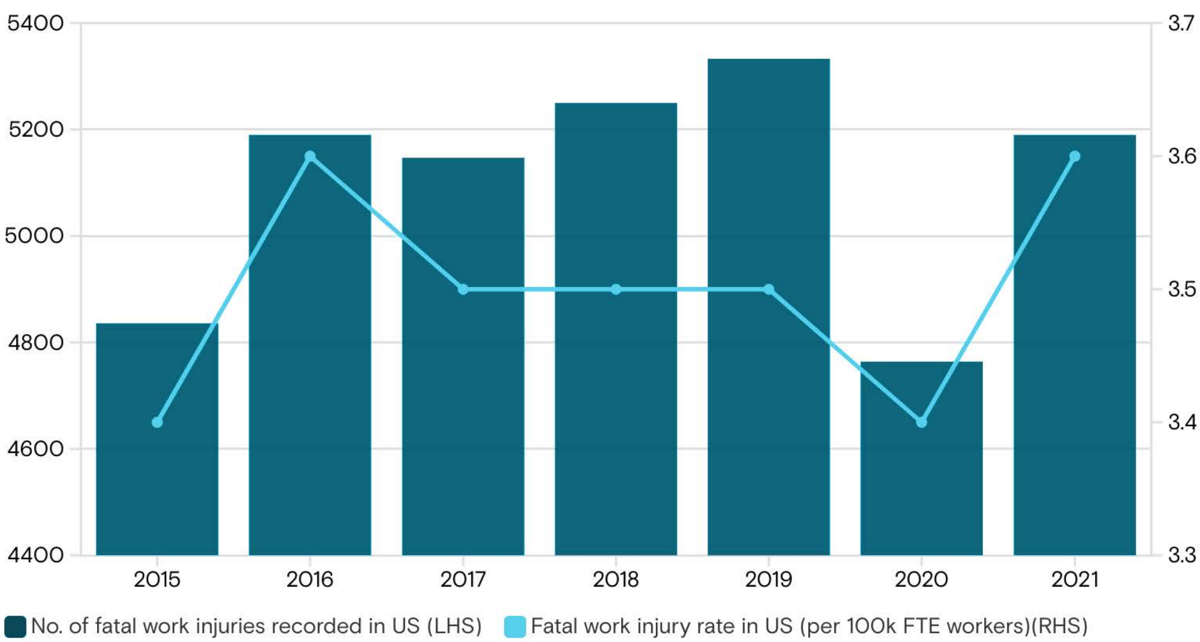
50%
Dependency ratio in Japan by 2030

Manufacturing and Dangerous Jobs: Beyond elderly care, other sectors are also grappling with significant labor shortages. A recent Goldman Sachs report highlights the potential for humanoid robots in car manufacturing and dangerous jobs like disaster rescue and nuclear reactor work. The report projects that "Assuming a labor substitution rate of 5-15% for car manufacturing as well as dangerous jobs like disaster rescue and nuclear reactor work, the demand for humanoid robots can potentially reach 1.1 million to 3.5 million units globally."

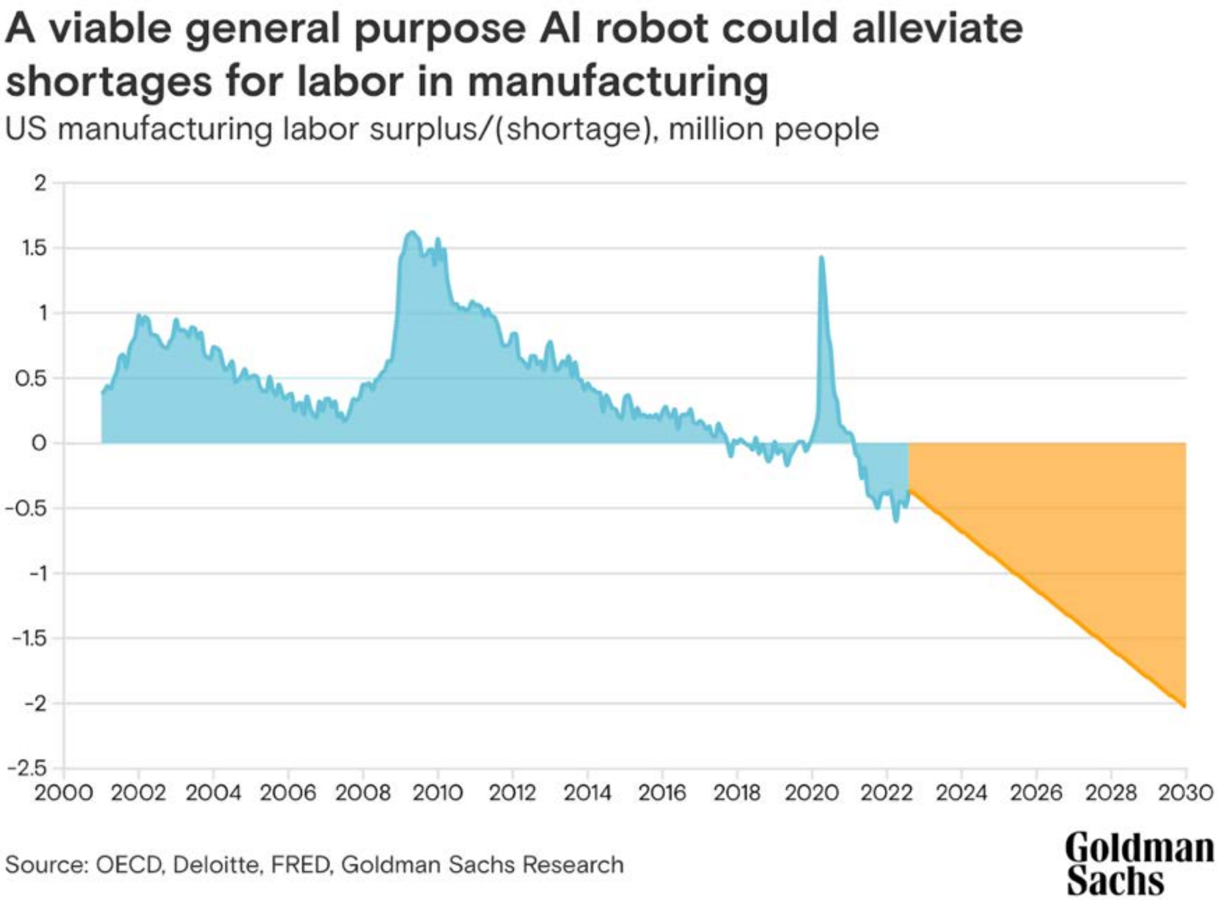
This isn't just about replacing workers, but about filling crucial gaps in industries where human labor is becoming scarce or where the work itself poses significant risks to human health and safety. As the report notes, "In a 'blue-sky' scenario, where innovation unfolds rapidly and demand soars, Goldman Sachs Research can envision humanoid robots becoming the next 'must-have' device, not unlike smartphones or EVs. Such robots would be vital for manufacturing and dangerous work, but they would also help with elderly care and fill in for labor shortages in factories."

A substantial number of workers around the world are at risk of injury and death

US 2015-2021 work injuries statistics



Source: : US Bureau of Labor Statistics, Goldman Sachs Research
FTE workers: Full-time equivalent (FTE) employees computed using reported hours worked (2,000 hours = 1 FTE)



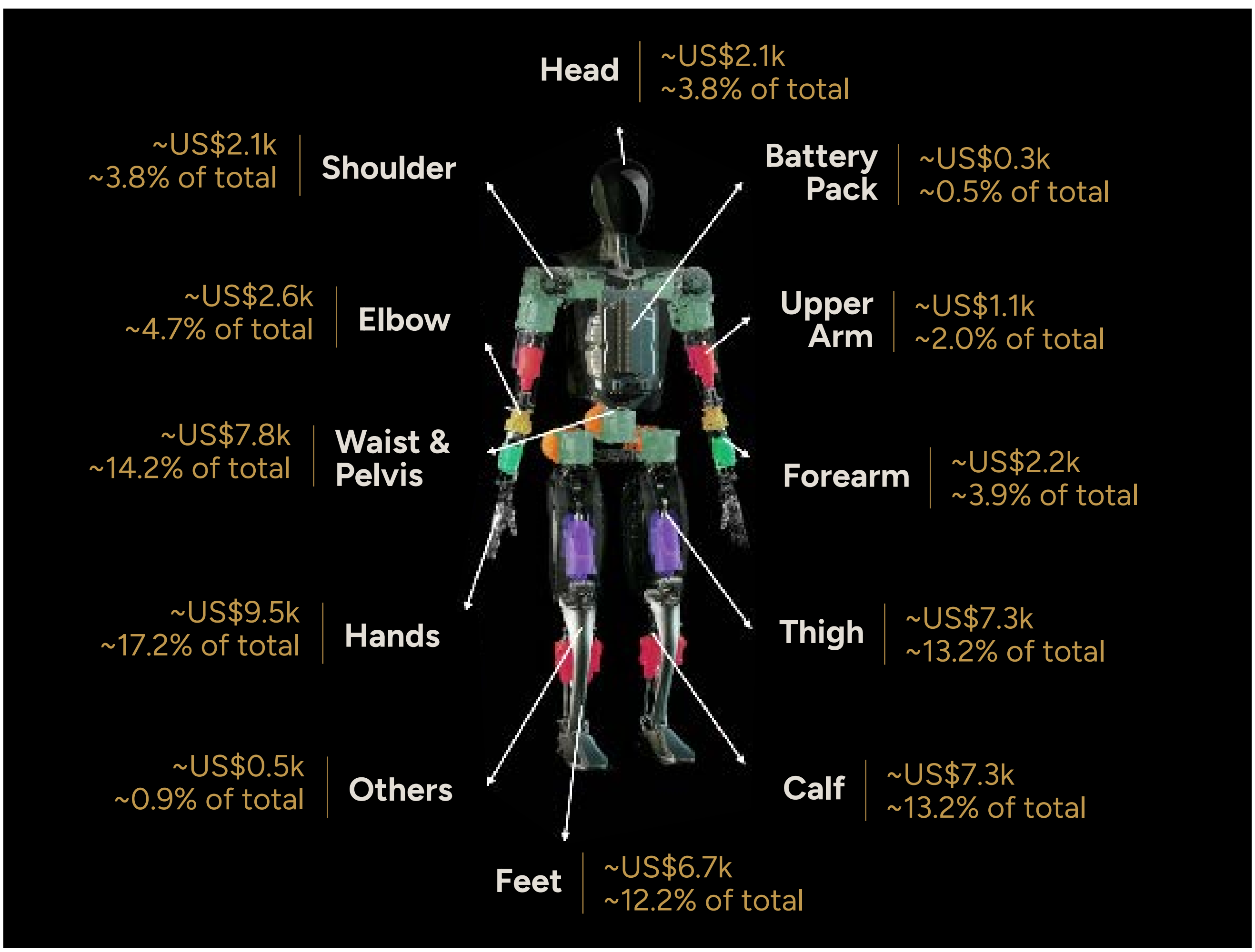
Demand from China and Japan: China and Japan, two of the world's most rapidly aging nations, face an urgent need for humanoid robots to fill the growing labor gap and support their economies. In Japan, more than 29% of the population is over 65, a figure projected to reach 35% by 2040. Similarly, China's working-age population is declining at an unprecedented rate, with its birth rate dropping to just 1.09 births per woman in 2023, well below the replacement rate of 2.1. By 2050, China's elderly population is expected to surge to 366 million, almost 30% of the country. This demographic crisis creates an immense demand for automation in both countries. Currently, Japan leads the world in robot density, with 399 industrial robots per 10,000 employees in 2022, yet labor shortages persist in healthcare, manufacturing, and eldercare. The Chinese entrepreneurial community is responding to its challenge with a compelling menagerie of humanoid robots.

ENABLING AFFORDABILITY

Falling Costs: The third key driver propelling the humanoid robot market forward is the rapidly falling cost of production. As with many technological revolutions, the economics of scale and ongoing innovations are making what was once prohibitively expensive increasingly affordable.

Given the relatively early stages of both humanoid robot development and adoption, the estimated costs of building a humanoid robot vary widely. As a 2024 report by Morgan Stanley points out, "Per our estimates, building humanoid robots could range from $10k to $300k depending upon configuration and downstream application."

To provide a concrete example, the firm conducted an analysis of what it could cost to build Tesla's Optimus Gen-2 humanoid robot from the ground up. Their finding? "Per primary component supplier price quotes and proprietary analyses, we estimate Tesla Optimus Gen2's current BoM is $50-60k per unit (ex-software)." See the below breakdown of estimated costs of the Tesla's Gen-2 humanoid robot by major part:



Source: Morgan Stanley Research Bluepaper "Humanoids: Investment Implications of Embodied AI"

Rapid Cost Reduction: However, these costs are falling faster than many anticipated. According to a Goldman Sachs report, "There are signs that robot components, from high-precision gears to actuators, could also cost less than previously expected, leading to faster commercialization. The manufacturing cost of humanoid robots has dropped — from a range that ran between an estimated $50,000 (for lower-end models) and $250,000 (for state-of-the art versions) per unit last year, to a range of between $30,000 and $150,000 now. Where our analysts had expected a decline of 15-20% per annum, the cost declined 40%."

This rapid decline in costs is making humanoid robots increasingly accessible to a wider range of industries and applications. It's worth noting that Tesla CEO Elon Musk has set an ambitious target of a $20,000 selling price for the Optimus robot. While this might seem optimistic, the combination of scale production, AI-driven R&D acceleration, and the utilization of cost-effective components from China could make such a price point achievable in the future. In addition, companies such as Unitree announced a price of US$16,000 for their G1 robot in late 2023.

	NPV	Humanoid Robot Cost					
	$-	**$1**	**$16,000**	**$40,000**	**$63,000**	**$110,000**	**$228,000**
Productivity Uplift	1%	-$3,565	-$20,609	-$46,177	-$70,679	-$120,749	-$246,457
	5%	$16,513	-$531	-$26,099	-$50,601	-$100,671	-$226,379
	10%	$41,611	$24,567	-$1,001	-$25,503	-$75,574	-$201,282
	15%	$66,708	$49,664	$24,096	-$406	-$50,476	-$176,184
	25%	$116,903	$99,859	$74,292	$49,789	-$281	-$125,989
	50%	$242,391	$225,347	$199,779	$175,277	$125,207	-$501
	75%	$367,879	$350,835	$325,267	$300,765	$250,695	$124,987
	100%	$493,367	$476,323	$450,755	$426,253	$376,183	$250,475
	200%	$995,318	$928, 274	$952,707	$928,204	$878,134	$752,426
	400%	$1,999,221	$1,982,177	$1,956,609	$1,932,107	$1,882,037	$1,756,329

Source: ARK Invest

As costs continue to fall and capabilities rise, we're approaching a tipping point where humanoid robots will become not just technologically feasible, but economically compelling for a wide range of applications.

We are already past the point where "human minimum wage" significantly exceeds "the hourly operating cost of a capable humanoid robot."

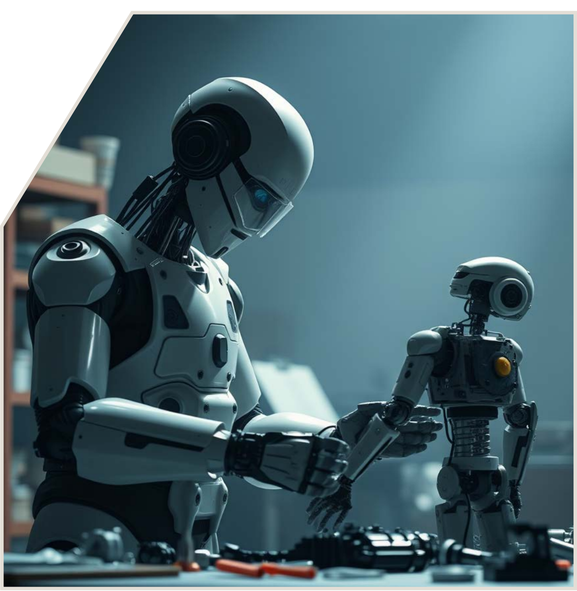
FIRST PRINCIPLES THINKING & HUMANOID ROBOTS

While the convergence of technologies, labor shortages, and falling costs are driving the humanoid robotics market forward, true breakthroughs often come from challenging our fundamental assumptions. Let's apply first principles thinking to envision how we might advance this industry even further.

Moonshots are born when we strip away preconceived notions and rebuild from the ground up by applying first principles thinking.

Let's apply this powerful approach to the humanoid robotics industry—a field ripe for innovation and transformation.

Manufacturing Costs: At their core, humanoid robots are composed of mechanical components (the body) and artificial intelligence (the brain). The cost and performance of these robots hinge on the materials used, the design of their components, and the intelligence that drives them. Typically the highest cost of any large complex system is human labor. ***In the out-years we will see humanoid robots, building humanoid robots, which will reduce labor to near zero, enabling a massive and rapid demonetization.***

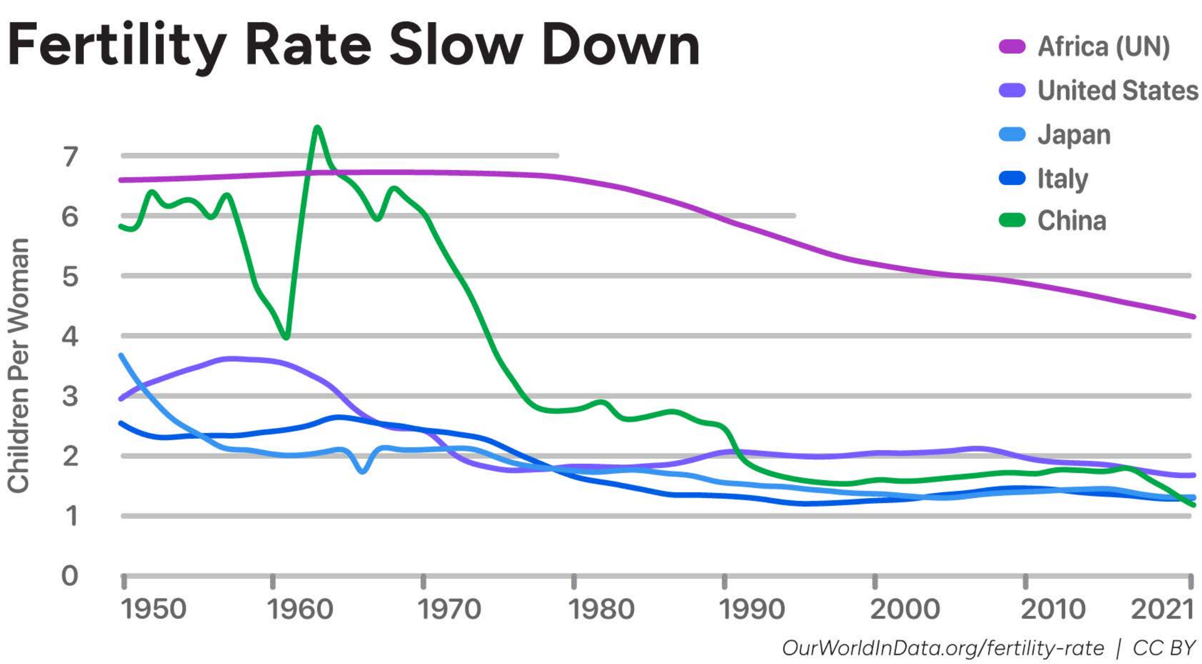


Intelligence Costs: The cost of developing increasingly capable multimodal generative AI systems for use in humanoid robots ***is being born by the large hyperscalers (Google, OpenAI, xAI, Anthropic, etc.) and will be continuously ported to humanoid robots at no additional cost.*** Humanoid robot intelligence is riding on a massive AI Metatrend.

Investment Capital: The human labor market represents 50% of the US$105 trillion global domestic product, or approximately US$50 trillion. Increasing market drivers (below) and the potential for sales numbering in the billions assures that the leading humanoid robot companies will have near-unlimited access to capital in a similar fashion to the top AI companies.

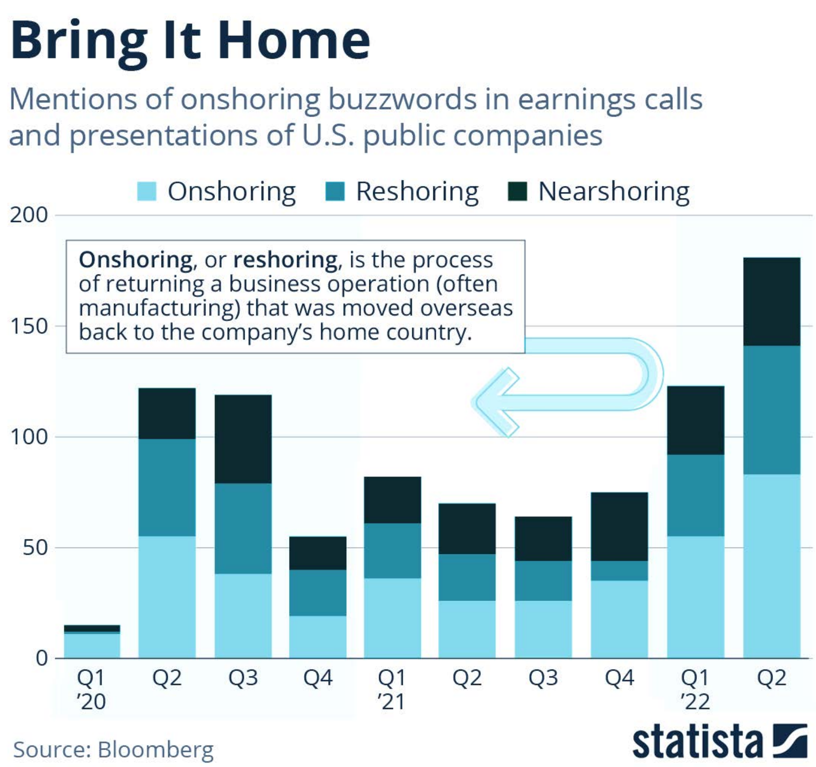
Market Need: A mix of market factors are driving a perfect storm for humanoid robot investment, construction, and adoption. These include:

- **Massive reduction in birth rates:** Reduction in birthrate will drive nations to turn to humanoid robots to fill jobs and maintain their GDP. The global fertility rate has fallen from 5 children per woman in 1950 to 2.4 in 2020. In 2021, the U.S. birth rate fell to its lowest point in more than a century: 56 births per 1,000 women aged 15-44. China's birth rate has dropped to just 1.09 births per woman in 2023, well below the replacement rate of 2.1. Japan's birth rate hit a record low of 1.34 in 2020. By 2050, it's projected that 55 countries will see their populations decrease by at least 1%. The working-age population in China is expected to shrink by 200 million people by 2050.



- **Elder population support:** The global population aged 65 and over is growing faster than all other age groups. By 2050, one in six people in the world will be over age 65 (16%), up from one in 11 in 2019 (9%). In Japan, 29% of the population is already over 65, the highest proportion in the world, and is projected to reach 35% by 2040. The U.S. Census Bureau projects that by 2034, older adults will outnumber children for the first time in U.S. history. The global market for elder care technology is expected to reach US$13.6 billion by 2022. There's a projected shortage of 355,000 paid caregivers by 2040 in the U.S. alone.

- **On-shoring of manufacturing:** The COVID-19 pandemic exposed vulnerabilities in global supply chains, accelerating the trend of reshoring. 69% of U.S. manufacturing companies surveyed in 2021 were considering bringing production back to North America. The Reshoring Index, which tracks the rate at which companies are shifting production back to the U.S., hit a record high in 2020. China's share of U.S. manufacturing imports fell from 67% in 2012 to 55% in 2020.



- **Need for competitive labor pricing:** The average hourly compensation cost for manufacturing workers in the U.S. was US$39.69 in 2019, compared to US$6.50 in China and US$4.45 in India. Automation could reduce labor costs by 18-33% in countries like South Korea, Japan, Germany, and the U.S. by 2025. The average cost of an industrial robot has fallen by 50% since 1990 and is projected to fall by another 65% by 2025. By 2030, up to 30% of the hours worked globally could be automated. In the U.S., the minimum wage has increased in 27 states since 2014, putting pressure on labor costs.

MARKET SIZE: HOW BIG CAN IT GET?

Projected Humanoid Market Value: Let's examine the estimates from four of the world's leading investment and research firms: Goldman Sachs, Morgan Stanley, Macquarie, and Ark Invest.

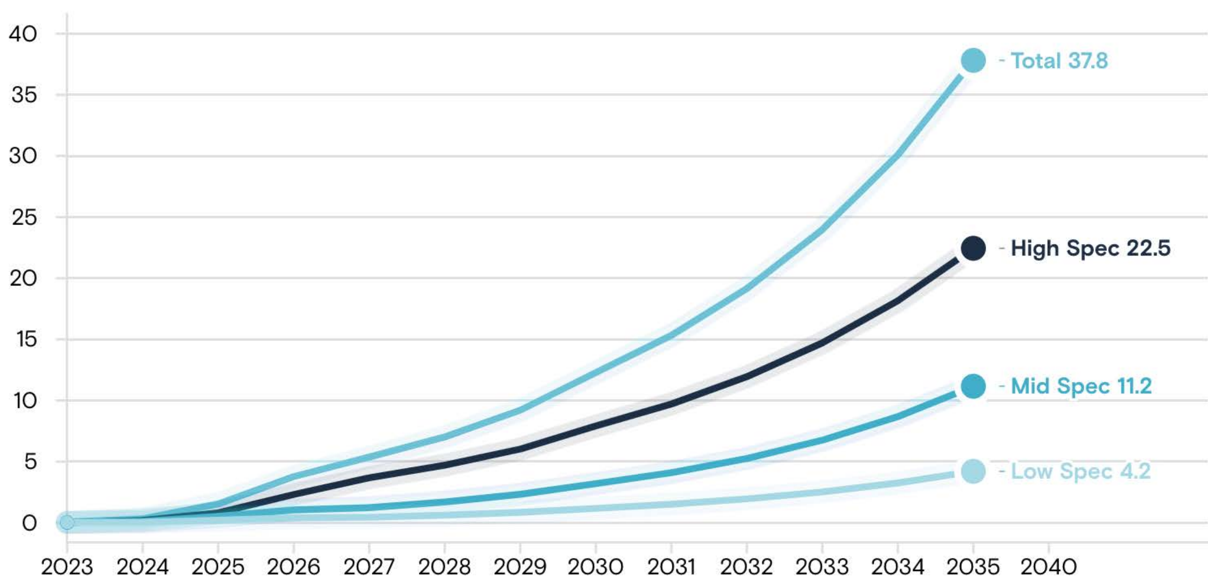
Goldman Sachs projects that "The global market for humanoid robots could reach US$38 billion by 2035." This represents a more than sixfold increase from their previous projection of US$6 billion, indicating rapidly accelerating growth expectations.

Morgan Stanley, focusing on the U.S. market, offers a more expansive long-term view. They estimate that "the US humanoids market could generate ~US$4 billion total revenue by 2030, ~US$240 billion total revenue by 2040, and ~US$1 trillion total revenue by 2050." This projection suggests a dramatic acceleration in market growth, particularly in the 2040-2050 period.

Macquarie presents a highly optimistic outlook, suggesting a potential market value of up to US$3 trillion by 2050. This figure underscores the transformative potential of humanoid robots across multiple sectors of the economy.

Humanoid robots are expected to become a $38 billion market by 2035

Forecast global humanoid robot market size ($ billion)



Source: Goldman Sachs Research
High, mid, and low spec refer to robot sophistication, from basic functionality to state of the art.

Goldman Sachs

However, the most bullish projection comes from ARK Invest. In their report "How ARK Is Thinking About Humanoid Robotics," they suggest that the global market for humanoid robots could be worth up to US$24 trillion. This estimate is based on the potential for humanoid robots to operate at scale in both household and manufacturing settings. As Elon Musk stated during Tesla's Q1 2024 earnings call, "If you've got a sentient humanoid robot that is able to navigate reality and do tasks at request, there is no meaningful limit to the size of the economy." ARK's research indicates that this US$24 trillion could be split roughly equally between household and manufacturing robotics applications.

> *"If humanoid robots are able to operate at scale, they could generate ~$24 trillion in revenues, split roughly equally between household and manufacturing robotics."*
> **— ARK Invest**

Generalizable Robotics Represent A Potential $24+ Trillion Global Revenue Opportunity

Household Robotics

~2.3 Hours of Unpaid Work per Day

×

~2.8 Billion Working Age Population

×

~$10.75 Weighted Average Hourly Wage

×

½ Value Attributed to Free Time vs Paid Time

=

~$12.5 Trillion Opportunity

Manufacturing Robotics

ARK Forecasts Global Manufacturing GDP At ~$28.5 Trillion In 2030

Productivity Uplift

Take Rate	10%	25%	50%	100%	200%	400%
10%	286	714	1,429	2,857	5,715	11,430
20%	571	1,429	2,857	5,715	11,430	22,860
50%	1,429	3,572	7,144	14,287	28,575	57,149

Revenue Opportunity*
(Billions)

=

~$12+ Trillion Opportunity
(Average Of The Green Cells)

Source: Ark Invest report "How ARK Is Thinking About Humanoid Robotics"

While these projections vary widely, they all point to an industry poised for explosive growth and transformative impact across multiple sectors of the global economy.

Projected Number of Robots: When it comes to the number of humanoid robots that could be deployed, estimates again vary widely, on the conservative side, financial institutions have projected rather low figures:

- **Goldman Sachs: 1.4 million units by 2035.**
- **Morgan Stanley: 63 million units (U.S. only) by 2050.**

These projections pale in comparison to the ambitious visions of some industry leaders, including Brett Adcock, Elon Musk, and Jensen Huang:

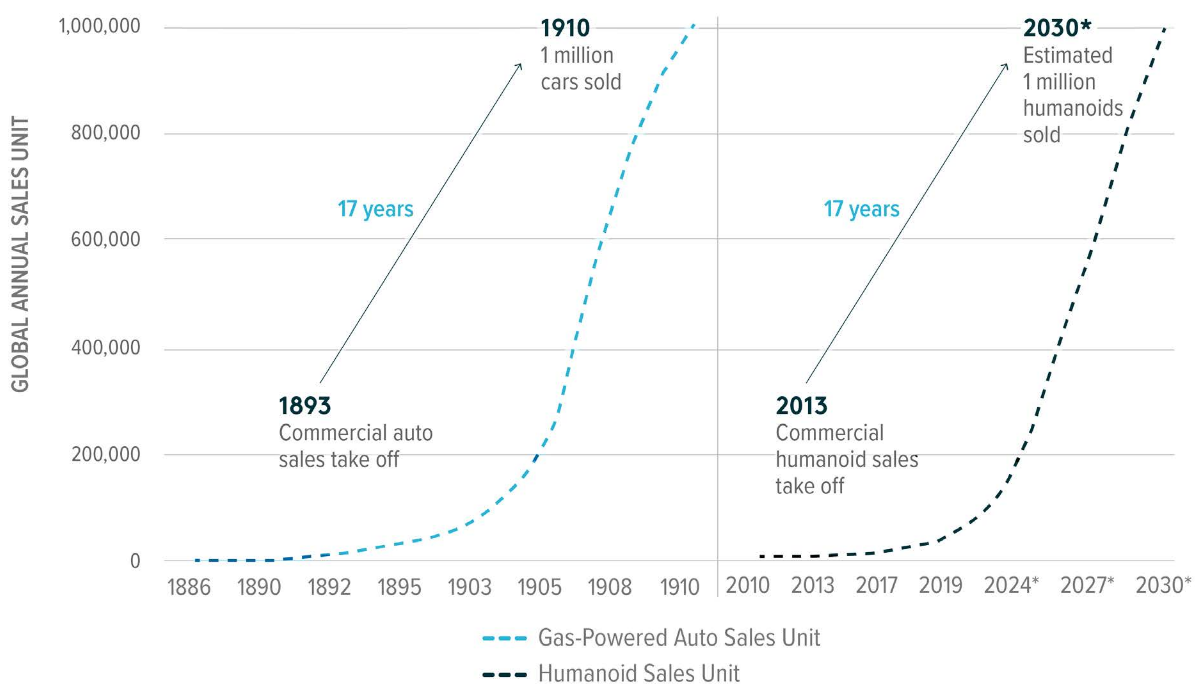
> **"The world will eventually need about 10 billion humanoid robots from all the various manufactures... by 2040."**
> **– Brett Adcock, CEO, Figure AI**

> **"Humanoid robots will be as common as cars are today."**
> **– Jensen Huang, CEO, NVIDIA**

> **"Humanoid robots will be 10X more common than cars."**
> **– Elon Musk, CEO, Tesla**

EARLY HUMANOID ADOPTION CURVE RESEMBLES THAT OF EARLY AUTOMOBILES

Sources: Global X ETFs with information derived from: Strategy + Business. (2023, August 15). Boston Dynamics wants to change the world with its state-of-the-art robots. Whisbi. (2022, February 1). The history of car sales.



2010-2019 are Global X estimates. *Indicates Global X forecast.

16 MAJOR HUMANOID ROBOT MANUFACTURERS

The humanoid robot race is on, with over 30 well-funded companies vying for leadership in this burgeoning field. While the majority of these companies are based in the U.S. and are being funded by players such as OpenAI, Amazon, NVIDIA and others, **a growing number of these companies are based in China—driven by the dual challenges of transitioning away from a "cheap labor" economy and addressing the needs of a rapidly aging population following its one-child policy.**

This surge in Chinese robotics development, with multiple startups unveiling their designs in 2024, intensifies the US-China AI race and signals a new era in robotic technologies.

Let's take a closer look at sixteen of the leading humanoid robotics companies and their flagship models.

NOTE: These 16 companies are presented below in two categories: **Market Leaders** and **Up-and-Comers**. This distinction is done based upon the maturity of the companies' technology and their financial backing and/or market capitalization.

5 MARKET LEADERS

Tesla ______ p23
Figure AI ______ p26
Agility Robotics ______ p29
Boston Dynamics ______ p31
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11 UP-AND-COMERS

1X Technologies ______ p35
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TESLA

Company
Tesla

Founded
2003

CEO
Elon Musk

Market Cap
~US$1.04 Trillion
(as of November 11, 2024)

Location
Texas, USA

Robot(s)
Optimus
Gen-2, Gen-3

AI Partner
Internal AI Division

Website
tesla.com

Gen-2 & Gen-3 Technical Specifications:

Description: Tesla's Optimus program represents a bold evolution in humanoid robotics, with two generations showcasing rapidly advancing capabilities. The Gen-2 model features enhanced sensors and improved locomotion, demonstrating tasks from factory operations to synchronized dance routines. The upcoming Gen-3 marks a significant advancement in dexterity with 22 degrees of freedom in hand movement, enabling delicate manipulation tasks from egg handling to potential piano playing.

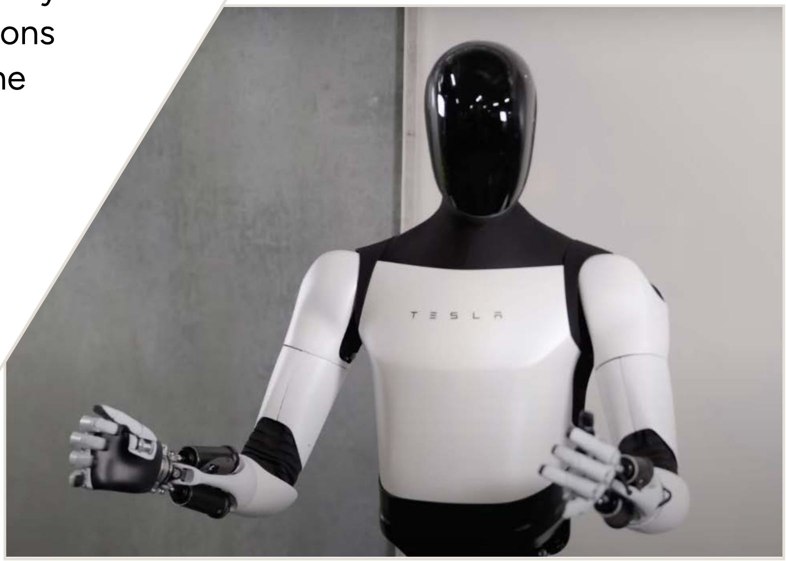
Gen-2

Height: 5 feet 10 inches (178 cm)
Weight: 130 pounds (59 kg)
Load: 45 pounds (20.4 kg)

Gen-3's enhanced tactile sensing and force control capabilities represent a quantum leap in manipulation precision, while maintaining industrial-grade lifting strength.

Major Partnerships: Unlike competitors, Tesla leverages its internal AI division and vast automotive technology stack, integrating advanced machine learning capabilities developed through its vehicle autonomy program. The company's vertical integration allows for rapid development and deployment of new features.

Commercialization Plans: Tesla plans to deploy 1,000 Optimus units in its own factories throughout 2024, following its proven automotive development strategy. CEO Elon Musk projects an eventual consumer price point of $20,000-$30,000, positioning Optimus for both industrial and domestic applications. The company's ambitious vision includes applications ranging from factory labor to home assistance, with Musk suggesting Optimus could become "the biggest product ever of any kind."



"Optimus has the potential to be more significant than Tesla's vehicle business over time."
– Elon Musk, CEO

FIGURE

Company
Figure AI

Founded
2022

CEO
Brett Adcock

Valuation
2.6 Billion

Location
California, USA

Robot(s)
Figure 02, Figure 01

AI Partner(s)
NVIDIA, OpenAI

Website
figure.ai

Figure 02 Technical Specifications:

Description: Figure AI's second-generation humanoid robot, Figure 02, represents a quantum leap in autonomous robotics technology, earning the company a 2024 RBR50 Innovation Award. The sleek, matte-black robot features advanced speech-to-speech capabilities and sophisticated hand-eye coordination through six onboard RGB cameras. Its fourth-generation hands offer remarkable dexterity with 16 degrees of freedom.

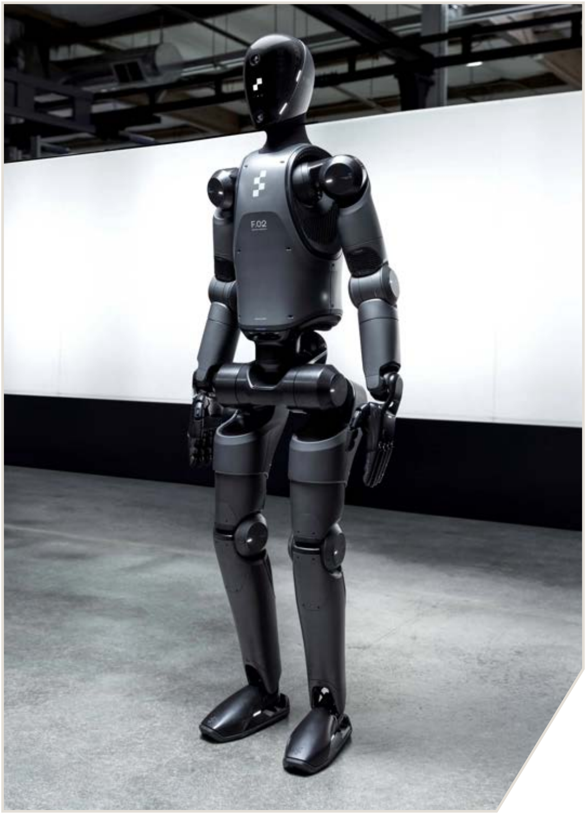


Figure 02

Height: 5 feet 6 inches (168 cm)
Weight: 132 pounds (60 kg)
Load: 44 pounds (20 kg)

The robot's enhanced computational capabilities, powered by NVIDIA processors with tripled CPU and GPU capacity, enable sophisticated AI inference and autonomous operation.

FIGURE

Major Partnerships: Figure AI has secured strategic partnerships with industry leaders Microsoft and OpenAI for AI development, while also establishing a significant presence in manufacturing through BMW. A successful pilot program at BMW's Spartanburg, South Carolina plant demonstrated Figure 02's capabilities in continuous operation through seven-day workweeks, handling various tasks including tote movement. The permanent deployment of a robot fleet to BMW's facility began in January 2024.

Commercialization Plans: Backed by $675 million in Series B funding from prominent investors including Microsoft, OpenAI, and Intel, Figure AI is pursuing both industrial and domestic applications. While the company focuses primarily on manufacturing deployment, it has begun exploring household applications, including kitchen assistance tasks. Founder Brett Adcock has outlined plans to achieve a sub-$20,000 price point, making the technology more accessible for widespread adoption.

"If these robots can do everything a human can, I have to think that we'd be able to put 3 to 5 billion in the workforce."
– Brett Adcock, CEO

AGILITY ROBOTICS

Company
Agility Robotics

Founded
2015

CEO
Peggy Johnson

Valuation
~US$1 Billion

Location
Oregon, USA

Robot
Digit

AI Partner(s)
NVIDIA

Website
agilityrobotics.com

Digit Technical Specifications

Description: Digit's unique design features include telescopic, bird-like legs that allow it to crouch or reach to grab objects and move them to specified locations. Digit is ideally suited for warehouse and logistics operations. While pick-and-place might seem simple, it's historically been a low-skill, labor-intensive task. Automating this process allows humans to focus on higher-value work. Investors have demonstrated confidence in the vision for the future of workplace automation.

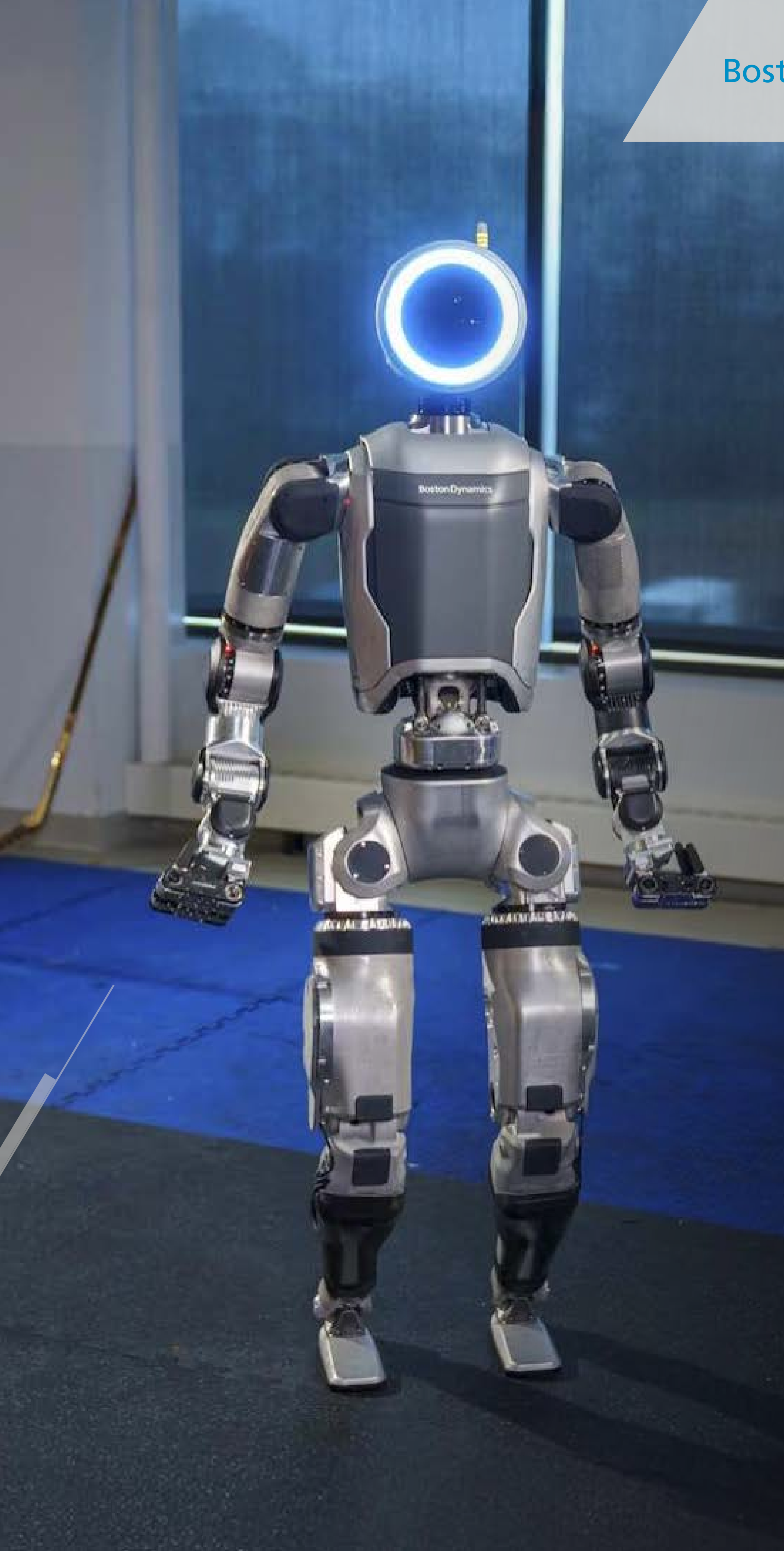
Digit

Height: 5 feet 9 inches (175 cm)
Weight: 143 pounds (64.8 kg)
Load: 35 pounds (15.8 kg)

Major Partnerships: The company has established strategic relationships with industry leaders, most notably Amazon, which began testing a Digit fleet at its Seattle R&D facility for tote recycling in October 2023. A groundbreaking deployment with GXO Logistics at a SPANX facility in Georgia marked the industry's first commercial implementation of humanoid robots under a robots-as-a-service model. Additionally, Ricoh USA provides comprehensive support services across North America.

Commercialization Plans: Agility Robotics is constructing "RoboFab," a 70,000-square-foot manufacturing facility in Salem, Oregon, scheduled to open in late 2024 with an annual production capacity of 10,000 units. Under CEO Peggy Johnson's leadership, the company plans to deliver Digits to partner program customers in 2024, followed by general market availability in 2025. With projected ROI under two years, Digit addresses the critical labor shortage in logistics, targeting over one million unfilled positions in the sector.

BostonDynamics



Company
Boston Dynamics

Founded
1992

CEO
Robert Playter

Valuation
~US$1.1 Billion

Location
Massachusetts, USA

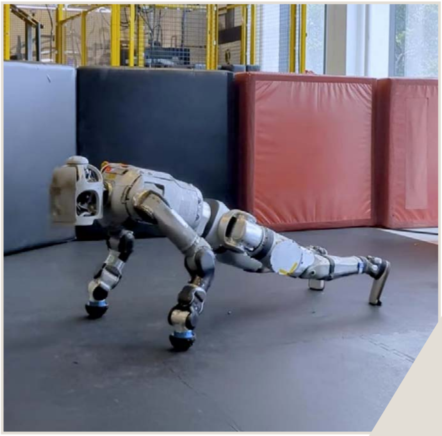
Robot
Atlas (Electric)

AI Partner
NVIDIA

Website
bostondynamics.com

Atlas Technical Specifications

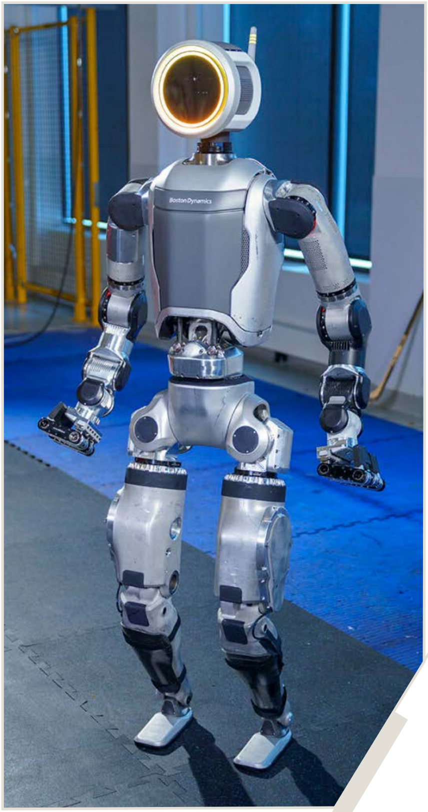
Description: Boston Dynamics' Atlas, transitioning from hydraulictoall-electricpowerin2024,representsthepinnacle of humanoid robotics innovation. The robot demonstrates exceptional agility, capable of complex movements including running, jumping, and backflipping. Atlas features advanced three-fingered hands and sophisticated sensor arrays that enable real-time adaptation and complex object manipulation in dynamic environments.



Atlas

Height: 4 feet 11 inches (150 cm)
Weight: 196 pounds (89 kg)
Load: 55 pounds (25 kg)

The robot's enhanced capabilities are powered by sophisticated machine learning models, enabling autonomous navigation and complex task execution in industrial settings.



Major Partnerships: A landmark collaboration with Toyota Research Institute (TRI) accelerates Atlas's development toward becoming a true general-purpose humanoid, combining Boston Dynamics' hardware expertise with TRI's advanced Large Behavior Models (LBMs). The company also maintains innovation through its independent AI Institute, focusing on next-generation robotics research while the main company pursues commercial applications.

Commercialization Plans: Followingits$1.1billionacquisition by Hyundai Motor Group in 2021, Boston Dynamics is taking a methodical approach to Atlas's market entry, prioritizing reliability and practical utility. Drawing from successful commercialization experiences with their Spot and Stretch robots, the company is carefully developing Atlas for industrial applications while maintaining its position at the forefront of robotics innovation.

Company
Unitree Robotics

Founded
2016

CEO
XingXing Wang

Valuation
~US$1 Billion

Location
Hong Kong, China

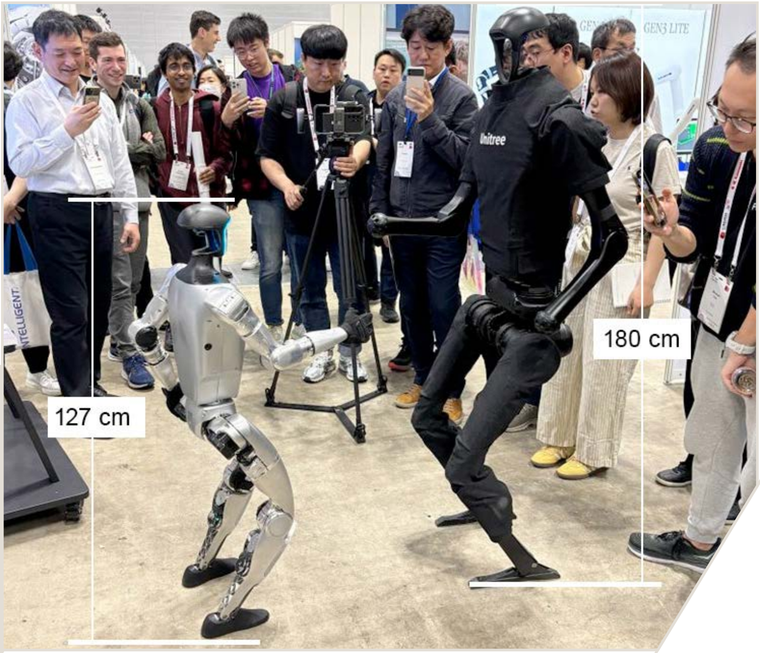
Robot(s)
H1, G1

AI Partner
NVIDIA

Website:
unitree.com

H1 & G1 Technical Specifications

Description: Unitree has revolutionized the humanoid robotics market with two distinctive models: the industrial-focused H1 and the compact G1. Both robots showcase exceptional mobility, demonstrated through groundbreaking untethered walking demonstrations at CES 2024 and NVIDIA GTC. The robots feature sophisticated sensing capabilities, including 3D LiDAR, Intel RealSense D435 depth cameras, and noise-canceling microphone arrays.



H1

Height: 5 feet 11 inches (180 cm)
Weight104 pounds (47 kg)
Load: 66 pounds (30 kg)

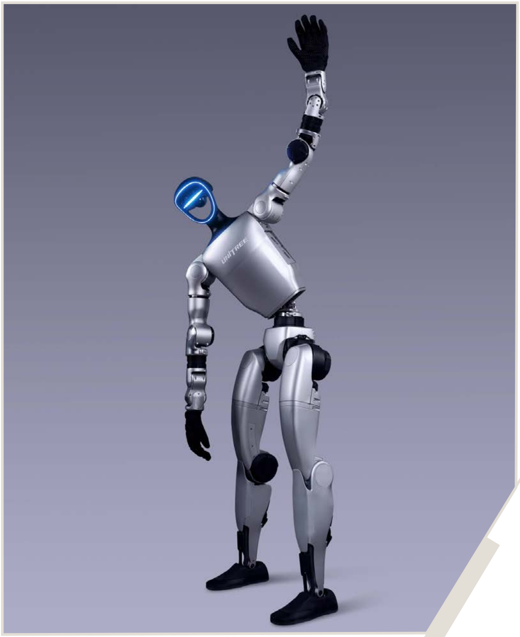
G1

Height: 4 feet 2 inches (127 cm)
Weight: 77 pounds (35 kg)
Load: 7 pounds (3.2 kg)

The G1 features 23-43 degrees of freedom and achieves 120 Nm maximum torque, demonstrated by its record-setting 4.6-foot standing long jump.

Major Partnerships: Unitree has established a key partnership with NVIDIA, incorporating NVIDIA ORIN controllers in the G1's EDU version. This collaboration enhances the robots' AI capabilities and positions them as advanced research and development platforms.

Commercialization Plans: Employing a vertical integration strategy for manufacturing, Unitree has achieved remarkable cost efficiency. The H1 is positioned as a high-end industrial solution at $90,000, while the G1 disrupts the market with a $16,000 starting price. Both models are currently available for educational, research, and industrial applications, with the company focusing on making advanced robotics more accessible through competitive pricing.



Company
1X Technologies

Founded
2014

CEO
Bernt Øyvind Børnich

Valuation
~US$375 Million

Location
California, USA

Robot(s)
NEO

AI Partner
OpenAI, NVIDIA

Website
1x.tech

Apollo Technical Specifications

Description: 1X Technologies' latest humanoid robot, NEO Beta, represents a significant evolution from their wheeled EVE model to a sophisticated bipedal platform engineered for home environments. The robot features advanced sensors and AI systems that enable natural human interaction, emotion recognition, and seamless integration with home automation systems.

Height: 5 feet 5 inches (165 cm)
Weight: 66 pounds (30 kg)
Load: 44 pounds (20 kg)

NEO's sophisticated AI system incorporates a groundbreaking generative model trained on thousands of hours of real-world robot operation data, effectively addressing the "sim2real gap" in robotics training.

Major Partnerships: The company's strategic partnerships include Everon by ADT Commercial, which deployed 150-250 EVE units for commercial security applications. Investment backing from Tiger Global, OpenAI, and EQT Ventures strengthens their market position.

Commercialization Plans: 1X Technologies has outlined ambitious deployment targets, aiming to place thousands of units by 2025 and potentially millions by 2028. Their focus on home environments positions NEO as a pioneering platform for domestic robotics integration.

Company
Agibot

Founded
2023

CEO
Peng Zhihui

Valuation
~US$990 Million

Location
Shanghai, China

Robot
Yuanzheng A2

AI Partner
N/A

Website
agibot.com

Yuanzheng A2 Technical Specifications

Description: Agibot's flagship Yuanzheng A2 represents China's ambitious entry into advanced humanoid robotics. The robot demonstrates exceptional precision in manipulation tasks, including the ability to thread needles. Equipped with sophisticated sensory systems, the A2 can process visual, audio, and text information, while maintaining impressive mobility and strength characteristics.

Height: 5 feet 9 inches (175 cm)
Weight: 121 pounds (55 kg)
Load: 88 pounds (40 kg)

The robot features comprehensive sensor integration, including RGBD cameras and LiDAR systems, enabling advanced environmental awareness and task execution.

Major Partnerships: Agibot has secured backing from prominent investors including Hillhouse Capital and BYD, strengthening its position in the competitive humanoid robotics market.

Commercialization Plans: With aggressive deployment targets of 300 units by the end of 2024, Agibot aims to compete directly with established players like Tesla's Optimus, emphasizing superior cost control and commercialization capabilities.

APPTRONIK

Company
Apptronik

Founded
2016

CEO
Jeff Cardenas

Valuation
~US$1 Billion

Location
Texas, USA

Robot
Apollo

AI Partner
NVIDIA

Website
apptronik.com

Apollo Technical Specifications

Description: Apollo, Apptronik's versatile humanoid robot, represents a culmination of over a decade of research in human-centered robotics. The robot features linear actuators that mimic human muscle mechanics, enabling a full range of mobility and precise force control. Its advanced safety systems allow for direct human collaboration in various workplace settings.

Height: 5 feet 8 inches (172 cm)
Weight: 160 pounds (72.5 kg)
Load: 55 pounds (24.9 kg)

The robot integrates with NVIDIA's foundation model for robot learning through Project GR00T, enhancing its adaptive capabilities.

Major Partnerships: Apptronik maintains strategic partnerships with NASA, building on their collaboration on the Valkyrie robot. Recent partnerships include Mercedes-Benz for manufacturing applications and GXO Logistics for warehouse automation, demonstrating Apollo's versatility across industries.

Commercialization Plans: The company is conducting proof-of-concept programs with both Mercedes-Benz and GXO Logistics, focusing on automating physically demanding,

BEIJING HUMANOID ROBOT INNOVATION CENTER

Company
Beijing HRIC

Founded
2023

CEO
N/A

Funding
Undisclosed

Location
Beijing, China

Robot(s)
Tiangong

AI Partner
N/A

Website
N/A

Tiangong Technical Specifications

Description: Tiangong, recently announced as the world's first open-source electric humanoid robot, represents a groundbreaking achievement in accessible robotics development. The robot features comprehensive sensor integration including visual perception sensors, 3D vision systems, and high-precision IMU for advanced motion control.

Height: 5 feet 4 inches (163 cm)
Weight: 94.7 pounds (43 kg)
Load: N/A

The robot employs State Memory-based Predictive Reinforcement Imitation Learning for natural movement across various terrains including slopes, stairs, grass, and sand, averaging 6.2 mph with peak speeds of 7.5 mph.

Major Partnerships: As a state-backed initiative, the center has launched an unprecedented open-source platform offering three versions:

- Tiangong 1.0 LITE: Focused on andromorphic walking and running
- Tiangong 1.1 Pro: Enhanced upper/lower limb coordination and intelligent interaction
- Tiangong 1.2 MAX: Full closed-loop embodied intelligence capabilities

Commercialization Plans: The open-source initiative aims to accelerate industry adoption by reducing development cycles and costs. Over 100 units are currently deployed across warehouse operations, power plant inspections, and logistics. Complete structural blueprints, software architecture, and electrical systems will be released by the end of 2024, supporting the goal of creating the world's largest open community for embodied intelligent robots.

Company
EngineAI Robotics
Founded
2023
CEO
Zhao Tongyang
Valuation
Undisclosed
Location
Shenzhen, China
Robot
SE01
AI Partner
NVIDIA, Intel
Website
engineai.com.cn

SE01 Technical Specifications

Description: EngineAI's SEO1 represents a breakthrough in humanoid robotics, particularly in achieving human-like locomotion through an advanced end-to-end neural network system. The robot features dual processors from NVIDIA and Intel, three high-precision stereo cameras, and an aerospace-grade aluminum alloy frame for optimal strength-to-weight ratio.

Height: 5 feet 6 inches (170 cm)
Weight: 121 pounds (121 kg)
Load: N/A

The robot's innovative harmonic joint module eliminates traditional "choppy" robotic movements, achieving unprecedented smoothness and energy efficiency in motion.

Major Partnerships: The company leverages strategic collaborations with Intel and NVIDIA for processing capabilities, while developing proprietary technologies including specialized harmonic joint modules and visual neural network systems.

Commercialization Plans: EngineAI aims to complete its full product line development by the end of 2024, targeting production of 1,000 units by 2025. Future expansion includes PM and PA series for home and industrial applications, emphasizing practical implementation of embodied intelligence.

Company
Engineered Arts

Founded
2004

CEO
Will Jackson

Valuation
~US$100 Million

Location
Cornwall, UK

Robot
Ameca

AI Partner
OpenAI

Website
engineeredarts.co.uk

Star1 Technical Specifications

Description: Engineered Arts' Ameca represents a breakthrough in human-like robot interaction, featuring remarkably sophisticated facial expressions and conversational abilities. The robot incorporates 27 facial actuators, 5 neck actuators, and over 60 actuators in total, enabling nuanced emotional expressions and natural movements.

Height: 6 feet 1 inch (187 cm)
Weight: 108 pounds (49 kg)
Load: N/A

The Generation 2 version showcases advanced capabilities including stable diffusion for creative tasks and sophisticated AI-driven interactions, though walking functionality remains under development.

Major Partnerships: Ameca has gained international recognition through high-profile appearances, including a groundbreaking United Nations press conference in July 2023, where it demonstrated advanced conversational abilities discussing global challenges.

Commercialization Plans: While focusing on entertainment and social interaction applications, Engineered Arts continues to expand their humanoid lineup, recently introducing Azi as a companion to Ameca. The company emphasizes developing human-like communication capabilities for various commercial applications.

FOURIER

Company
Fourier Intelligence

Founded
2015

CEO
Alex Gu

Valuation
~US$330 Million

Location
Shanghai, China

Robot
GR-2

AI Partne
NVIDIA

Website
fourierintelligence.com

GR-2 Technical Specifications

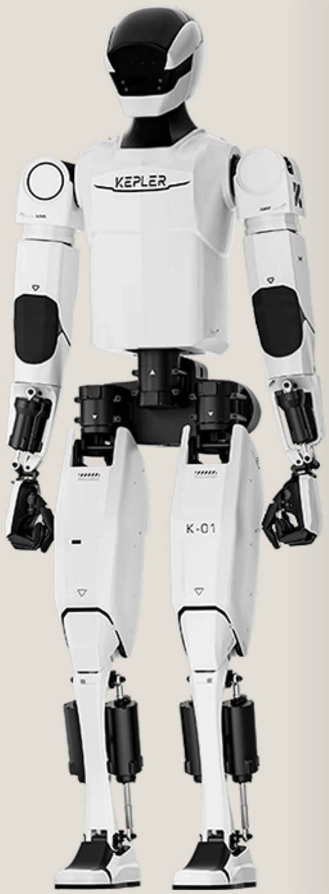
Description: Fourier Intelligence's GR-2, successor to the world's first mass-produced humanoid robot GR-1, represents a significant advancement in assistive robotics technology. The robot features 53 degrees of freedom and sophisticated 12-degree-of-freedom hands equipped with six array-type tactile sensors for real-time force sensing and grip adjustment.

Height: 5 feet 9 inches (175 cm)
Weight: 139 pounds (63 kg)
Load: 6.6 pounds (3 kg) per arm

The robot's FSA 2.0 actuator system, featuring seven distinct actuators, generates peak torques exceeding 380 N.m, enabling human-like movement and precision control.

Major Partnerships: The robot's development platform supports major frameworks including ROS, Mujoco, and NVIDIA's Isaac Lab, facilitating broad collaboration with developers and researchers in the robotics community.

Commercialization Plans: Building on GR-1's success as a mass-produced humanoid, GR-2 targets the growing elderly care market, where U.S. in-home care costs exceed $60,000 annually. The robot's enhanced capabilities and improved manufacturing efficiency position it as a scalable solution for healthcare applications.



KEPLER ROBOTICS

Company
Kepler Robotics

Founded
2023

CEO
Hu Debo

Valuation
Undisclosed

Location
Shanghai, China

Robot:
Forerunner K2

AI Partner
N/A

Website
gotokepler.com

Star1 Technical Specifications

Description: Kepler's Forerunner K2 represents their second-generation humanoid robot, featuring advanced embodied intelligence and sophisticated hardware capabilities. The robot boasts 52 degrees of freedom across its body, with 11 degrees of freedom per hand and flexible fingertip sensors incorporating 96 contact points for precise manipulation.

Height: 5 feet 10 inches (178 cm)
Weight: 187 pounds (85 kg)
Load: 33 pounds (15 kg) per arm

The K2's integrated cloud-based cognitive models and embodied control systems enable autonomous task completion through imitation and reinforcement learning.

Major Partnerships: During development, Kepler collaborated with nearly 50 target customers across various industries, gathering insights to refine the robot's capabilities for specific commercial applications.

Commercialization Plans: Following the K1's launch in November 2023, the K2 has entered small-batch production with a three-stage commercialization strategy: initial deployment, vertical industry expansion, and universal application. The robot is currently being tested in intelligent manufacturing, logistics, and high-risk operations.

ROBOTERA
星动纪元

Company
Robot Era

Founded
2023

CEO
Chen Jianyu

Valuation
Undisclosed

Location
Beijing, China

Robot
Star1

AI Partner
N/A

Website
robotera.com

Star1 Technical Specifications

Description: Robot Era's Star1 humanoid robot has established itself as a speed and endurance champion in the humanoid robotics space. The robot features extraordinary computing power of 275 TOPS and proprietary 400-Nm joint motors with precision planetary reducers. Star1's innovative "denoising world model" enables effective environmental prediction and adaptation across varied terrains.

Height: 5 feet 6 inches (171 cm)
Weight: 143 pounds (65 kg)
Load: N/A

The robot's advanced AI system integrates large language models and supports both imitation and reinforcement learning, enabling dynamic switching between running, walking, and jumping gaits.

Major Partnerships: Emerging from Tsinghua University's incubator program, Robot Era has focused on technical innovation and capability demonstration rather than immediate commercial partnerships.

Commercialization Plans: While specific deployment targets remain undisclosed, Robot Era positions Star1 for both household and workplace applications, emphasizing the robot's adaptability to real-world environments and natural terrain navigation capabilities.

SANCTUARY AI

Company
Sanctuary AI

Founded
2018

CEO
James Wells (Interim)

Valuation
Undisclosed

Location
Vancouver, Canada

Robot
Phoenix (Generation 7)

AI Partner
NVIDIA

Website
sanctuary.ai

Phoenix Technical Specifications

Description: Sanctuary AI's Phoenix, now in its seventh generation, represents a breakthrough in human-like robotic capabilities. The robot demonstrates advanced dexterity with improved range of motion in wrists, hands, and elbows, supported by sophisticated visual acuity and tactile sensing systems. Recent hardware improvements include miniaturized hydraulics that reduce weight and power consumption while maintaining safety standards.

Height: 5 feet 7 inches (170 cm)
Weight: 155 pounds (70.3 kg)
Load: 55 pounds (25 kg)

Phoenix's AI control system, Carbon, enables task automation within 24 hours, a dramatic improvement from previous weeks-long training periods.

Major Partnerships: A strategic partnership with Magna International positions Phoenix for deployment in automotive manufacturing facilities. Magna will also serve as a contract manufacturer for future Phoenix units, streamlining production capabilities and scaling potential.

Commercialization Plans: Following successful retail deployment at Mark's store in Langley, British Columbia, where Phoenix completed 110 distinct tasks, the company is expanding into manufacturing applications. Recent hardware optimizations have reduced the bill of materials and increased build efficiency, supporting broader commercial deployment.

Company
Xpeng

Founded
2014

CEO
He Xiaopeng

Market Cap:
~US$12 Billion
(as of November 11, 2024)

Location
Guangzhou, China

Robot(s)
Iron

AI Partner
Internal AI Division

Website
xpeng.com

Iron Technical Specifications

Description: Xpeng's Iron humanoid robot represents a significant advancement in integrated automotive and robotics technology. The robot leverages the company's autonomous vehicle technology stack and proprietary Turing AI chip, featuring advanced end-to-end AI models integrated with their Eagle Vision system.

Height: 5 feet 8 inches (173 cm)
Weight: 154 pounds (70 kg)
Load: N/A

The robot features 15-degree-of-freedom hands enabling sophisticated manipulation capabilities, while its AI system allows autonomous walking and complex human-like movements including standing, sitting, and lying down.

Major Partnerships: Iron utilizes Xpeng's in-house technologies, including their proprietary 40-core Turing AI chip capable of processing AI models with 30 billion parameters, demonstrating the company's vertical integration strategy.

Commercialization Plans: Already operational in Xpeng's automotive production lines assembling the P7+ electric vehicle, Iron's deployment is expanding beyond manufacturing to retail environments, offices, and eventually homes. The robot represents Xpeng's strategic diversification beyond electric vehicles into advanced robotics and AI systems.

INVESTMENT CLIMATE & OPPORTUNITIES

The burgeoning humanoid robot industry is attracting significant investment interest, both in private companies and publicly traded entities. One of the most notable recent investment announcements came from Figure AI, which secured a massive $675 million funding round from a roster of high-profile investors including Jeff Bezos, Microsoft, OpenAI, NVIDIA, Intel, and Cathie Wood's ARK Invest. This investment values Figure AI at $2.6 billion, underscoring the immense potential investors see in the humanoid robot market.

Goldman Sachs has noted a "stronger commitment from the supply chain, start-ups in the U.S. and Asia, multiple listed players setting up new robot divisions and potentially more government support (i.e., from China)." This growing investment climate is creating opportunities for investors across various stages and sectors of the robotics industry.

For those interested in publicly-traded companies involved in humanoid robotics, Morgan Stanley has created "The Humanoid 66," a proprietary list of 66 stocks that best express the humanoid theme. These companies fall into three categories:

1. **Enablers:** Companies developing humanoid robots or their inputs (brain and body)
2. **Beneficiaries:** Companies that could benefit from humanoid labor
3. **Enabler & Beneficiary:** Companies that both develop humanoids/humanoid inputs and could benefit from humanoid labor

The list includes companies developing humanoid robot parts (especially those responsible for fine motor skills and movement), batteries, and semiconductors. It also features potential beneficiaries in sectors like Transportation, Autos, Oil & Gas, Restaurants, Construction, and E-Commerce. (See a visual breakdown of The Humanoid 66 categories on the next page.)

Source: Morgan Stanley Research Bluepaper "Humanoids: Investment Implications of Embodied AI"

MAJOR IMPLICATIONS: JOBS & ABUNDANCE

Jobs

Following are nine key areas where we expect to see humanoid robots enter our global ecosystem.

These sectors screen high for factors that make them suitable for humanoid adoption, including danger, repetitiveness, high labor costs, and unionization rates.

Implications for Abundance

The promise of humanoid robots lies in their potential to elevate human potential and experience. While many reading this report may love their profession and jobs, most people in the world have taken jobs to survive, to put food on the table or provide insurance for their family.

By taking over repetitive, dangerous, and mundane tasks, humanoid robots promise to free humans to pursue creative, innovative, and passion-driven endeavors. We're moving towards a world where individuals can focus more on personal growth, well-being, and building deeper connections, rather than being constrained by tedious or hazardous work.

"Technology is the means by which humanity takes a vacation from basic survival."
— Sadguru

Brett Adcock's vision of the future paints a picture of unprecedented abundance. He explains, "The goal is to put these robots into the physical world with no additional infrastructure needed for them to operate. So, you can put robots into the workforce so we don't need to go build new systems and new electronics and everything else for the robots to work with."

This could lead to dramatic reductions in the cost of goods and services. As Adcock puts it, "You can basically create a world where goods and services prices are trending to zero in the limit and GDP spikes to infinity... You basically can request anything you would want and it would be relatively affordable for everybody in the world."

The timeline for this transformation may be closer than many realize. Adcock believes that "within the next 3 years, we'll definitely have robots being piloted in our homes."

As we stand on the brink of this new era, it's clear that the introduction of humanoid robots into our societies will irrevocably redefine the dynamics of human interaction, labor, and daily life.

With the arrival of humanoid robots, we're reimagining the very fabric of our society and economy.

The World is Changing Faster Than Ever. Here's How You Keep Up, Survive, and Thrive...

You've just finished reading about the incredible breakthroughs happening in robotics, a future where we are freed from manual labor so we can focus our efforts on bigger initiatives.

But are you prepared for the other exponential changes coming your way?

The next decade will bring *more technological advancements than the last 100 years combined.*

AI, robotics, virtual reality, quantum computing, and biotechnology are converging to disrupt and reinvent every industry and reshape every aspect of our lives.

How will you, as a leader, entrepreneur, or investor surf and capitalize on this tsunami of change rather than get crushed by it?

The answer lies in getting early access to the right knowledge and being supported by a community of highly successful, abundance minded and moonshot driven individuals.

Every March, for the past 13 years, Peter H. Diamandis, MD has gathered industry disruptors and changemakers to educate his community on the latest breakthroughs and what the road ahead holds.

"I have grown my company 10x. We're in hyperscale mode."
– Blake Miller, CEO, Homebase.ai

Picture yourself learning from and having conversations with the leaders who have been driving this exponential change. Past attendees have been fortunate to hear from visionaries like **Cathie Wood**; **Elon Musk**; **Sam Altman**; **Marc Benioff**; **Tony Robbins**; **David Sinclair, PhD**; **Eric Schmidt**; **Ray Kurzweil**; **Emad Mostaque**; **will.i.am**; **Sal Khan**; **Arianna Huffington**; **Michael Saylor**; and **Martine Rothblatt** (just to name a handful in recent years).

Even more important than early insights and **Knowledge** is the right ***Community***.

A community that understands your challenges and inspires you to pursue your Massive Transformative Purpose (MTP) and Moonshot(s).

Community is core to Abundance360. Our members are hand-selected and carefully cultivated—fellow entrepreneurs, investors, business owners, and CEOs running businesses valued from $10M to over $10B.

Having the right **Knowledge** and **Community** can be the difference between thriving in your business and maximizing your investments—or getting disrupted and crushed by the tsunami of change.

Abundance360 provides the early insights and support network you need to understand how these technologies will transform our world and how you can use them to grow your business and impact.

Admission to Abundance360 is only through invitation or application. If you're interested in joining our Community, **visit Abundance360.com to learn more**.

"Abundance360 is among the most valuable and transformative decisions I've ever made."
– David Erickson, Co-Founder, Promise Hub

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