

Exploring Humanoid Robots

Implications for Society VII

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Exploring Humanoid Robots

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Advanced Humanoid Robots

- Humanoid Robotic technology is evolving at an unprecedented pace
- Innovations in AI, machine learning, and automation are making robots smarter, more adaptable, and increasingly capable of performing complex tasks
- Introduction of **advanced humanoid** robots is expected to have numerous effects on societies

Increased Human-Robot Collaboration

- Future robots will **not replace humans entirely** but will work alongside them to increase productivity
- Collaborative robots are already being used in industries such as manufacturing, healthcare, and logistics to assist human workers with repetitive and labor-intensive tasks
 - Right tool for the job



AI-Powered Decision Making

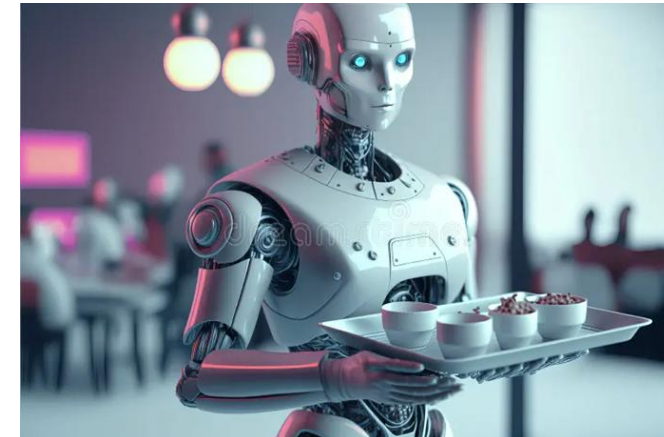
- Advancements in **AI** will enable robots to make real-time decisions based on data analysis
- This will allow for greater efficiency and accuracy in various applications, from autonomous vehicles to customer service chatbots
- Will humans accept ?



Future of Robots Effects on Society

Expansion of Service Robots

- Service robots, including robotic assistants, caregivers, and household robots, will become more common
- These robots will help with daily chores, provide companionship for the elderly, and even assist in healthcare settings



Future of Robots Effects on Society

Increased Automation in Various Sectors

- Robots , **humanoid and industrial**, will continue to automate processes in agriculture, construction, logistics, and retail
- Automated warehouses, drone deliveries, and robotic farming equipment are already transforming traditional business models



Effects on Society Estimated Number in Service

- Deployment of humanoid robots is still in early stage
- Estimated Number of Active Humanoid Robots Mid 2025
- Industrial (Factories, Warehouses) ~1,000–2,000
- Care (Elderly, Healthcare, Social Companions) ~4,000–6,000

Future of Robots Effects on Society

Ethical and Regulatory Challenges

- As humanoid robots and AI become more advanced, ethical and legal considerations will arise
- Governments and industry organizations will need to establish regulations to ensure responsible AI and robotics development
- Will there be a **Federal AI or Humanoid Robot Regulatory Agency?**

Effects on Society Economic Effects of Robots

- The rise of robotics has significant economic implications, affecting job markets, productivity, and economic growth
- While robots bring efficiency and cost savings, they also raise concerns about job displacement and income inequality
- **Anthropic CEO Dario Amodei** issued a warning:
- He predicted that within five years, **AI** could automate away up to 50% of all entry-level white-collar jobs!
- How will society respond if he is correct?



Effects on Society Economic Effect of Robots

Increased Productivity and Efficiency

- Robots can perform tasks faster and with greater precision than humans, leading to increased productivity
- In industries such as manufacturing, automation has led to higher output levels, reduced production costs, and improved product quality

Effects on Society Economic Effect of Robots

Job Displacement and Workforce Reskilling

- The recently published **MIT** paper, “Robots and Jobs: Evidence from U.S. Labor Markets,” by Daron Acemoglu and Pascual Restrepo
- Finds that **industrial robots** do have a **negative impact on workers**
- The researchers found that **for every robot added per 1,000 workers** in the U.S., **wages decline by 0.42%**
- Employment-to-population ratio goes down by 0.2 percentage points — to date, this means the loss of about 400,000 jobs
- The impact is more sizable within the areas where robots are deployed:
- Adding one more robot in a geographic areas used for economic analysis **reduces employment by six workers** in that area

Effects on Society Economic Effect of Robots

- Advances in AI, dexterity, and training ease are fast-tracking humanoid robots into the physical world where software automation on its own is less effective
- Labor shortages, aging populations, and reshoring efforts are creating new demand for automation of all types
- Humanoid robots are approaching **cost parity with human labor**
- They are poised to take on **physical jobs** across industries within the next five years

Average Annual Cost per Manufacturing Worker – U.S. (2025)

• Cost Component	Estimated Annual Amount	Notes
• Wages & Salaries*	\$52,000 – \$60,000	Hourly wage \$25–\$29/hour.
• Benefits*	\$15,000 – \$20,000	Includes health insurance, etc
• Payroll Taxes*	\$5,000 – \$6,000	Employer-paid portion
• Other Overhead	\$3,000 – \$5,000	Varies by company
• Total Average Cost	\$75,000 – \$90,000	Per full-time employee per year

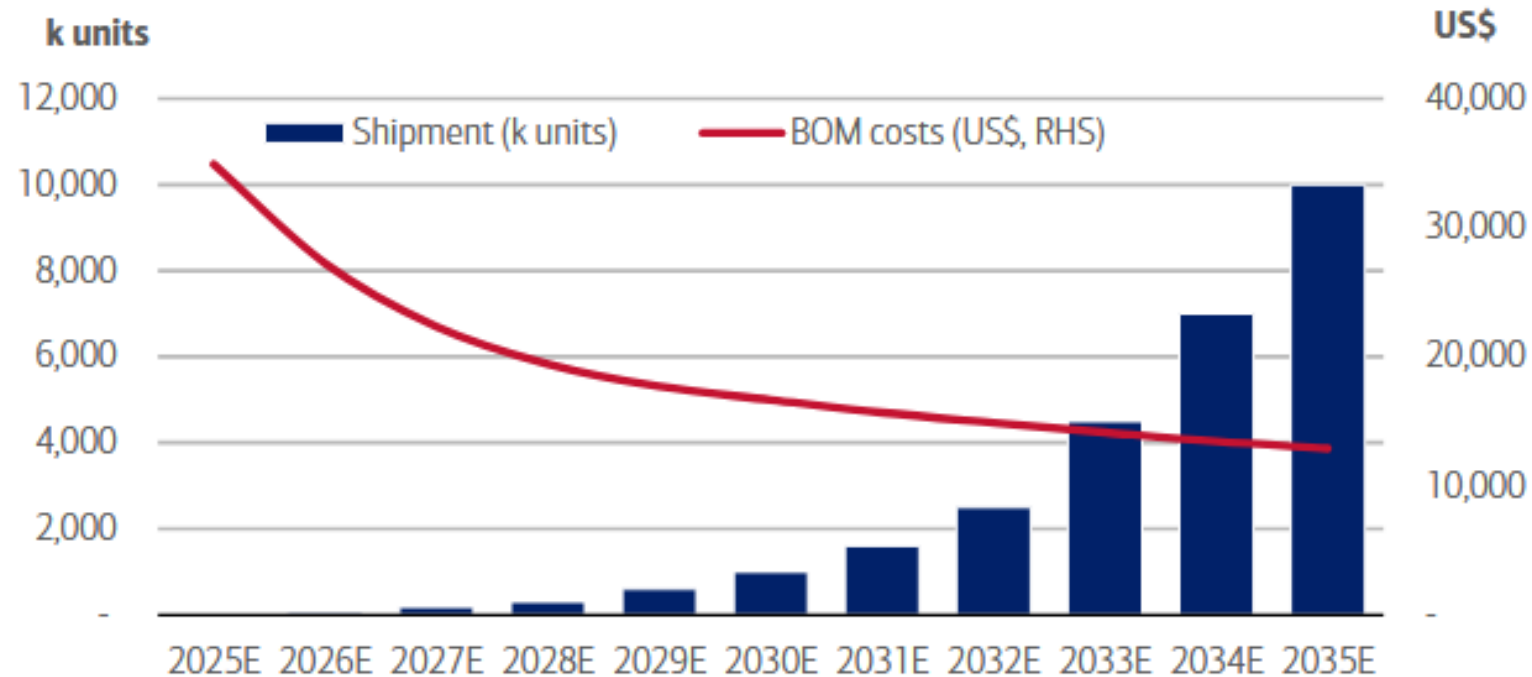
- * Not part of humanoid robot costs

Effects on Society

Economic Effect of Robots

Exhibit 4: Humanoid robot's BOM costs may fall below \$17k by 2030, when annual shipments reach 1mn

Humanoid robot shipments vs. BOM costs (in China)



Source: BofA Global Research estimates

BANK OF AMERICA INSTITUTE

Effects on Society U.S. Non-Farm Employment May 2025

Total non- farm	159,561,000	Government (15%)	23,593,000
Private (85%)	135,968,000	Federal(1.5%)	2,363,000
Goods producing(13%)	21,700,000	State(2%)	2,897,000
Construction (5%)	8,314,000	Local(4%)	6,902,000
Manufacturing (8%)	12,761,000	Education state(1.6%)	2,620,000
Private service(71%)	114,268,000	Education local(5%)	8,216,000
Retail(10%)	15,576,000		
Warehousing(1%)	1,827,000		
Accommodation and food(1%)	1,952,000		

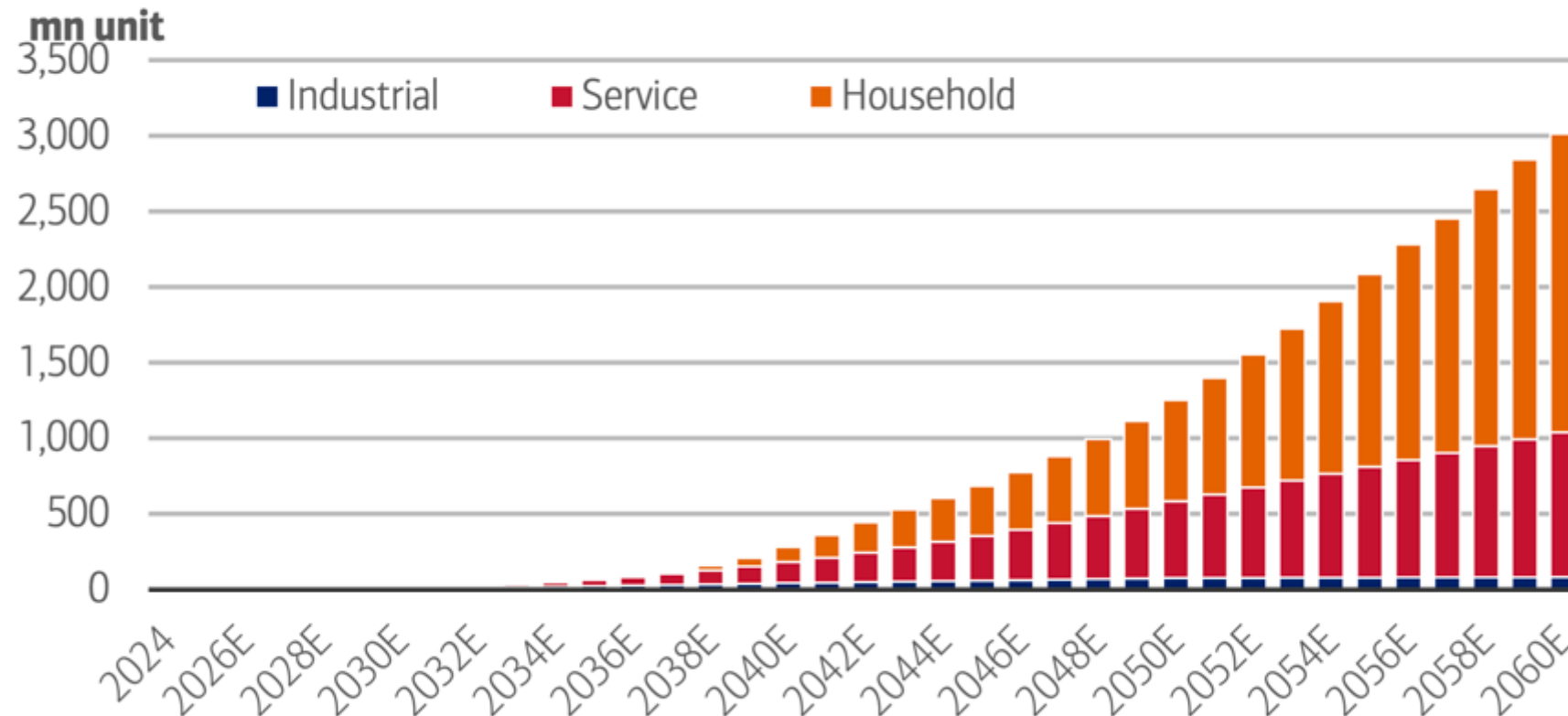
Effects on Society U.S. Manufacturing Employment

- Key Manufacturing Sectors by Employment

Sector	Approx. Employment (millions)	Examples
• Food manufacturing	1.7	Meat, dairy, beverages
• Fabricated metal products	1.4	Tools, structural metal parts
• Transportation equipment	1.3	Cars, aircraft, rail systems
• Machinery	1.1	Agricultural, construction machinery
• Computer & electronic products	1.0	Semiconductors, devices
• Plastics & rubber products	0.7	Packaging, auto parts
• Chemical manufacturing	0.8	Pharmaceuticals, fertilizers

Exhibit 5: Total units in ownership (UIO) could reach 3 billion by 2060E

Long-term forecast of humanoid robot UIO between industrial, service and household applications.

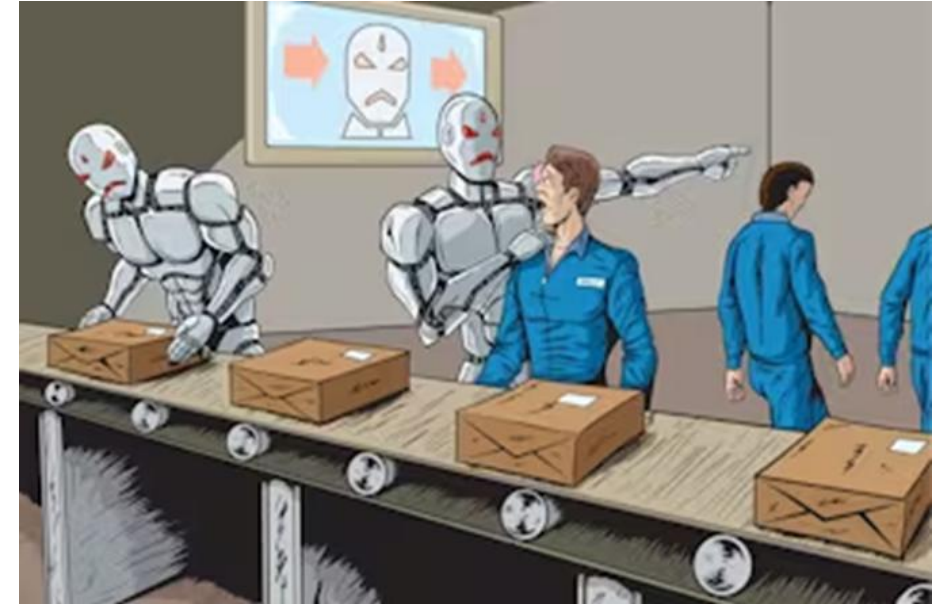


Source: BofA Global Research

Effects on Society Economic Effect of Robots

Job Displacement and Workforce Reskilling

- While robots **create new job opportunities**, they also **displace traditional roles**
- Jobs that involve repetitive or routine tasks are at high risk of automation
- To counteract this, requires **investment** in workforce reskilling programs to equip workers with the skills needed for new technology-driven roles



Economic Growth and Competitiveness

- Nations that embrace robotics and automation will have a **competitive edge** in the global economy
- Both in manufacturing and service industries
- Companies that integrate robotic technology can scale operations more efficiently, leading to economic growth and increased global competitiveness
- Will this lead to less global trade?

Challenges for Developing Countries

- Developing nations that rely heavily on low-skilled labor may face challenges due to automation
- Advanced countries may achieve lower labor costs by use of humanoid robots displacing demand from lower labor cost countries- **reshoring**
- Countries with limited access to advanced technology may struggle to compete in the global market, leading to economic disparities
- Will this lead to **conflicts** or **business opportunities**?

Cost Reduction and Business Profitability

- Automation reduces labor costs, leading to increased profitability for businesses
- Industries such as e-commerce, logistics, and manufacturing are already experiencing substantial cost savings due to robotic automation
- Will governments **tax humanoid robots** to support programs for humans?

Creation of New Industries and Jobs

- As robotics technology advances, **new industries will emerge**, creating jobs in fields such as AI development, robotic engineering, and automation maintenance
- The demand for skilled professionals in these areas will rise significantly
- Will humans be able to learn the skills needed?
- Will there be enough demand for these skills?



Effects on Society

Economic Effect of Robots

- The integration of robots into daily life will have profound social consequences, affecting human interactions, employment patterns, and ethical considerations

Effects on Society Social Effects of Robots

Changes in Employment and Work Culture

- The nature of work will evolve as robots take over repetitive tasks
- Employees will need to adapt by acquiring new skills and embracing roles that require human creativity, emotional intelligence, and problem-solving abilities
- How will humans deal with worker displacement?



Effects on Society Social Effects of Robots

Enhanced Healthcare Services

- Robotic technology will **revolutionize healthcare** by enabling advanced surgical procedures, **robotic caregivers for the elderly**, and **AI-powered diagnostic systems**
- This will improve medical outcomes and provide better access to healthcare services
- Possibly lower medical care costs
- How will patients respond to medical care by robots?



Effects on Society Social Effects of Robots

Impact on Social Interactions

- As robots become more integrated into society, **human-robot interactions** will increase
- While service robots can provide companionship and assistance, there is concern that excessive reliance on robots may reduce human social connections
- Will humans **trust** humanoid robots?



Effects on Society Social Effects of Robots

Ethical and Privacy Concerns

- The use of AI-driven robots raises ethical questions regarding **data privacy, decision-making biases**, and the **potential for misuse**
- Governments and organizations will need to implement regulations to ensure ethical AI development and protect user privacy
- Some humanoid robot manufacturers have called for regulations

Effects on Society Social Effects of Robots

Educational Transformation

- Humanoid Robots will play a **significant role** in education by providing personalized learning experiences, tutoring assistance, and interactive teaching methods
- AI-driven educational tools may enhance learning outcomes and bridge gaps in education access
- How will human teachers adapt?



Humanoid Robots

Effects on Society

Conclusion

- Humanoid robots are poised to **reshape economies** and **societies worldwide**
- While automation and AI-driven robots offer numerous benefits, including increased productivity, economic growth, and improved quality of life, they also present challenges such as job displacement and ethical concerns
- To maximize the advantages of robotics, governments, businesses, and individuals must embrace innovation while implementing strategies to address the social and economic impacts
- Investing in education, reskilling programs, and regulatory frameworks will be crucial in ensuring a balanced and inclusive transition into a robot-powered future

Next Session

Future of Humanoid Robots

Ignoring Yogi!