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MSCI Thematic Insight

Subject Area: **Robotics and AI**

The rise of the machines?

AI, robots and industrial transformation

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How close are we to a world where artificial intelligence (AI) and robots are ubiquitous? A world where automation has streamlined our daily routines and where technology has fundamentally changed the way we live, work, and play.

Definitions

Artificial intelligence (AI) *leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind.*[1]

A robot *is an autonomous machine capable of sensing its environment, carrying out computations to make decisions, and performing actions in the real world.* [2]

Automation *is the creation and application of technologies to produce and deliver goods and services with minimal human intervention.*[3]

1 https://www.ibm.com/topics/artificial-intelligence
2 https://robots.ieee.org/learn/what-is-a-robot/
3 https://www.techopedia.com/definition/32099/automation

AI, robots and **automation at home**

From chatbots to virtual assistants, AI has changed the way people can interact with technology: whether it's navigating from A to B, deciding what to wear based on weather forecasts, choosing the night's viewing on Netflix or Amazon Prime, suggesting how we should respond with 'canned' AI email responses or even who should we fall in love with.

A group of AI experts analyzed a list of 17 common domestic tasks (from grocery shopping and laundry to teaching a child) and estimated that, on average, 39% of the time spent on each task could be automated in a decade.[4] Automating grocery shopping was considered the easiest to accomplish (a potential 59% automation rate within the next decade) while physical childcare was the most difficult (a 21% automation rate[5]). Robotic vacuum cleaners and mops, among other domestic service robots, were 2020's best-selling robots worldwide[6].

According to ReportLinker, the household (or domestic) robots market (robots both for repetitive tasks like floor cleaning and lawn mowing, but also entertainment, companionship and aid for seniors) can be valued at USD 8.0 billion and be expected to reach USD 18.9 billion over the next five years (a CAGR of 18.8% between 2023 and 2028)[7]. There is also a projected rise in the use of home automation and control equipment. For instance, Research and Markets predicted that the worldwide market, covering lighting, HVAC, security and entertainment and so on, to increase from USD 53.0 billion in 2021 to USD 156.6 billion by 2031[8] (a CAGR of 12.1% from 2022 to 2031).

1 https://www.ibm.com/topics/artificial-intelligence
2 https://robots.ieee.org/learn/what-is-a-robot/
3 https://www.techopedia.com/definition/32099/automation
4 https://europeansting.com/2023/04/12/domestic-chores-could-be-done-by-robots-40-of-the-time-within-a-decade-new-study/
5 Ibid.
6 https://ifr.org/img/worldrobotics/Executive_Summary_WR_2020_Service_Robots.pdf
7 https://finance.yahoo.com/news/household-robots-market-growth-trends-121900653.html
8 https://www.alliedmarketresearch.com/home-automation-and-control-market

AI, robots and **automation at work**

The impact of AI, robots and automation is already being felt in many industries, from manufacturing and automotive to retail and healthcare - in automating repetitive tasks, enhancing customer experiences and promoting innovation.[9] The AI and automation trend has been fuelled by the exponential growth in data, the growing sophistication of machine learning and the widespread deployment of cloud computing.[10] These technologies have been used to streamline operations, increase productivity and reduce costs.[11]

The manufacturing sector is leveraging automation and robots to enhance efficiency and lower expenses.[12] The industrial automation market was valued at USD 133.4 billion in 2020, and projected to reach USD 274.4 billion by 2030 (a 7.5% CAGR).[13] The manufacturing sector encompasses the utilization of robots in assembly lines as well as self-driving vehicles that transfer materials and goods throughout factories. The industrial robot market was estimated at USD 55 billion in 2020, with around 2.7 million units in operation globally, and projected by 2028 to exceed USD 165 billion.[14] Collaborative robots, or "cobots", that work alongside humans, are also becoming increasingly used in manufacturing and logistics to improve productivity and safety. According to Future Market Insights (FMI), the global market for cobots will surpass USD 2.2 billion by end-2023, and expand at a CAGR of over 25% to 2033, to reach over USD 20.5 billion.[15] Self-driving delivery robots have sensors and navigation technology to allow travel on roads, sidewalks and indoors without a "handler". Adoption has included food and package delivery, hospital logistics and hotel service. According to Inkwood Research's projections, the global market for autonomous delivery robots is expected to reach $14.47 billion by 2030 recording a CAGR of 21.31% between 2022 and 2030.[16] Robots are likely to see growth in extreme and dangerous natural and industrial environments (e.g. deep sea, outer space, nuclear reactors, chemical spills, search and rescue, domestic fires, and forest wildfires).[17]

Self-driving cars are one of the most high-profile examples of the impact of robotics and AI trend. There is increasing sophistication in the integration of technology in automobiles[18] and the ability of self-driving cars to interpret their surroundings with AI. These vehicles receive information from cameras placed around it and detect various objects, including roads, traffic signs, other vehicles, and pedestrians. [19] Next Move Strategy Consulting predicted the global market for autonomous vehicles was USD 106 billion in 2021 and would reach over USD 2.3 trillion in 2030. [20]

AI technologies such as machine learning, decision theory and intelligent search are also supporting novel business models and business process innovation,[21] and have been used by companies to establish industry leadership.[22] For example, Google Cloud has an AI tool to assist big-box retailers identify and assess the availability of consumer packaged goods products on shelves through videos and images obtained from e.g. ceiling-mounted cameras, camera-equipped self-driving robots, or store associates.[23] Walmart recently announced investments in supply-chain automation technologies to serve customers faster and more accurately.[24]

The healthcare industry is also experiencing transformation with the help of robotics e.g. in surgery to perform intricate procedures with great precision and accuracy. GlobalData valued the global market for surgical robots at USD 4.6 billion in 2020, and an annual growth rate of 8.5% p.a. to reach USD 10.3 billion by 2030.[25] This growth is underpinned by AI integration. Stryker Corporation announced in 2023 that they will tap health data and artificial intelligence (AI) to improve surgical robot outcomes.[26] The implementation of AI applications in healthcare could result in an annual reduction of USD 150 billion in US healthcare costs by 2026. This cost reduction may be largely attributed to a shift from reactive to proactive healthcare: health management rather than disease treatment.[27]

9 Sharma, Satish (2023). Future of Automation and AI in Small Businesses. In AI for Small Business: Leveraging Automation to Stay Ahead (pp 85-102). CSMFL Publications.
10 Ibid.
11 Ibid; Thatikonda, D. 2020. AI-Supply chain Risk Management during Pandemic. European Journal of Electrical Engineering and Computer Science. 4, 6 (Nov. 2020).
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What trends are supporting growth for AI, robots and automation?

Ageing Population

By 2030, the share of the population aged 60 years and over will increase from 1 billion in 2020 to 1.4 billion, according to the WHO, and hit 2.1 billion by 2050.[28] The number of individuals aged 80 and over will also triple to reach a total of 426 million.

E-commerce

Rapid growth is driving demand in the logistics sector. Companies like Fanuc develop automation solutions for e-commerce fulfilment.[29]

Advancements in technology

The computing power of machines has increased exponentially: combined with more sophisticated algorithms, machines may learn rapidly from data and improve their performance over time.[30] Robots can now perform more complex tasks with greater accuracy and efficiency. Nvidia Corp. and Oracle announced a partnership in 2022 to incorporate tens of thousands of Nvidia GPUs into Oracle's AI infrastructure to develop a 'supercomputer' in the cloud.[31] Advances in sensors (LIDAR, RADAR, ultrasonic) are employed by autonomous robots to support real-time navigation and obstacle avoidance.[32]

Rapid urbanization

The UN projects 68% of the world population will live in urban areas by 2050.[33] This trend should support demand for cleaning robots and humanoid robots for entertainment and companionship.

Labor shortages

The post-pandemic labor shortage led to an increased interest in robots across industrial and consumer industries, including the introduction of robots as instructors in education and even surfing![34] According to the National Restaurant Association, the restaurant sector had a US workforce of 15 million people at end 2022: some 400,000 below 2019 levels.[35] In Asia, companies have embraced robot servers: Pizza Hut has deployed them in 1,000 of its restaurants in China, but to-date the U.S. has only seen small tests by some chains.[36]

Focus on sustainability

Autonomous robots not only enhance operational efficiency, but they also offer other sustainability (environmental) benefits. For example, EcoRobotix launched an autonomous robot in 2021 for precise weeding in agriculture, with a promised reduction in herbicide use of up to 95%.[37]

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29 https://roboticsandautomationnews.com/2020/11/27/fanuc-and-plus-one-robotics-develop-automation-solutions-for-e-commerce-fulfillment/38566/
30 Minh, D., Xiang Wang, H., Fen Li, Y. and Nguyen, T.N. (2022). "Explainable artificial intelligence: a comprehensive review". Artificial Intelligence Review. 55. pp. 3503-3568; https://www.forbes.com/sites/bernardmarr/2022/02/21/the-top-10-tech-trends-in-2022-everyone-must-be-ready-for-now/?sh=1146f763827d; https://www.weforum.org/agenda/2022/07/top-10-trends-in-tech/
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35 https://fortune.com/2023/04/06/restaurant-labor-shortage-servers-waiters-robots/
36 Ibid.
37 https://innovationorigins.com/en/weeding-robot-saves-nearly-100-on-pesticides-2/

The benefits of AI, robots and **automation for businesses**

AI tools are ideal for lifting productivity by accessing vast amounts of information, performing complex computations at high speed and supporting pattern recognition and prediction.[38] In 2016, the DeepMind's AlphaGo AI system beat the grandmaster Lee Sedol in the ancient Chinese game Go in just five games. The fastest human typist can produce 212 words per minute[39] but an AI language model like GPT-3 can generate text at over 4,000 words per second.[40]

AI can help improve human decision-making processes and productivity via context-relevant pattern recognition, pattern learning and intelligent data analysis.[41] Machine learning algorithms have been used to analyze medical records and predict the likelihood of certain diseases or health conditions. Research from South Korea saw AI systems show superior performance in identifying invasive T1 cancers in early stages.[42] The tool had a detection rate of 91% for T1 cancers and 87% for node-negative cancers, while the group of radiologists detected 74% for both types. With the AI tool alone, the rate for detecting breast cancer was 88.8%, while for the radiologists, it was 75.3%. However, when radiologists were aided by the AI, accuracy increased to 84.8%. Similarly, a study by researchers at the Florida International University indicated that a stroke could be rapidly diagnosed, with an accuracy rate of 83%, with a machine learning (ML) algorithm that integrates hospital data and social health markers. The indication can be made before any lab tests or imaging, and so provide a control on misdiagnosis as well as improved patient monitoring.[43]

In another arena, technology such as Advanced Driver Assistance Systems (ADAS), which uses sensors and cameras to detect objects on the road and assist the driver in controlling the car, accelerate progress towards zero road deaths.[44] Autonomous vehicles will likely become more common on our roads, with self-driving cars and trucks increasingly reliable and efficient. The National Highway Traffic Safety Administration (NHTSA) noted that over 90% of the traffic accidents are due to a human driver error,[45] while ICDP, a specialist international automotive research consultancy, forecasted that adoption of ADAS in Europe could lower the number of accidents by around 15% by 2030.[46] Robots, automation, and AI can also improve safety in physically demanding work environments. A study by the Bank of Korea suggested that use of robots could reduce injury rates by 8%.[47]

Recent breakthroughs in generative AI (algorithms used to create new content, including audio, code, images, text, simulations, and videos[48]), such ChatGPT, Bing Chat and Google Bard that give us "complete" (if sometimes hallucinatory) content based on our text prompts; DeepMind's AlphaCode that writes computer programs at a competitive level; and DALL-E and MidJourney, that can create credible graphics and artistic images from a "requirements" description, have the potential to be highly disruptive to the global economy and patterns of work. Goldman Sachs has estimated that such innovations could drive a 7% (or almost USD 7 trillion) increase in global GDP and a 1.5 percentage points increase in productivity over a 10-year period.[49] PwC suggested AI could contribute USD 15.7 trillion in total to the global economy by 2030, with the largest gains expected in China (26% GDP boost by 2030) and North America (a 14.5% GDP by 2030)[50]. Similarly, Accenture has gauged that AI has the capacity to enhance profitability rates by 38% on average and generate an economic increase of USD 14 trillion across 16 industries in 12 economies by 2035.[51]

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39 https://www.academyoflearning.com/blog/the-fastest-typists-in-the-world-past-and-present/
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Conclusion

AI, robots and automation are rapidly transforming our world: from self-driving cars to robotic surgeries, the impact of these technologies is already being observed in every industry. While this transformation holds the promise of increased efficiency and productivity, it has also raised important questions about the role of technology in our lives, the potential displacement of human workers and the ethical implications of creating intelligent machines, especially with the controversy of biased training datasets and weak anchoring in truth.

Goldman Sachs has calculated that 63% of the US workforce would be impacted by AI while a further 30% working in physical or outdoor jobs could be unaffected.[52] Approximately 7% of American workers are at risk of being replaced by generative AI with at least 50% of their job tasks in scope of such technology.[53] Although automation has the potential to displace certain jobs, historical trends have shown that the creation of new jobs has typically balanced out this effect. Earlier technological advancements triggered the emergence of roles such as webpage designers, software developers and digital marketing professionals. The creation of new positions resulting from technological advances accounted for over 85% of the employment growth in the past 80 years.[54] Economist David Autor found that 60% of today's occupations didn't even exist in 1940.[55]

What are the ethical implications of relying on AI, robots and automation too heavily? Technologies by themselves are not inherently evil. It's how we choose to implement them and use them that determines their societal impact. Visual and text training sets for AI recognition-based applications and the calibration of generative AI have been regularly criticized for inherent sexism and racism. That has led to real social effects in their use by law enforcement, for example, as well as embarrassment and alarm for tech companies who have rapidly withdrawn or re-configured chatbots, even those built on the latest large language models.[56] AI can support creative ideation in many industries but equally it can be used to break the sort of passwords widely used in practice as part of the digital economy. An AI tool successfully cracked more than 50% of the passwords it was given in less than a minute, and 65% of them in under an hour.[57] There are also concerns that the use of AI and other advanced technologies could lead to a dystopian future like the totalitarian society depicted in George Orwell's novel 1984, where the government uses surveillance and propaganda to control every aspect of people's lives, where individual freedom and privacy are non-existent, and "truth" has no permanence. Such fears have been amplified by observation of countries where this model is already closer to current reality, as well as the social influence and aggressive data-gathering of many of the tech giants that have led the growth of surveillance capitalism. These issues need to be worked through and may need legislation and regulation so that technology is used in a complementary way to improve lives in a responsible and sustainable way.

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His research focuses on organisational ambidexterity: How companies can excel at both incremental and radical innovation.

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