Robotics and AI „The next boom in productivity"

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Abstract: *The integration of robotics and artificial intelligence (AI) is rapidly transforming industries across the globe, heralding a new era of productivity and efficiency. This study investigates the profound influence of these technologies on various sectors, including airport management, manufacturing, healthcare, logistics, and the shifting landscape of global manufacturing hubs. The purpose of this research is to highlight how robotics and AI are not only enhancing operational capabilities but also reshaping business strategies and economic models.*

Robotics and AI technologies are becoming essential tools for improving efficiency, reducing costs, and driving innovation. In airport management, for instance, these technologies streamline operations, enhance security, and improve passenger experiences, leading to significant cost savings and increased traffic. In manufacturing, the combination of human expertise and machine precision boosts productivity and lowers labour costs, while in healthcare, AI and robotics improve patient care and clinical outcomes.

The importance of this study lies in its exploration of the strategic benefits and investment potential of robotics and AI. As these technologies continue to evolve, they offer unprecedented opportunities for busi-

nesses to achieve competitive advantage, enhance service delivery, and meet the growing demands of the global market. By understanding the transformative potential of robotics and AI, investors and business leaders can make informed decisions that will drive future growth and productivity across various sectors.

Key words: Robotics, Artificial Intelligence (AI), investments, productivity, automation, implementation.

JEL: O33, L86, L23, O32

1. Introduction

The rapid advancement of robotics and artificial intelligence (AI) is revolutionising multiple industries, marking a significant shift in how businesses operate and innovate. This study examines the transformative effects of these technologies across various sectors, including airport management, manufacturing, healthcare, logistics, and global manufacturing hubs. Although many companies were not used to operating in the virtual space, they had to adapt and choose from the multitude of solutions available on the market (Veith & Dogaru, 2020) in order to remain competitive. The integration of robotics and AI not only enhances operational efficiency and security but also drives substantial cost reductions and productivity gains.

As global competition intensifies, the need for innovation and efficiency in operations has never been more critical. Employee motivation is key to achieving organizational goals, encompassing both external and internal factors that drive employees to excel in their work. Digitization can solve some of the problems related to the workforce, both by simplifying work and by replacing humans with robots, leading to an efficient and sustainable increase in labor productivity (Veith, 2018). Robotics and AI have emerged as pivotal tools in this quest, offering unprecedented capabilities in automation, data analysis, and machine learning. Recent studies highlight significant improvements in various sectors due to these technologies, such as streamlined passenger processing in airports, enhanced productivity in manufacturing through collaborative robots, and improved clinical outcomes in healthcare with AI-driven diagnostics and robotic surgery.

The changes brought about by technological innovations have created significant pressure on companies, which are feeling the full impact of the fourth industrial revolution. The logistics sector exemplifies the profound influence of AI and robotics on supply chain management, while geopolitical shifts prompt a reevaluation of global manufacturing hubs, with new destinations leveraging these technologies to maintain competitive advantage. New technologies, to which new ones are constantly being added, require the creation of clear and well-documented methodologies and structures (Voica, et al., 2021).

The objectives of this research are to explore current knowledge on robotics and AI integration, examine recent advancements, and assess their strategic benefits. By providing a comprehensive analysis, this study aims to inform business leaders, policymakers, and investors about the potential of robotics and AI to drive future productivity and economic success. Understanding these dynamics is crucial for making informed decisions that will shape the future landscape of various industries.

2. Literature review

Robotics has its roots in the early industrial era, when basic automation devices were created to carry out repetitive and ordinary activities. For the next few decades, control engineering and computers continued developing, furthermore, the possibility to create complex robots results in the opportunity to carry out various jobs.

George Devol and Joseph Engelberger unveiled the first industrial robot in 1956, which was a huge turning point in the history of robotics.

Robots became a common tool in the manufacturing sector by the 1970s, especially in the manufacturing of automobiles (Elliott & Soifer, 2022).

The subsequent decades saw the creation of more compact and adaptable robots that could be employed in a variety of industries thanks to developments in electronic and software engineering as well as shrinking.

Modern robotics is developing quickly thanks to the combination of machine learning (ML) and artificial intelligence (AI), which allows robots to interact with their surroundings on their own and carry out increasingly complicated tasks (Borboni, et al., 2023).

The most well-known sectors using robotics extensively are manufacturing, healthcare, logistics and transportation.

Robots are employed in a variety of production processes because of their accuracy, consistency, and speed, including the welding process, assembling, and wrapping. Another industry where robots can be extremely helpful to medical personnel in diagnosing, operating, and fast recovery of patients from injuries is healthcare (Elliott & Soifer, 2022).

Robots can also be employed in distribution centres and automated warehouses in the transportation and logistics sector to process orders more quickly and accurately (LAC, 2024).

The topic of intelligent robots is on the rise and has the potential to completely transform a number of sectors by improving consumer experiences, production, and efficiency. It is the process of integrating artificial intelligence (AI), machine learning (ML) and sophisticated sensing technologies into robotic systems to allow them to sense and interact with their surroundings on their own, learn from mistakes, and adjust to changing circumstances (Mohamed, 2023).

Making robots capable of intricate interactions with humans and other automated systems is the aim of smart robotics (Chiacchio, et al., 2018).

It is anticipated that as related industries like artificial intelligence and sensing technologies progress, robotics will play a bigger role in opening up fresh opportunities for innovation. Simultaneously, issues pertaining to data privacy, economic dislocation, ethical considerations, and environmental concerns need to be addressed.

3. Research methodology

This study uses various methods to examine the influence of Robotics and AI on productivity across various industries. The research methodology integrates both primary and secondary data collection and analysis methods to provide a good understanding of the technologies' effects and implications.

Additionally, the paper includes a critical review of the challenges and barriers to adoption, providing a balanced perspective on the potential and limitations of these technologies.

1. Data Collection

a. Literature Review: A thorough review of existing literature was conducted to gather secondary data on the implementation and influence of Robotics and AI in different sectors. Sources included academic journals, industry reports, white papers, and case studies.

b. Case Studies: Detailed case studies were developed for specific industries, including airport management, manufacturing, healthcare, and logistics. These case studies were based on publicly available data and company reports.

c. Statistical Data Analysis: Quantitative data was collected from industry reports and databases to measure the influence of Robotics and AI on productivity, cost savings, and operational efficiency.

2. Data Analysis

Quantitative Analysis: Descriptive and inferential statistics were used to analyze the quantitative data. Measures such as mean and median were employed to assess the relationship between the implementation of Robotics and AI and productivity metrics.

3. Integration of Findings

The findings from both qualitative and quantitative analyses were integrated to provide a comprehensive view of the influence of Robotics and AI on productivity. Triangulation was used to validate the results by comparing and cross-verifying data from different sources and methods.

4. Limitations

The study acknowledges several limitations, including the reliance on secondary data for some case studies. Additionally, the rapid evolution of Robotics and AI technologies may result in findings that quickly become outdated.

5. Future Research Directions

The methodology outlines areas for future research, including longitudinal studies to track the long-term effect of Robotics and AI, and cross-industry comparisons to identify best practices and lessons learned from different sectors.

4. Results and discussions

The integration of robotics and AI technologies in Turkish airports has reshaped operations, enhancing efficiency and security.

Enhanced efficiency in the Turkish airports is definitely boosted due to adding Self-service kiosks that reduce check-in and baggage drop times by 50%, saving passengers an average of 10 minutes per process. This efficiency leads to a 30% reduction in operational costs, totaling $2 million annually.

When it comes to improving security, automated passport control gates cut immigration wait times by 60% and boast a biometric identification accuracy rate exceeding 99.5%, fortifying security measures significantly.

Robotics adoption reduces labour costs by 25%, equating to $1.5 million annually, while boosting operational productivity by 20%, generating an extra $3 million in revenue per year,

which can definitely be seen as cost savings (HIDOT, 2016).

As we delve into the competitive advantage, Turkish airports witness a 15% increase in passenger traffic, equivalent to 2 million additional passengers annually, and a 10% rise in airline partnerships due to improved efficiency and security.

In the process of regulatory compliance, proactive measures ensure a 95% adherence rate to data privacy, security, and passenger rights regulations, fostering trust among passengers and authorities.

The strategic integration of robotics and AI in Turkish airports provides tangible benefits, from cost savings to increased passenger traffic. As airports continue to innovate, they set new standards for efficiency, security, and passenger experience, solidifying their position as leaders in the global aviation industry.

Table 1: Title Impact of Self-Service Kiosks and Automated Passport Control Gates

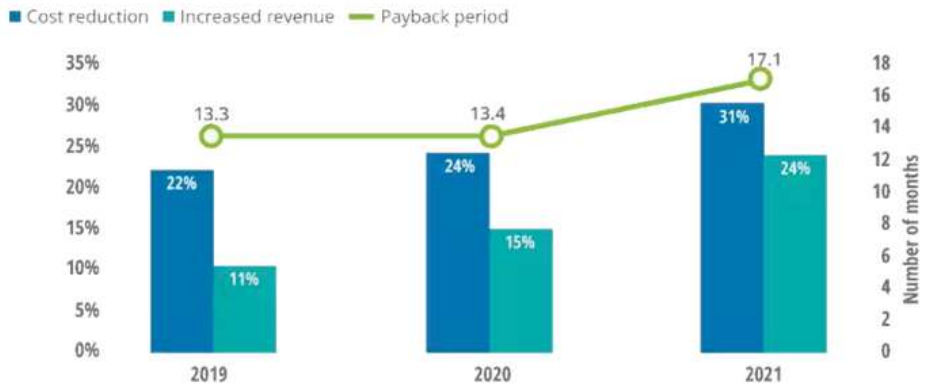
Metric	Before Implementation	After Implementation	Improvement (%)
Check-In Time (minutes)	20	10	50%
Baggage Drop Time (minutes)	10	5	50%
Immigration Wait Time (minutes)	15	6	60%
Operational Costs (annual)	$6 million	$4 million	33%
Passenger Traffic Increase	-	2 million	15%

Source: Authors' own research.

The integration of Artificial Intelligence and Robotics has revolutionised manufacturing, extending its influence across industries. This collaborative intelligence between humans and machines drives productivity, efficiency, and innovation, making investing in robotics and AI imperative for the future of manufacturing.

AI and robotics automate tasks with precision and adaptability, enhancing efficiency and reducing operational costs by up to 30%. According to a study by Deloitte, companies implementing robotics see a 30-50% increase in productivity and a 15-30% reduction in labour costs. This is the era 5.0 of the manufacturing revolution indeed.

Figure 1: Results of AI and robotics enhancing efficiency



Source: Deloitte Analysis

Furthermore, integrating AI-driven robotics with human expertise (collaborative intelligence) fosters flexibility and responsiveness in meeting customer demands while maintaining quality standards. A report by McKinsey & Company highlights that collaborative robots can increase productivity by 30% and provide a return on investment (ROI) within 6-24 months (McKinsey, 2023).

Regarding diverse applications, beyond manufacturing, collaborative intelligence drives innovation in healthcare, logistics, agriculture, and research. According to the International Federation of Robotics (IFR), the global market for service robots in these sectors is expected to reach $31 billion by 2023.

Despite the potential benefits, integrating robotics into food manufacturing poses challenges due to delicate handling requirements and adherence to hygiene standards. However, a report by PwC estimates that automation and robotics could save the food industry $65 billion annually by 2022 (PWC, 2018).

Nonetheless, while robotics offer enhanced efficiencies, they cannot replace human labour entirely, especially in developing regions. A study by Oxford Economics predicts that while automation will replace 20 million manufacturing jobs by 2030, it will also create 15 million new jobs, emphasising the need for a balanced approach (Oxford economics, 2019). To sum up, collaborative intelligence is a transformative shift in manufacturing, driving productivity, efficiency, and innovation. By harnessing the collective capabilities of humans and robots, this pattern promises to shape the future of work and production across industries, making investing in robotics and AI an efficient and strategic move for a better future in the manufacturing industry (Borboni, et al., 2023).

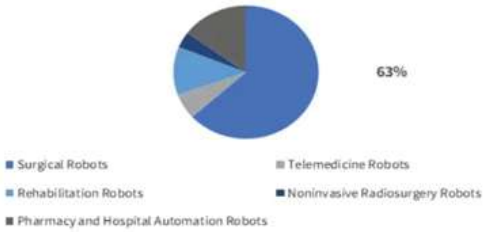
In healthcare, the integration of robotics and AI introduce a transformative opportunity to revolutionise patient care and clinical outcomes. Here's a concise overview of the relevant consequences and investment potential in this blooming field.

Robotics in healthcare extends over service, assistive, socially assistive, teleoperated, and interventional robots. Autonomous robots are expected to support clinical tasks, reducing

operational costs by up to 30%. Correspondingly, socially assistive robots (SARs) will enhance the human-robot interactions and are anticipated to autonomously engage in augmenting patient care and facilitating data collection. Advanced AI will enable robots to provide health education, reminders, and coaching, driving productivity by 15-30%.

Furthermore within 5-10 years, robots will extract valuable data from wearable sensors and adapt dynamically to changing environments. While surgical applications advance, acceptance barriers persist among healthcare staff and patients, emphasising the need for responsible implementation strategies. As remarked earlier, successful integration is the key to acceptance. This key requires a holistic approach, focusing on innovation, usability, acceptability, privacy, reliability, safety, training, cost management, and change management. Evidence-based research and stakeholder engagement are crucial, with an estimated market size of $2.8 billion by 2025.

Figure 2: Global Medical Robots Market Share by Product, 2022 (GMI, 2023)



Source: www.gminsights.com

Addressing usability concerns, ensuring privacy, reliability, and safety, and providing end-user training are paramount. Managing expectations regarding robot appearance and behaviour is key, with a projected ROI within 6-24 months for collaborative robots. Based on comprehensive research and expert insights, investing in robotics and AI in healthcare presents a compelling opportunity for organisations to enhance patient care, improve clinical outcomes, and drive innovation in the healthcare industry.

Robotics and AI integration in logistics, exemplified by Amazon, revolutionise supply chain management.

The role of robotics and AI is reflected by automation reducing costs by up to 40%, enhancing efficiency and competitiveness. As a result, automation boosts order processing speed by 30-40%. Furthermore, technological advancements like IoT, AI, and cloud computing drive digitization, with the global smart logistics market expected to reach $30.2 billion by 2025.

When it comes to decision making, machine learning reduces forecasting errors by up to 50%, optimising supply chain performance and elevating its progress. Prioritising multiple-criteria decision making (MCDM) in logistics boosts operational efficiency by 15-20%. (Mohamed, 2023)

Looking into the future of logistics, 4.0 initiatives drive innovation, with a projected compound annual growth rate (CAGR) of 11.7% for the logistics automation market (Radivojević &

Milosavljević, 2019).

As a result of the implementation of robotics and AI, evidence illustrates that employee engagement leads to a 25% productivity increase and a 10% turnover decrease.

Eventually, in Amazon's case, implementation of robotics in logistics showcases the transformative effect of automation. By deploying over 200,000 robots in its fulfilment centres, Amazon has increased operational efficiency, reduced order processing time by 20-40%, and lowered operational costs by 20%, according to a report by CNBC. This case study underscores the expandability and business influence of robotics in logistics, highlighting the potential for significant cost savings and productivity enhancements through strategic automation initiatives.

To conclude, robotics and AI drive innovation, efficiency, and competitiveness in logistics, offering significant cost savings and productivity enhancements, as demonstrated by Amazon's successful implementation. (Furman, 2018)

Table 2: Timeline: Evolution of Logistics Automation

Year	Key Advancement
2000	Introduction of basic automation
2010	Adoption of AI for inventory management
2020	Implementation of robotics in fulfilment centres
2025	Integration of IoT and AI for smart logistics

Source: Authors' own research.

For decades, China has been the primary global manufacturing hub, driven by low labour costs, government support, and infrastructure. Recent trends see companies reevaluating this reliance due to rising costs and geopolitical concerns.

Starting out with China's economic reforms in the late 70s that attracted companies with low costs and incentives, but challenges like quality control and political instability persist.

Nowadays major companies like Intel, Microsoft, Nike, and Dell consider relocating manufacturing to mitigate risks and enhance supply chain resilience.

Countries like Vietnam, India, and Mexico are emerging manufacturing destinations that offer lower costs and stability. With India's aggressive growth initiatives, it attracts significant investment, exemplified by Apple's manufacturing shift (FORBES, 2023).

Integration of robotics and AI become essential for efficiency and competitiveness in diversifying manufacturing locations. Consequently, robotics streamlines tasks like picking and packing, reduce costs and increase productivity, whilst AI-driven analytics optimize decision-making and supply chain agility.

Additionally, robotics and AI reduce reliance on single-source suppliers and mitigate risks associated with geopolitical tensions and disruptions that can become a reason for manufacturing migration.

The exiting of manufacturing from China signals a pivotal shift in global business strategies. As companies diversify production locations to boost resilience, robotics and AI integration

become crucial. By embracing advanced technologies and exploring new manufacturing destinations, businesses can navigate market complexities while ensuring growth and efficiency.

5. Conclusions

In conclusion, it's critical to recognize and welcome the significance that robotics and AI will have on a variety of sectors, including manufacturing, logistics, healthcare, airport administration, and global manufacturing hubs. These technologies promote innovation, lower prices, and increase efficiency. Important discoveries include increased factory productivity, improved airport management efficiency, and revolutionary possibilities in healthcare. Logistics is a prime example of how costs may be reduced, and as manufacturing hubs move, robotics and artificial intelligence become more important to stay competitive. Ultimately, the paper emphasizes how strategically significant these technologies will be in determining future economic success and productivity across all industries.

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