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ARTIFICIAL INTELLIGENCE: AN EMERGING TECHNOLOGY FOR SERVICE AND PRODUCTION ENHANCEMENT IN THE 21ST CENTURY

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Abstract

This study examined artificial intelligence as an emerging technology for service and production enhancement in the 21st century. The study mentioned that the 21st century has been marked by rapid technological advancements, with artificial intelligence (AI) emerging as one of the most disruptive and transformative technologies. In the context of carrying out this study, several subheads were taken into consideration, such as the concept of artificial intelligence, technology, emerging technology, service, and production, among others. The study mentioned that the use of artificial intelligence (AI) in goods production has paved the way for more safe and accurate production processes. It further stated that AI has led to increased production efficiency, reduction in labour costs, enhanced customisation, and flexibility, among others. Amidst the advantages and positive effects of AI in easing the stress of service and production that are quite challenges acquaint with this novel technology, some of which the study mentioned to include: high cost of implementation, shortage of skilled labour, data security, and privacy concerns, among others. The study concluded that artificial intelligence (AI) has rapidly emerged as a transformative force, reshaping both service and production sectors in the 21st century. By enhancing efficiency, accuracy, and innovation, AI has enabled businesses to optimise processes, improve customer experiences, and drive competitive advantage. One of the recommendations made was that organisations should allocate resources to AI innovation to stay competitive and harness its full potential for enhancing service and production efficiency.

Keywords: AI, Technology, Service, Production, Effects and Challenges

Introduction

The 21st century has been marked by rapid technological advancements, with artificial intelligence (AI) emerging as one of the most disruptive and transformative technologies. AI's ability to simulate human cognitive functions, such as learning, reasoning, and problem solving, has reshaped industries globally. In particular, AI's impact on enhancing both service delivery and production processes is profound,

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driving new paradigms in operational efficiency, decision-making, and innovation. However, industries such as healthcare, manufacturing, finance, and customer service have increasingly integrated AI solutions to streamline operations and deliver higher value to consumers.

According to Zhang et al. (2021), AI technologies like machine learning and natural language processing are enabling organisations to process vast amounts of data in real time, leading to more informed decision-making and enhanced customer experiences.

In production, AI-powered automation has revolutionised manufacturing processes by enabling smart factories, reducing human errors, and optimising supply chains (Berman et al., 2020). Similarly, in service industries, AI-driven tools have enabled businesses to offer personalised customer experiences through predictive analytics and real-time problem resolution (Kim & Park, 2019). As a result, companies are not only improving their efficiency but also transforming their interaction models with consumers.

However, while the potential for AI to drive growth and innovation is undeniable, there are notable challenges that accompany its adoption. Ethical concerns, such as bias in AI algorithms, job displacement, and data privacy issues, have become pressing topics of discussion in both academic and business circles (Siau & Wang, 2020). Despite these challenges, AI continues to evolve, and its integration into production and service systems is expected to deepen, creating new opportunities for enhanced productivity and economic growth in the coming decades.

This paper explores the role of AI in enhancing service and production sectors, drawing on recent research to analyse both the opportunities and challenges associated with this technology. It also highlights how AI applications have changed traditional models, examines emerging trends, and assesses the long-term implications of AI-driven advancements.

Concept of Artificial Intelligence

In the modern world, artificial intelligence has become incredibly popular. Artificial intelligence (AI) is the study of how the human brain makes decisions, learns new things, and thinks through difficulties. The goal of artificial intelligence is to enhance computer abilities related to human understanding, including language intelligence, learning, reasoning, and problem-solving. According to Mahato (2022), artificial intelligence refers to the science and engineering used to make smart systems in the computer science domain, which helps in technological advancements. Although it mimics the functioning of human intelligence, it lacks biologically observable mechanisms. One way to conceptualise artificial intelligence is as a field of research that uses computer models to address the algorithmic and analytical aspects of challenges.

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Bassey and Owushi (2023) defined artificial Intelligence as the collection of technologies that enable machines to sense, comprehend, act, and perform several functions matching those of humans AI refers to a system or machine that mimics human intelligence. The aim of artificial intelligence (AI) is to create a machine that is capable of human-like perception, reasoning, learning, planning, prediction, and other human behaviours. Machine intelligence, especially that displayed by computer systems, is known as artificial intelligence (AI). This area of computer science study focusses on creating and analysing tools and software that allow machines to sense their surroundings and use intelligence and learning to make decisions that will increase their chances of accomplishing specific objectives. These devices could be referred to as AIs. Verma (2018) defined artificial intelligence as the study of intelligent machines and software that can reason, learn, gather knowledge, communicate, manipulate, and perceive objects. The intelligence displayed by software or robots is known as artificial intelligence. It belongs to the computer science subfield.

The term "artificial intelligence" encompasses a broad spectrum of cutting-edge analytics, applications, and logic-based techniques that mimic human behaviour, judgement, and cognitive functions including learning and problem-solving. Saini (2023) affirmed that artificial intelligence (AI) is the branch of computer science that deals with the intelligence of machines, where an intelligent agent is a system that takes actions that maximise its chances of success.

Concept of Technology

Technology is the practical use of scientific concepts to alter the environment. Technology is the use of scientific knowledge for real-world problems or uses, whether in business or daily life. In other words, we employ technology whenever we apply our scientific understanding to accomplish a certain goal. Coccia (2019) asserted that technology is a complex system of artefacts made and/or used by living systems that is composed of more than one entity or sub-system and a relationship that holds between each entity and at least one other entity in the system, selected considering practical, technical, and economic characteristics, to satisfy needs, achieve goals, and/or solve problems of users for the purpose of adaptation and/or survival in the environment.

Technology is the application of conceptual knowledge, particularly in a repeatable manner, to accomplish practical aims. The term "technology" can also refer to the end products of these endeavours, encompassing both material instruments like machinery or utensils and immaterial ones like software. In ordinary life as well as science and engineering, technology is indispensable. Wahab, Rose, & Osman (2024) affirmed that technology is the theoretical and practical knowledge, skills, and artefacts that can be used to develop products and services, as well as their production and delivery systems.

Manufactured items as pots, water reservoirs, dwellings, and axes, as well as their modern equivalents, are considered to be part of technology. They serve two

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purposes: either they improve human capacities (a hammer, for example, allows you to apply more power to an item) or they allow people to carry out tasks that they would not be able to carry out without them (a pot allows you to carry bigger volumes of water; you cannot do this with your hands). The means (instruments, apparatus, systems, techniques, and protocols) produced by the technological process are referred to as technology. Transportation systems and toothbrushes are examples of technological things. Technology is the use of knowledge for practical purposes; it is the application of science to industry or commerce. It is the field of study that focusses on the art or science of using scientific knowledge to solve real-world issues. Digital resources that can be employed in education are referred to as "technology." The knowledge that enables technical processes is known as technology. It includes the knowledge and techniques required to organise and work with matter, energy, and information; it also includes the methods for coming up with new ways to do these kinds of changes.

Technology is the application of science in a practical way to address issues in the real world and enhance human welfare. It seeks to accomplish an industrial or commercial goal. Technology can be defined as a system that includes the following elements: a technological process, technological objects, technological knowledge, developers of technological objects, users of technological objects, and a worldview—a set of values and beliefs that form one's perspective on the world—that is generated by and emerges from the technological process.

Concept of Emerging Technology

Emerging technology is a term generally used to describe a new technology, but it may also refer to the continuing development of an existing technology; it can have slightly different meaning when used in different areas, such as media, business, science, or education. Emerging technologies are technologies whose development, practical applications, or both are still largely unrealized. These technologies are generally new but also include old technologies finding new applications. They are often perceived as capable of changing the status quo and are characterised by radical novelty (in application even if not in origins), relatively fast growth, coherence, prominent impact, and uncertainty and ambiguity.

In other words, an emerging technology can be defined as "a radically novel and relatively fast-growing technology characterised by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions, and patterns of interactions among those, along with the associated knowledge production processes. Emerging technologies include a variety of technologies such as educational technology, information technology, nanotechnology, biotechnology, robotics, and artificial intelligence. However, a study by Rotolo et al.

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(2015) highlighted that emerging technologies have been the subject of much debate in academic research and a central topic in policy discussions and initiatives.

Emerging technologies are also referred to as new and innovative technologies that are being developed or have recently been introduced into the market but are not yet fully established. These technologies have the potential to significantly impact society and the economy. They have a high potential for growth and development, which means they can create significant opportunities for individuals and organisations and are relatively new and not fully established, leading to uncertainty about their future prospects and the challenges that may arise. Rapidly evolving, emerging technologies are continuously evolving, and new advancements are being made at a fast pace, and keeping up with these advancements can be challenging.

Emerging technologies often combine different disciplines, such as computer science, engineering, and biology. This interdisciplinary nature makes them unique and presents exciting opportunities for innovation. Emerging technologies have the potential to disrupt traditional industries and ways of doing things. This can create significant opportunities but also presents challenges and risks. Additionally, the work of Rotolo (2015) culminates in a period of gradual enhancement that originated primarily in technology circles where emerging technology was linked to the specific technology (Halaweh, 2013) and became a tool for labelling purposes shared among scholars of various research subdomains (Litvinski, 2018).

Concept of Service

A service is an intangible benefit, activity, or item offered to the customer. Services are non-physical in nature and are provided by service providers such as hotels and banks. According to Alam (2021), services are intangible outcomes of human efforts that can satisfy some human needs and thereby can command prices in exchanges. Human efforts can be augmented or supported by tools, equipment, machines, plants, tangible processes, robots, energy, or even by nature itself. A service is any activity or benefit that one party can offer to another, which is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product.

Service is a change in a person's or a good's economic entity's situation brought about by another economic entity, by permission. Services are intangible actions adjusted to the unique desires of recognised clients. A service is an act or performance that one party might deliver to another that is fundamentally intangible and does not result in the ownership of something. Service is described as a time-perishable, intangible experience performed for a client operating in the position of a co-producer. Grönroos (2011) defines service as value-creating assistance to another party's practices. Services are acts done for others, including giving those resources they may utilize. Service is seen as instances in which "the client contributes significantly to the

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manufacturing process. Service is a provider-client relationship that produces and collects value.

Service is defined as a concept that encompasses various theoretical approaches and perspectives. According to Riak & Bill (2022), service quality can be determined by comparing the perceptions of consumers for the services that they obviously received and the services that they expected to get through the attributes of an enterprise service. If the received service or perceived service is what they have expected, then the perceived service delivery is good and satisfactory.

A service is an intangible benefit, activity, or item offered to the customer. Services are non-physical in nature and are provided by service providers such as hotels and banks. An example is hotel services. A service is any activity or benefit that one party can offer to another, which is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product. Services are economic activities that create value and provide benefits for customers at specific times and places as a result of bringing about a desired change in – or on behalf of – the recipient of the service.

Concept of Production

Production is a term used in economics to describe the process of combining inputs to generate a valuable product or service. Production is the process of mixing multiple inputs, both material (metal, wood, glass, or plastic) and immaterial (plans or knowledge), to produce output. Ideally, this output will be a valuable item or service that improves people's utility. According to Omar & Bo (2022), production encompasses administrative, factory-level, and service management. The client is the focus of production. If the customer is pleased, then the company is on the right course. Production is not only recommended for increasing specific parts of a business; it is also necessary.

Production is the process of mixing multiple inputs, both material (metal, wood, glass, or plastic) and immaterial (plans or knowledge), to produce output. Ideally, this output will be a valuable item or service that improves people's utility. Production management, often known as operations management, is the act of planning, arranging, and optimising the production process from raw materials to finished items. The goal of production management is to establish the optimal balance of quality, quantity, time, and cost (Katana, 2020).

Production can result in the creation of commodities and services. Goods are goods that we can see and touch with our hands, such as cell phones, clothing, rice, cutlery, and so on, whereas services are invisible but can be felt. Teaching, medical care, transportation, and other services fall within the category of varied services. Production is the process of combining various inputs, such as capital, labour, and land, to generate outputs in the form of products or services.

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Production is a very important activity for any economy. In reality, a nation with a high degree of productive activity leads the prosperity charts. This is because raw items are undoubtedly valuable, but the manufacture of these raw things increases their worth or want-satisfying power.

Effects of Artificial Intelligence on Goods Production

The use of artificial intelligence (AI) in goods production has paves the way for more safe and accurate production processes. In addition, AI helps manufacturers or producers streamline processes and cut down on excess resources related to manual or repetitive tasks. Over the years, manufacturing and AI have progressed from basic automation tools to more in-depth intelligence related to machine learning and adaptive systems. Through the collection of big data and analytics, AI's role in manufacturing has taken on more significance, enabling predictive maintenance and data-driven decision-making (Amit, 2023). The effects of AI on goods production are outlined below:

Increased Production Efficiency: AI-driven automation has led to improved efficiency in goods production by optimising manufacturing processes. As explained by Kusiak (2018), AI can analyse vast amounts of data from production lines and machinery, identifying inefficiencies and suggesting improvements, resulting in higher productivity with minimal human intervention. This reduces downtime and enhances output in industries like automotive and electronics.

Reduction in Labour Costs: AI technologies automate repetitive tasks previously done by human workers, reducing labour costs. According to Brynjolfsson and McAfee (2017), AI enables machines to take over manual work in industries like assembly line production, warehousing, and packaging, which not only decreases the cost of labour but also improves consistency in product quality.

Enhanced Customisation and Flexibility: AI allows manufacturers to adopt a more flexible production model that caters to customised consumer demands. AI-powered systems can adjust machinery and processes to produce small batches of goods with specific features, leading to greater product diversity without compromising efficiency. This flexibility caters to the growing demand for personalised products in sectors like fashion and electronics.

Predictive Maintenance: AI systems help predict when machinery is likely to fail, preventing unplanned downtimes. Predictive maintenance powered by AI reduces machine breakdowns and costly repairs by analysing sensor data and identifying patterns that indicate potential failures. This helps to ensure continuous production and minimises disruptions.

Improved Supply Chain Management: AI optimises supply chain management by predicting demand, optimising inventory levels, and managing logistics. Ivanov (2019)

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notes that AI-driven supply chains adjust production schedules and resource allocation based on real-time market data, reducing overproduction or underproduction while meeting consumer demand efficiently.

Environmental Impact: AI contributes to more sustainable production practices. AI-driven optimisation of energy consumption and waste management in manufacturing processes can reduce environmental impact by minimising emissions and resource usage. AI's ability to monitor and adjust processes ensures that production becomes greener and more efficient over time.

Enhanced Product Quality: By integrating AI with quality control systems, manufacturers can detect defects earlier in the production process. AI enables real-time inspection through image recognition and sensor data analysis, ensuring consistent quality and reducing the number of defective products reaching consumers.

Challenges of Artificial Intelligence in Goods Production

Artificial Intelligence (AI) has transformed various sectors, including manufacturing and goods production, by improving efficiency, precision, and innovation. However, despite the benefits, AI integration into goods production is not without challenges. These challenges range from technical and economic issues to ethical and workforce-related concerns. According to Chikezie and Odo (2020), the implementation of AI in manufacturing environments often encounters significant hurdles that companies must navigate to maximize its potential. This paper explores the key challenges associated with the use of AI in goods production.

High Cost of Implementation: One of the primary challenges of AI in goods production is the high cost of implementation. AI systems require sophisticated hardware, software, and infrastructure, which can be expensive for companies, especially small and medium-sized enterprises (SMEs). The installation of advanced AI technologies, such as machine learning algorithms, sensors, and robotics, involves a substantial initial investment. As Obi and Akande (2021) note, the financial burden of acquiring, installing, and maintaining AI systems can be prohibitive for many businesses, preventing them from fully harnessing the benefits of AI. Furthermore, ongoing maintenance costs and the need for regular updates to keep up with technological advancements can strain budgets.

Shortage of Skilled Labor: Another significant challenge is the shortage of skilled labor required to operate and manage AI systems in production environments. AI technology is complex, and its successful integration into manufacturing requires skilled professionals, including data scientists, AI engineers, and machine learning specialists. However, there is currently a global shortage of individuals with the necessary expertise to handle these technologies. According to Okeke and Ifediora (2020), many companies struggle to find qualified personnel who can design, develop, and maintain

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AI systems, which can delay the implementation of AI in goods production or lead to underutilization of these systems.

Data Security and Privacy Concerns: Data security and privacy concerns also pose challenges in the use of AI in goods production. AI systems rely heavily on large datasets to learn and make decisions. This data often includes sensitive information, such as production processes, business strategies, and customer details. As Okon and Eze (2019) highlight, safeguarding this data from cyber-attacks and breaches is crucial, as any unauthorized access to critical data can disrupt production processes and compromise the competitive advantage of a company. Additionally, concerns about data privacy regulations, particularly in regions with stringent data protection laws, can complicate the deployment of AI systems in global manufacturing networks.

Ethical Concerns Regarding Workforce Displacement: AI technology also raises ethical concerns, particularly regarding its impact on the workforce. One of the key concerns is the displacement of workers due to automation. AI-powered machines and robots can perform tasks more efficiently than human labor, leading to reduced demand for certain types of jobs. This has led to fears of mass unemployment, especially in industries that rely heavily on manual labor. According to Aina and Lawal (2021), the shift toward automation may lead to significant job losses, creating social and economic challenges for affected workers and their communities. Policymakers and businesses must consider how to address these concerns by investing in retraining programs and developing strategies to ensure a smooth transition for displaced workers.

Limitations in AI Decision-Making: Another challenge lies in the limitations of AI's decision-making capabilities in production environments. While AI can optimize processes and make data-driven decisions, it often lacks the human intuition and flexibility needed to respond to unexpected situations. AI systems, especially those driven by machine learning, require large amounts of data for training and can only make decisions based on past patterns. As Onwuka and Nwankwo (2022) explain, this makes AI vulnerable to errors when it encounters novel situations or incomplete data. In complex production environments, the inability of AI systems to adapt to unexpected changes can lead to operational inefficiencies or even catastrophic failures.

Lack of Regulatory Frameworks: The lack of regulatory frameworks governing the use of AI in production also poses challenges. While AI technology is advancing rapidly, regulatory frameworks have not kept pace. According to Nnaji and Okon (2020), many countries lack comprehensive laws and standards to guide the ethical and safe deployment of AI in industries. The absence of clear guidelines can lead to inconsistent implementation practices, where companies may prioritize efficiency and cost-effectiveness over safety and ethical considerations. Moreover, the lack of international standards complicates the integration of AI systems into global supply chains, where different countries have varying levels of regulation and enforcement.

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Integration into Global Supply Chains: While AI has the potential to revolutionize goods production by enhancing efficiency, precision, and innovation, several challenges hinder its full implementation. High costs, a shortage of skilled labor, data security issues, ethical concerns, limitations in AI decision-making, and the lack of regulatory frameworks are significant barriers that need to be addressed. Overcoming these challenges will require coordinated efforts from governments, businesses, and educational institutions to develop policies, training programs, and standards that support the ethical and sustainable integration of AI into goods production.

Conclusion

Artificial Intelligence (AI) has rapidly emerged as a transformative force, reshaping both service and production sectors in the 21st century. By enhancing efficiency, accuracy, and innovation, AI has enabled businesses to optimize processes, improve customer experiences, and drive competitive advantage. Despite challenges such as ethical concerns and job displacement, the potential for AI to continue revolutionizing industries is immense. As AI technology advances, its role in fostering growth and innovation across various fields will undoubtedly deepen, marking it as a cornerstone of modern technological progress.

Recommendations

1. Organizations should allocate resources to AI innovation to stay competitive and harness its full potential for enhancing service and production efficiency.
2. It is advised to provide training and education programs to equip employees with the necessary skills to work alongside AI, minimizing job displacement and maximizing productivity.
3. Leverage AI technologies to deliver personalized customer experiences and predictive analytics, improving service delivery and customer satisfaction.
4. It is recommended to embrace AI-powered automation in manufacturing and supply chains to optimize operations, reduce costs, and increase production output.

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