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The Impact of Artificial Intelligence Applications on Industrial Company Performance

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Abstract:
Currently, the success of a company hinges on its ability to adapt to the digital revolution to remain competitive. In this perspective, the integration of artificial intelligence becomes crucial as a central axis of productivity. This study aims to identify the impact of artificial intelligence applications on the performance of industrial companies. Businesses are increasingly recognizing the significant advantages that AI can provide, leading many large companies to adopt AI in various forms or integrate it into their overall strategy. These trends reflect broader trends, as many companies consider transforming their core business models by integrating artificial intelligence into their operations and products. To achieve the research objectives, a descriptive analysis approach was used to examine related concepts of artificial intelligence. Key findings of this article include that implementing various AI strategies in industries, such as machine learning, natural language processing, and data analytics, can bring many benefits. These benefits include increased productivity and efficiency, improved sustainability and energy efficiency and advancements in employment and supply chain management.
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Introduction

The evolution of industrial revolutions reflects humanity's ongoing quest for progress and innovation. From the inception of the First Industrial Revolution to the current Fourth, each period has significantly impacted society and industrial practices. Today, amidst the Fourth Industrial Revolution, characterized by the fusion of technology, communication, artificial intelligence, and big data, industrial enterprises face unprecedented transformations.

The First Industrial Revolution, originating in the late 18th century, not only revolutionized manufacturing but also spurred societal changes. Despite initial challenges like harsh working conditions, this era laid the foundation for labor rights and workplace safety regulations, prioritizing worker well-being. Subsequent revolutions saw advancements in transportation, communication, and production, propelling humanity into a new era of technological innovation.

In the latter part of the 20th century, the Third Industrial Revolution marked a pivotal moment with the rise of the Internet and digital communication. This era witnessed significant advancements in artificial intelligence and data analysis, empowering industrial enterprises to utilize big data for informed decision-making and operational efficiency.

Today, as we navigate the complexities of the Fourth Industrial Revolution, industrial enterprises stand at the threshold of a new era of innovation and growth. With a focus on enhancing performance and profitability, organizations are turning to AI applications to revolutionize their operations. From production and supply chain management to quality control and innovation, AI strategies are reshaping industrial enterprise practices.

It is crucial to explore the impact of AI applications on industrial enterprise performance comprehensively. By leveraging AI technologies, industrial enterprises have the opportunity to optimize processes, improve decision-making, and drive sustainable growth. This evolution represents a significant shift in management practices and underscores humanity's adaptability in a changing technological landscape.

In this study, we delve into the transformative potential of AI applications on industrial enterprise performance, through empirical analysis and related studies, we aim to provide insights into how AI is revolutionizing industrial operations and shaping the future of enterprise performance in the Fourth Industrial Revolution.

Based on the information provided, the core issue under examination can be summarized into the following question:

How do AI applications impact industrial company performance?

1- Literature Review

As for artificial intelligence, since its inception in 1956, it has been defined as the intelligence exhibited by machines and software that mimics human mental abilities, such as the ability to learn, reason, and react. It is the machine's ability to simulate human thinking and how it works, such as its ability to think, discover, and learn from past experiences. (Benazza & Djilali Toumi, 2024)

AI encompasses a diverse range of definitions, which can be organized into four main categories:

1-1-Artificial Intelligence Systems that think like humans (Thinking Humanly)

John Haugeland defined it in his book titled "Artificial Intelligence the Very Idea", published in 1985, as: "the innovative new endeavor to induce thought in machines. This research's main objective is not just to create some brilliant fake or mimic intellect. Not at all. "AI" simply desires the authentic article: devices that are, in the most literal sense, minds." (John, 1985)

AI is commonly defined as: "the capacity of a digital computer or computer-controlled robots to carry out actions typically associated with intelligent individuals, such as reasoning, meaning-finding, generalization, and experience-based learning." (Djoudi, 2024)

In 1955 John McCarthy was the first to define the term Artificial Intelligence, as follows: "The development of machines with intelligent behavior is the aim of artificial intelligence." (Bazilinskyy, 2013)

1-2-Artificial Intelligence Systems that act like humans (Acting Humanly)

Elaine Rich characterizes what AI researchers have been doing for the last 50 years: "The study of artificial intelligence aims to find out how to make a computer carry out human-level tasks in a different way. The goal of artificial intelligence is to create computer programs that can solve specific problems or make decisions based on descriptions of those problems, with the ultimate goal of simulating human thought processes and comprehending human nature. or return to the different evidence processes provided into the programmer to get a decision on a case." (Djoudi, 2024)

"AI is the study of how to make computers do things that people are better at. That means it covers tasks like solving problems, comprehending natural language, understanding, and performing science." (Rich, 1985)

The majority of proffered definitions of artificial intelligence rely on comparisons to human behavior; Marvin Minsky said the following words about AI: "The science of making machines do things that would require intelligence if done by men" while Schildt claims: "An intelligent program is one that exhibits behavior similar to that of a human when confronted with a similar problem. It is not necessary that the program actually solve, or attempt to solve, the problem in the same way that a human would." (Defining Artificial Intelligence)

1-3-Artificial Intelligence Systems that think rationally (Thinking Rationally)

When a system acts in a way that maximizes goal achievement given the knowledge at hand, it is said to be rational; in other words, is to "rationalize" the system's behavior, relative to its circumstances, by interpolating just the right mental structure to do the job. (John, 1985)

Charniak and McDermott stated in 1985 that the AI is: "the use of computational models to examine mental abilities" while Winston defined AI in 1992 as: "The study of the computations that make it possible to perceive, reason, and act." (Duygulu, 2011)

1-4-Artificial Intelligence Systems that act rationally (Acting Rationally)

Artificial Intelligence AI is: "The study of creating intelligent agents is known as computational intelligence." An agent is just something that acts, computer agents are expected to do more: it should be able to sense its surroundings, operate independently, endure over an extended length of time, adjust to changes, and set and pursue objectives. When an agent acts in a way that maximizes the best outcome—or, in the event of uncertainty, the best predicted outcome—they are acting rationally. (Russel, 2010)

AI has also been defined as "the set of theories and techniques implemented in order to create machines capable of simulating human intelligence." On the other hand, this concept can refer to "the set of tasks and techniques that allow a machine to simulate human intelligence, to predict, learn, make decisions, and perceive the environment." This new

technology has the potential to transform several aspects of administrative work, such as automated decision-making, predictive analysis, document processing, and interaction with citizens. (Benmehdi & Chouali, 2024)

Based on the previous definitions, the following can be considered a mini-summary or conclusion:

"Artificial Intelligence (AI) is a specialized area within computer science and information science focused on creating hardware and software systems capable of solving problems and completing tasks that, if performed by humans, would be deemed intelligent. This multidisciplinary field explores both the cognitive aspects of thinking and reasoning, as well as the behavioral aspects of action and problem-solving. Its ultimate goal is to develop machines that exhibit intelligent behavior and can autonomously adapt to diverse contexts and challenges."

2-Applications of AI in Industrial Company

In industrial enterprises, various artificial intelligence strategies are employed, including machine learning, natural language processing, data analytics...

2-1- Machine learning

Along with robotics and AI, is poised to have profound social, political, and business impacts, reshaping numerous modern industries and potentially displacing jobs. A 2017 research paper estimated that 47% of all US jobs are at "high risk" of automation within the next two decades. However, historical revolutions have often led to increased productivity and net job creation, albeit with changes in the nature of work. While the specific tasks AI will create remain uncertain, current trends suggest that certain jobs may be relatively "safe" in the short term, particularly those requiring extensive human contact, social skills, strategic and creative thinking, and comfort with ambiguity and unpredictability. (Amit M & Maude, 2018)

2-2- Natural Language Processing (NLP)

The definition of characters, words, and sentences in a document is an essential step in the linguistic analysis of digital natural language text. Understanding these units, however, presents different difficulties based on the language being processed, the documents' origin, and other elements. Considering the variety of human languages and writing systems, this task is by no means simple. Natural languages inherently contain ambiguities,

which are often amplified by writing systems and can lead to additional ambiguities.

One of the main challenges in Natural Language Processing (NLP) is resolving these ambiguities. A small number of well-formed corpora in a small number of languages were the main focus of early NLP research. However, recent years have seen substantial progress by leveraging large and diverse corpora from various sources, including the vast and continually expanding pool of dynamically generated text available on the Internet. The increasing diversity and quantity of corpora has created the need for methods for automatically gathering and preparing text corpora for NLP tasks. (Palmer, 2010)

Natural Language Processing (NLP) is indeed a key strategy within artificial intelligence (AI) that focuses on enabling computers to understand, interpret, and generate human language. By leveraging various techniques, the goal of natural language processing (NLP) is to make it easier for computers to interact with human language naturally. This includes activities like comprehending meanings, extracting information from texts, and creating new messages. Among the various uses for natural language processing (NLP) are conversational robots, intelligent search engines, automated customer support agents, social media post analysis, language translation, and many more. These applications rely on advanced NLP capabilities to achieve more intelligent and comprehensive interactions with human language, ultimately enhancing user experience and efficiency in various domains. (Copeland, 2023)

2-3- Data analytics

Analyzing and converting unstructured data into information that is relevant and helpful so that decisions may be made with confidence is known as data analytics.

Large datasets have their roots in the 1960s and 1970s, when the world of data was just getting started with the creation of relational databases and the first data centers. This is despite the fact that the concept of big data is still relatively new. People started to notice in 2005 how much data users were producing on websites like Facebook and YouTube. Around the same time, Hadoop, an open-source system designed primarily for storing and analyzing massive datasets, was established. NoSQL also began gaining popularity during this period. The development of open-source frameworks like Hadoop (and more recently Spark) was crucial for the

growth of big data as they made working with big data easier and cheaper in terms of storage. In the years following, the volume of big data skyrocketed. Users continued to generate massive amounts of data, not only humans. An Increasing number of items and gadgets are now online thanks to the Internet of Things (IoT), which is gathering information about consumer behavior and product performance. More data is being produced as a result of the development of machine learning. Big data has advanced significantly, but its advantages are still being realized. The use of cloud computing has increased big data. (Benazza & Djilali Toumi, 2024)

Data analytics is the collection, transformation, and organization of data in order to draw conclusions, make predictions, and drive informed decision making.

The 21st century has seen a massive increase in the generation of data from various sources such as businesses, organizations, and individuals. With the advancement of technology and the increasing availability of data, it has become imperative for organizations to make data-driven decisions. The vast amounts of data generated in the modern era require sophisticated techniques for their analysis, which is where data analytics comes into play.

In the twenty-first century, data analytics has emerged as a vital tool for decision-making. Enterprises and institutions depend on data analytics to comprehend their clientele, rivals, and industry patterns, and to create knowledgeable choices that can stimulate expansion and enhance functions. However, a methodical and structured approach to data analysis is necessary in order to derive relevant insights from the data. This is where the use of statistical data analysis is necessary. (Seyyed Ali & Hamid, 2023)

3- How AI affects the efficiency of industrial enterprises?

The impact of AI applications extends to various aspects of industrial enterprise performance, ranging from improving employment processes and energy efficiency in cities to enhancing quality management systems, optimizing supply chain management, and improving marketing strategies and customer experience…

3-1-Productivity and efficiency

The advent of Industry involves different types of impacts on different areas of the manufacturing industry. Companies that integrate Industry solutions can envision benefits such as revenue growth and cost reduction, also due to a more efficient use of energy. Smart machines are automated

and support human work, and consequently workforce skills and requirements are changing:

The increasing use of smart devices in manufacturing settings, in addition to enhanced connectivity between them, is leading to global plant optimization and improving industrial productivity. Collaborative productivity is facilitated by communication channels between individuals, between humans and smart devices (HCI), and among smart devices themselves (M2M). Utilizing big data and M2M, the entire production process can be optimized, leading to leaner manufacturing routes and enhanced resource utilization. The flexibility included into smart machines—which may self-reconfigure to fit a variety of product types—further boosts productivity. Additionally strengthening the system's resilience, this dynamic reconfiguration enables new machines to join easily without the need for manual configuration or human involvement. (Chiara, Giuditta, Roberto, & Sergio, 2019)

3-2- Urban Energy Efficiency

The development of smart technology, in particular artificial intelligence (AI), is critical to improving industrial processes and urban surroundings' energy efficiency. This technology encourages a move toward sustainable economies and green innovation in addition to being a tool for increasing efficiency. AI can significantly contribute to raising awareness of green energy in addition to developing creative solutions to increase environmental sustainability by offering efficient techniques and tools for monitoring and managing energy consumption. The following are the main ideas that illustrate this impact: (Xiangyi, Qing, & Ying, 2024)

- ✓ **Direct Impact of AI on Urban Energy Efficiency:**
  - AI technology utilizes historical data analysis to swiftly identify and address environmental issues, aiding city managers in making informed decisions.
  - It formulates energy allocation plans to minimize waste, thus enhancing urban energy utilization efficiency.
- ✓ **Indirect Impact of AI on Urban Energy Efficiency:**
  - Integration of AI with information technologies in energy production and storage can establish integrated regional energy systems, improving the efficiency of renewable energy outputs.
  - AI-driven smart grid construction and management facilitate intelligent scheduling and distribution of electricity, reducing

energy transmission losses and promoting green and sustainable urban energy development.

- ✓ **Green Technology Innovation and its Role in Energy Efficiency:**
  - Green technology innovation is pivotal for enhancing energy savings and emission reduction capacity in industrial production and economic development.
  - By developing and improving green technologies, enterprises can establish management models and control mechanisms to minimize energy losses and improve resource allocation efficiency, ultimately accelerating the digitalization and green transformation of enterprises and increasing energy efficiency in cities.
- ✓ **Impact of AI on Industrial Digitization and the Digital Economy:**
  - AI's development has transformed traditional production management models and spurred rapid growth in the digital economy.
  - Applied in various industries, AI prompts production intelligence, service personalization, and scientific decision-making, increasing market entry efficiency and core competitiveness of enterprises.
  - It expands theoretical systems in areas such as quality and efficiency transformation, aiding government departments in resource allocation and improving energy efficiency.
  - Additionally, AI empowers the digital economy era by leveraging intelligent power grids, expanding energy network coverage, and promoting the development of green energy and low-carbon circulation.

3-3-Employments

With advances in machine learning, big data, artificial intelligence, and other technologies, a new generation of intelligent robots that can perform routine, repetitive, and regular production tasks requiring human judgement, problem-solving, and analytical skills has emerged.

Robotic process automation technology can be extremely helpful in processing large amounts of data because it can learn and mimic the way workers perform repetitive new tasks related to data collection, report running, data copying, data integrity checking, reading, processing, and

email sending. In a technologically and informatics-driven economy, employers are pushing workers into more creative roles.

Generally, the "new technology-economy" paradigm that is derived from automation machine and AI technology is affecting the breadth and depth of employment, which is manifested as follows: (Yang & Xiuwu, 2024)

- It reduces the demand for coded jobs in enterprises while increasing the demand for nonprogrammed complex labour.
- The development of digital technology has deepened and refined the division of labour, accelerated the service trend of the manufacturing industry, increased the employment share of the modern service industry and created many emerging jobs.
- Technological advances and modern productive forces enhance the autonomy and efficiency of workers. This results in improved job satisfaction and job quality. Although the introduction of machinery can eliminate or replace many workers, the development and expansion of machinery itself can generate additional employment opportunities. While machines may replace workers in certain manual tasks, the total number of workers in factories can ultimately surpass the number of craft workers they have replaced. This indicates a relative reduction in certain sectors or types of work, alongside an absolute increase in employment across the entire economy or in new sectors created by automation. Therefore, the relative decline in the number of workers performing specific manual tasks is accompanied by an absolute increase in the overall number of workers, driven by the growth of automated and manufacturing industries.
- Internet information technology reduces the distance between countries in both time and space, promotes the transnational flow of production factors, and deepens the international division of labour. The emergence of AI technology leads to the decline of a country's traditional industries and departments. Under the new changes to the division of labour, these industries and departments may develop in late-developing countries and serve to increase their employment through international labour export.

3-4- Quality Management Systems

AI is driving significant advancements in the way businesses approach quality assurance, reshaping traditional quality management systems. Here are three ways AI is shaping the future of quality management, illustrated with practical examples: (Greg Waldstreicher, 2023)

- ✓ **Data-Driven Decision-Making:** Large volumes of data may be analyzed in real-time by AI-powered quality assurance systems, allowing companies to base choices on insights, trends, and patterns. This results in a more proactive approach to quality control, making it possible to quickly identify and address possible problems. For example, a car manufacturing company can examine real-time data from multiple sources, including production lines, customer feedback, and historical records, using AI-powered quality assurance systems. Through the identification of trends, patterns, and insights, the organization may enhance its quality management strategy and make well-informed decisions, swiftly recognizing and resolving possible problems.
- ✓ **Automated Quality Control:** Businesses can automate a variety of quality control procedures using AI algorithms, which lowers human error and improves efficiency. This guarantees a higher degree of accuracy in identifying defects and inconsistencies in goods and services while also saving time and resources. Using AI algorithms, a pharmaceutical corporation may automate the 99.999% accurate inspection of pills and capsules during the production process. The business can guarantee a higher degree of precision in identifying faults and disparities by decreasing human error and boosting productivity, which will ultimately result in safer and more dependable pharmaceuticals.
- ✓ **Predictive Quality Management:** By examining past data and spotting trends that may indicate future issues, artificial intelligence (AI) in quality management can forecast possible quality concerns. By doing this, companies may deal with possible problems before they get out of hand, maintaining a high standard of quality and raising the satisfaction of clients. For instance, by examining past data and spotting trends that may indicate future issues, a food processing facility might utilize AI in quality management to anticipate any quality concerns. With this kind of foresight, the factory can deal with possible problems before they become more serious, maintaining a high standard of quality and raising customer satisfaction.

3-5- Supply Chain Management

AI is one of the technologies that can be utilized in supply chain management. AI-powered solutions have the potential to revolutionize stock management due to their capacity to handle massive amounts of data. These intelligent systems can rapidly analyze and interpret huge datasets, delivering real-time actionable insights for demand and supply planning. These AIs provide accurate forecasts of future trends in consumer behavior and seasonality thanks to their complex algorithms.

By predicting the wants of the clients, an artificial intelligence application may help eliminate unnecessary inventory expenses. Enhancing warehouse efficiency through automation is crucial for efficiently managing the supply chain. It would make it possible to quickly retrieve goods from storage facilities and easily transport them to clients. AI in warehouses has the potential to boost productivity in a variety of areas, such as the speed at which problems are resolved, the simplicity with which regular tasks may be finished, and the amount of time employees can devote to more crucial everyday tasks like planning.

AI-powered warehouse process automation could cut costs and save time by eliminating the need for human labor. Additionally, studies have demonstrated that AI can enhance coordination between many stakeholders in the supply chain, including manufacturers, suppliers, and retailers. Artificial intelligence (AI) can help businesses collaborate more successfully by enabling information sharing and communication, which will boost performance. (Baha M, 2023)

3-6-Improving Marketing Strategies & Customer Experience

Artificial Intelligence (AI) Customer Experience involves harnessing the power of AI technologies to augment customer interactions, streamline business operations, and ultimately bolster overall customer satisfaction. The technologies deployed in this approach range from machine learning algorithms to natural language processing (NLP), predictive analytics, and even robotic process automation.

AI facilitates a highly personalized customer experience by sifting through large volumes of customer data, including browsing patterns, purchase history, and social media behavior. This capacity for in-depth analysis enables businesses to discern individual customer preferences, thus tailoring their recommendations and interactions to cater to these specific

tastes and needs. 10 ways AI can improve customer experience: (10 Excellent Ways AI will Improve Customer Experience in 2024, 2024)

1. **Personalized Recommendations:** AI makes individualized product or service recommendations based on user interests by using machine learning algorithms to examine historical customer actions and preferences.
2. **Chatbots and Virtual Assistants:** Artificial intelligence (AI)-driven chatbots improve efficiency and customer satisfaction by providing real-time customer service, responding to questions, fixing problems, and providing individualized help around-the-clock.
3. **Voice Assistants and Natural Language Processing (NLP):** Voice assistants like Siri, Alexa, and Google Assistant utilize NLP powered by AI to understand and respond to spoken commands, providing hands-free assistance and convenience.
4. **Predictive Customer Service:** AI uses data analysis to anticipate future consumer behavior, providing proactive customer support and outreach that increases customer loyalty and happiness.
5. **Advanced Analytics:** Large volumes of consumer data are analyzed by AI algorithms to find trends, predict demands, and highlight areas where the customer experience can be improved.
6. **Sentiment Analysis:** Businesses can better understand customer impressions and pinpoint areas for improvement by using artificial intelligence (AI) to analyze text from a variety of sources and evaluate sentiment.
7. **Real-Time Personalization:** AI dynamically adjusts user experiences in real time based on customer actions, creating highly personalized interactions and improving engagement.
8. **Seamless Omnichannel Experience:** With the help of artificial intelligence (AI), data from several channels may be combined to provide clients with a smooth transition across online, in-store, mobile, and social media platforms.
9. **Customer Segmentation:** Businesses can offer tailored experiences and marketing campaigns that appeal to particular demographics, habits, and interests by using AI to evaluate customer data and generate precise segmentation.
10. **AI-Powered CRM:** AI enhances CRM systems by automating tasks such as data entry and lead scoring, providing intelligent insights, and enabling sales teams to prioritize leads effectively, thereby optimizing customer relationship management and improving overall efficiency.

Conclusion

In the fast-paced era of technological transformation we live in, artificial intelligence (AI) strategies have become indispensable for industrial enterprises, serving as a key driver for enhancing their performance and increasing their competitiveness in the market. AI enables industrial enterprises to access sophisticated technologies that help them analyze data effectively and make informed decisions. Thanks to machine learning and big data analysis capabilities, AI can identify hidden patterns and trends in data, thus guiding strategies and tactics more effectively.

The impact of AI applications extends to various aspects of industrial enterprise performance, ranging from improving recruitment processes and energy efficiency in cities to enhancing quality management systems, optimizing supply chain management, and improving marketing strategies and customer experience. For example, it can contribute to improving the efficiency of production processes and reducing production costs by enhancing predictive maintenance and optimizing inventory management and distribution logistics. In terms of quality management systems, AI can be used to analyze processes and identify areas for improvement to achieve maximum quality. In supply chain management, AI can analyze data and identify trends and necessary improvements to enhance material flow and supply. As for marketing and improving customer experience, AI can help target the desired audience more effectively and improve customer interactions by analyzing data and delivering personalized and effective services.

In summary, the use of artificial intelligence in industrial enterprises is a cornerstone for achieving continuous improvement and competitive excellence in the evolving global market.

The paper puts forth several important recommendations and suggestions:

- ✓ Enhance investment in AI applications: Industrial enterprises can be recommended to increase investment in AI applications to enhance efficiency and effectiveness in their operations.
- ✓ Skill development and training: It is recommended to provide continuous training and development for employees to learn and effectively use AI technologies in the industrial environment.

- ✓ Provide legal and ethical frameworks: Industrial enterprises should establish policies and legal and ethical frameworks to ensure responsible and sustainable use of smart technologies.
- ✓ Measure performance and evaluate results: Industrial enterprises should develop appropriate performance indicators and regularly assess the impact of AI applications on performance.

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