Section A-Research paper

SMART BUSINESS AND INDUSTRIAL COMPETITIVENESS ARE DRIVERS OF AI

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Abstract:

Beyond our wildest expectations, AI is transforming both the pace of industrial development and our way of life. Many countries have launched national AI initiatives to highlight the value and use of AI in smart enterprises. However, it is necessary to ignore issues with the practical application of AI to contemporary industrial issues. The biggest problem right now is finding different applications that might provide value and meet the expanding market while also satisfying capital needs. A systematic framework called "Industrial AI" was given together with its major enabling technologies in order to give a clear road map for the methodical development and integration of AI in industrial processes. In the manufacturing industry as a whole, this paper presents a complete analysis of the key enabling solutions for industrial AI. It also discusses how these solutions' systematic adoption can help open up new chances for value creation and delay the emergence of problems. Keywords: Industrial AI, Enabling Technologies, Applications, Artificial intelligence, Industry 4.0

1 Introduction

The promise of artificial intelligence (AI) to revolutionize the industrial 4.0 world has long been touted. The perspective is real, but AI cannot be hurried. To begin with, artificial

intelligence (AI) in industrial manufacturing refers to a variety of use cases at various stages of production, including the development of product generative designs, production forecasting for inventory management, computational modeling, fault evaluation, process planning, and preventive analytics on the manufacturing stage. Second, the right people and information are necessary for the deployment of AI. The factory floor still has a lot of equipment and tools that aren't linked to one another. Additionally, it is quite difficult for manufacturers to build and educate an internal data science team on the use of AI.

If the right foundations, such as AI engines, AI frameworks, on-premise hardware, as well as data architecture, are in place, manufacturers may start using what AI has to offer. Most AI systems today can collect data and use unsupervised machine learning (ML) to generate knowledge and suggestions under the direction of AI experts. The development of automated machine learning will free up AI experts from more mundane AI optimization tasks, enabling them to research new applications for AI. However, not all AI models need to be complex. In the current industry, straightforward AI models are more than capable of handling many of the easy pickings.

This essay will examine several significant industries that, in the near future, stand to benefit from the use of artificial intelligence. Let's first clarify what artificial intelligence really is.

2 Companion Works

Despite the fact that artificial intelligence (AI) technologies are rapidly gaining popularity in science and technology, the majority of research and development projects on autonomous systems currently focus largely on robotics and autonomous vehicles [4]. Additional uses of AI technology include big data analytics, computational modelling and machine vision, machine learning, language processing, pattern recognition, etc. The reason resource management AI technologies are often excluded from this list is probably since there aren't many industrial applications for them.

Although there are safety standards for both products and processes, they probably do not yet include cutting-edge algorithms, as discussed in the article "AI-Powered Collision Avoidance Safety System for Industrial Woodworking Machinery," which discusses the challenge of implementing AI and machine learning in safety-critical manufacturing machinery. By delaying industry engagement until the technology is sufficiently mature, its inclusion in the current certification programs accomplishes this. By using a prototype (based on ultrasonic sensors and integrated with temporal convolutional network (TCN) algorithms), the study

aims to demonstrate how AI technology may fulfill precautions like halting machinery's operation and bringing it to a safe condition when particular criteria are achieved. The prototype is very sensitive and particular for recognizing whether a person is near industrial machinery.

3 Industrial Development and Artificial Intelligence

AI is extensively utilized nowadays. Today, a large number of companies—from early-stage start-ups to established corporations—are developing AI applications, in contrast to 1989, when there were hardly any AI enterprises. Although artificial intelligence has been the subject of academic and scientific research since the 1950s, the technology has only recently started to gain considerable momentum. It scarcely needs to be mentioned that the present explosion in AI research, financing, and useful commercial applications is unmatched. The New IDC Expenditure Guide from market research firm IDC, released on September 19, 2018, predicted that by 2022, worldwide investment on intellectual and AI technologies will amount to $77.6 billion. The same goes for Gartner's prediction that $3.9T in business value would have been produced by AI by 2022. Applications of AI not only promise to improve the overall human experience but also better business results.

AI is increasingly being used to gain an advantage in industrial production and to cause severe disruption. If industrial organizations ignore the benefits of AI, it is predicted that they would lose their competitive advantage. Many industrial production facilities currently only employ AI for fundamental jobs like product research, design and development, manufacturing, and quality control, even though many are deploying it across the whole value chain. The main reasons for using AI technology in industrial settings are the need to automate repetitive and cognitive operations, assist decision-making via continuous machine learning (ML), and improve decision-making [5]. The creation and use of AI have grown significantly during the last 10 years. Today, machines already carry out 29% of all routine or complex tasks [7].

AI is projected to be a big driver of business competitiveness in the not-too-distant future. AI-based solutions are generally recognized as the driving force behind the digitization and reformation of factories because of their adaptability and in-depth understanding of complicated industrial processes [1]. This is so because these qualities are becoming more and more important to increase competitiveness [2]. By looking at industrial automation and digitalization trends, we can predict that the factories of the future will be multipurpose and

able to swiftly adapt to the new design characteristics [3]. In a manner similar to this, intelligent industrial robot control techniques will allow robots to adapt to the probabilistic approach, allowing for more human-like performance by carrying out tasks that have not been specifically programmed to the robot or intelligently communicating and cooperating with people. IIoT and AI-based real-time supervision in machinery and equipment may optimize output by monitoring the different production stages and identifying changes in the production parameters [23][24][25].

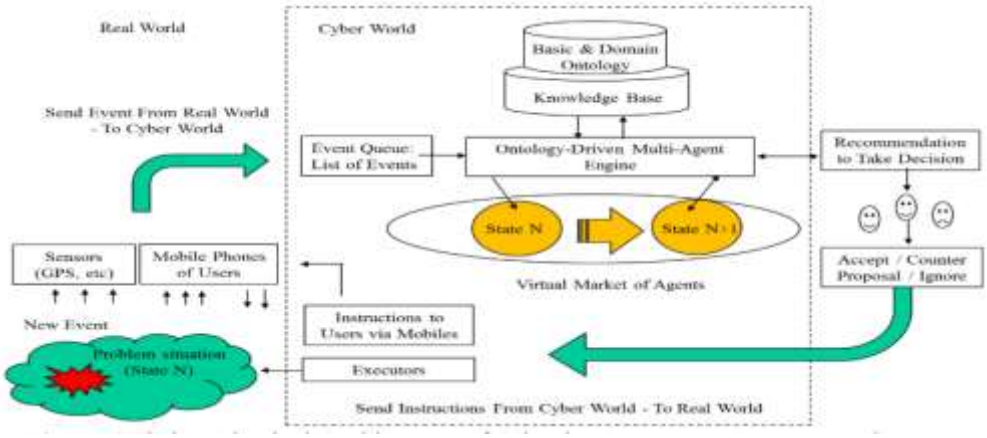

Figure 1: Adaptive resource management

Both supervised and unsupervised machine learning algorithms can analyze real-time data from many production shifts and identify previously undetected connections in workflows, outputs, and processes. Cobots, or collaborative robots, are made possible by vision sensors in robotics. Cobots are used in cooperation with humans to help or free them from repetitive tasks. They are projected to create and provide automated tasks while being connected to an IoT network of intelligent devices [17][18].

1.1 Applications in Industry

Industrial AI systems need to have backup systems and very comparable safety standards, and their resilience has to be assessed (along with unexpected performance in new conditions). AI-based monitoring systems have the potential to improve security and efficacy while introducing fresh, successful human-machine interactions [6]. The development of AI is one of the driving forces behind improvements in industrial robot control. The use of AI in automated robotic devices is quickly becoming one of the main areas of attention as industrial equipment needs improved performance, adaptability to product variations, enhanced safety, lower costs, etc. However, reaching these goals using standard control methods is neither

doable nor sustainable. AI applications are expanding in many areas of industrial equipment production, with a focus on improving quality assurance, maintenance, energy usage, safety, and operating efficiency. One such instance is Amazon Robotics (AR), which employs AI for a variety of activities [19][20].

The effective use of AI is crucial for small and medium-sized enterprises (SMEs) worldwide. AI solutions are already playing a bigger role in the industrial sectors, particularly as they help with production process optimization, equipment issue prediction, and the development of smarter, more effective services. Big data and intelligent ICT usage may help many different industries by increasing performance and production and creating new opportunities [21][22].

1.2 A Window to Smart Companies

Artificial intelligence (AI) is receiving a lot of attention from businesses, lawmakers, academic research institutions, and the general public. Governments, communities, and businesses should anticipate the advantages of AI strategies, particularly in the fight against Covid-19, enabling resilience, and promoting green, sustainable development. AI has the power to alter how people live and work in addition to perhaps upending business assumptions.

Despite the promise of intelligent enterprises, certain industries are hesitant to use AI in real-world applications. When two different engineers inside a corporation provide solutions to almost identical issues using different or the same AI algorithms, this is a prevalent dilemma that occurs in industrial applications. Such a condition could not be tolerated since industrial environments often demand the three characteristics of systematism, speed, and inheritance for successful functioning. There are further challenges that limit the use of AI in industrial contexts.

The most successful AI applications have been in computer vision, language processing, social networking, robotics, and autonomous mobility. Emphasis should be placed on the fact that big data from industrial production equipment has a completely different structure and format than big data from the sources mentioned above. Because of this, it is challenging to employ the AI technologies created in the aforementioned domains directly. As a consequence, AI's performance in industrial applications has been inconsistent.

Transporters move about the factory buildings on their own, plants optimize power utilization while in operation, and machinery performs quality-control checks and makes the necessary adjustments while manufacturing is still going on. Artificial intelligence has great potential for the business world. It already makes production more predictable, flexible, and effective.

Although there is a ton of knowledge on the subject, it is sometimes quite disjointed, ill-organized, and restricted to only a few specific use cases. For better or worse, discussions about corporate AI use cases recently have cantered on digital applications. These include programs for tracking user clicks on adverts, making recommendations, predicting client churn, personalizing the user experience, and identifying different frauds. But what about those divisions of a business or organization whose activities go outside the online sphere? They must need AI as well.

1.3 Industrial digitization and AI

The digital economy is a reality today, and more and more industries are turning digital. There is ongoing data creation, processing, and analysis. The massive volumes of data present in industrial settings are used to generate digital models of whole plants and systems. For some time now, these digital twins have been used to organize industrial processes as well as the design and planning of products and machinery. This increases production makes customized things more rapidly and economically available and provides for more flexibility and efficiency. What could happen, though, if the equipment and processes were able to autonomously draw conclusions from this vast volume of data and enhance their performance in real-time? There would be several options. The nice aspect is that this can really be done gradually using AI.

Expert Systems (a)

b) Robotics

NLP (Natural Language Processing), neural networks, and c

1.3.1 Expert Systems

The ES is simply a piece of "smart" computer software based on Boolean logic with the goal of simulating human expertise in a particular sector and solving issues without the assistance of a human expert. Despite being a well-established technology, experts in the power and electrical systems are not extremely at ease using an ES. Fig. 1 presents the basic elements of ES. The knowledge base's representation of knowledge or expertise is the fundamental part of

an ES. The current information is bought from the particular domain specialists to be included in the computer software. Expert knowledge and a database holding information that supports the expert knowledge with facts, statistics, and assertions make up the two main components of knowledge data. For instance, a database might be thought of as the equivalent of a catalog of human knowledge. Similar to this, various data-related computational techniques could be linked to expert knowledge.

1.3.2 Robotics

The manufacturing process is greatly aided by robotics. Even though the majority of industrial robots are stationary most of the time, they nevertheless face the danger of running into nearby objects. The use of AI to robotics has ushered in the concept of collaborative robots, sometimes referred to as "cobots," that can efficiently interact with humans and obey their instructions. Artificial intelligence (AI) technologies are being used in quality management to notify factories of potential production faults that might degrade the quality of the finished product. Examples of mistakes include process variances, small machine behavior anomalies, changes in raw resource availability, and others.

1.4 AI's Possibilities and Opportunities

The focus of scientific research has been on AI for even more than 30 years. During this period, significant technical breakthroughs have been made, including better software and hardware, increased computing power, and improved data transport. Using artificial intelligence brings up whole new options for flexible, efficient manufacturing, even when it comes to complex and increasingly specialized small batch runs of goods. The following Roland Berger study reveals the gravity of the effects: By 2035, industrial process lines and intelligent, technologically networked systems might boost productivity by an additional €420 billion in Europe alone. According to a study, artificial intelligence (AI) would have contributed to global economic development of over US$15.7 trillion by 2030.

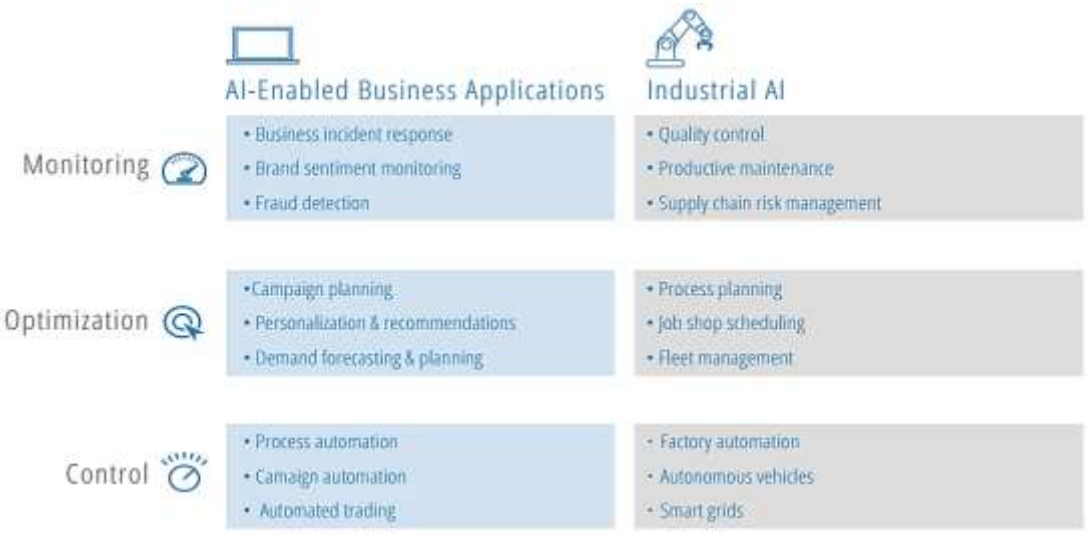

Figure 2: Applications of AI (Source: CloudPulse Strategies)

However, the true applications of AI are already starting to appear in routine industrial operations, such as language recognition for easy jobs, cataloging the surrounding environment using cameras, lasers, or X-rays, and providing virtual personal assistants for logistics. According to a PwC poll conducted in 2018, 62 percent of significant organizations are already using AI technology. Siemens provides a variety of services, including predictive maintenance, along with additional application areas for design and industrial assurance. Equipment availability and efficiency are increased by continuous process improvement provided by intelligent software and cloud-based solutions like MindSphere [26][27][28].

The list of use cases shown here isn't intended to be exhaustive; rather, it's intended to showcase a few of the many uses for industrial AI.

Process monitoring, quality control, fault isolation, supply chain risk management, inventory monitoring, smart grids, industrial safety, predictive maintenance, product design, robotics, autonomous cars, and factory automation are just a few examples.

1.5 Finance Management using AI

The arrival of AI technology has caused a dramatic change in the finance and banking sector. There are a ton of AI use cases in this industry. In many instances, highly developed software robots are taking the place of human employees in order to process loan applications in milliseconds. Robo-financial advisors swiftly scan through many layers of data in a manner similar to this to recommend the best assets for customers. These Robo-advisors might also keep an eye on your internet behavior, emails, and other personal information in order to identify the markets and companies that are most closely related to your long-term needs and

goals. AI-based chatbots are also being utilized in the insurance sector to improve customer experience and create insurance plans and solutions based on consumer data. The development of AI-based solutions has dramatically accelerated the processing of claims, which is advantageous to both clients and insurance companies.

2 Discussion

New autonomous AI solutions for enterprise resource management provide a possibility to raise the standard and efficiency of business operations. As shown by the well-established industrial applications, multi-agent technology provides effective solutions for handling challenging resource management challenges under diverse situations of increasing involvedness, complexity, and dynamism. High levels of resource management flexibility help with a variety of tasks, including maximizing resource utilization, reducing order loss during peak hours, cutting costs and penalties, and improving service quality and response times for new orders.

Artificial intelligence is transforming industrial production and our everyday lives in ways that are inconceivable to most people. The national-level artificial intelligence projects that numerous governments across the globe have started have highlighted the importance and significance of artificial intelligence in the intelligent sector. Artificial intelligence in manufacturing is still a difficulty that must be addressed and cannot be ignored in order to handle current, practical challenges. The biggest problem right now is finding specialized applications that provide value to meet the growing expectations of the market and capital. To provide a clear route for the development and implementation of artificial intelligence in industrial systems, system architecture, and supporting technologies are proposed. The importance of key enabling technologies for industrial AI in smart industries is discussed in this article, along with examples of how these enabling technologies may be systematically used to open up opportunities to generate new value and avoid problems.

Conclusion

This article argues that by utilizing an AI approach, the complexity of industrial applications may be managed. An outstanding example of how this is taking place is the current usage of AI techniques by Carnegie Mellon University, MCC, ARPA, an ESPRIT initiative, a Palo Alto consortium, and others. Additional industrial products might soon be created as a result of the application of artificial intelligence (AI) ideas to other industries including distributed databases, computer-supported cooperative work, and air traffic management. An important

advantage of using AI is the ability to integrate separate, pre-existing knowledge-based systems. Since software for industrial applications is usually developed on the fly, this element is essential. Consequently, businesses have a large number of separate systems that were developed over time by multiple people using a variety of techniques. Since they all operate in the same physical environment, have important but distinct areas of expertise, and share these qualities, these systems may cooperate with other independent systems of the same sort.

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