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REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

Role of Artificial Intelligence (Ai) & Collaborating Robots under Industry4.0 in the Engineering Technology Sector

By

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Abstract

The term "artificial intelligence" (AI) refers to a set of capabilities that can be implemented in various settings, including businesses, educational institutions, and government agencies. In healthcare, artificial intelligence is being used for disease diagnosis, the creation of individualised treatment programs, the monitoring of patients' health, and even the forecasting of disease outbreaks. In the field of finance, artificial intelligence is used to identify fraudulent activity, manage risks, and automate activities like as loan applications and trading. AI is utilised in retail to improve the overall customer experience, evaluate and better manage consumer behavior, and optimize supply chain operations. Using AI is crucial to streamline industrial processes, decrease waste, and increase quality control. The application of AI in the transportation sector includes the creation of autonomous cars, the optimization of routes, and the reduction of congestion. In education, AI is being utilized to build new educational tools and technologies, personalize the educational experience for students, and evaluate student achievement. In the entertainment industry, artificial intelligence is used to build new types of interactive media and create personalised recommendations for movies, television series, and music.

Keywords: Industry 4.0, Artificial Intelligence, collaborating robots

Introduction

The field of computer science, artificial intelligence (AI), seeks to develop intelligent machines capable of performing tasks that normally require human-like intelligence. These tasks include learning, reasoning, problem-solving, perception, natural language understanding, and decision-making. Artificial Intelligence (AI) is a subfield of computer science. Artificial intelligence (AI) systems can be taught to spot patterns in data, learn from experience, adapt to new circumstances, and make predictions or judgments based on their acquired learning. Artificial intelligence applications can be found in various industries, including but not limited to healthcare, banking, transportation, education, entertainment, and more. Artificial intelligence (AI) employs a wide variety of methods, the most well-known of which are machine learning, deep learning, natural language processing, computer vision, and robotics.

The term "Industry 4.0" refers to the current phase of the fourth industrial revolution, defined by incorporating cutting-edge technology and digitalization into various industrial sectors. The third industrial revolution, which saw the extensive use of automation and computerization in manufacturing and production, is a foundation for this new development.

The Internet of Things (IoT), big data analytics, artificial intelligence, machine learning, advanced robotics, cloud computing, and 3D printing are some of the technologies that fall under Industry 4.0. These technologies make it possible for machines, devices, and systems to connect and share data, resulting in increased efficiency, flexibility, and productivity. It is anticipated that Industry 4.0 will bring about a transformation in a variety of industries, including manufacturing, transportation, healthcare, energy, and agriculture, amongst others, by bringing about the creation of systems that are more intelligent, more connected, and more autonomous. Also, technology has the potential to make it possible for new business models and to disrupt old industries, which could result in huge economic and societal shifts.

Challenges of AI in Industry-4

Even though AI (artificial intelligence) has the potential to provide Industry 4.0 several benefits, several issues need to be solved. Among these difficulties are the following:

- Data Quality: To be trained properly, AI algorithms need to be provided with high-quality data. This can be hard in manufacturing contexts, where data may need to be consistent, noisy, or complete.
- Integrating artificial intelligence (AI) with other technologies of Industry 4.0, such as the internet of things (IoT) and cloud computing, might introduce new cybersecurity threats, such as the theft of data or assaults on linked equipment.
- Workforce Skills: Implementing AI in manufacturing may call for new skills and training for the workforce. This can be difficult for businesses to do and may cause present processes to be disrupted.
- Compliance with Regulations: The application of artificial intelligence in manufacturing may be subject to requirements for regulatory compliance, the specifics of which might vary by sector and country.
- Ethics and Bias: AI systems may exhibit biases based on the data they are trained on, leading to unfair or discriminatory outcomes. Ensuring that AI systems are ethical and unbiased is an ongoing challenge.
- Integration Complexity: Integrating AI with Pre-Existing Systems and Procedures Integrating AI with Pre-Existing Systems and Procedures Can Be Complicated and Requires Significant Investment and Expertise.

In general, addressing these challenges will be essential for the successful adoption of AI in Industry 4.0. Businesses must collaborate with technology vendors, regulators, and other stakeholders to ensure that AI is used in the manufacturing industry responsibly and effectively.

Review of Literature

SAVAS S. (2021)

In the research paper titled “The Effects of Artificial Intelligence on Industry: Industry 4.0” ICT allows consumers worldwide access to products. This makes consumption easier, but it also makes manufacturers globally competitive. Doesn't appear conceivable to ignore Industry 4.0 components to boost the economy, compete with global manufacturing power, and preserve supply-demand equilibrium. So, a country strategy is needed to understand and assess these technologies. For a decade, major countries have been driving this new industrial revolution. But, as AI research advances, the divide between creating and consuming nations will grow.

Popkova E. and Sergi B.(2021)

In the research paper titled "Human capital and AI in industry 4.0. Convergence and divergence in social entrepreneurship in Russia" This article proved hypothesis H0 and showed that social companies cannot automate as quickly as commercial companies. Social companies can also improve. AI-based digital modernisation of social firms is desirable and achievable, but it should consider social entrepreneurship. Social companies need human and artificial intellectual capital. AI will gain value as automation increases. .

Ktari J. et.al (2022)

In the research paper titled "Lightweight AI Framework for Industry 4.0 Case Study: Water Meter Recognition" This effort was done in partnership with Tunisia's Water Production and Management Corporation. This prototype will be utilised for company digitization and governance. This paper developed deep learning, OCR, and AI model to detect and extract water meter numbers. Moreover, an Android app used this model. Operators' iPhones take meter photos. Our programme detects, extracts, calculates monthly meter consumption, and saves all important information in Firebase, including meter number, location, date, etc.

Park J. (2022)

In the research paper titled "Big Data and AI for Process Innovation in the Industry 4.0 Era" New algorithms, methods, and technologies for autonomous decision-making and real-time evaluations are being developed based on the studies described in this editorial. When IoT, Process Mining, and BDA research show few successful applications in Industry 4.0. Although this Special Issue is closed, more in-depth examination of Big Data and AI for process innovation is expected.

Chhaya K., (2020)

In the research paper titled "Convergence of 5G, AI and IoT Holds the Promise of Industry 4.0" A complete digital transformation approach can solve many complicated business problems across industries. AI, 5G, and IoT combine. Digital technologies like AI, 5G, and IoT and operational technologies on the ground must be integrated and coordinated to actualize Industry 4.0. The correct mix of technologies is needed to create and deliver value. With 5G, AI, and IoT, organisations across industries want to take this enormous leap.

Mhlanga D. (2020)

In the research paper titled "Industry 4.0 in Finance: The Impact of Artificial Intelligence (AI) on Digital Financial Inclusion" The study examined how AI affects digital financial inclusion. Digital financial inclusion is becoming essential to the argument on how to get lower-pyramid people financially active. Fintech firms, however, are use AI to incorporate low-income workers, the poor, women, youth, and small enterprises in mainstream financial markets. The study found that AI affects digital financial inclusion in risk identification, measurement, and management, information asymmeIoT,atbot customer assistance, fraud detection, and cybersecurity.

González-Sarmiento, et.al (2020)

In the research paper titled "Big Data and Artificial Intelligence in the Development of Industry 4.0; A Bibliometric Analysis" This study tracks Scopus-published AI and big data research for Industry 4.0. . Results of the bibliometric analysis quantity of publications per year, productivity of countries, research areas, journals, and analysis of the most frequent keywords and their relationship. This paper describes big data and AI in Industry 4.0 texts and their bibliometric analysis, concluding that these research subjects are commonly developed in the scientific literature. Despite focusing on companies and industries, big data and AI were

key to organisational digitization. In the Fourth Industrial Revolution, machines will communicate to learn and act.

Regona M. (2022)

In the research paper titled "Opportunities and Adoption Challenges of AI in the Construction Industry: A PRISMA Review" This PRISMA-based study reviewed AI in construction literature. AI should be used throughout the construction project lifetime, according to the report. advantages. Modern construction's pre-construction, procurement, and post-construction complexity is driving interest in digital technologies. AI applications for the sector are still in the early stages, and there are considerable research gaps that make digital construction site inventions possible. AI applications in other industries can help the construction industry close this gap.

Barton M., et.al (2022)

In the research paper titled "Identification Overview of Industry 4.0, Essential Attributes and Resource-Limited Embedded Artificial-Intelligence-of-ThingsDevices for Small and Medium-Sized Enterprises," This article identified SMEs' Industry 4.0 needs and advanced their digitalization. Analyzing 2016–2022 research articles and studies revealed the features. SME technologies include Horizontal and Vertical System Integration for non-communicating systems. Big Data is the most essential Industry 4.0 technology, according to our articles. Big Data integrates additional attributes. IoT data are kept in repositories or the Cloud, assessed by AI, and simulated.

Research Methodology & Data Analysis

The research is based on primary data. A survey method is adopted for the study. The tool for the collection of data is a questionnaire. A list of questions in a systematic order is prepared and forwarded to the respondents. The convenience sampling method is used for the collection of data. Data is processed using SPSS software. The Chi-square test, Friedman's test, and non-parametric Binomial test are applied for data analysis.

Objective 1: To identify the Association between the size of organisation and Artificial intelligence (AI) users.

Null Hypothesis:H_{01}: There is no association between the size of organisation and Artificial intelligence (AI) users.
Alternate Hypothesis:H_{11}: There is an association between the size of organisation and Artificial intelligence (AI) users.

To study this null hypothesis chi square test is applied and results are as follows.

Chi-Square Tests

	Value	df	p-value
Pearson Chi-Square	6.606[a]	4	.158
Likelihood Ratio	7.172	4	.127
N of Valid Cases	71		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is .49.

Interpretation: Above result indicates that the p-value is 0.158. It is greater than the standard p-value of 0.05. Therefore, the chi-square test is accepted. Hence null hypothesis is accepted.

Conclusion: There is no association between the size of organisation and Artificial intelligence (AI) users.

Findings: To understand the findings of the hypothesis cross table is obtained and presented in the following table.

Size of the Organisation

Have you experienced/applied artificial Intelligence (AI) or Collaborative Robots in your Organisation. Crosstabulation

Q2. Size of the Organisation:		Q4. Have you experienced/applied artificial Intelligence (AI) or Collaborative Robots in your Organisation.		Total
		No	Yes	
Large	Count	4	11	15
	Expected Count	7.4	7.6	15.0
Large Corporate	Count	13	15	28
	Expected Count	13.8	14.2	28.0
Medium	Count	8	6	14
	Expected Count	6.9	7.1	14.0
Micro Enterprise	Count	1	0	1
	Expected Count	.5	.5	1.0
Small	Count	9	4	13
	Expected Count	6.4	6.6	13.0
Total	Count	35	36	71
	Expected Count	35.0	36.0	71.0

Above table indicate that the proportion of AI users and non-users is 35 and 36, respectively, which is almost equal in number. Hence there is no association between the size of the organization and the use of Artificial intelligence (AI) users.

Objective 2: To identify the reasons for not using Artificial Intelligence.

Null Hypothesis:H_{01}: There is no significant reason for not using AI.
Alternate Hypothesis:H_{11}: There is a significant reason for not using AI.

To study the above null hypothesis, Friedman's test is applied, and the results are as follows.

Test Statistics[a]	
N	35
Chi-Square	4.981
df	3
Asymp. Sig.	.173

a. Friedman Test

Interpretation:

The above result indicates that the p-value is 0.173. It is greater than the standard p-value of 0.05. Therefore, the Friedman test is accepted. Hence the null hypothesis is accepted.

Conclusion: There is no significant reason for not using AI.

Finding: To understand the hypothesis's finding, the reasons' mean rank are calculated and presented in the following table.

Ranks	
	Mean Rank
5.1 Limitations of Financial Provision	2.26
5.2 Lack of Knowledge of adoption	2.77
5.3 Returns in Investment is Low	2.43
5.4 Other	2.54

There is no specific reason for not using AI.
Objective 3: To study the use of AI in various departments of Organisation.

Null hypothesis:H_{01}: There is no difference in proportion for the use of AI in various departments of organisation.
Alternate hypothesis:H_{11}: There is a difference in proportion for the use of AI in various departments of organisation.

To study the above null hypothesis Binomial test is applied and results are as follows.

Binomial Test

		Category	N	Observed Prop.	Test Prop.	p-value
[7.1 Business Analytics]	Group 1	No	18	.50	.50	1.000
	Group 2	Yes	18	.50		
	Total		36	1.00		
[7.2 Customer Interface (Chatbot/e-commerce/Online Sales)]	Group 1	No	21	.58	.50	.405
	Group 2	Yes	15	.42		
	Total		36	1.00		
[7.3 Predictive Analysis and Maintenance]	Group 1	No	10	.28	.50	.011
	Group 2	Yes	26	.72		
	Total		36	1.00		
[7.4 Smart Manufacturing]	Group 1	No	11	.31	.50	.029
	Group 2	Yes	25	.69		
	Total		36	1.00		
[7.5 Productivity Improvement & Repetitive Work]	Group 1	No	5	.14	.50	.000
	Group 2	Yes	31	.86		
	Total		36	1.00		
[7.6 Inventory Management]	Group 1	No	27	.75	.50	.004
	Group 2	Yes	9	.25		
	Total		36	1.00		
[7.7 Product Testing (Visual AI)]	Group 1	No	19	.53	.50	.868
	Group 2	Yes	17	.47		
	Total		36	1.00		
[7.8 Others]	Group 1	No	29	.81	.50	.000
	Group 2	Yes	7	.19		
	Total		36	1.00		

The statistical rule is if the p-value is less than the standard p-value of 0.05, then there is a significant difference in proportion for the use of AI in that respective department of organisation. Observations of the above table are as follows.

For business analytics use of AI is 50% of the total AI users.
For customers interface use of AI is 42% of the total AI users.
For Predictive analysis and maintenance use of AI is 72% of total AI users.
For smart Manufacturing use of AI is 69% of Total AI users.
For Productivity Improvement & Repetitive Work use of AI is 86% of Total AI users.
For Inventory Management use of AI is 25% of Total AI users.
For Product Testing (Visual AI) use of AI is 47% of Total AI users.
For others use of AI is 19% of the total AI users.

Findings of the Study

The application of artificial intelligence (AI) is widespread across numerous sectors, and this trend is only expected to continue. However, before it can be widely implemented across all sectors, a number of obstacles and constraints must first be conquered.

One of the reasons why artificial intelligence might not be deployed in some fields is due to the expensive expense of putting it into practise. Creating and deploying artificial intelligence (AI) systems may be a pricey endeavour, and some businesses may not have the financial resources necessary to invest in the technology. In addition, artificial intelligence systems might call for specialised hardware and software that is either difficult to obtain or prohibitively expensive. There is also the possibility that certain sectors do not yet have completely defined processes that can be automated by AI. This presents another obstacle. This indicates that before businesses can fully utilise the benefits of AI, they may first need to devote time and resources to analysing and refining their processes. In addition, there may be worries regarding the privacy and security of data, particularly in sectors that deal with sensitive data. If businesses are unsure of the level of security that will be provided for their data, they may be hesitant to implement AI. In conclusion, the use of AI may run into resistance from either organisational or cultural factors. It's possible that some workers won't adapt to change, and management might not completely comprehend all of the potential advantages that AI could provide. In general, artificial intelligence (AI) is a powerful technology that has the potential to disrupt many different industries.

Bibliography

Barton, M., Budjac, R., Tanuska, P., Gaspar, G., & Schreiber, P. (2022). Identification Overview of Industry 4.0 Essential Attributes and Resource-Limited Embedded Artificial-Intelligence-of-Things Devices for Small and Medium-Sized Enterprises. Applied Sciences (Switzerland), 12(11). https://doi.org/10.3390/app12115672

Regona, M., Yigitcanlar, T., Xia, B., & Li, R. Y. M. (2022). Opportunities and Adoption Challenges of AI in the Construction Industry: A PRISMA Review. Journal of Open Innovation: Technology, Market, and Complexity, 8(1). https://doi.org/10.3390/joitmc8010045

Park, J., & Bae, H. (2022). Big Data and AI for Process Innovation in the Industry 4.0 Era. Applied Sciences (Switzerland), 12(13), 1–5. https://doi.org/10.3390/app12136346

Ktari, J., Frikha, T., Hamdi, M., Elmannai, H., & Hmam, H. (2022). Lightweight AI Framework for Industry 4.0 Case Study: Water Meter Recognition. Big Data and Cognitive Computing, 6(3). https://doi.org/10.3390/bdcc6030072

González-Sarmiento, E., Roa-Perez, J., & Ortiz-Ospino, L. (2021). Big Data and Artificial Intelligence in the Development of Industry 4.0; A Bibliometric Analysis. IOP Conference Series: Materials Science and Engineering, 1154(1), 012008. https://doi.org/10.1088/1757-899x/1154/1/012008

Huang, Z., Shen, Y., Li, J., Fey, M., & Brecher, C. (2021). Manufacturing and Advanced Robotics. Sensors, 19(21), 1–35.

Savas, S. (2021). The Effects of Artificial Intelligence on Industry: Industry 4.0. Current Studies in Basic Sciences, Engineering and Technology 2021, 95–106.

Mhlanga, D. (2020). Industry 4.0 in finance: the impact of artificial intelligence (ai) on digital financial inclusion. International Journal of Financial Studies, 8(3), 1–14. https://doi.org/10.3390/ijfs8030045

Chhaya, K. (2020). Convergence of 5G, AI and IoT holds the promise of Industry 4.0. Telecom Business Review, 13(1), 60–64. https://search.ebscohost.com/login.aspx?direct=true&db=bsu&AN=149063715&site=ehost-live

Popkova, E. G., & Sergi, B. S. (2020). Human capital and AI in industry 4.0. Convergence and divergence in social entrepreneurship in Russia. Journal of Intellectual Capital, 21(4), 565–581. https://doi.org/10.1108/JIC-09-2019-0224