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Impact of AI on Industrial Engineering: A Systematic Literature Review (SLR) of Peer-Reviewed Articles and Conference Proceedings

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Abstract

The key objective of the study was to identify the impact of artificial intelligence (AI) on industrial engineering using a systematic literature review (SLR) approach. Fifteen peer-reviewed journal articles and conference papers from world's key digital databases were analyzed to address the research objectives. Findings indicated that AI plays a vital role in transforming industrial engineering by automating complex operations, improving predictive maintenance, and promoting innovation through data-driven decision-making. The incorporation of AI in industrial environments assists in the attainment of impactful outcomes. Despite these benefits, large-scale adoption of AI remains challenging due to high implementation costs, shortage of skilled professionals, and resistance to technological change. Industries need to develop standardized frameworks, strengthen infrastructure, improve data management, and foster a culture of innovation and continuous learning for the efficient adoption and sustainability of AI powered industrial systems. The study has provided pertinent theoretical, managerial, methodological, and social implications by conducting a comprehensive SLR on the impact of AI on industrial engineering.

Keywords
AI; Industrial engineering; AI and industrial engineering; Impact; Challenges to adopt AI; industrial environments; Strategies

1. Introduction
Artificial intelligence (AI) innovations have played a revolutionary role in all fields including industrial engineering in the current age of globalization. Tredinnick (2017) defines AI as "a cluster of technologies and approaches to computing focused on the ability of computers to make flexible rational decisions in response to unpredictable environmental conditions." AI has created several opportunities and prospects in industrial engineering (Al Bashar & Khan, 2017). It assists industrial engineers to make informed decision making to uplift the existing systems and services (Ozkarahan et al., 2005). It proves impactful to refine and revamp industrial education and management systems in the ever-changing industrial landscape (Padovano & Cardamone, 2024).

Innovations of artificial intelligence (AI) have a significant positive impact on industrial engineering. AI improves value of the products for optimizing the level of customer satisfaction (Tsang & Lee, 2022). The adoption of AI proves fruitful for sustainable industrial engineering operations and initiation of trending techniques in the industrial industry (Tseng et al., 2021). AI assists manufacturers to make manufacturing environment dynamic and innovative according to the demands of industry 4.0 (Peres et al., 2020). Smooth functioning of industrial operations is ensured and smart systems are implemented innovatively (Lu et al., 2022). AI has potential to reshape the manufacturing systems through auto-monitoring, inspection, and optimization (Rahman et al., 2025). It enables machines to process required tasks automatically and creates intelligent interpretation and analysis (Ahmed et al., 2022). Smart and innovative systems are initiated to deliver customer centered services through the incorporation of AI tools in industrial engineering (Zhang et al., 2019). It is assisting in empowering manufacturing systems innovatively and in digital transformation of industrial engineering (Elahi et al., 2023).

Some challenges are attached with the integration of AI in industrial engineering settings. Shortage of training opportunities is a key challenge to adopt AI in industrial engineering effectively (Benis et al., 2021). Unnecessary delays in edge computing, cloud computing and complexity in computational applications have made it difficult to incorporate AI in industrial applications efficiently (Sodhro et al., 2019). Unavailability of authentic datasets is a prominent barrier for the attainment of sustainable outcomes in AI based industrial engineering systems (Kim et al., 2022). Lack of funding is a key issue too for the adoption of artificial intelligence tools in industrial engineering (Shoushtari et al., 2024).

Problem Statement
Artificial intelligence innovations have brought transformative changes in all fields of life including industrial engineering. Smart systems are being initiated in industrial engineering through the incorporation of AI tools. Customers are provided satisfactory services through AI powered industrial engineering systems. In past, studies were conducted in regards to AI and industrial engineering using quantitative, qualitative, experimental, and mixed methods. However, an in-depth study covering the impact of AI on industrial engineering was not conducted through systematic literature review methodology. It is an important gap in existing body of knowledge. Therefore, the current study was conducted to identify the impact of AI on industrial engineering. The study was executed using systematic literature review (SLR) methodology. Fifteen seminal studies published on the topic were included to conduct the SLR. The study has provided valuable theoretical, managerial, methodological and social implications by conducting a comprehensive SLR for identifying the impact of AI on industrial engineering.

1.1 Objectives

The study's objectives are as follows:

1. To identify the impact of artificial intelligence (AI) in industrial engineering
2. To reveal challenges to adopt AI in industrial environments

1.2 Research questions of the study

The research questions of the study are as follows:

3. What is the impact of artificial intelligence (AI) in on industrial engineering?
4. Which are the challenges for adopting AI in industrial environments?
5. What are the practical solutions to incorporate AI innovations in industrial engineering?

2. Research methodology

The research methodology of systematic literature review was incorporated to address the study's objectives. "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) framework was applied to ensure authenticity, reproducibility, and transparency. PRISMA is an evidence-based set of reporting items that assists in maintaining accuracy of the systematic reviews (Moher et al., 2015).

PRISMA was originally developed to conduct studies in clinical sciences however it is now widely used in various disciplines including industrial engineering. It ensures rigor process throughout the systematic review based studies. It assists in showing impactful findings that are based on data driven insights. Recommendations and conclusions of the studies based on systematic reviews are considered robust and insightful.

There are four phases in PRISMA that are followed in an organized manner. These phases are known as identification, screening, eligibility, and inclusion. A four-phase diagram is illustrated to show the entire process. This diagram shows as how the required documents are retrieved from different digital platforms. Different stages of the exclusion of the irrelevant studies are displayed and finally the most relevant seminal studies are selected to conduct the SLR effectively and efficiently.

In systematic literature review based studies, pre-determined procedures and protocols are defined to show a roadmap to conduct the study efficiently. Replicable procedures are elaborated for the collection of required data and analysis.

This method supports in reducing any bias during the whole search process and maintain reliability and validity during the research process. The results from the included studies are synthesized and provided in an integrated form for deriving collective insights (Shahzad et al., 2024).

In the present age, researchers are using the methodology of systematic literature review in various fields including engineering, industrial engineering, agriculture, health sciences, computing sciences, library science, English, political science, archival studies, history, education, and management sciences. Various studies have been conducted using SLR technique (Iqbal et al., 2023; Shahzad et al., 2023).

In systematic review, consolidated findings are presented from diverse empirical studies conducted worldwide. A broader outlook is offered in SLR based studies. Data driven decisions are made for policy development (Khan et al., 2022; Shahzad & Khan, 2022). Keeping in view the significance of SLR and nature of the study, this approach was employed in the current study to identify the impact of artificial intelligence (AI) on industrial engineering.

2.1 Literature search

For searching required documents to conduct the SLR on the topic, an in-depth search was executed through world's key digital databases. Search was made through 10 major relevant databases. These databases included IEEE Xplore, Web of Science, Scopus, Emerald, Science Director, Springer Link, Summon, Taylor & Francis, Wiley Inter Science, and Google Scholar. The author independently carried out search to avoid any possible bias during the retrieval process of the required documents. Different searching techniques were employed to retrieve all required studies. Search was done keeping in view the study's key variables. Impact of AI on industrial engineering was explored through different dimensions to make a broader coverage. Advanced search filters were applied to ensure relevancy and accuracy. Different operators were used to exclude and refine the retrieved results.

2.2 Search strategy

An in-depth search was executed carefully for accessing all core studies on the topic to conduct the systematic literature review effectively. The search strategy was carefully developed. The following key terms and combinations were applied for the retrieval of the required studies.

("Artificial Intelligence" OR "AI technologies" OR "AI-driven transformation" OR "AI-based decision support systems" OR "AI in industrial engineering" OR "Artificial Intelligence applications in industry" OR "AI-enabled industrial automation" OR "AI-driven manufacturing systems" OR "AI integration in industrial processes" OR "AI for smart factories" OR "Machine learning and Artificial Intelligence in industrial operations" OR "AI in production planning and control" OR "AI-enabled predictive maintenance" OR "AI for sustainable industrial development" OR "AI-based optimization in manufacturing" OR "AI-assisted industrial design and management" OR "Artificial Intelligence for process efficiency improvement" OR "Impact of Artificial Intelligence on industrial performance" OR "AI-enabled operational intelligence")
AND
("Industrial engineering" OR "Industrial and production systems" OR "Smart manufacturing" OR "Intelligent automation" OR "Industrial digitalization" OR "Human–AI collaboration in industry" OR "AI adoption in industrial engineering" OR "Challenges in adopting AI technologies" OR "Barriers to AI implementation in industry" OR "AI readiness and adoption framework" OR "AI integration challenges in manufacturing" OR "Organizational and technical challenges of AI adoption" OR "Industrial transformation through AI" OR "AI-driven innovation and process optimization" OR "Machine learning in industrial production" OR "Automation and intelligent systems engineering" OR "AI adoption barriers in industrial operations" OR "Data-driven industrial decision-making" OR "AI and Industry 4.0 integration challenges"). Table I displays the criteria of inclusion and exclusion.

Table 1: Inclusion and exclusion criteria

Sr. No.	Inclusion Criteria	Exclusion Criteria
1	Peer-reviewed research articles and conference proceedings	Non-peer-reviewed materials
2	Studies accessible through major scholarly databases	Blogs, web pages, institutional repositories, etc.
3	Publications written in the English language	Studies not published in English
4	Research papers aligned with the study's core objectives and constructs	Irrelevant or outdated studies not aligned with the scope of AI in industrial engineering
5	Recent studies emphasizing AI's role and implications in industrial engineering	Papers lacking methodological rigor or failing to address the key constructs of the current research
6	Studies published from 2004 to 2025	Studies prior to 2004

Figure 1 shows the entire search process.

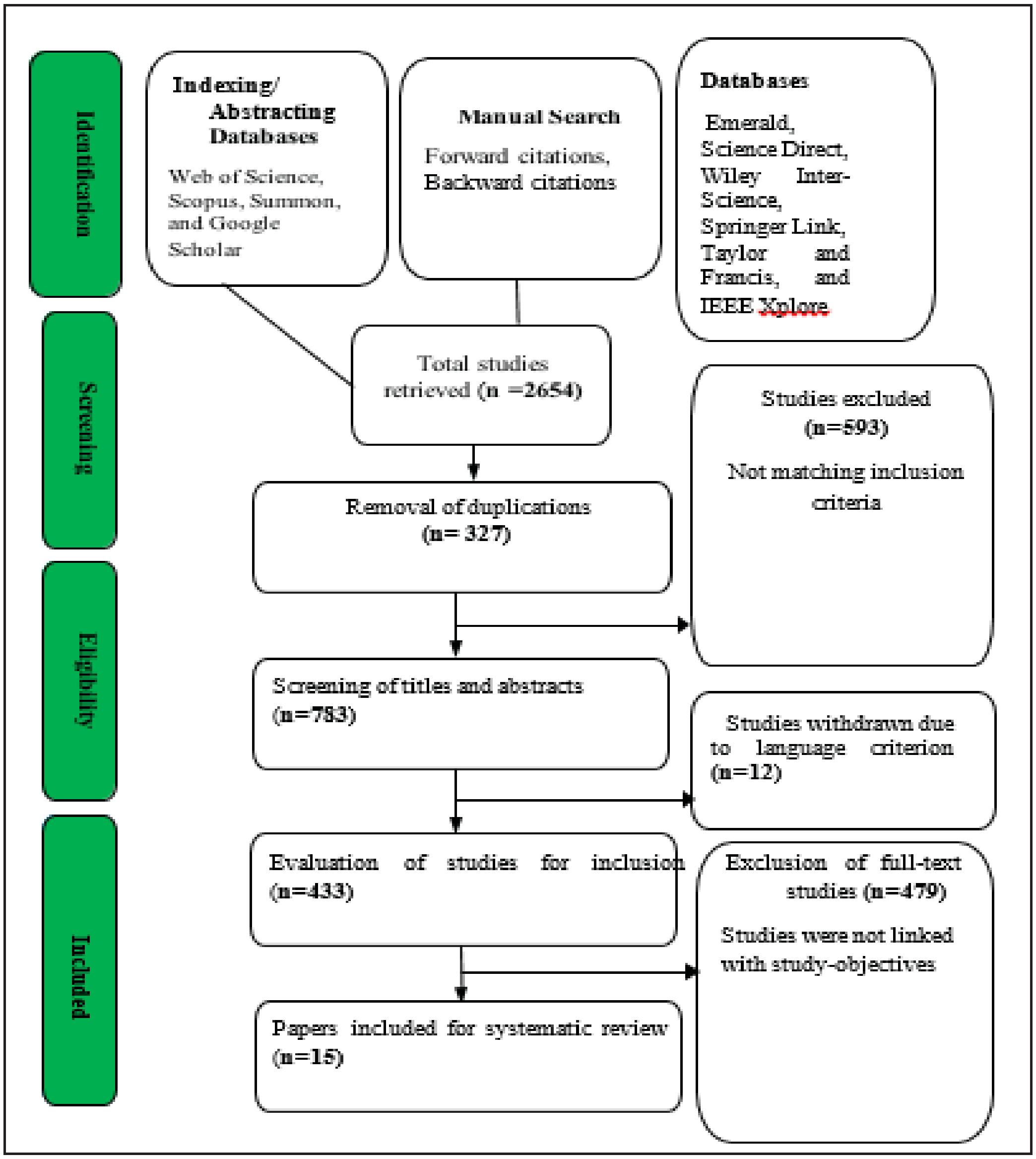

Figure 1. Diagram of the search process

3. Results

Table 2 displays the datasets extracted through the included studies (n = 15) to conduct the SLR on the topic. It shows information i.e. authors & publication years, affiliations, journals & conferences titles, impact of AI on industrial engineering, and challenges to adopt AI in industrial engineering.

Table 2. Data extracted via included studies

Authors & Years	**Affiliation**	**Journals/Conferences**	**Impact of AI on industrial engineering**	**Challenges to adopt AI in industrial engineering**
Ahmed et al., 2022	Pakistan	IEEE transactions on industrial informatics	• Advancement from Traditional AI to Explainable AI in Industrial Systems • Enhancement of Transparency and Trust in Automated Decision-Making • Improvement of System Diagnostics and Fault Interpretation • Facilitation of Human–Machine Collaboration through Explainable Insights • Strengthening of Ethical and Accountable Industrial AI Practices	• Complexity in Developing Interpretable AI Models for Industry 4.0 • Balancing Model Accuracy with Explainability • Lack of Standardized Frameworks for Implementing Explainable AI in Industrial Settings
Al Bashar & Khan, 2017	Bangladesh	Journal of Scientific Research and Engineering Development	• Enhanced Process Optimization • Improved Predictive Maintenance • Increased Production Efficiency • Intelligent Decision-Making Support • Automation of Complex Industrial Tasks	• High Implementation Costs • Lack of Skilled Workforce • Data Quality and Integration Issues
Benis et al., 2021	Israel	Sensors	• Advancement of Industry 4.0 Competencies in Engineering Education • Facilitation of Remote and Digital Learning through AI Tools • Enhancement of Industrial Training and Skill Development • Promotion of Smart Manufacturing Practices in Academic Curricula • Strengthening of Human–Machine Collaboration in Engineering Management	• Limited Digital Infrastructure in Educational and Industrial Institutions • Need for Continuous Skill Development and Re-Skilling • Adaptation Challenges to AI-Driven Learning and Work Environments
Elahi et al., 2023	Finland	Discover Artificial Intelligence	• Application of AI Across the Entire Lifecycle of Industrial Equipment • Enhancement of Equipment Design, Operation, and Maintenance Efficiency	• Integration Difficulties Across Different Phases of Equipment Lifecycle

			• Implementation of Predictive Analytics for Fault Detection and Prevention • Optimization of Asset Management and Operational Performance • Facilitation of Intelligent Decision Support in Equipment Lifecycle Management	• Data Fragmentation and Inconsistency Issues • High Cost and Complexity of Implementing Lifecycle-Wide AI Solutions
Kim et al., 2022	South Korea	International Journal of Precision Engineering and Manufacturing	Advancement of Intelligent Manufacturing and Automation Processes Improvement in Quality Control through Machine Learning and Vision Systems Optimization of Production Planning and Resource Management Enhancement of Predictive Maintenance and Fault Detection Capabilities Facilitation of Smart and Flexible Manufacturing Systems	High Implementation and Maintenance Costs Shortage of Skilled Workforce in AI-Integrated Manufacturing Data Management and Standardization Difficulties Across Industrial Systems
Lu et al., 2022	China	IEEE/CAA Journal of Automatica Sinica	Development of Parallel Factories Enabled by Big AI Models Transformation of Industrial Operations through Scenario Engineering Enhancement of Automation and Intelligent Decision Systems Integration of Field Foundational Models for Smart Manufacturing Improvement in Operational Scalability and Real-Time Responsiveness	Complexity in Implementing Large-Scale AI Models in Industrial Settings High Computational and Infrastructure Requirements Difficulty in Aligning AI Models with Dynamic Industrial Scenarios
Ozkarahan et al., 2005	Germany	International Conference on Advances in Information Systems	Enhanced Decision-Making through Intelligent Optimization Automation of Complex Industrial Processes Integration of AI with Operations Research for System Efficiency Predictive Analysis for Production and Supply Chain Management Improved Resource Allocation and Process Design	Data Quality and Availability Constraints Integration Complexity with Existing Industrial Systems Lack of Skilled Personnel in AI and OR Applications
Padovano & Cardamone, 2024	Italy	Computers and Education: Artificial Intelligence	Facilitation of Human–AI Collaboration in Engineering Education Personalization of Competency-Based Learning Pathways Enhancement of Curriculum Design through Data-Driven Insights Support for Skill Mapping and Workforce Readiness Integration of Intelligent Tutoring Systems in Industrial Engineering Training	Ethical and Pedagogical Concerns in Human–AI Interaction Resistance to Change in Educational and Industrial Contexts Limited Frameworks for Effective Human AI Collaboration
Peres et al., 2020	Portugal	IEEE access	Acceleration of Smart Manufacturing and Autonomous Systems	Data Security and Privacy Concerns in Industrial Networks

			Real-Time Monitoring and Predictive Maintenance Capabilities Integration of Cyber-Physical Systems for Intelligent Production Data-Driven Optimization of Industrial Operations Enhancement of Flexibility and Adaptability in Industrial Processes	Lack of Standardization Across AI-Driven Industrial Systems Limited Interoperability Between AI Technologies and Existing Infrastructure
Rahman et al., 2025	USA	Automation	Integration of Machine Learning with Digital Twin Technologies for Automation Real-Time Process Optimization through Edge AI Systems Enhancement of Predictive Maintenance and System Reliability Facilitation of Intelligent Decision-Making in Industrial Operations Advancement of Autonomous and Adaptive Industrial Environments	Interoperability Issues Between Digital Twin and Edge AI Platforms Data Synchronization and Communication Latency Problems High Computational and Implementation Costs for Scalable Deployment
Shoushtari et al., 2024	Iran	International journal of industrial engineering and operational research	Improvement of Project Planning and Scheduling Accuracy Enhancement of Risk Assessment through Predictive Analytics Optimization of Resource Allocation and Cost Management Facilitation of Data-Driven Decision-Making in Project Execution Strengthening of Efficiency and Productivity in Industrial Project Management	Limited Availability of High-Quality Project Data Resistance to Technological Change Among Project Teams Complexity in Integrating AI Tools with Traditional Project Management Systems
Sodhro et al., 2019	Sweden	IEEE Transactions on Industrial Informatics	Enhancement of Real-Time Decision-Making through Edge Computing Reduction of Latency in Industrial Automation Systems Improvement of Energy Efficiency in Smart Industrial Environments Integration of AI Algorithms for Predictive and Adaptive Control Strengthening of Industrial IoT Systems through Intelligent Processing	Limited Processing Power at Edge Devices Security and Privacy Risks in Distributed AI Systems Complexity in Synchronizing Edge and Cloud-Based Industrial Operations
Tsang & Lee, 2022	Hong Kong	Engineering Applications of Artificial Intelligence	Advancement of Semi-Automated Design and Innovation Processes Acceleration of Product Development Cycles through AI Tools Enhancement of Design Quality via Intelligent Data Analysis Integration of AI for Optimized Industrial Design Decision-Making	Dependence on High-Quality and Diverse Design Data Difficulty in Balancing Automation with Human Creativity Technical Barriers in Implementing AI Across Diverse Design Environments

			Facilitation of Knowledge Discovery from Large-Scale Design Data	
Tseng et al., 2021	Taiwan	Journal of Industrial and Production Engineering	Promotion of Sustainable and Data-Driven Industrial Practices Optimization of Operations through Predictive Analytics and Automation Integration of AI Technologies within Industry 4.0 Frameworks Enhancement of Efficiency in Production and Supply Chain Systems Facilitation of Smart Decision-Making for Sustainable Development	Insufficient Data Infrastructure for AI Implementation Organizational Resistance to Digital Transformation High Costs and Complexity of Integrating AI with Legacy Systems
Zhang et al., 2019	China	The International Journal of Advanced Manufacturing Technology	Establishment of a Structured Framework for Industrial Artificial Intelligence (I-AI) Facilitation of Intelligent Manufacturing System Development Enhancement of Flexibility and Adaptability in Industrial Operations Support for Innovation in Emerging Industrial Application Scenarios Integration of AI for Strategic Planning and Process Optimization	Lack of Unified Standards and Frameworks for I-AI Implementation Technical Complexity in Integrating AI with Legacy Manufacturing Systems High Resource Requirements for Developing Scalable AI Solutions

3.1 Affiliation of the contributed studies

The geographical distribution of the selected studies shows that research on the impact of AI in industrial engineering is globally dispersed widespread. Asian countries such as China, South Korea, Iran, Pakistan, and Bangladesh lead in producing studies in the area of AI and engineering. European nations, including Germany, Italy, Finland, Portugal, and Sweden, also play a key role, driven by advanced Industry 4.0 initiatives. Figure 2 shows geographical territories of the included studies. It shows that 15 included studies were contributed from 14 different countries.

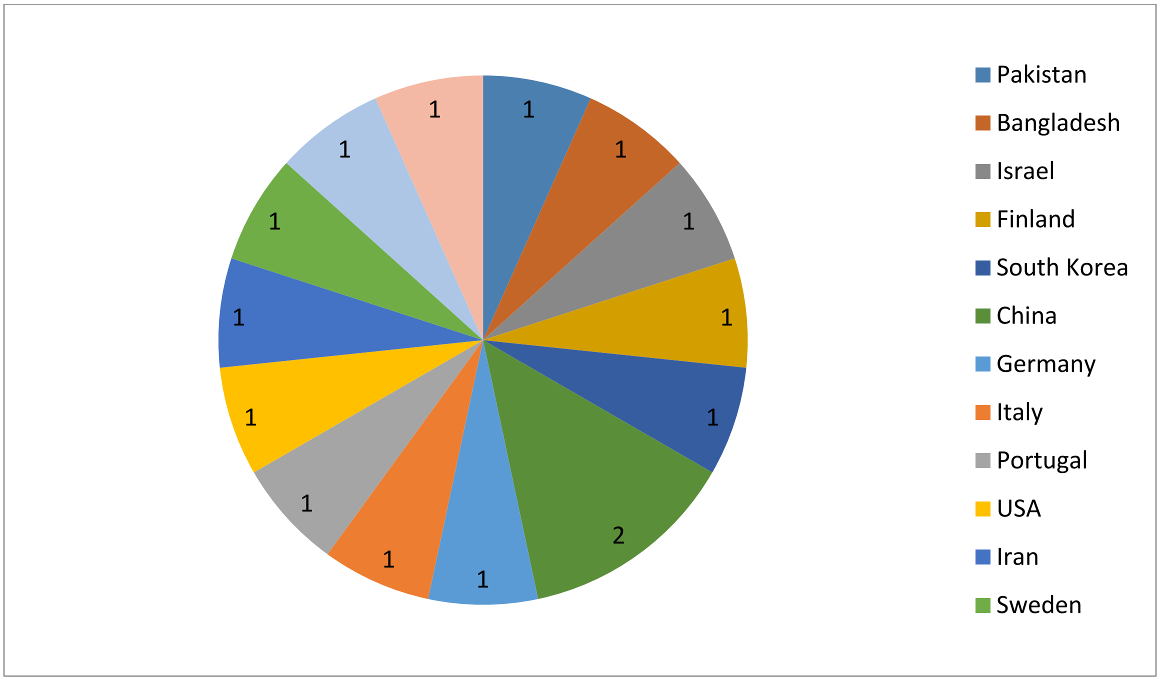

Figure 2. Geographical territories of the studies

3.2 History and timeline of the studies
Figure 3 displays the history and timeline of the included articles and conference proceedings. It shows that most of the included studies (n =10) were published after 2021.

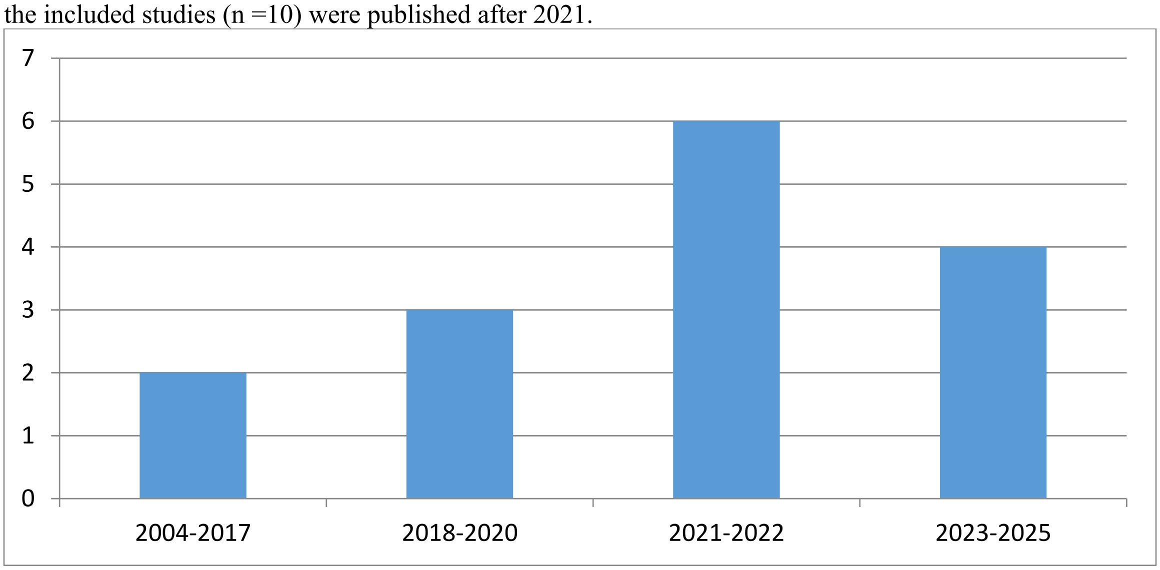

Figure 3. History and timeline of the studies

3.3 Impact of AI on industrial engineering
Findings of the study revealed that artificial intelligence (AI) has significant positive impacts on industrial engineering. AI has brought transformative changes in industrial engineering through the optimization of procedures. Industries are improving decision making on the basis of AI powered datasets (Ahmed et al., 2022). AI supports in making predictive analysis and leads towards effective resource allocation (Ozkarahan et al., 2005). It assists in efficient automation and results in increased industrial efficiency (Al Bashar & Khan, 2017; Peres et al., 2020). Smart systems are adopted through the incorporation of AI in industrial engineering.

Artificial intelligence has supported in manufacturing industry through the intelligence based systems. Faults are automatically detected and production losses are reduced (Kim et al., 2022; Rahman et al., 2025). Digital twin applications and edge computing bring smart changes in industrial engineering through real-time process optimization (Rahman et al., 2025; Sodhro et al., 2019). Scalability of factories increases and responsiveness enhances through the adoption of large AI models innovatively (Lu et al., 2022). It shows that AI shapes smart manufacturing to facilitate all the stakeholders.

Artificial intelligence transforms project management and practices of system engineering efficiently in industrial settings. Automated design systems refine decision making procedures and improve innovative outcomes (Tsang & Lee, 2022). AI powered analytics reduce risk, improve strategic planning, and cost effectiveness for the attainment of impactful outcomes (Shoushtari et al., 2024). The frameworks of AI in industrial engineering offer organized ways to implement intelligence systems in industrial settings (Zhang et al., 2019). These innovations show the significant role of AI in industrial engineering.

Artificial intelligence (AI) brings improvements in production management systems and facilitates sustainability in lifecycle of industrial environments. The innovation of predictive analytics supports in sustainable operations having maximized resource use efficiency (Elahi et al., 2023; Tseng et al., 2021). Equipment design, and maintenance become reliable and cost-efficient through lifecycle-based AI applications (Elahi et al., 2023). Data-driven decisions improve equipment longevity performance across industries increases (Kim et al., 2022; Rahman et al., 2025). Efficient industrial systems are implemented through the adoption of AI in industrial settings.

Artificial intelligence (AI) assists in reshaping the education of industrial engineering and grows workforce professionally through cutting edge tools. Skill based learning is provided through modern tools and technologies. Curriculum is transformed through the assistance of AI innovations in industrial engineering. AI assists in preparing engineers for meeting industry 4.0 demands (Padovano & Cardamone, 2024). AI supports in the provision of remote learning and the delivery of smart manufacturing simulations (Benis et al., 2021). Human-machine collaboration is enhanced and ethical usage of AI is ensured for effective outcomes. Better skilled future engineers are produced to manage complex systems innovatively (Ahmed et al., 2022; Benis et al., 2021). Table III shows the major and sub-categories of the impacts of AI on industrial engineering.

Table 3. Impact of AI on industrial engineering

Major category of impact	Sub-categories
Process Optimization and Decision-Making	• Data-driven decision support • Predictive analytics and forecasting • Resource allocation efficiency • Process optimization and workflow automation • Smart system integration • Real-time monitoring and adaptive control • AI-based performance benchmarking • Dynamic scheduling and production planning
Smart Manufacturing and Automation	Intelligent automation of production lines • Fault detection and predictive maintenance • Digital twin integration and simulation models • Edge computing for process optimization • Scalable and responsive smart factories • Robotics and machine vision applications • Quality inspection through AI sensors • Cyber-physical systems and self-learning operations
Project and Systems Engineering Transformation	Automated design and modeling tools • AI-driven project scheduling and monitoring • Risk assessment and predictive failure analysis • Cost optimization through intelligent algorithms • Strategic and operational planning

	• Knowledge-based systems for engineering design • Frameworks for AI-integrated industrial systems • Simulation and scenario-based decision testing
Sustainable Industrial Operations and Lifecycle Management	Sustainable resource management • Energy efficiency optimization • Lifecycle-based equipment maintenance • Waste minimization and environmental impact reduction • Predictive sustainability analytics • AI-supported circular economy practices • Equipment longevity and reliability enhancement • Data-driven environmental compliance tracking
Education, Workforce Development, and Human-AI Collaboration	AI-enabled curriculum modernization • Skill-based and experiential learning programs • Smart manufacturing simulations in education • Remote and blended learning through AI tools • Human–machine collaboration enhancement • Professional development through adaptive AI training • Ethical and responsible AI literacy • Preparing workforce for Industry 4.0 and beyond

3.4 Challenges to adopt AI in industrial engineering
Certain challenges are linked to the adoption of AI in industrial engineering. Unauthentic data quality sets make it difficult to incorporate AI innovation in industrial environments. Inconsistent practices and lack of standards of AI in industrial engineering are prominent barriers for the adoption of AI applications in engineering (Ahmed et al., 2022; Ozkarahan et al., 2005). Due to the unavailability of uniform standards, impactful outcomes might not be attained in industrial engineering. Lack of interoperability across industrial systems causes barriers for effectively adopting AI applications (Peres et al., 2020; Rahman et al., 2025). Inadequate infrastructure and digital readiness are potential issues for the adoption of AI in industrial settings (Benis et al., 2021; Tseng et al., 2021).
Funding costs, technical complications, and computations needs are also key challenges for the effective adoption of AI in industrial engineering environments. Unavailability of advanced ICT infrastructure makes it difficult to adopt cutting edge applications in engineering settings (Lu et al., 2022; Rahman et al., 2025). Lack of strategic planning is also a prominent issue. Sustainability costs are very high that cause multiple challenges for the smooth functioning of AI powered engineering systems and services (Al Bashar & Khan, 2017; Kim et al., 2022). The integration of AI with existing engineering systems and products is difficult due to certain technical limitations (Elahi et al., 2023; Zhang et al., 2019).

Unavailability of skilled human resource is a key challenge for the efficient adoption of AI innovations in engineering environments. The lack of skilled engineers causes problems for the successful adoption of AI in engineering environments (Kim et al., 2022; Ozkarahan et al., 2005). Staff resistance to adopt change at workplace hinders the incorporation of AI technology in industrial settings (Padovano & Cardamone, 2024; Shoushtari et al., 2024). Ethical issues are also linked to the implementation of AI powered systems in industrial environments (Ahmed et al., 2022; Padovano & Cardamone, 2024). Lack of awareness about the potential prospects of AI innovations in industrial engineering environments is also a key challenge for its effective integration. Table 4 displays the challenges for adopting AI applications in industrial settings.

Table 4. Challenges for adopting AI applications

Data and Standardization Challenges	• Poor data quality and lack of data authenticity • Absence of standardized AI protocols and procedures • Inconsistent data formats across industrial systems • Lack of data governance and validation mechanisms • Insufficient interoperability between AI systems and legacy technologies • Fragmented data collection and reporting methods • Difficulty in benchmarking due to non-uniform industrial datasets

Technological and Infrastructure Challenges	• Limited ICT infrastructure and inadequate digital readiness • High computational power requirements for AI models • Integration complexity with existing industrial systems • Limited scalability of AI-powered manufacturing systems • Technical incompatibility across AI hardware and software platforms • Reliability and security issues in industrial automation systems • High sustainability and maintenance costs of AI-driven systems
Financial and Strategic Implementation Challenges	• High initial funding and implementation costs • Insufficient budget allocation for AI research and development • Lack of long-term strategic planning and policy direction • Cost–benefit uncertainty in AI adoption projects • Limited access to investment for small and medium industrial firms • Risk aversion in adopting AI technologies due to unclear ROI • Complex sustainability and lifecycle management costs
Human Resource, Ethical, and Organizational Challenges	• Shortage of skilled engineers and AI specialists • Resistance to change among industrial workforce • Lack of AI literacy and awareness in engineering environments • Ethical concerns regarding automation and decision-making fairness • Insufficient training and capacity-building programs • Fear of job displacement due to automation • Weak organizational culture for innovation adoption • Lack of collaboration between engineers and data scientists

4. Discussion

The current study aimed to identify the impact of artificial intelligence (AI) on industrial engineering. Systematic literature review (SLR) methodology was incorporated to address the study's objectives. 15 peer-reviewed journal articles and conference proceedings published in world's key databases were selected to conduct the study.

Findings of the study revealed that the integration of artificial intelligence (AI) into industrial engineering has redefined how industries approach production, design, and operational management. AI has enabled the automation of complex engineering tasks, predictive maintenance, and real-time decision-making. It has transformed traditional production environments into intelligent, adaptive systems. Through machine learning, deep learning, and data analytics, industrial operations have achieved enhanced efficiency, reduced downtime, and optimized resource utilization. This transformation is assisting in sustainable manufacturing processes by minimizing waste, improving precision, and enabling energy-efficient operations. AI has proved impactful for innovation and competitiveness in industrial engineering, fostering smarter workflows and enhanced product quality.

The impact of AI extends to data driven decision frameworks and the refinements in workforce roles. Industrial engineers are now increasingly engaged in designing and managing AI-enabled systems rather than performing repetitive manual tasks. This evolution has encouraged interdisciplinary collaboration among engineers, data scientists, and IT specialists. The initiation of digital twins and edge AI technologies has improved system monitoring and predictive capabilities, allowing engineers to model, simulate, and optimize operations before implementation. The convergence of AI with Industry 4.0 technologies including the Internet of Things (IoT), robotics, and cloud computing has made industrial systems more responsive, flexible, and capable of continuous learning.

However, several key challenges exist that create multiple barriers for the full realization of AI's potential in industrial engineering. The key challenge is the high cost associated with implementing and maintaining AI systems, particularly in small and medium-sized enterprises that often lack sufficient financial and technical resources. The shortage of a skilled workforce capable of developing, managing, and interpreting AI applications causes a prominent difficulty. Many industries still struggle with integrating AI tools into legacy systems, resulting in data fragmentation and interoperability issues. Ethical concerns, such as job displacement and algorithmic transparency, also cause complex socio-technical challenges. Furthermore, the absence of standardized frameworks and regulations cause complications across industrial AI systems.

5. Recommendations

On the basis of the study's findings, following practical solutions are offered for the effective implementation of AI innovations in industrial environments.

1. Industries should develop standardized frameworks to ensure smooth integration of AI systems across different engineering environments.
2. Organizations must invest in staff training to address the shortage of AI-skilled professionals and promote continuing professional development (CPD).
3. Firms should allocate sufficient financial resources and explore cost-sharing models for adopting AI technologies.
4. Digital infrastructure should be enhanced to support large-scale AI applications.
5. Industries should improve data management practices to ensure data quality, consistency, and interoperability across systems.
6. Management should promote an innovation-driven culture to reduce resistance to change and encourage employees to adopt AI transformation.
7. Engineers and researchers must design interpretable and explainable AI models to balance accuracy with transparency in industrial decision-making.
8. Collaborative frameworks between academia, industry, and policymakers should be established to create shared AI knowledge and develop unified standards.
9. Industries should strengthen cybersecurity and data privacy protocols in all AI-integrated operations.
10. Organizations must adopt pilot projects to evaluate performance of AI based systems before complete implementation of AI applications in industrial engineering settings.

6. Conclusion

The current study aimed to identify the impact of artificial intelligence (AI) on industrial engineering. Systematic literature review (SLR) methodology was incorporated to address the study's objectives. 15 peer-reviewed journal articles and conference proceedings published in world's key databases were selected to conduct the study. Results revealed that AI significantly enhances industrial engineering by automating complex operations, enabling predictive maintenance, and fostering innovation through data-driven decision-making and intelligent system integration. However, its large-scale adoption is constrained by high implementation costs, limited skilled personnel, and resistance to change. Standardized and collaborative frameworks need to be adopted supported by skilled professionals, robust infrastructure, quality data management, and a culture of innovation to ensure an effective AI integration in industrial environments.

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