



THE ROLE OF AI-IOT PLATFORMS IN ENHANCING COMPETITIVENESS OF SMEs IN MANUFACTURING SECTOR

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Abstract- The combination of Artificial Intelligence (AI) and the Internet of Things (IoT) is revolutionizing the manufacturing industry by allowing small and medium enterprises (SMEs) to become more competitive in the market. Companies can now enjoy low operational costs, high product quality, and faster decisions thanks to these AI driven advancements. While AI analytics optimize production output, IoT smart devices enable monitoring and maintenance to be done in real time. In addition, AI IoT platforms improve logistics, resource distribution, and supply chain management. The implementation of these technologies encourages SMEs to innovate and allows them to compete with larger businesses. In addition, AI helps create personalized experiences for customers based on data and insights, which helps position businesses strongly in the market. Although there are many implementation obstacles, AI IoT solutions do provide great long-term sustainability. However, addressing issues such as investment barriers and cyber security is essential for broad acceptance. Future innovations will increase digital transformation in the manufacturing industry, thereby empowering SMEs even more. The successful implementation of AI-IoT depends on scalable and cost-effective solutions, workforce development, and the strength of cybersecurity measures.

Keywords: AI-IoT integration, SME competitiveness, smart manufacturing, cost-effective, cybersecurity.

INTRODUCTION:

Artificial Intelligence (AI) and the Internet of Things (IoT) have emerged as key enablers of industrial transformation, and the rapid evolution of technology has drastically changed the global manufacturing sector. Due to operational limitations and a lack of resources, small and medium-sized businesses (SMEs), which are the foundation of many economies, struggle to remain competitive. By combining automation, real-time data collecting, and predictive analytics, AI-IoT platforms provide creative solutions that boost output and efficiency. SMEs may improve decision-making, decrease downtime, and optimize production processes with the help of these intelligent systems. Smart

sensors and networked devices make it easier to monitor production lines, guaranteeing waste reduction and quality control. Algorithms powered by AI can anticipate equipment breakdowns, enabling preventative maintenance and financial savings. Additionally, by facilitating agile supply chain management, these technologies lower delays and improve customer satisfaction. Small and medium-sized businesses can satisfy changing market needs and promote sustainable growth by implementing AI-IoT solutions. However, obstacles including cyber security risks, expensive installation, and the requirement for qualified staff prevent broad adoption. In order to fully utilize AI-IoT in the manufacturing sector, these obstacles must be removed. A competitive edge and operational excellence can be attained by SMEs through the use of intelligent automation. Strategic IoT and AI integration is essential to the future of digital manufacturing in order to spur innovation and efficiency.

REVIEW OF LITERATURE:

Anbesh Jamwal et al. (2023) Industry 4.0 and sustainability are related ideas that present new commercial prospects for SMEs. An empirical examination in an emerging economy is carried out in this study. The findings provide factual backing for tackling sustainability concerns in Industry 4.0 for small and medium-sized manufacturers.

Haider Ali and Leo Hajjar (2024) this paper examines the capabilities that AI, and other information technologies have in aid of SMEs .This study provides guidelines for policymakers, providers of technology, and managers of SMEs in order to encourage the growth of SMEs with a digital focus. It gives a clear guidance to achieve excellence in business operations, flexible market response, and growth

Elias G. Carayannis et al. (2024) the study provides a detailed examination of SMEs and Gen AI and emphasizes the necessity of strategic AI incorporation while aiming to tackle the challenges and policy problems SMEs face in utilizing AI to achieve sustainable growth. We hope to take practical as well as theoretical angles and so help SMEs



formulate the directions, steps, and strategies that they need to have in the Age of Generate AI.

Sinoxolo Boyana et al. (2024) an analysis of geographic distribution indicates the gaps in research available from different regions of the world. Based on the results, it is evident that there has been a marked improvement in the operations of SMEs due to the use of digital technologies, however, issues surrounding resource availability and an organization's strategic intent continue to present challenges.

Richa Bhalla et al. (2025) this study analyzes AI and other IoT business use cases along with employee relations management as methods of enabling SMEs. AI, the analytics of data and other tools enable the SMEs to work more effectively, be more innovative, and enhance customer satisfaction. This paper presents particular examples, case studies, and recommendations to improve the strategy of SMEs in the digital environment.

Mostafa Elmarzouki and Jiuhe Wang (2025) this study examines how Industry 4.0 technologies are being adopted and how they affect productivity in manufacturing SMEs in Hebei, China, an area that is marked by a lack of funding, poor infrastructure, and a skilled labor population. According to the results, automation and the Internet of Things are strongly linked to increases in productivity, whilst big data analytics and artificial intelligence help to lower costs and accelerate time to market.

RESEARCH GAP:

There are gaps in the integration of AI, IoT, and Industry 4.0 for the long-term sustainability of SMEs, even as more research focuses on AI, IoT, and Industry 4.0 within the SME. This research is based on **theoretical aspects**. While other studies are around improving operational effectiveness, strategic frameworks are relatively scarce, with most discussing the strategic issues faced by SMEs while attempting to balance digital transformation and resource constraints. There is a lack of **empirical evidence** on how different regions of SMEs understand and deal with policy and infrastructure issues on the adoption of Industry 4.0 technology.

STATEMENT OF PROBLEM:

Small and medium-sized businesses in manufacturing have a difficult time in staying with the competitive business world because their processes are outdated, costs are high, and they don't manage resources well. Unlike big companies, they often can't afford to use AI and IoT due to money issues, lack of tech know-how, and worries about security. Without real-

time monitoring and predictive analytics, they face more production hiccups, quality problems, and supply chain snags. If they do not embrace digital changes, these companies might lose customers to tech-savvy rivals. This study looks at how AI-IoT platforms can help improve manufacturing, boost productivity, and make better decisions for these businesses. It also tries to find out what stops them from adopting this tech and suggests ways to smoothly integrate it. To maintain SMEs' long-term viability and competitiveness in the changing industrial landscape, these issues must be resolved.

OBJECTIVE OF THE STUDY:

1. To analyze how AI-IoT integration affects SMEs' cost-cutting, productivity, and operational efficiency in the manufacturing industry.
2. To determine the difficulties and barriers SMEs encounter when implementing AI-IoT technologies and to suggest solutions for these problems to improve their competitiveness in the market.

SCOPE OF THE STUDY:

This study focuses on how AI-IoT platforms may help SMEs become more competitive in the manufacturing industry. It looks at the ways in which these technologies enhance operational effectiveness, maximize resource use, and lower costs. The study also looks at skill shortages, cybersecurity threats, and budgetary limitations that SMEs face while implementing AI-IoT solutions. The study is restricted to SMEs involved in manufacturing processes, examining smart automation, predictive maintenance, and real-time data usage. It encompasses geographically those industries that aggressively seek digital transformation. To enable smooth AI-IoT adoption, the findings will offer guidance to technology developers, policymakers, and SMEs. Additional research can look into long-term economic effects, sector-specific AI-IoT applications, and legislative frameworks to encourage SMEs to use digital technology.

RESEARCH METHODOLOGY:

The study gathered **secondary data**; the data was collected using online sources and journals. The study uses **theoretical information** as data collection in this study.

LIMITATIONS:

- **There is no empirical validation because it depends on pre-existing literature and not on any real-world data.**
- **Generalization problems as theoretical models fail to adequately depict industry-specific challenges.**
- **Technological rapid advancement may make theoretical insights outdated very fast.**
- **Limited practical applicability as the study may not address real-time implementation barriers.**
- **Potential bias in selected literature, leading to an incomplete perspective on AI-IoT adoption.**

COST-CUTTING BENEFITS OF AI-IOT INTEGRATION:

The process automation, resource optimization, waste reduction, and energy consumption reduction, AI-IoT solutions assist SMEs in making considerable cost savings. Key areas where AI-IoT helps save costs include the following:

1. Predictive maintenance

Conventional maintenance methods in manufacturing can result in unplanned malfunctions or needless repairs. Through the collection of real-time data from sensors integrated into machines, AI-IoT makes predictive maintenance possible. In order to minimize downtime and maintenance expenses, sophisticated AI algorithms examine this data and forecast failures before they happen.

2. Energy efficiency

Real-time energy usage patterns are monitored by AI-IoT systems to optimize energy consumption. Reduced electricity costs are the result of dynamic energy usage adjustments made by smart sensors and AI-driven automation. IoT-enabled HVAC and lighting systems, for example, automatically adapt to occupancy and environmental conditions to ensure minimal waste.

3. Supply chain optimization

Demand forecasting, inventory management, and logistics are all made easier by AI-IoT solutions. By avoiding stockouts and overstocking, automated tracking systems lower holding expenses and material waste. Predictive analytics powered by AI assists SMEs in streamlining their procurement plans, which improves supplier negotiations and reduces costs.

4. Labor cost reduction

AI-powered automation frees up human resources for more strategic responsibilities by eliminating the need for repetitive manual chores. Significant cost savings can result from a reduction in the need for manual labour through automated quality control, robotic process automation (RPA), and AI-powered customer service.

PRODUCTIVITY ENHANCEMENT THROUGH AI-IOT INTEGRATION:

By enhancing decision-making, decreasing downtime, and enabling intelligent automation, AI-IoT solutions increase productivity. The following are some ways that AI-IoT-driven productivity gains help SMEs:

1. Real-time monitoring and decision-making

Managers are given real-time insights into production processes by the constant data collection and transmission via IoT devices. AI-driven analytics facilitate rapid decision-making, the discovery of inefficiencies, and the dynamic modification of procedures to maximize output.

2. Automation of repetitive tasks

Robotic automation in assembly lines driven by AI increases productivity, lowers human error, and boosts overall efficiency. Intelligent manufacturing robots precisely perform monotonous jobs, freeing up human workers to concentrate on intricate problem-solving.

3. Enhanced quality control

AI-enabled vision systems for real-time product analysis detect defects and guarantee consistent quality standards. By reducing the rates of rework and scrap, automated quality control systems boost output and save expenses.

4. Workforce optimization

AI-driven workforce analytics help SMEs allocate labor resources effectively. AI algorithms analyze worker performance, shift patterns, and skill sets to optimize staffing and scheduling, ensuring maximum output with minimal labor costs.

OPERATIONAL EFFICIENCY IMPROVEMENTS:

SMEs must maintain operational efficiency if they want to compete in the industrial sector. In the following ways, AI-IoT technologies improve operational efficiency:

1. Smart manufacturing systems

Smart factories, where machines communicate with one another and optimize production processes on their own, are made possible by AI-IoT integration. Throughput is

increased, bottlenecks are reduced, and workflow coordination is improved by this interconnectivity.

2. Supply chain visibility

SMEs can see the supply chain from beginning to end with real-time tracking and AI-powered analytics. Demand forecasting, supplier risk assessment, and logistics optimization are all made easier with AI-IoT solutions, which guarantee seamless operations.

3. Data-driven decision-making

Large volumes of operational data are gathered by AI-IoT platforms, enabling SMEs to make data-driven choices. Predictive analytics and dashboards driven by AI assist managers in finding inefficiencies and swiftly putting corrective measures into place.

4. Enhanced safety and compliance

AI-IoT solutions increase worker safety by keeping an eye on the surroundings and identifying potentially dangerous circumstances. By ensuring that SMEs follow industry rules, automated compliance monitoring lowers legal risks and improves operational effectiveness.

CHALLENGES IN AI-IOT ADOPTION:

SMEs have a number of difficulties when integrating AI-IoT technologies, notwithstanding the advantages. High expenses, insufficient knowledge, security issues, and integration difficulties are some of these obstacles.

1. High initial investment costs

It takes a significant financial investment in hardware, software, and infrastructure to implement AI-IoT solutions. Due to their limited financial resources, SMEs frequently find it difficult to afford these technology.

Solution: Small and medium-sized businesses can benefit from government grants, subsidies, and financial aid initiatives that promote digital transformation. Cloud-based AI-IoT solutions remove the need for on-premise infrastructure, making them more affordable options.

2. Lack of technical expertise

Small and medium-sized businesses can benefit from government grants, subsidies, and financial aid initiatives that promote digital transformation. Cloud-based AI-IoT solutions remove the need for on-premise infrastructure, making them more affordable options.

Solution: SMEs can obtain access to specialized knowledge by collaborating with industry teams and partnering with AI-IoT solution providers. Upskilling initiatives and training programs can also help close the skills gap.

3. Data security and privacy concerns

Large volumes of data are generated by IoT devices, leaving SMEs open to data breaches and cybersecurity risks.

Solution: Data security can be improved by putting strong cybersecurity measures in place, such as multi-factor authentication, end-to-end encryption, and frequent security audits. Safe data handling is ensured by adherence to industry standards such as GDPR and ISO 27001.

4. Integration challenges with legacy systems

Modern AI-IoT technologies cannot be implemented on many SMEs' antiquated systems. It can be difficult and expensive to integrate new technologies with the infrastructure that already exists.

Solution: Smooth integration can be made possible by using Application Programming Interfaces (APIs) and middleware solutions. SMEs can migrate more smoothly with the use of gradual adoption tactics, beginning with pilot projects

5. Scalability issues

The deployment of AI-IoT requires scalable solutions that can grow with the business. Selecting adaptable technologies might be challenging for many SMEs.

Solution: By using modular AI-IoT systems that allow for incremental updates, long-term scalability is guaranteed. Scalability and flexibility are provided by cloud-based systems without requiring significant upfront costs.

CONCLUSION:

The scope for cost reduction, productivity increases, and improved efficiency operations of an SME is enormous with the integration of AI-IoT solutions. With predictive maintenance, energy efficiency measures, optimized supply chain, and automated workforce automation, businesses reduce costs while increasing output. But strategic hurdles include high initial investment costs, lack of technical knowledge, security risks, and difficulties in integration.

The AI-IoT integration offers tremendous opportunities for cost savings, productivity enhancement, and operational efficiency to SMEs. Predictive maintenance, energy consumption optimization, streamlined supply chains, and automation of repetitive tasks contribute to significant cost savings through AI-IoT solutions. Further, smart manufacturing systems and AI-based analytics ensure efficiency in the operations and create a competitive advantage in the dynamic digital environment. Still, SMEs have encountered considerable challenges while adopting AI-IoT, which include high initial costs, a lack of technical expertise, security of data, integration problems with legacy systems, and scalability.



The successful implementation of AI-IoT depends on scalable and cost-effective solutions, workforce development, and the strength of cybersecurity measures. Using a phased approach and available financial support, SMEs can fully exploit AI-IoT technology to achieve competitiveness in the marketplace. In today's fast-paced digital environment, the integration of AI-IoT is not a choice but a requirement for continued growth and competitiveness.

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