

Exploring the Role of Internet of Things in Raising the Awareness, It's Application for Sustainable Industrial Growth

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Abstract

The Internet of Things (IoT) has emerged as a transformative digital technology that is reshaping industrial operations by enhancing connectivity, real-time monitoring, and intelligent decision-making. This paper explores the role of IoT in raising industrial awareness and examines its applications in promoting sustainable industrial growth. It highlights how IoT-enabled systems facilitate predictive maintenance, resource optimization, energy efficiency, environmental monitoring, and data-driven decision-making, thereby improving operational productivity and reducing environmental impacts. The study further discusses the contribution of IoT to Industry 4.0 and Industry 5.0 by integrating smart sensors, cloud computing, artificial intelligence, and advanced analytics to support sustainable manufacturing practices. The paper identifies key implementation challenges, including cybersecurity, data privacy, interoperability, infrastructure costs, and workforce readiness. It concludes that strategic adoption of IoT, supported by robust governance and digital capabilities can significantly enhance industrial competitiveness, environmental sustainability, and long-term economic growth while accelerating the transition toward intelligent and resilient industrial ecosystems.

Keywords: *Internet of Things (IoT); Industrial Awareness; Sustainable Industrial Growth; Industry 4.0; Smart Manufacturing; Digital Transformation; Decision Support Systems (DSS)*

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1. Introduction

The Internet of Things (IoT) has emerged as a transformative digital technology that is reshaping industrial ecosystems by enabling seamless communication among interconnected devices, sensors, machines, and enterprise systems. Through real-time data acquisition and intelligent information exchange, IoT has significantly improved industrial awareness regarding production processes, equipment performance, resource utilization, and operational efficiency. The integration of IoT with cloud computing, artificial intelligence (AI), and edge computing has further strengthened industrial digitalization by facilitating predictive analytics and automated decision-making. The industries are increasingly adopting IoT-enabled solutions to enhance productivity, improve product quality, and achieve sustainable competitiveness in rapidly evolving business environments. As organizations

transition towards Industry 4.0 and Industry 5.0, IoT has become a critical technological foundation for achieving intelligent, connected, and sustainable industrial development (Mu et al., 2024). Industrial awareness extends beyond technological adoption and encompasses the capability of organizations to monitor, interpret, and respond proactively to operational, environmental, and market conditions. IoT facilitates this awareness by continuously collecting real-time information from production systems, supply chains, energy networks, and workplace environments through smart sensors and connected devices (Rame, 2024). Such intelligent monitoring enables industries to identify inefficiencies, predict equipment failures, optimize maintenance schedules, and reduce operational risks before they affect productivity. The enhanced industrial awareness supports compliance with environmental regulations, improves occupational safety, and promotes efficient utilization of natural resources. These capabilities position IoT as an essential enabler of sustainable industrial transformation that balances economic growth with environmental stewardship and social responsibility. The education and entrepreneurship play a crucial role in developing sustainable business models (Gaikwad, 2016). The practical applications of IoT have expanded considerably across manufacturing, logistics, healthcare, agriculture, transportation, and energy industries. Smart factories increasingly utilize IoT-enabled cyber-physical systems to automate production planning, quality inspection, predictive maintenance, inventory management, and supply chain coordination.

The IoT technologies support precision agriculture through intelligent irrigation systems, healthcare through remote patient monitoring, and smart energy management through connected power grids. These applications demonstrate that IoT not only enhances operational efficiency but also strengthens organizational resilience by enabling data-driven decision-making and continuous process optimization. As industries increasingly embrace digital transformation, IoT applications continue to create new opportunities for innovation, value creation, and sustainable industrial growth (Islam et al., 2025). Despite its significant benefits, widespread implementation of IoT continues to face several technological, organizational, and strategic challenges. Industrial organizations frequently encounter cybersecurity threats, data privacy concerns, interoperability issues, infrastructure complexity, integration difficulties with legacy systems, and substantial implementation costs leading to digital stress (Gaikwad & Bhattacharya, 2024). Furthermore, the shortage of digitally skilled professionals, organizational resistance to technological change, and inadequate governance frameworks often limit the successful deployment of IoT initiatives. These challenges highlight that sustainable industrial growth cannot be achieved through technological investment alone but requires strategic leadership, workforce capability development, digital governance, and human-centric innovation. Accordingly, organizations must adopt integrated implementation strategies that simultaneously address technological, managerial, environmental, and social dimensions of digital transformation (Ghobakhloo, 2024). The growing importance of IoT in promoting industrial awareness and sustainability has attracted considerable attention from researchers, policymakers, and industry practitioners. However, existing literature predominantly emphasizes technological innovations and engineering applications, while comparatively limited research examines how IoT contributes to organizational awareness, sustainable industrial growth, and long-term resilience through an integrated managerial perspective. The transition towards Industry 5.0 further emphasizes human-centric, resilient, and environmentally responsible industrial systems in which IoT serves as a key enabling technology for sustainable value creation. This study explores the role of IoT in raising industrial awareness and examines its applications for sustainable industrial growth by synthesizing contemporary theoretical insights and practical industrial evidence. The findings are expected to provide valuable guidance for industries seeking to accelerate digital transformation while strengthening sustainability, competitiveness, and organizational resilience (Ahmed et al., 2025).

2. Background of Study

The Internet of Things (IoT) has emerged as one of the most disruptive technologies driving industrial digitalization by connecting physical assets, intelligent sensors, machines, and enterprise systems into an integrated communication network. This interconnected environment enables industries to generate, process, and analyze real-time operational data, thereby improving visibility across manufacturing and business processes. As organizations increasingly adopt digital technologies to remain competitive, IoT has become a fundamental pillar of smart industrial ecosystems by facilitating automated monitoring, predictive maintenance, intelligent quality control, and data-driven operational management. IoT has evolved beyond connectivity to become a strategic resource for enhancing industrial awareness, operational excellence, and sustainable economic development (Mu et al., 2024). The transition from conventional manufacturing toward Industry 5.0 has significantly expanded the role of IoT in promoting sustainable industrial growth. Unlike Industry 4.0, which primarily emphasized automation and efficiency, Industry 5.0 integrates human-centric innovation, resilience, and environmental sustainability into industrial development. IoT technologies facilitate this transition by enabling continuous monitoring of production systems, optimizing energy utilization, minimizing industrial waste, and supporting environmentally responsible manufacturing practices (Gaikwad, 2016). These capabilities contribute to achieving sustainability objectives while simultaneously improving productivity, operational flexibility, and industrial competitiveness in an increasingly digital economy (Uslu, 2026). Industrial awareness has become increasingly important as organizations face growing environmental concerns, resource scarcity, regulatory requirements, and rapidly changing market conditions. IoT enables industries to develop comprehensive awareness of operational performance through continuous monitoring of equipment health, production efficiency, workplace safety, emissions, and supply chain activities. The availability of accurate real-time information enables managers to detect anomalies, forecast equipment failures, optimize maintenance schedules, and improve resource allocation before disruptions occur. Such intelligent monitoring enhances organizational responsiveness while supporting evidence-based strategic decisions that contribute to sustainable industrial development and long-term competitiveness (Bhat et al., 2024).

The practical applications of IoT have expanded rapidly across manufacturing, logistics, healthcare, agriculture, transportation, and energy sectors. Smart factories employ IoT-enabled cyber-physical systems to automate production planning, optimize inventory, improve product quality, and strengthen predictive maintenance capabilities. Similarly, logistics organizations use connected devices for real-time asset tracking and supply chain visibility, while energy industries integrate IoT into smart grid management and renewable energy optimization. These applications demonstrate that IoT not only improves operational efficiency but also supports sustainable industrial practices through intelligent automation, responsible resource utilization, and continuous organizational innovation (Ferrisi et al., 2025). Although the industrial benefits of IoT are substantial, organizations continue to encounter challenges relating to cybersecurity, interoperability, infrastructure investment, workforce readiness, and digital governance. The successful adoption of IoT therefore requires an integrated strategy that combines technological innovation with organizational capability development, policy support, and sustainable management practices. As industries continue to embrace digital transformation, IoT is expected to become an indispensable enabler of resilient, human-centric, and environmentally responsible industrial ecosystems. The understanding its role in raising industrial awareness and promoting sustainable industrial growth has become an important research priority for academics, policymakers, and industrial practitioners (Hammad et al., 2025).

3. Rationale of Study

The growing adoption of the Internet of Things (IoT) across industrial sectors has fundamentally transformed production systems by enabling real-time monitoring, intelligent automation, and data-driven decision-making. Despite rapid technological advancements, existing research largely concentrates on IoT architectures, communication protocols, and engineering applications, while comparatively limited attention has been devoted to understanding how IoT enhances industrial awareness and contributes to sustainable industrial growth from a managerial and strategic perspective. Furthermore, industries continue to face increasing pressure to improve operational efficiency while simultaneously achieving environmental sustainability and social responsibility. A comprehensive examination of IoT's role in promoting industrial awareness and sustainable development is both timely and essential for advancing academic knowledge and supporting industrial transformation. This study seeks to bridge this gap by synthesizing contemporary evidence on IoT-enabled sustainable industrial practices and identifying strategic pathways for long-term industrial resilience and competitiveness (Díaz-Martínez et al., 2026). The rationale for this study is further strengthened by the accelerating transition toward Industry 5.0, where sustainable, human-centric, and resilient industrial ecosystems increasingly depend on intelligent digital technologies. Organizations require comprehensive understanding not only of the technological capabilities of IoT but also of its strategic implications for sustainability, resource optimization, environmental performance, and industrial competitiveness. While IoT offers significant opportunities for improving energy efficiency, reducing waste, enabling circular economy practices, and enhancing operational transparency, successful implementation depends upon effective governance, organizational readiness, workforce awareness, and strategic integration. This study provides a holistic perspective by examining both the opportunities and implementation challenges associated with IoT adoption, thereby offering practical insights for researchers, policymakers, and industrial practitioners seeking to accelerate sustainable industrial development through intelligent digital transformation (Zhao et al., 2025).

4. Objectives of Study

- To examine the role of the Internet of Things (IoT) in enhancing industrial awareness across modern industrial ecosystems
- To explore the applications of IoT in promoting sustainable industrial growth through improved operational efficiency, resource optimization, and intelligent decision-making
- To identify the major technological, organizational, environmental, and managerial challenges associated with the adoption of IoT in industrial sectors
- To analyze the contribution of IoT-enabled technologies toward sustainable manufacturing, industrial innovation, and Industry 5.0 transformation
- To propose strategic recommendations and future directions for strengthening IoT adoption to achieve sustainable, resilient, and competitive industrial development

5. Review of Literature

The Internet of Things (IoT) has evolved into a fundamental enabler of intelligent industrial ecosystems by facilitating seamless communication between physical assets and digital platforms. Recent research emphasizes that IoT significantly improves industrial awareness through continuous monitoring, real-time data acquisition, and intelligent process optimization. These capabilities enable industries to monitor machine conditions, optimize production schedules, and reduce operational disruptions through predictive maintenance and automated decision-making. The review further highlights that IoT-based industrial intelligence contributes to enhanced operational transparency, productivity, and sustainable

resource utilization, making it an indispensable component of modern smart manufacturing systems (Ferrisi, 2025).

The relationship between IoT and sustainable industrial production has received increasing scholarly attention in recent years. Systematic evidence suggests that IoT technologies improve sustainability by optimizing energy consumption, reducing material waste, enhancing production flexibility, and strengthening environmental monitoring throughout manufacturing processes. Real-time data generated through interconnected devices enables industries to improve resource efficiency while supporting environmentally responsible production practices. These findings indicate that IoT serves as a strategic technological infrastructure for integrating sustainability objectives with industrial competitiveness and operational excellence (Martínez et al., 2026).

Contemporary studies have also examined IoT within the broader framework of Industry 4.0 and Industry 5.0, emphasizing its role in facilitating intelligent, resilient, and human-centric manufacturing systems. Researchers argue that IoT enables seamless integration of cyber-physical systems, artificial intelligence, cloud computing, and advanced analytics, thereby improving organizational responsiveness and industrial adaptability. IoT supports collaborative human-machine interaction, decentralized production control, and intelligent automation, which collectively contribute to resilient industrial ecosystems capable of addressing rapidly changing market conditions and sustainability requirements (Zhao et al., 2025).

Researchers have equally acknowledged that successful IoT implementation extends beyond technological deployment and requires addressing several organizational and managerial challenges. Studies identify cybersecurity vulnerabilities, data interoperability, workforce capability gaps, digital governance, and organizational readiness as major determinants of IoT adoption success. The literature suggests that industries achieving sustainable digital transformation are those that effectively integrate IoT technologies with organizational strategy, employee competence, innovation capability, and responsible governance mechanisms. Such integration ensures that technological investments generate measurable improvements in industrial sustainability and organizational performance (Soori et al., 2025).

Despite the rapid expansion of IoT research, the literature remains fragmented regarding the mechanisms through which IoT enhances industrial awareness and contributes to sustainable industrial growth. Recent systematic reviews indicate that although IoT consistently improves operational efficiency, predictive maintenance, and resource optimization, greater emphasis is required on integrating social sustainability, workforce development, digital resilience, and human-centric industrial innovation into future research frameworks. The scholars recommend developing comprehensive models that simultaneously evaluate technological, organizational, environmental, and strategic dimensions of IoT adoption to maximize sustainable industrial outcomes (Román-Salinas et al., 2026).

6. Discussion and Analysis

The review demonstrates that the Internet of Things (IoT) has evolved beyond a connectivity platform into a strategic enabler of sustainable industrial transformation. IoT-enabled industries continuously collect and analyze real-time operational data, allowing organizations to improve production planning, predictive maintenance, quality assurance, and resource utilization. The integration of IoT with artificial intelligence, cloud computing, and advanced analytics has enhanced industrial awareness by enabling

faster, more accurate and evidence-based decision-making. These capabilities not only improve operational efficiency but also support environmental sustainability through reduced energy consumption, optimized material usage, and minimized industrial waste. IoT has become a fundamental technology for achieving intelligent, resilient, and sustainable industrial ecosystems aligned with Industry 5.0 objectives (Díaz-Martínez et al., 2026). The analysis further indicates that although IoT adoption offers substantial industrial benefits, its successful implementation depends upon overcoming several technological and organizational barriers. Industries continue to encounter cybersecurity threats, interoperability challenges, data privacy concerns, infrastructure complexity, and integration issues with legacy manufacturing systems. Furthermore, organizational readiness, workforce digital competencies, effective governance, and leadership commitment significantly influence the success of IoT-enabled transformation initiatives. The sustainable industrial growth requires organizations to adopt comprehensive implementation strategies that integrate technological innovation with human-centric management practices, regulatory compliance, and continuous organizational learning. Such an integrated approach enhances industrial resilience while ensuring responsible and secure deployment of IoT technologies across complex manufacturing environments (Rejeb et al., 2025).

IoT is expected to play an increasingly important role in supporting sustainable industrial growth through intelligent automation, circular economy practices, predictive analytics, and carbon-efficient manufacturing. The convergence of IoT with emerging technologies such as digital twins, generative artificial intelligence, blockchain, and edge computing will enable industries to create autonomous, adaptive, and environmentally responsible production systems. These developments will strengthen industrial awareness by providing real-time visibility into environmental performance, operational risks, and resource optimization while facilitating compliance with global sustainability standards. The organizations that strategically integrate IoT with sustainability-oriented business models and digital governance frameworks will be better positioned to achieve long-term competitiveness, innovation, and resilient industrial development in the evolving digital economy (Martínez et al., 2026).

7. Findings of Study

- The present study finds that the Internet of Things (IoT) has become a pivotal technology for enhancing industrial awareness by enabling real-time monitoring, intelligent connectivity, and data-driven decision-making across industrial operations. IoT-enabled systems provide continuous visibility into production processes, equipment performance, energy utilization, inventory movement, and workplace conditions, allowing organizations to identify operational inefficiencies and respond proactively to emerging challenges. The integration of IoT with Artificial Intelligence (AI), cloud computing, edge computing, and advanced analytics further strengthens industrial intelligence by facilitating predictive maintenance, process optimization, and evidence-based managerial decisions. IoT significantly improves productivity, operational efficiency, product quality, and organizational responsiveness while supporting digital transformation initiatives aligned with Industry 4.0 and Industry 5.0.
- The study further reveals that IoT plays a vital role in promoting sustainable industrial growth by enabling efficient resource management, minimizing waste generation, reducing energy consumption, and improving environmental performance. Smart industrial ecosystems supported by IoT facilitate intelligent monitoring of emissions, water usage, carbon footprints, and supply chain operations, thereby assisting organizations in achieving sustainability objectives and regulatory compliance. The findings indicate that IoT not only contributes to economic performance through enhanced operational efficiency and cost optimization but also strengthens environmental sustainability and social responsibility. IoT serves as an important catalyst for

achieving sustainable manufacturing practices, circular economy initiatives, and long-term industrial resilience.

- Despite its substantial benefits, the study identifies several critical challenges that influence the successful adoption of IoT within industrial environments. Cybersecurity vulnerabilities, data privacy concerns, interoperability among heterogeneous devices, infrastructure complexity, high implementation costs, and integration with legacy information systems remain major technological barriers. Additionally, organizational issues such as inadequate digital competencies, resistance to technological change, insufficient governance mechanisms, and limited strategic leadership often restrict effective implementation. Therefore, the study concludes that sustainable industrial growth through IoT requires an integrated approach combining advanced technological infrastructure with organizational readiness, workforce capability development, robust cybersecurity frameworks, and supportive public policies. Such a holistic strategy will enable industries to maximize the benefits of IoT while fostering innovation, competitiveness, and sustainable economic development.

8. Conclusion

The Internet of Things (IoT) has emerged as a transformative technology that is fundamentally reshaping industrial operations by enhancing awareness, connectivity, and intelligent decision-making. This study demonstrates that IoT plays a significant role in promoting sustainable industrial growth through real-time monitoring, predictive analytics, smart automation, and efficient resource management. By integrating IoT with advanced digital technologies such as Artificial Intelligence (AI), cloud computing, edge computing, and big data analytics, industries can improve operational efficiency, reduce production costs, optimize energy utilization, and strengthen environmental sustainability. IoT-enabled industrial ecosystems support evidence-based managerial decisions, enhance organizational resilience, and facilitate the transition toward Industry 4.0 and Industry 5.0, where innovation, sustainability, and human-centric manufacturing become key drivers of industrial competitiveness.

The realization of IoT's full potential requires organizations to address several technological, organizational, and governance-related challenges. Cybersecurity risks, data privacy concerns, interoperability issues, infrastructure investment, digital skill shortages, and resistance to organizational change remain critical barriers that demand strategic attention. Therefore, industries should adopt comprehensive digital transformation strategies that combine technological innovation with effective governance, workforce development, policy support, and sustainable business practices. Future advancements in Generative Artificial Intelligence, digital twins, blockchain, 6G communication, and edge intelligence are expected to further enhance IoT capabilities, creating more intelligent, resilient, and environmentally responsible industrial ecosystems. The strategic adoption of IoT will remain instrumental in achieving sustainable industrial growth, fostering innovation, and strengthening global industrial competitiveness in the rapidly evolving digital economy.

References

- Ahmed, S., et al. (2025). From Industry 4.0 to 5.0: Leveraging AI and IoT for sustainable industrial transformation. *International Journal of Industrial Engineering and Operations Management*. <https://doi.org/10.1108/IJIEOM-04-2025-0070>
- Bhat, F. A., et al. (2024). Emerging challenges in the sustainable manufacturing system: Transition from Industry 4.0 to Industry 5.0. *Global Journal of Flexible Systems Management*. <https://doi.org/10.1007/s40032-024-01046-y>

- Díaz-Martínez, M. A., Román-Salinas, R. V., Fuentes-Rubio, Y. A., Morales-Rodríguez, M. A., Cervantes-Zubirias, G., & Rivera-García, G. E. (2026). IoT-driven pathways toward corporate sustainability in Industry 4.0 ecosystems: A systematic review. *Sustainability*, 18(2), 1052. <https://doi.org/10.3390/su18021052>
- Ferrisi, S. (2025). Sustainability awareness in manufacturing: A review of IoT audio sensor applications in the Industry 5.0 era. *Sensors*, 25(10), 3041. <https://doi.org/10.3390/s25103041>
- Gaikwad, S. R. (2016). Linking entrepreneurship to education for futuristic India. *International Journal of Economics and Commerce*, 2(3), 87–90. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=KufjkiwAAAAJ&sortby=pubdate&authuser=1&citation_for_view=KufjkiwAAAAJ:d1gkVwhDpl0C
- Ghobakhloo, M. (2024). A roadmap toward human-centric, sustainable, and resilient Industry 5.0. *Information Systems Frontiers*. <https://doi.org/10.1007/s10796-024-10476-z>
- Hammad, M. Y., Rahamaddulla, S. R., Tamyez, P. F. M., & Fauzi, M. A. (2025). From Industry 4.0 to 5.0: Leveraging AI and IoT for sustainable and human-centric operations. *International Journal of Industrial Engineering and Operations Management*.
- Islam, M. T., et al. (2025). A review of the Industry 4.0 to 5.0 transition. *Machines*, 13(4), 267. <https://doi.org/10.3390/machines13040267>
- Martínez, M. A. D., Fuentes-Rubio, Y. A., Román-Salinas, R. V., Grande-Ramírez, J. R., & Delgado-Macié, J. (2026). A systematic review of Industry 5.0 and sustainability in manufacturing: Clustering of concepts, characteristics, and technological enablers. *Discover Sustainability*, 7(1). <https://doi.org/10.1007/s43621-025-02453-6>
- Martínez, M. A. D., Román-Salinas, R. V., Fuentes-Rubio, Y. A., et al. (2026). The impact of the Internet of Things on corporate sustainability strategies: A systematic literature review. *Results in Engineering*. <https://doi.org/10.1016/j.rineng.2026.105345>
- Mu, X., et al. (2024). The applications of Internet of Things (IoT) in industrial management: A science mapping review. *International Journal of Production Research*. <https://doi.org/10.1080/00207543.2023.2290229>
- Rame, R. (2024). Industry 5.0 and sustainability: An overview of emerging trends. *Intelligent Green Technologies and Applications*, 3(4), 100050. <https://doi.org/10.1016/j.ingrde.2024.100050>
- Rejeb, A., Rejeb, K., Treiblmaier, H., Zailani, S., & Iranmanesh, M. (2025). Industry 5.0 and sustainable industrial transformation: A systematic review of digital technologies, resilience, and circular economy. *Discover Sustainability*. <https://doi.org/10.1007/s43621-025-01166-0>
- Román-Salinas, R. V., Díaz-Martínez, M. A., Fuentes-Rubio, Y. A., et al. (2026). IoT-enabled sustainability in production systems: A systematic review of Industry 4.0 mechanisms and the transition toward human-centric manufacturing. *Preprints*.
- Soori, M., Arezoo, B., & Dastres, R. (2025). Sustainable manufacturing in Industry 4.0 by artificial intelligence and Internet of Things: A review. *Review manuscript*.
- Zhao, W., Li, Y., & colleagues. (2025). How are Industry 4.0 technologies transforming a sustainable future? A systematic review. *Digital Transformation and Society*. <https://doi.org/10.1108/DTS-11-2024-0225>