Trending: Jurnal Ekonomi, Akuntansi dan Manajemen
Volume 4, Nomor 3, Juli 2026
e-ISSN: 2962-083X; p-ISSN: 2964-531X, Hal. 597-609
DOI: https://doi.org/10.30640/trending.v4i3.7273
Tersedia: https://jurnaluniv45sby.ac.id/index.php/Trending

Sustainable Development in the Digital Era: the Role Artifical Intelligence and the Internet of Things in Suporting the Green Economy

Adira Devina Mahmudi[1*], Alvina Safitri[2], Mila Hariani[3]
[1-3] Management Study Program, University of Sunan Giri Surabaya, Indonesia
Email: devinamahmudi.unsuri@gmail.com [1], alvinasafitri.unsuri@gmail.com [2], milamasroni@gmail.com [3]
**Penulis Korespondensi: devinamahmudi.unsuri@gmail.com*

Abstract*. Sustainable development has become a global priority in addressing environmental challenges while maintaining economic growth and social welfare. In the digital era, Artificial Intelligence (AI) and the Internet of Things (IoT) have emerged as key technologies that support the implementation of a green economy through efficient and data-driven resource management. This study aims to analyze the role of AI and IoT in supporting sustainable development, examine their contribution to improving resource efficiency, and identify the challenges associated with their implementation. The study employs a conceptual research method with a qualitative approach based on a literature review of recent scientific journals, books, and other relevant academic publications. The findings indicate that AI enhances decision-making, optimizes resource utilization, and reduces operational waste, while IoT enables real-time monitoring and automated management across various sectors. The integration of AI and IoT creates intelligent systems that improve energy efficiency, support environmental management, and strengthen green economy practices. However, challenges such as digital infrastructure gaps, limited human resources, high implementation costs, and data security concerns remain. Therefore, collaboration among governments, industries, and educational institutions is essential to maximize the contribution of AI and IoT to sustainable development.*

Keywords*: Artificial Intelligence; Digital Transformation; Green Economy; Internet of Things; Sustainable Development.*

1. INTRODUCTION

Sustainable development has become an increasingly important development concept amid various global challenges, such as climate change, environmental degradation, and the limitation of natural resources. This concept emphasizes a balance between economic, social, and environmental aspects in the development process in order to create a more prosperous and sustainable life for society. Sustainable development does not only focus on economic growth, but also pays attention to environmental preservation and overall social welfare. Meeting the needs of the present generation without compromising the ability of future generations to meet their own needs is the main objective of sustainable development (Nasution et al., 2024). In the context of globalization and rapid technological advancement, efforts to achieve sustainable development require innovative, adaptive, and integrated approaches across various sectors. Collaboration among governments, businesses, communities, and educational institutions is an important factor in creating effective solutions to various development problems. In addition, the utilization of digital technology, increased public awareness, and the implementation of environmentally friendly policies are strategic steps in supporting the achievement of sustainable development in the future.

Naskah Masuk: 22 April 2026; Revisi: 20 Mei 2026; Diterima: 30 Juni 2026; Terbit: 13 Juli 2026

On the other hand, the development of the digital era has brought major changes to various aspects of human life, ranging from the economy, education, and social sectors to the environment. The growth of information and communication technology has enabled transformation in the way people work, interact, and make decisions. Technology increases productivity and offers new opportunities for resource management (Wati & Rajuddin, 2025). This development is marked by the increasingly widespread use of the internet, artificial intelligence, big data, the Internet of Things (IoT), and various digital platforms that help human activities become faster, more effective, and more efficient. In the business world, digital technology can improve operational efficiency and expand market access, while in the governmental sector technology can support transparency and more optimal public services. In addition, technology also plays a role in supporting environmental management through energy monitoring systems, waste reduction, and more measurable resource use. This makes technology an important component in supporting sustainable development. With the integration of technology into various sectors, many development challenges can be addressed through more innovative and adaptive approaches to changing times. Therefore, the digital era provides excellent opportunities to generate more creative and efficient solutions, thereby supporting sustainable development and improving people's quality of life as a whole.

Green economy has emerged as an approach designed to integrate economic growth with environmental preservation. This concept arose as a response to various global problems, such as environmental pollution, climate change, excessive exploitation of natural resources, and increasing human demand for energy and production materials. The green economy emphasizes the importance of economic development that is not solely profit-oriented, but also considers environmental sustainability and long-term social welfare. This concept highlights the importance of using resources efficiently and reducing negative environmental impacts. The green economy also encourages the use of environmentally friendly technology and sustainable business practices (Bukran & Ramdani, 2024). In its implementation, the green economy promotes the utilization of renewable energy, reduction of carbon emissions, better waste management, and efficient use of natural resources in various economic activities. In addition, the implementation of a green economy can create new opportunities for environmentally oriented employment and improve economic competitiveness sustainably. In practice, the green economy covers various sectors, including energy, agriculture, and industry, all of which play important roles in maintaining a balance between economic growth and environmental preservation. Therefore, the green economy is an essential part of achieving

sustainable development, as it encourages the creation of a more environmentally friendly, efficient, and future-oriented development system.

Along with technological advancement, Artificial Intelligence (AI) and the Internet of Things (IoT) have emerged as major innovations in the digital era that significantly influence various sectors of life. The development of these two technologies has encouraged transformation in the way humans manage information, operate systems, and improve efficiency in various economic and social activities. AI is capable of processing and analyzing large amounts of data to support better decision-making. AI technology can be used to predict energy consumption patterns, optimize production processes, improve operational efficiency, and support more accurate and faster environmental management. Meanwhile, IoT enables various devices to connect and exchange data in real time. Through sensors and internet networks, IoT can monitor environmental conditions, energy usage, transportation systems, and industrial activities automatically and continuously. Both technologies have great potential in improving resource efficiency (Zakiansyah & Sutabri, 2025). The integration of AI and IoT also enables the creation of smarter systems to reduce energy waste, minimize carbon emissions, and improve the effectiveness of natural resource management. In the industrial sector, the implementation of these technologies can help create more energy-efficient and environmentally friendly production processes, while in agriculture AI and IoT can be used to monitor soil conditions, humidity, and plant needs more precisely. Thus, AI and IoT can significantly contribute to supporting the green economy, as both technologies are capable of creating innovative, efficient, adaptive, and sustainable solutions to address various development challenges in the modern era.

The utilization of AI and IoT in various sectors has demonstrated positive impacts on efficiency and sustainability in both economic activities and environmental management. The presence of these digital technologies helps various sectors operate more effectively, save resources, and reduce negative environmental impacts. These technologies can help the energy sector reduce waste and optimize electricity usage through automated monitoring systems and real-time data analysis. With the help of AI, energy consumption can be predicted and regulated according to demand, making electricity use more efficient. Meanwhile, IoT enables devices within energy systems to connect and monitor energy distribution and consumption more accurately. In agriculture, AI and IoT support increased productivity while reducing the use of water and fertilizers (Amelia et al., 2025). These technologies enable farmers to monitor soil conditions, humidity, weather, and crop needs more precisely so that resource use becomes more optimal and environmentally friendly. In addition, in waste management, these

technologies can improve the effectiveness of recycling systems through more automated and efficient monitoring, sorting, and waste management processes. Environmental management strategies supported by technological innovation and efficient resource utilization are important steps in supporting environmental sustainability and more sustainable development (Sharma, 2025). This demonstrates that digital technology has a strategic role in supporting green economy practices, as it can create innovations that not only improve productivity but also maintain a balance between economic growth and environmental preservation.

However, the implementation of AI and IoT in sustainable development also faces various challenges. The digital divide remains an obstacle in several regions, especially in developing countries. In addition, human resources capable of managing these technologies are still needed. The use of digital technology also raises concerns regarding data security and privacy (Manurung et al., 2023). Therefore, appropriate policies and strategies are needed to optimize the utilization of these technologies. Based on the explanation above, it can be seen that the integration of digital technology and the green economy is highly important in supporting sustainable development. AI and IoT have great potential to improve the efficiency and effectiveness of resource management when utilized properly.

2. LITERATURE REVIEW

Main Theories

Sustainable Development and Green Economy

Sustainable development is a development concept that aims to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. This concept emphasizes a balance between economic, social, and environmental aspects in every development activity (Wulan, 2025). In its development, the green economy has emerged as an approach that supports sustainable development by emphasizing the efficient use of resources and the reduction of environmental impacts. The green economy also encourages more responsible production and consumption practices. Thus, the green economy has become an important part of efforts to achieve sustainable development in the modern era.

Artificial Intelligence (AI)

Artificial Intelligence (AI) is a technology that enables machines or computer systems to imitate human thinking and decision-making abilities. AI works by processing large amounts of data to produce more accurate and efficient information. In the context of the green economy, AI can be used to optimize energy consumption, predict environmental conditions, and improve the efficiency of production processes (Auliasari et al., 2025). The implementation

of AI also helps manage resources more accurately and systematically. Therefore, AI plays an important role in supporting sustainable development practices.

Internet of Things (IoT)

The Internet of Things (IoT) is a technology that connects various devices through internet networks so they can exchange data in real time. IoT utilizes sensors and communication systems to monitor and control various activities automatically. In the green economy, IoT plays a role in improving the efficiency of resource use, such as water, energy, and raw materials (Maharany et al., 2024). Examples include the use of sensors in smart irrigation systems or electricity consumption monitoring. Thus, IoT helps create more efficient and environmentally friendly systems.

Integration of AI and IoT

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) provides a major contribution to supporting the green economy (Wiradinata & Malik, 2024). IoT functions as a data collector through various sensors, while AI plays a role in analyzing the data to produce optimal decisions. The collaboration between these two technologies enables the creation of smarter and more efficient systems in resource management. Examples can be seen in smart cities, smart farming, and digital-based energy management systems. Therefore, the integration of AI and IoT has become one of the innovative solutions in realizing sustainable development in the digital era.

Previous Studies

Several previous studies indicate that digital technology plays a significant role in supporting the green economy:

a. Research by the International Energy Agency (2020) states that digitalization, including AI and IoT, has the potential to reduce global carbon emissions by up to 15% through energy efficiency.
b. A study by OECD (2019) shows that AI can improve energy-use efficiency and support data-driven decision-making in the industrial sector.
c. Research by Atzori *et al*. (2010) explains that IoT is capable of improving operational efficiency through real-time monitoring systems.
d. Jabareen (2009), in his study on conceptual methods, emphasized the importance of developing a theoretical framework to understand the relationships among concepts in qualitative research.

From these studies, it can be concluded that AI and IoT have significant contributions in improving resource efficiency and supporting environmental sustainability.

Conceptual Framework

The conceptual framework of this study is based on the development of the digital era, which has encouraged the emergence of various technological innovations, particularly Artificial Intelligence (AI) and the Internet of Things (IoT). The development of these technologies provides great opportunities to improve efficiency and effectiveness in various sectors of life, including the management of natural resources and the environment. The digital era has brought major changes in the way humans work, communicate, and manage activities related to economic and environmental needs. Advances in digital technology enable many processes that were previously carried out manually to become more automated, faster, and integrated. In the context of resource and environmental management, the use of modern technology has become very important in helping to address various problems such as energy waste, high production waste, and the suboptimal management of data and information. AI plays a role in processing, analyzing, and predicting large amounts of data so that decision-making processes can become faster, more precise, and more accurate. AI technology is also capable of providing recommendations based on data analysis results, thereby helping to improve operational efficiency and reduce the risk of human error. Meanwhile, IoT enables various digital devices to connect with one another to collect and transmit data in real time, allowing monitoring and control processes to be carried out more optimally (Nurani et al., 2025). IoT technology also supports the creation of automatic monitoring systems that can be used in energy management, water usage, and continuous environmental monitoring. The combination of AI and IoT creates a smarter, more adaptive, and integrated working system because the data obtained from IoT devices can be processed by AI to produce more accurate and useful information. Through the utilization of these two technologies, resource use can become more economical and efficient, waste can be minimized, and productivity in resource and environmental management can increase sustainably. In addition, the implementation of AI and IoT also provides opportunities for companies and governments to create new innovations that support work efficiency, reduce environmental impacts, and establish more modern and sustainable development systems in the digital era.

Efficiency in resource utilization resulting from the use of AI and IoT has become one of the main principles of the green economy. The green economy emphasizes the importance of efficient resource use, emission reduction, and the implementation of environmentally friendly technologies (Judijanto & Al-Amin, 2024). The concept of the green economy does not only focus on increasing economic growth, but also pays attention to the balance between economic, social, and environmental aspects so that development can proceed sustainably. In

its implementation, the use of digital technologies such as AI and IoT can help companies and governments manage energy, water, and other resources more effectively and in a controlled manner. AI can be used to analyze resource usage patterns in order to identify more economical and efficient solutions, while IoT enables environmental monitoring processes to be carried out in real time through interconnected sensors and devices. In addition, the use of digital technology can help reduce production waste, suppress pollution levels, and improve operational efficiency across various industrial sectors. Increased attention to environmental sustainability, efforts to combat global warming, and the drive to achieve climate neutrality are also increasingly encouraging companies to reorganize their supply chains and production activities to become more efficient and environmentally friendly (Barbaglia et al., 2023). With more automated and data-based systems, decision-making processes related to environmental management can be carried out more quickly, accurately, and effectively. Digital technology also provides convenience in evaluating resource use so that sustainability targets can be achieved more optimally. With the support of digital technology, the implementation of the green economy can be carried out more optimally and measurably. This shows that digital technology has a strategic role in supporting sustainable economic practices while also becoming an innovative solution in addressing various environmental challenges in the modern era.

Ultimately, the implementation of a green economy supported by AI and IoT technologies is expected to make a major contribution to achieving sustainable development. Sustainable development emphasizes the importance of balancing economic growth, environmental preservation, and social welfare (Putri & Sari, 2024). This concept underlines that meeting the needs of the present generation must still consider the sustainability of natural resources for future generations. In this context, the utilization of AI and IoT technologies can become one of the innovative solutions to support the creation of more effective, modern, and environmentally friendly development. AI has the ability to process and analyze large amounts of data, thereby supporting decision-making processes and the formulation of more appropriate policies related to environmental management and resource utilization. On the other hand, IoT enables real-time environmental monitoring through interconnected devices, allowing various problems to be identified and addressed more quickly and accurately. In addition, the integration of digital technology also plays a role in improving energy efficiency, reducing waste, and encouraging more optimal resource use in various sectors, such as industry, agriculture, transportation, and urban management. The implementation of a green economy based on digital technology can also create new economic opportunities, improve social

welfare, and encourage economic activities that are more oriented toward sustainability principles. Therefore, the synergy between digital technology and the green economy has become an important factor in supporting the achievement of sustainable development goals in the modern era. This conceptual framework demonstrates the close relationship between technological development, the implementation of the green economy, and sustainable development, in which technological advancement acts as the main support in creating a more innovative, efficient, and sustainable development system.

3. RESEARCH METHOD

Type and Research Approach

This study employs a conceptual method with a qualitative approach. The conceptual method was chosen because it aims to examine and analyze the relationship between Artificial Intelligence (AI), the Internet of Things (IoT), the green economy, and sustainable development based on theories and findings from previous studies (Waruwu, 2024). The qualitative approach is used to understand phenomena comprehensively through the interpretation of various literature sources. This study focuses on developing conceptual understanding rather than using direct empirical data. Therefore, this research emphasizes systematic and comprehensive theoretical analysis.

Data Sources

The data used in this study are secondary data obtained from various sources such as journal articles, conference proceedings, reference books, and recent scientific publications listed in the bibliography (Hayyan et al., 2025). The selection of sources was based on their relevance to the topics of Artificial Intelligence, the Internet of Things, the green economy, and sustainable development. This aims to ensure that the data used are valid and up to date.

Data Collection Techniques

The data collection technique in this study was conducted through a literature review method. This method was carried out by searching for, collecting, and analyzing various scientific sources relevant to the research topic (Fatimah et al., 2025). The process included searching for journals through scientific databases, reference books, and other publications. The collected data were then selected and classified according to the research needs. Through this technique, the researcher was able to obtain comprehensive information related to the concepts and theories used in the study.

Data Analysis Techniques

The data analysis techniques used in this study were qualitative descriptive analysis and content analysis. Descriptive analysis was used to explain the concepts of Artificial Intelligence, the Internet of Things, the green economy, and sustainable development systematically. Meanwhile, content analysis was conducted by examining and interpreting the contents of various collected literature sources. The analysis process was carried out by identifying patterns, relationships, and interconnections among concepts. The results of the analysis were then systematically organized to answer the research questions.

4. RESULTS AND DISCUSSION

The literature review indicates that Artificial Intelligence (AI) plays a strategic role in supporting the green economy by improving efficiency, accuracy, and decision-making in resource management. AI processes large volumes of data to optimize resource allocation, reduce waste, and enhance operational performance (Hong & Xiao, 2024). Its implementation can be observed in smart grid systems that optimize electricity distribution based on real-time consumption patterns, industrial production processes that minimize material waste, and precision agriculture that optimizes water and fertilizer use according to land and weather conditions (Setiawan et al., 2025). Complementing AI, the Internet of Things (IoT) provides accurate real-time information through interconnected sensors and devices, enabling continuous monitoring of energy consumption, predictive maintenance, smart irrigation, and environmental quality management (Udeh et al., 2024; Anggraini et al., 2025). Together, these technologies establish a more efficient and sustainable resource management system that supports environmentally responsible economic activities.

The findings further demonstrate that the integration of AI and IoT generates greater benefits than the application of either technology independently. IoT continuously collects real-time data, while AI analyzes these data to produce intelligent and timely decisions. This synergy creates adaptive systems capable of improving efficiency, responsiveness, and sustainability in various sectors, including smart cities, smart agriculture, and smart industries (Zakiansyah & Sutabri, 2025). The implementation of these technologies contributes to higher resource efficiency, reduced carbon emissions, and enhanced innovation across multiple economic sectors (Juanda et al., 2025). However, maximizing these benefits requires technological readiness, effective organizational strategies, leadership support, and continuous human resource development (Vong et al., 2025).

Despite these advantages, several challenges continue to hinder the implementation of AI and IoT in sustainable development. The digital divide remains a major obstacle, particularly in developing countries where technological infrastructure is still limited. In addition, the shortage of skilled human resources, high investment costs, and concerns regarding cybersecurity, data privacy, transparency, and accountability in AI-based decision-making reduce the effectiveness of technology adoption (Khaidar & Fikry, 2025). These findings indicate that technological innovation alone is insufficient to achieve sustainable development unless supported by adequate infrastructure, regulatory frameworks, and human capital development.

The discussion also highlights that the integration of AI and IoT extends beyond operational efficiency by contributing to broader environmental, academic, and practical outcomes. The application of these technologies improves energy efficiency, minimizes resource waste, reduces carbon emissions, and supports more sustainable environmental management (Lamas et al., 2021). From an academic perspective, this study enriches the literature on the relationship between digital transformation, the green economy, and sustainable development by emphasizing that digital technologies function not only as productivity-enhancing tools but also as innovative solutions for addressing environmental issues such as pollution, waste management, and inefficient resource utilization (Ningsih, 2025). Consequently, this conceptual study provides a foundation for future research on AI and IoT implementation across sectors including industry, agriculture, transportation, energy, and urban management.

From a policy perspective, these findings underline the important role of governments, businesses, educational institutions, and society in accelerating the adoption of AI and IoT for sustainable development. Governments are expected to establish supportive regulations, expand digital infrastructure, strengthen data security, and provide incentives for environmentally friendly technological innovation (Wiradinata & Malik, 2024). Simultaneously, improving digital competencies through education and professional training is essential to ensure successful technology adoption. For businesses, particularly small and medium-sized enterprises, AI and IoT adoption represents a strategic opportunity to improve operational efficiency, reduce production costs, and enhance long-term competitiveness. Collaborative efforts among stakeholders are therefore essential to maximize the benefits of digital transformation within the green economy.

Finally, the findings demonstrate that AI and IoT significantly contribute to achieving the Sustainable Development Goals (SDGs), particularly those related to affordable and clean energy, industry, innovation and infrastructure, responsible consumption and production, and climate action. Digital technologies such as IoT-enabled monitoring systems and AI-driven analytics improve energy distribution, optimize industrial production, strengthen environmental monitoring, and promote the sustainable use of natural resources (Singh et al., 2022). Furthermore, the implementation of AI and IoT creates new opportunities for innovation-oriented employment while supporting inclusive and environmentally responsible economic growth. Overall, the integration of AI and IoT represents a strategic pathway toward a more efficient, adaptive, and sustainable development model that aligns with green economy principles and global sustainability objectives.

5. CONCLUSION AND SUGGESTIONS

Based on the results of the study, it can be concluded that Artificial Intelligence (AI) and the Internet of Things (IoT) play strategic roles in supporting sustainable development through the development of the green economy. AI contributes to improving efficiency and accuracy in decision-making through data analysis and resource demand prediction, while IoT plays a role in providing real-time data that supports transparency and efficiency in resource management. The integration of AI and IoT creates intelligent systems capable of improving the effectiveness of energy, agriculture, industrial, and environmental management in a sustainable manner. However, the implementation of these two technologies still faces various challenges, such as unequal access to technology, limited human resources, high investment costs, and data security risks. Therefore, comprehensive efforts are required to optimize the utilization of digital technologies in supporting the green economy and sustainable development.

The active role of governments is necessary in formulating policies that support the development and implementation of AI and IoT technologies within the green economy, including through the provision of adequate digital infrastructure and incentives for industrial sectors that adopt environmentally friendly technologies. In addition, improving human resource capacity through education and training in digital technology is an important aspect in supporting optimal implementation. For business actors, especially Micro, Small, and Medium Enterprises (MSMEs), gradual adaptation to digital technology is necessary to improve efficiency and competitiveness. Future studies are recommended to use empirical approaches in order to directly measure the impact of AI and IoT implementation on

sustainable development across various sectors, thereby providing more comprehensive and applicable results.

DAFTAR REFERENSI

Amelia, P., Diningsih, H., Nurmaelani, S., Nurhaeni, S., Jumiyati, & Budiawati, Y. (2025). Artifical Intelligence untuk Optimasi Efisiensi dan Produktivitas Hasil Pertanian. *Jurnal Ilmu Pertanian Tirtayasa*, *7*(1), 461–474.

Anggraini, L., Zahara, M. L., Sonadinata, H., Zaki, S., Budiawati, Y., Agribisnis, J., Pertanian, F., Sultan, U., & Tirtayasa, A. (2025). Literature Review: Analisis Implementasi IoT pada Sistem Irigasi Cardas untuk Efisiensi Penggunaan Air. *Integrative Perspectives of Social and Science Journal (IPSSJ)*, *2*(3), 3601–3611.

Auliasari, P. A., Astuti, E., Jamilatun, S., Rhomadoni, F. R., Setya, B., & Febriani, A. V. (2025). Transformasi Manajemen Energi di Gedung Perkantoran Modern melalui Teknologi Cerdas. *Semnastek*, 1–10.

Barbaglia, M., Bianchini, R., Buttic, V., Elia, S., & Mariani, M. M. (2023). The role of environmental sustainability in the relocation choices of MNEs : Back to the home country or welcome in a new host country ? *Journal of International Manajement*, *29*(5), 1–21. https://doi.org/10.1016/j.intman.2023.101059

Bukran, & Ramdani, R. (2024). *Pengaruh Kebijakan Ekonomi Hijau terhadap Inovasi Bisnis Berkelanjutan di Sektor Manufaktur*. *1*(3), 35–42.

Fatimah, S., Zen, N. H., & Fitrisia, A. (2025). Literatur Riview dan Metodologi Ilmu Pengetahuan Khusus. *Innovative: Journal of Social Science Reaserch*, *5*(1), 41–48.

Hayyan, M. Al, Nuryana, T., Azzam, A. Z., & Prayoga, Y. (2025). Peran Kecerdasan Buatan (Artificial Intelligence / AI) dalam Pengembangan Produk Ramah Lingkungan. *Jurnal Teknologi Dan Sains Moderen*, *2*(6), 263–271.

Hong, Z., & Xiao, K. (2024). Digital economy structuring for sustainable development : the role of blockchain and artificial intelligence in improving supply chain and reducing negative environmental impacts. *Scientific Reports*, *14*(3912), 1–12. https://doi.org/10.1038/s41598-024-53760-3

Juanda, A., Rozaki, Z., Wulandari, R., & Ikbar, R. (2025). Ekonomi Hijau di Era Digital. *E-Prosiding UMY*, 205–209.

Judijanto, L., & Al-Amin. (2024). Penerapan Ekonomi Hijau dalam Pembangunan Berkelanjutan: Analisis Literatur Teritis dan Empiris. *Journal of Community Dedication*, *3*(4), 52–60.

Khaidar, A.-, & Fikry, M. (2025). Pengaruh Teknologi Internet of Things Terhadap Manajemen Aset Digital Secara Real-Time. *Jurnal Teknik Informatika*, *17*(2), 84–90.

Lamas, P. F., Lopes, S. I., & Carames, T. M. F. (2021). Green IoT and edge AI as key technological enablers for a sustainable digital transition towards a smart circular economy. *Sensors*, *21*(17), 1–36.

Maharany, S., Perangin, T. B., Anggraeni, A. S., & Wantira, A. D. (2024). Implementasi Green Logistics di Era Society 5.0 dalam Mendukung Ekonomi Hijau dan Pembangunan Berkelanjutan. *Snast*, 105–111.

Manurung, J., Sihombing, A. P., Emas, & Pandiangan, B. (2023). Sosialisasi Dan Edukasi Tentang Keamanan Data Dan Privasi Di Era Digital Untuk Meningkatkan Kesadaran Dan Perlindungan Masyarakat. *Jurnal Pengabdian Masyarakat Nauli*, *2*(1), 1–7.

Nasution, A. M., Ulfa, N., & Harahap, N. (2024). Strategi Perencanaan Pembangunan Berkelanjutan. *Trending: Jurnal Akuntansi*, *2*(1), 208–216.

Ningsih, P. S. (2025). Peran smart farming, IoT, dan pertanian presisi dalam mewujudkan ketahanan pangan berkelanjutan. *Interface: Journal of Multidiciplinary*, *1*(1), 22–36.

Nurani, A., Nabila, H. T., Azza, & Herlambang, I. B. (2025). Peran Artifical Intelligence dalam Sistem Iot untuk Pertanian Cerdas: Sistematic Literatur Review. *JATI Jurnal Mahasiswa Teknik Informatika*, *9*(1), 1446–1455.

Putri, A., & Sari, N. (2024). Pembangunan Ekonomi Syariah : Peran Pembangunan Berkelanjutan Berbasis Ekonomi Hijau. *Religion: Jurnal Agama, Sosial, Dan Budaya*, *3*(2), 401–408.

Setiawan, P. A. C., Indra, N. E., & Sukadarmika, G. (2025). Pertanian Vertikal Pintar : Peran IoT dalam Mewujudkan Keberlanjutan dan Efisiensi Sumber Daya. *Majalah Ilmiah Teknologi Elektro*, *24*(1), 23–34.

Sharma, R. R. (2025). Environmental strategic role orientations of multinational enterprises : Different shades of green. *Journal of International Management*, *31*(5), 1–14. https://doi.org/10.1016/j.intman.2025.101283

Singh, R., Akram, S. V., Gehlot, A., Buddhi, D., Priyadarshi, N., & Twala, B. (2022). Energy system 4.0: digitalization of the energy sector with inclination towards sustainability. *Sensors*, *22*(17), 1–34.

Udeh, E. O., Amajuoyi, P., Adeusi, K. B., & Scott, A. O. (2024). *The role of IoT in boosting supply chain transparency and efficiency*. *11*(01), 178–197.

Vong, K. C., Udomvitid, K., Ueki, Y., Intalar, N., Pongsathornwiwat, A., Pannakkong, W., Komolavanij, S., & Jeenanunta, C. (2025). *Strategic human resource development for industry 4 . 0 readiness : a sustainable transformation framework for emerging economies*. *17*(15), 1–35.

Waruwu, W. (2024). Metode Penelitian dan Pengembangan (R&D): Konsep, Jenis, Tahapan dan Kelebihan. *Jurnal Ilmiah Profesi Pendidikan*, *9*(2), 1220–1230.

Wati, K. L., & Rajuddin, O. W. N. (2025). Transformasi Digital dalam Manajemen Bisnis: Tantangan dan Peluang di Era Industri 4.0. *Jurnal Ekonomi Dan Bisnis STIE*, *5*(1), 206–213.

Wiradinata, M. A., & Malik, A. (2024). Inovasi dan Teknologi Untuk Mendukung Pembangunan Berkelanjutan di Era Digital Indonesia. *Jurnal Media Akademik*, *2*(12), 1–13.

Wulan, S. R. (2025). Konsep Keseimbangan (Mīzān) dalam Islam sebagai Dasar Pembangunan Berkelanjutan. *Socius: Jurnal Penelitian Ilmu-Ilmu Sosial*, *2*(6), 526–532.

Zakiansyah, M., & Sutabri, T. (2025). Integrasi Internet of Things (IoT) dan Kecerdasan Buatan (AI) untuk Smart City di Indonesia. *Jurnal Sains Student Reaserch*, *3*(2), 346–354.