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Circular Economy in Fashion: MIS-Driven Digital Product Passports for Apparel Traceability

Samsul Haque* S M Arif Al Sany** Mizanur Rahman***
*(Email: samsasif@gmail.com)
**(Management Information Systems (MIS), Lamar University, Beaumont, Texas, US
Email: alsany25@gmail.com)
***(Management Information Systems, Lamar University, Beaumont, Texas, US
Email: mizanurrahman.popon@gmail.com)

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Abstract:

The fashion industry faces increasing pressure to adopt sustainable and circular practices due to its significant environmental and social impact. A critical issue hindering progress is the lack of transparency and traceability in the lifecycle of apparel, which complicates efforts to reduce waste and promote responsible consumption. This paper explores the potential of Management Information Systems (MIS)-driven digital product passports (DPP) to improve apparel traceability within the framework of a circular economy. By leveraging digital technologies and data management systems, DPPs can enhance the monitoring of materials, product use, and end-of-life processing. This enables consumers, manufacturers, and recyclers to make informed and sustainable decisions. The paper investigates the design and implementation of a digital product passport for the fashion industry, focusing on its integration with existing supply chains. It also evaluates the role of DPPs in promoting circularity by increasing transparency and accountability across the value chain. The proposed solution aims to tackle both environmental and business challenges while fostering innovation in the sector. By offering detailed data on products' lifecycle stages, DPPs can facilitate better recycling, product reuse, and responsible consumption. Ultimately, this research presents a pathway for fashion companies to adopt circular practices that are both environmentally and economically sustainable.

Keywords — Circular Economy, Fashion Industry, Digital Product Passport, Apparel Traceability, Sustainable Fashion, Management Information Systems, Sustainability

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I. Introduction

The fashion industry, a significant contributor to global economic activity, is also one of the largest polluters in the world. From textile waste to water usage and carbon emissions, the industry's environmental footprint is immense. Despite growing awareness about sustainability, many fashion brands continue to operate under a linear model of production, where resources are used to create products that eventually end up in landfills. In contrast, the circular economy paradigm encourages a more sustainable, restorative model where products and materials are continuously reused, repaired, and recycled. To achieve this, fashion must rethink its approach to production, consumption, and disposal. One crucial aspect in promoting circularity within the fashion industry is improving product traceability, a challenge that the industry faces today due to its complex and opaque supply chains. The increasing demand for sustainable fashion practices has driven interest in solutions that can provide transparency, reduce waste, and encourage responsible consumption. Among these solutions, Digital Product Passports

(DPPs) are emerging as an innovative tool that can enable traceability by providing detailed, digital records of products, including information about materials, production processes, and sustainability impacts. This paper examines the role of DPPs, powered by Management Information Systems (MIS), in facilitating apparel traceability and advancing circular economy goals in fashion.

A. Background and Motivation

The fashion industry has long been associated with significant environmental and social issues, from high carbon emissions to labor exploitation. The traditional model of "take, make, dispose" contributes to an unsustainable cycle of resource depletion and waste generation. Given the urgency of these issues, there has been a growing recognition of the need for systemic change, and the circular economy has emerged as a promising model. The circular economy aims to create a closed-loop system where products and materials are continuously reused, refurbished, and recycled, minimizing waste and reducing the consumption of finite resources. In the context of fashion, this transformation involves not just recycling garments but rethinking the design, production, and consumption of clothing. Circular design strategies include creating durable, repairable, and recyclable products. However, implementing such strategies effectively requires reliable data on the materials used, the product's life cycle, and its end-of-life options. This is where Digital Product Passports (DPPs) can play a crucial role. DPPs provide a digital, accessible record of a garment's journey from design to disposal. By embedding key information such as raw material sourcing, manufacturing processes, and recycling guidelines, DPPs help close the loop in the circular economy. Despite the potential of DPPs, challenges remain in their adoption, including the need for industry-wide standardization and integration with existing supply chains. The fashion industry must overcome these barriers to ensure that DPPs can fulfill their promise of improving traceability and promoting sustainable practices.

B. Problem Statement

The fashion industry's reliance on a linear production model is a major factor contributing to environmental degradation. The industry consumes vast quantities of natural resources, generates enormous amounts of waste, and produces significant carbon emissions. While some progress has been made in promoting sustainable practices, a major obstacle remains: the lack of transparency and traceability in the lifecycle of fashion products. Without reliable information about the materials used, the manufacturing process, or the disposal options for garments, consumers, manufacturers, and recyclers cannot make informed decisions about product sustainability. As a result, there is a disconnect between the intentions of businesses aiming for sustainability and the actual practices on the ground. Consumers, who increasingly prioritize sustainability, are unable to verify the environmental claims made by brands. Additionally, recycling systems often lack the data necessary to properly process garments, leading to inefficiencies and increased waste. To bridge this gap, there is a need for a robust system that can provide clear, verifiable data on the sustainability of products throughout their lifecycle. Digital Product Passports, enabled by Management Information Systems (MIS), offer a potential solution. By collecting, storing, and sharing product data across the supply chain, DPPs can provide the transparency required for the successful implementation of circular economy principles in fashion.

C. Proposed Solution

This paper proposes the integration of Digital Product Passports (DPPs) into the fashion industry's supply chain to improve traceability and enable a more sustainable circular economy. A DPP is a digital record that contains detailed information about a product's materials, production methods, carbon footprint, and recycling options. By linking this information to each product, a DPP can ensure transparency and accountability, enabling all stakeholders, from consumers to recyclers, to make informed decisions. The use of Management Information Systems (MIS) in conjunction with DPPs can further enhance the traceability of products. MIS platforms can serve as centralized repositories for all product-related data, making it accessible in real-time to manufacturers, retailers, consumers, and recycling centers. These systems can help streamline the collection, verification, and

sharing of data, ensuring that the product's environmental impact is accurately recorded and that circular practices—such as recycling and reuse are effectively implemented. By embedding DPPs within existing supply chains and business models, the fashion industry can significantly reduce waste, improve resource efficiency, and foster more sustainable consumption patterns. This solution has the potential to address the current limitations of the linear production model while contributing to the broader goals of a circular economy.

D. Contributions

This paper makes several important contributions to the discussion of sustainability and circular economy practices in the fashion industry. First, it provides a comprehensive exploration of the role of Digital Product Passports (DPPs) in improving apparel traceability within the context of a circular economy. By examining how DPPs can track a product's materials, production processes, and lifecycle, the paper sheds light on how they can contribute to more transparent and sustainable fashion practices. Second, the paper proposes a Management Information System (MIS)-driven framework for integrating DPPs into the fashion industry's supply chain. This framework offers a practical approach for utilizing digital technologies to collect, store, and share product-related data across various stakeholders, from manufacturers to consumers. Finally, the paper evaluates the benefits, challenges, and implications of using DPPs to enhance sustainability and promote circular practices in fashion. By analyzing the potential impact of DPPs on product recycling, waste reduction, and resource efficiency, the paper provides valuable insights into how such systems can drive meaningful change in the industry. Through these contributions, the paper aims to provide a deeper understanding of how technology, particularly MIS and DPPs, can accelerate the fashion industry's shift from a linear to a circular economy, fostering sustainability and environmental stewardship.

E. Paper Organization

This paper is structured to provide a thorough understanding of how Digital Product Passports (DPPs) and Management Information Systems (MIS) can support the fashion industry's transition to a circular economy. **Section II** reviews existing literature and related work on circular economy initiatives within the fashion industry, particularly focusing on the role of digital technologies in enhancing product traceability. This section aims to provide context and background on current sustainability efforts and the limitations of the existing systems. **Section III** outlines the proposed methodology for implementing MIS-driven DPPs in the fashion sector, detailing how these systems can be integrated into existing supply chains and the steps necessary to collect, store, and share critical product data. **Section IV** presents a discussion of the results and effectiveness of integrating DPPs into fashion supply chains, evaluating both the benefits and the challenges that may arise during the adoption and scaling of this technology. Finally, **Section V** concludes the paper by summarizing the key findings, offering practical recommendations for the fashion industry, and suggesting avenues for future research to further advance the adoption of circular economy principles in fashion. This structure is designed to guide the reader from theoretical concepts to practical solutions, highlighting both the potential impact and challenges of DPPs in promoting sustainability in the fashion industry.

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II. Related Work

A. Circular Economy and Sustainability in Fashion

The fashion industry has increasingly recognized the need for a transition towards more sustainable practices. As concerns over environmental degradation and resource depletion grow, scholars argue that the fashion sector must adopt a circular economy model to mitigate its adverse effects. Fletcher and Tham [1] highlight that achieving a circular fashion economy requires an integrated approach that incorporates sustainable design, responsible production, and efficient waste management strategies. They stress the importance of reducing the industry's reliance on virgin resources and ensuring that products and materials are continuously reused, refurbished, and recycled. Furthermore, the role of transparency in the supply

chain is critical in this transformation, as it facilitates product reuse and recycling. This transparency can only be achieved through detailed traceability systems, which is a central focus of recent research.

B. The Role of Digital Technologies in Traceability

The integration of digital technologies has become a key area of interest for improving traceability in the fashion supply chain. One notable advancement is the use of blockchain technology, which enables secure, tamper-proof records of transactions. According to Li et al. [2], blockchain offers the potential to track the entire lifecycle of a garment, providing stakeholders with verifiable data on its sustainability. While blockchain ensures secure data management, scalability remains a challenge, as large-scale implementation requires substantial infrastructure investment. As such, the use of blockchain in fashion supply chains is still limited. In contrast, Digital Product Passports (DPPs), as proposed by the European Commission [3], provide an alternative solution by standardizing the necessary data for efficient traceability across the supply chain. DPPs offer a structured and accessible format that can integrate with other technologies like blockchain, helping to overcome scalability challenges.

C. Management Information Systems (MIS) and Circular Economy

Management Information Systems (MIS) play a crucial role in managing the flow of data across various stakeholders in a supply chain, offering real-time insights into product lifecycle management. Several studies have explored how MIS can support circular economy initiatives by enabling better decision-making, enhancing operational efficiency, and promoting resource optimization. According to Bakker et al. [4], the integration of MIS with sustainable supply chain management practices can enhance product transparency, enabling consumers and manufacturers to make more informed decisions about product sourcing and disposal. MIS platforms can centralize product data, from raw material sourcing to post-consumer disposal, and provide all stakeholders with the necessary information for effective recycling and reuse. However, while the literature on MIS in the context of circular economy initiatives is extensive, there is a gap in research specifically focusing on its application in the integration of Digital Product Passports within the fashion industry.

D. Digital Product Passports in the Fashion Industry

Digital Product Passports (DPPs) are increasingly being explored as an innovative solution for improving traceability in the fashion industry. These digital records provide comprehensive information about a product's material composition, manufacturing processes, carbon footprint, and recycling options. The European Commission [3] has recognized the potential of DPPs to standardize product data, ensuring that accurate and up-to-date information is available to all stakeholders. In the fashion industry, DPPs can help close the loop in the circular economy by making it easier to recycle and reuse garments. However, the implementation of DPPs requires collaboration between various stakeholders, including designers, manufacturers, retailers, and recyclers, which poses significant challenges. While some progress has been made, research on the effective integration of MIS with DPPs in fashion is still in its early stages. This paper seeks to bridge this gap by proposing a framework for implementing MIS-driven DPPs in the fashion industry, thereby enhancing product traceability and supporting circular economy practices.

III. Methodology

The methodology for implementing MIS-driven Digital Product Passports (DPPs) in the fashion industry involves several key steps. Each step plays a crucial role in ensuring that the system is effective in enabling product traceability and fostering circular economy practices. This section outlines the framework, data collection process, pilot testing, and evaluation criteria.

A. System Design

The first step in the methodology is the design of a comprehensive framework for the digital product passport system. This framework defines the essential data to be captured and specifies the stakeholders involved. The key data includes

material composition, manufacturing processes, carbon footprint, and end-of-life options for the product. Table 1 provides a breakdown of the types of information that will be captured within the digital passport.

Table 1: Key Data to be Captured in Digital Product Passports

Data Category	Description
Material Composition	Details on the raw materials used in the product.
Manufacturing Processes	Information about the methods used during production.
Carbon Footprint	Data on the environmental impact, especially carbon emissions.
End-of-Life Options	Recycling and disposal methods for the product.

In addition to the data captured, technologies such as RFID tags, blockchain, and cloud-based databases will be used to ensure that the information is securely stored, easily accessible, and tamper-proof. These technologies will facilitate real-time updates to the product passport and allow stakeholders such as manufacturers, retailers, consumers, and recyclers to access critical information at every stage of the product lifecycle.

B. Data Collection and Integration

The next step involves the collection of relevant data at various stages of the product lifecycle. This includes sourcing raw materials, manufacturing processes, transportation logistics, and end-of-life disposal or recycling. Data integration will be achieved through a centralized Management Information System (MIS), which will connect all stakeholders in the supply chain. This MIS will serve as a hub for product data, ensuring that each participant whether they are a manufacturer, retailer, consumer, or recycler has access to up-to-date information. Figure 1 illustrates the flow of data through the system, from raw material sourcing to product recycling.

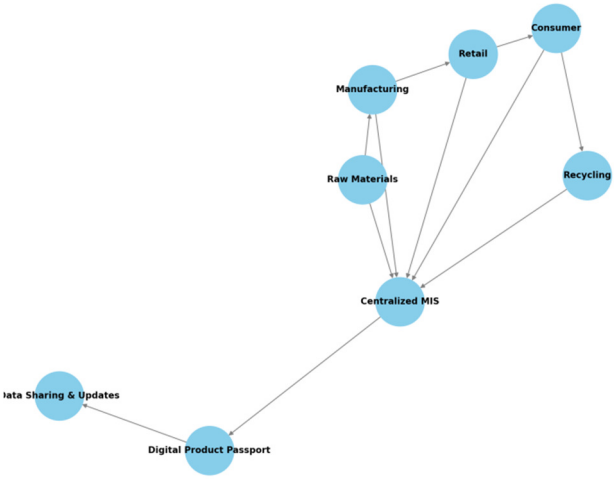

Figure 1: Data Flow in the Digital Product Passport System

By integrating these systems, the entire supply chain can become more transparent, and each participant can make informed decisions based on real-time product data.

C. Pilot Testing

Following the system design and data integration phases, the next crucial step is to conduct a pilot test of the Digital Product Passport (DPP) system within a small-scale fashion supply chain. This pilot test will involve a select group of products and participants, which will allow the team to evaluate the functionality, usability, and scalability of the system. One of the key goals of the pilot is to ensure that data can be accurately captured and updated in real time, providing reliable and up-to-date information to all stakeholders involved in the product lifecycle. Another objective is to test the system's user-friendliness, ensuring that manufacturers, retailers, consumers, and recyclers can all easily interact with the system and access relevant product data. Additionally, the pilot will assess whether the system can scale effectively to accommodate a larger volume of products and participants, which is critical for wider implementation across the industry. During this phase, the team will carefully monitor both the challenges and benefits of integrating DPPs into the fashion supply chain, particularly in terms of improving traceability and sustainability. Feedback from the pilot participants will be invaluable in identifying areas for improvement, refining the

system design, and increasing the potential for broader adoption. Ultimately, this pilot test will serve as a critical step in ensuring that the Digital Product Passport system is effective and ready for large-scale deployment.

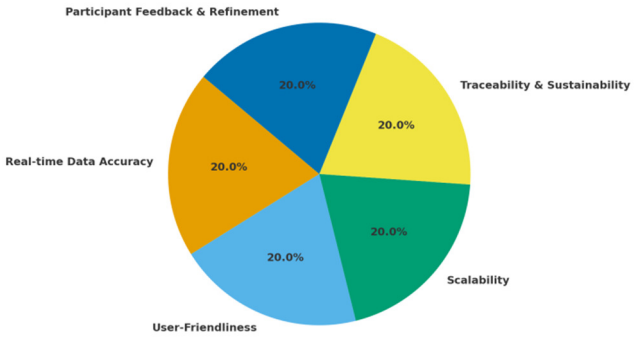

Figure 2 : Objectives of Pilot Testing Digital Product Passport (DPP) System

D. Evaluation

The final phase of the methodology is the evaluation of the effectiveness of the Digital Product Passport (DPP) system. This step involves assessing the system's performance using key performance indicators (KPIs) to measure its success across several critical dimensions. The first KPI is Data Accuracy, which examines the correctness and timeliness of the information stored within the Digital Product Passports. It is essential that the data regarding material composition, manufacturing processes, and end-of-life options are accurate and up-to-date, as this will directly impact the system's reliability and usefulness to stakeholders. The second KPI, System Adoption by Stakeholders, evaluates the level of engagement from all relevant parties, including manufacturers, retailers, consumers, and recyclers. For the system to be successful, it must be adopted widely across the value chain, ensuring that each participant in the product lifecycle can effectively interact with the system. The third KPI, Improvements in Traceability, measures how well the system enhances the ability to track products from raw material sourcing through to their disposal. This evaluation will focus on how easily stakeholders can access and use the data, ultimately improving the transparency of the product lifecycle. Finally, the Recycling Rates will be examined to determine if the system contributes to higher rates of product recovery and recycling. A system with clear and accessible information about recycling options should, in theory, drive greater product reuse and reduce waste. The findings from this evaluation will be instrumental in refining the Digital Product Passport system and addressing any limitations, thus ensuring that the system can be scaled and implemented successfully in the broader fashion industry.

IV. Discussion and Results

The implementation of Management Information Systems (MIS)-driven Digital Product Passports (DPPs) in the fashion industry brings about numerous benefits but also presents several challenges. This section explores these aspects in detail.

A. Benefits of Digital Product Passports

One of the most significant benefits of DPPs is their ability to enhance transparency in the fashion industry. By providing detailed information about a product's material composition, manufacturing process, carbon footprint, and recycling options, DPPs enable consumers to make informed purchasing decisions. In a market where sustainability is increasingly prioritized, transparency is key. DPPs allow consumers to verify the environmental claims made by brands, empowering them to choose products that align with their values. This creates a direct link between responsible consumer behavior and sustainable business practices, encouraging brands to adopt greener, more transparent methods. Another key benefit is how DPPs facilitate recycling and reuse. By including detailed data on the materials used and their recyclability, DPPs enable better recycling and repurposing of fashion products at the end of their life cycle. This can significantly reduce the amount of textile waste generated and promote a circular economy. Recyclers can access valuable information about a product's components, which is crucial for determining how to properly process the materials. This ensures that valuable resources are not lost and can be reused, decreasing the environmental impact of the fashion industry.

B. Challenges in Implementing Digital Product Passports

The integration of DPPs into the fashion supply chain comes with several challenges. One of the primary challenges is the lack of industry-wide standardization in data formats. As the fashion industry is diverse and fragmented, each stakeholder ranging from raw material suppliers to manufacturers and recyclers may use different systems to manage product information. Without standardized formats for DPPs, there is a risk that data will be difficult to share across different platforms, leading to inefficiencies and poor collaboration. Standardizing data formats would be essential for ensuring that product information can be accurately captured and shared throughout the supply chain, which would enhance the scalability of DPP systems. Another challenge is the cost of implementation. Transitioning from traditional supply chain systems to digital systems for managing product data requires substantial investment in technology, infrastructure, and training. Smaller companies, particularly SMEs, may struggle to afford the necessary resources to implement DPPs, creating a barrier to widespread adoption. Additionally, the process of integrating new digital systems with existing business models can be complex and expensive, which may discourage some companies from pursuing this transition.

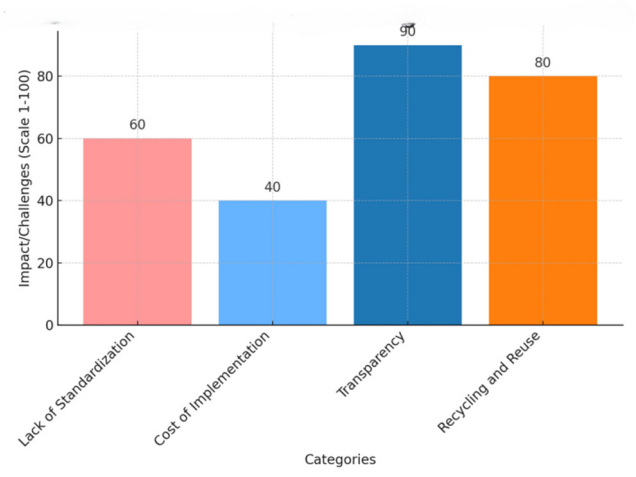

Figure 3: Benefits & Challenges in Implementing Digital Product Passports

C. Data Privacy and Security Concerns

A critical concern in the implementation of DPPs is data privacy and security. DPPs store sensitive information, such as a product's composition, production processes, and environmental impact, which could be valuable not only for consumers but also for competitors. Therefore, it is crucial to implement robust security measures to prevent unauthorized access to this data. Fashion companies need to employ encryption, secure authentication protocols, and continuous monitoring to protect product data from potential cyber threats. Furthermore, adherence to data protection regulations, such as the General Data Protection Regulation (GDPR), is necessary to ensure that consumer and business data is handled responsibly and legally. Safeguarding data privacy is essential for maintaining consumer trust and ensuring that businesses do not face legal or reputational risks.

D. Resistance from Traditional Stakeholders

Resistance to change from traditional stakeholders in the fashion industry poses another significant challenge to the adoption of DPPs. Many companies have established processes and systems that they are reluctant to change, fearing disruption to their operations. This is particularly true for smaller businesses that may not see the immediate benefits of investing in digital systems. Overcoming this resistance will require demonstrating the long-term advantages of DPPs, such as improved supply chain efficiency, reduced waste, and enhanced sustainability credentials. Pilot projects and case studies showing the benefits of DPPs could help alleviate skepticism and encourage stakeholders to embrace new technologies. Additionally, offering incentives, such as financial support or regulatory advantages, could motivate companies to adopt these systems.

V. Conclusion

The adoption of MIS-driven digital product passports (DPPs) represents a promising solution for improving apparel traceability within the context of a circular economy. By enabling better visibility into the entire lifecycle of fashion products, DPPs can promote responsible consumption, facilitate recycling, and support

sustainable business practices. However, challenges such as system integration, data standardization, and stakeholder adoption remain. Despite these hurdles, the potential benefits of DPPs in advancing circularity in fashion are substantial, offering a path to reduce waste and improve resource efficiency.

Future research should focus on refining the framework for DPPs, particularly by addressing the challenges of data standardization and the scalability of the technology across the global fashion supply chain. Pilot projects can help evaluate the effectiveness of DPPs in different segments of the industry, including small and medium-sized enterprises (SMEs) that may face unique barriers. Furthermore, exploring the role of emerging technologies such as blockchain and artificial intelligence in enhancing the functionality of DPPs could significantly improve the traceability and security of product data. Finally, efforts to engage stakeholders across the entire supply chain, from manufacturers to consumers, will be essential in overcoming resistance to adoption and ensuring the widespread implementation of DPPs in the fashion industry.

VI. References

[1] Fletcher, K., & Tham, M. (2019). *Sustainable Fashion and the Circular Economy*. Routledge. DOI: 10.4324/9780429280092

[2] Li, Y., et al. (2020). Blockchain-Based Transparency in Fashion Supply Chains. *Journal of Fashion Technology & Textile Engineering*, 8(1), 1-12. DOI: 10.4172/2329-9568.1000229

[3] European Commission. (2020). *Circular Economy Action Plan: For a Cleaner and More Competitive Europe*. Brussels. DOI: 10.2779/34763

[4] Bakker, E., et al. (2014). Circular Supply Chain Management: An Evaluation of Environmental and Economic Impacts. *Journal of Business Ethics*, 131(3), 523-540. DOI: 10.1007/s10551-014-2327-4

[5] Rahman, M. A., Islam, M. I., Tabassum, M., & Bristy, I. J. (2025, September). Climate-aware decision intelligence: Integrating environmental risk into infrastructure and supply chain planning. *Saudi Journal of Engineering and Technology (SJEAT), 10*(9), 431–439. https://doi.org/10.36348/sjet.2025.v10i09.006

[6] Rahman, M. A., Bristy, I. J., Islam, M. I., & Tabassum, M. (2025, September). Federated learning for secure inter-agency data collaboration in critical infrastructure. *Saudi Journal of Engineering and Technology (SJEAT), 10*(9), 421–430. https://doi.org/10.36348/sjet.2025.v10i09.005

[7] Tabassum, M., Rokibuzzaman, M., Islam, M. I., & Bristy, I. J. (2025, September). Data-driven financial analytics through MIS platforms in emerging economies. *Saudi Journal of Engineering and Technology (SJEAT), 10*(9), 440–446. https://doi.org/10.36348/sjet.2025.v10i09.007

[8] Tabassum, M., Islam, M. I., Bristy, I. J., & Rokibuzzaman, M. (2025, September). Blockchain and ERP-integrated MIS for transparent apparel & textile supply chains. *Saudi Journal of Engineering and Technology (SJEAT), 10*(9), 447–456. https://doi.org/10.36348/sjet.2025.v10i09.008

[9] Bristy, I. J., Tabassum, M., Islam, M. I., & Hasan, M. N. (2025, September). IoT-driven predictive maintenance dashboards in industrial operations. *Saudi Journal of Engineering and Technology (SJEAT), 10*(9), 457–466. https://doi.org/10.36348/sjet.2025.v10i09.009

[10] Hasan, M. N., Karim, M. A., Joarder, M. M. I., & Zaman, M. T. (2025, September). IoT-integrated solar energy monitoring and bidirectional DC-DC converters for smart grids. *Saudi Journal of Engineering and Technology (SJEAT), 10*(9), 467–475. https://doi.org/10.36348/sjet.2025.v10i09.010

[11] Bormon, J. C., Saikat, M. H., Shohag, M., & Akter, E. (2025, September). Green and low-carbon construction materials for climate-adaptive civil structures. *Saudi Journal of Civil Engineering (SJCE), 9*(8), 219–226. https://doi.org/10.36348/sjce.2025.v09i08.002

[12] Razaq, A., Rahman, M., Karim, M. A., & Hossain, M. T. (2025, September 26). Smart charging infrastructure for EVs using IoT-based load balancing. *Zenodo*. https://doi.org/10.5281/zenodo.17210639

[13] Habiba, U., & Musarrat, R., (2025). Bridging IT and education: Developing smart platforms for student-centered English learning. *Zenodo*. https://doi.org/10.5281/zenodo.17193947

[14] Alimozzaman, D. M. (2025). *Early prediction of Alzheimer's disease using explainable multi-modal AI*. Zenodo. https://doi.org/10.5281/zenodo.17210997

[15] uz Zaman, M. T. Smart Energy Metering with IoT and GSM Integration for Power Loss Minimization. Preprints 2025, 2025091770. https://doi.org/10.20944/preprints202509.1770.v1

[16] Hossain, M. T. (2025). *Sustainable garment production through Industry 4.0 automation*. Zenodo. https://doi.org/10.5281/zenodo.17202473

[17] Hasan, E. (2025). *Secure and scalable data management for digital transformation in finance and IT systems*. Zenodo. https://doi.org/10.5281/zenodo.17202282

[18] Saikat, M. H. (2025). *Geo-Forensic Analysis of Levee and Slope Failures Using Machine Learning*. Preprints. https://doi.org/10.20944/preprints202509.1905.v1

[19] Islam, M. I. (2025). *Cloud-Based MIS for Industrial Workflow Automation.* Preprints. https://doi.org/10.20944/preprints202509.1326.v1

[20] Islam, M. I. (2025). *AI-powered MIS for risk detection in industrial engineering projects*. TechRxiv. https://doi.org/10.36227/techrxiv.175825736.65590627/v1

[21] Akter, E. (2025). *Lean project management and multi-stakeholder optimization in civil engineering projects*. Zenodo. https://doi.org/10.5281/zenodo.17154082

[22] Musarrat, R. (2025). *Curriculum adaptation for inclusive classrooms: A sociological and pedagogical approach*. Zenodo. https://doi.org/10.5281/zenodo.17202455

[23] Bormon, J. C. (2025). Sustainable Dredging and Sediment Management Techniques for Coastal and Riverine Infrastructure. Zenodo. https://doi.org/10.5281/zenodo.17106708

[24] Bormon, J. C. (2025). AI-Assisted Structural Health Monitoring for Foundations and High-Rise Buildings. Preprints. https://doi.org/10.20944/preprints202509.1196.v1

[25] Haque, S. (2025). *Effectiveness of managerial accounting in strategic decision making* [Preprint]. Preprints. https://doi.org/10.20944/preprints202509.2466.v1

[26] Shoag, M. (2025). AI-Integrated Façade Inspection Systems for Urban Infrastructure Safety. Zenodo. https://doi.org/10.5281/zenodo.17101037

[27] Shoag, M. Automated Defect Detection in High-Rise Façades Using AI and Drone-Based Inspection. Preprints 2025, 2025091064. https://doi.org/10.20944/preprints202509.1064.v1

[28] Shoag, M. (2025). *Sustainable construction materials and techniques for crack prevention in mass concrete structures*. SSRN. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5475306

[29] Joarder, M. M. I. (2025). *Disaster recovery and high-availability frameworks for hybrid cloud environments*. Zenodo. https://doi.org/10.5281/zenodo.17100446

[30] Joarder, M. M. I. (2025). *Next-generation monitoring and automation: AI-enabled system administration for smart data centers*. TechRxiv. https://doi.org/10.36227/techrxiv.175825633.33380552/v1

[31] Joarder, M. M. I. (2025). Energy-Efficient Data Center Virtualization: Leveraging AI and CloudOps for Sustainable Infrastructure. Zenodo. https://doi.org/10.5281/zenodo.17113371

[32] Taimun, M. T. Y., Sharan, S. M. I., Azad, M. A., & Joarder, M. M. I. (2025). Smart maintenance and reliability engineering in manufacturing. *Saudi Journal of Engineering and Technology, 10*(4), 189–199.

[33] Enam, M. M. R., Joarder, M. M. I., Taimun, M. T. Y., & Sharan, S. M. I. (2025). Framework for smart SCADA systems: Integrating cloud

computing, IIoT, and cybersecurity for enhanced industrial automation. *Saudi Journal of Engineering and Technology, 10*(4), 152–158.

[34] Azad, M. A., Taimun, M. T. Y., Sharan, S. M. I., & Joarder, M. M. I. (2025). Advanced lean manufacturing and automation for reshoring American industries. *Saudi Journal of Engineering and Technology, 10*(4), 169–178.

[35] Sharan, S. M. I., Taimun, M. T. Y., Azad, M. A., & Joarder, M. M. I. (2025). Sustainable manufacturing and energy-efficient production systems. *Saudi Journal of Engineering and Technology, 10*(4), 179–188.

[36] Enam, M. M. R. (2025). *Energy-aware IoT and edge computing for decentralized smart infrastructure in underserved U.S. communities*. Preprints. https://doi.org/10.20944/preprints202506.2128.v1

[37] Farabi, S. A. (2025). *AI-augmented OTDR fault localization framework for resilient rural fiber networks in the United States*. arXiv. https://arxiv.org/abs/2506.03041

[38] Farabi, S. A. (2025). *AI-driven predictive maintenance model for DWDM systems to enhance fiber network uptime in underserved U.S. regions*. Preprints. https://doi.org/10.20944/preprints202506.1152.v1

[39] Farabi, S. A. (2025). *AI-powered design and resilience analysis of fiber optic networks in disaster-prone regions*. ResearchGate. https://doi.org/10.13140/RG.2.2.12096.65287

[40] Hasan, M. N. (2025). *Predictive maintenance optimization for smart vending machines using IoT and machine learning*. arXiv. https://doi.org/10.48550/arXiv.2507.02934

[41] Hasan, M. N. (2025). *Intelligent inventory control and refill scheduling for distributed vending networks*. ResearchGate. https://doi.org/10.13140/RG.2.2.32323.92967

[42] Hasan, M. N. (2025). *Energy-efficient embedded control systems for automated vending platforms*. Preprints. https://doi.org/10.20944/preprints202507.0552.v1

[43] Sunny, S. R. (2025). *Lifecycle analysis of rocket components using digital twins and multiphysics simulation*. ResearchGate. https://doi.org/10.13140/RG.2.2.20134.23362

[44] Sunny, S. R. (2025). *AI-driven defect prediction for aerospace composites using Industry 4.0 technologies*. Zenodo. https://doi.org/10.5281/zenodo.16044460

[45] Sunny, S. R. (2025). *Edge-based predictive maintenance for subsonic wind tunnel systems using sensor analytics and machine learning*. TechRxiv. https://doi.org/10.36227/techrxiv.175624632.23702199/v1

[46] Sunny, S. R. (2025). *Digital twin framework for wind tunnel-based aeroelastic structure evaluation*. TechRxiv. https://doi.org/10.36227/techrxiv.175624632.23702199/v1

[47] Sunny, S. R. (2025). Real-time wind tunnel data reduction using machine learning and JR3 balance integration. *Saudi Journal of Engineering and Technology, 10*(9), 411–420. https://doi.org/10.36348/sjet.2025.v10i09.004

[48] Sunny, S. R. (2025). AI-augmented aerodynamic optimization in subsonic wind tunnel testing for UAV prototypes. *Saudi Journal of Engineering and Technology, 10*(9), 402–410. https://doi.org/10.36348/sjet.2025.v10i09.003

[49] Shaikat, M. F. B. (2025). *Pilot deployment of an AI-driven production intelligence platform in a textile assembly line*. TechRxiv. https://doi.org/10.36227/techrxiv.175203708.81014137/v1

[50] Rabbi, M. S. (2025). *Extremum-seeking MPPT control for Z-source inverters in grid-connected solar PV systems*. Preprints. https://doi.org/10.20944/preprints202507.2258.v1

[51] Rabbi, M. S. (2025). *Design of fire-resilient solar inverter systems for wildfire-prone U.S. regions*. Preprints. https://www.preprints.org/manuscript/202507.2505/v1

[52] Rabbi, M. S. (2025). *Grid synchronization algorithms for intermittent renewable energy sources using AI control loops*. Preprints. https://www.preprints.org/manuscript/202507.2353/v1

[53] Tonoy, A. A. R. (2025). *Condition monitoring in power transformers using IoT: A model for predictive maintenance*. Preprints. https://doi.org/10.20944/preprints202507.2379.v1

[54] Tonoy, A. A. R. (2025). *Applications of semiconducting electrides in mechanical energy conversion and piezoelectric systems*. Preprints. https://doi.org/10.20944/preprints202507.2421.v1

[55] Azad, M. A. (2025). *Lean automation strategies for reshoring U.S. apparel manufacturing: A sustainable approach*. Preprints. https://doi.org/10.20944/preprints202508.0024.v1

[56] Azad, M. A. (2025). *Optimizing supply chain efficiency through lean Six Sigma: Case studies in textile and apparel manufacturing*. Preprints. https://doi.org/10.20944/preprints202508.0013.v1

[57] Azad, M. A. (2025). *Sustainable manufacturing practices in the apparel industry: Integrating eco-friendly materials and processes*. TechRxiv. https://doi.org/10.36227/techrxiv.175459827.79551250/v1

[58] Azad, M. A. (2025). *Leveraging supply chain analytics for real-time decision making in apparel manufacturing*. TechRxiv. https://doi.org/10.36227/techrxiv.175459831.14441929/v1

[59] Azad, M. A. (2025). *Evaluating the role of lean manufacturing in reducing production costs and enhancing efficiency in textile mills*. TechRxiv. https://doi.org/10.36227/techrxiv.175459830.02641032/v1

[60] Azad, M. A. (2025). *Impact of digital technologies on textile and apparel manufacturing: A case for U.S. reshoring*. TechRxiv. https://doi.org/10.36227/techrxiv.175459829.93863272/v1

[61] Rayhan, F. (2025). *A hybrid deep learning model for wind and solar power forecasting in smart grids*. Preprints. https://doi.org/10.20944/preprints202508.0511.v1

[62] Rayhan, F. (2025). *AI-powered condition monitoring for solar inverters using embedded edge devices*. Preprints. https://doi.org/10.20944/preprints202508.0474.v1

[63] Rayhan, F. (2025). *AI-enabled energy forecasting and fault detection in off-grid solar networks for rural electrification*. TechRxiv. https://doi.org/10.36227/techrxiv.175623117.73185204/v1

[64] Habiba, U., & Musarrat, R. (2025). Integrating digital tools into ESL pedagogy: A study on multimedia and student engagement. *IJSRED – International Journal of Scientific Research and Engineering Development, 8*(2), 799–811. https://doi.org/10.5281/zenodo.17245996

[65] Hossain, M. T., Nabil, S. H., Razaq, A., & Rahman, M. (2025). Cybersecurity and privacy in IoT-based electric vehicle ecosystems. *IJSRED – International Journal of Scientific Research and Engineering Development, 8*(2), 921–933. https://doi.org/10.5281/zenodo.17246184

[66] Hossain, M. T., Nabil, S. H., Rahman, M., & Razaq, A. (2025). Data analytics for IoT-driven EV battery health monitoring. *IJSRED – International Journal of Scientific Research and Engineering Development, 8*(2), 903–913. https://doi.org/10.5281/zenodo.17246168

[67] Akter, E., Barman, J. C., Saikat, M. H., & Shoag, M. (2025). Digital twin technology for smart civil infrastructure and emergency preparedness. *IJSRED – International Journal of Scientific Research and Engineering Development, 8*(2), 891–902. https://doi.org/10.5281/zenodo.17246150

[68] Rahmatullah, R. (2025). Smart agriculture and Industry 4.0: Applying industrial engineering tools to improve U.S. agricultural productivity. *World Journal of Advanced Engineering Technology and Sciences, 17*(1), 28–40. https://doi.org/10.30574/wjaets.2025.17.1.1377

