Journal of Frontiers in Multidisciplinary Research

Transforming Procurement Practices with Automation: A Review of Blockchain and RPA Integration for Enhanced Supplier Risk Management

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Article Info
E-ISSN: 3050-9726
P-ISSN: 3050-9718
Volume: 04
Issue: 01
January-June 2023
Received: 20-12-2022
Accepted: 16-01-2023
Published: 12-02-2023
Page No: 104-110

Abstract
This paper explores the integration of Blockchain technology and Robotic Process Automation (RPA) in procurement practices, specifically focusing on their potential to enhance supplier risk management. In today's global supply chains, procurement processes face significant challenges, including fraud, inefficiencies, and compliance issues. Blockchain, with its decentralized and immutable nature, provides enhanced transparency, secure transactions, and a reliable audit trail, while RPA streamlines routine procurement tasks, reduces human error, and enforces compliance. Together, these technologies create a synergistic solution that automates supplier verification, reduces fraud, and enables smarter, more efficient procurement workflows. However, integrating Blockchain and RPA is not without challenges, including technical difficulties, regulatory concerns, and scalability issues. Despite these barriers, the paper outlines the strategic benefits of these technologies, including improved operational efficiency, reduced procurement costs, and enhanced supplier relationships. The paper also presents policy and managerial recommendations for successful implementation, as well as future research directions in the areas of scalability, AI-enhanced automation, and regulatory compliance. This research provides valuable insights for organizations leveraging emerging technologies for more resilient and efficient procurement practices.

DOI: https://doi.org/10.54660/.IJFMR.2023.4.1.104-110

Keywords: Procurement Automation, Blockchain, Robotic Process Automation (RPA), Supplier Risk Management, Smart Contracts, Supply Chain Transparency

1. Introduction

1.1 Background on procurement challenges and the need for automation

Procurement has evolved into a complex function that extends beyond cost savings to strategic risk management and operational resilience. Organizations face multiple challenges, including supply chain disruptions, manual process inefficiencies, and supplier compliance vulnerabilities. Traditional procurement methods rely heavily on paperwork, human intervention, and legacy systems, which create inefficiencies and increase the risk of errors (Hamza, Collins, Eweje, & Babatunde, 2023; Mustapha & Ibitoye, 2022b).

The growing complexity of global supply chains necessitates more transparent, efficient, and data-driven procurement strategies. Automation has emerged as a critical solution to address these challenges, enabling organizations to streamline supplier selection, contract management, and compliance monitoring (Onukwulu, Agho, & Eyo-Udo, 2023). By leveraging technology-driven procurement processes, companies can reduce operational bottlenecks, enhance decision-making accuracy, and mitigate supplier-related risks.

In an increasingly competitive business environment, procurement automation is no longer an option but a necessity for organizations seeking to optimize efficiency, maintain regulatory compliance, and build resilient supply chains (Onukwulu, Fiemotongha, Igwe, & Ewim, 2023).

Effective supplier risk management is a cornerstone of sustainable supply chain operations, ensuring business continuity and regulatory adherence. Organizations operate within complex networks of suppliers, making them susceptible to risks such as financial instability, non-compliance, fraud, and geopolitical disruptions (Vo, 2023). Failure to manage these risks can lead to production delays, reputational damage, and financial losses. With businesses sourcing materials and services from multiple regions, regulatory landscapes vary, requiring robust mechanisms to track and enforce compliance. The need for real-time visibility into supplier performance has intensified, prompting companies to adopt more sophisticated risk assessment methodologies (Afolabi & Akinsooto, 2021; Odunaiya, Soyombo, & Ogunsola, 2022).

Technology-driven risk management frameworks empower procurement teams to monitor suppliers' financial health, assess contractual adherence, and detect fraudulent activities before they escalate. Automation enhances risk mitigation by reducing reliance on manual risk assessments, thereby improving the accuracy and consistency of supplier evaluations. As organizations expand their supplier networks, an integrated approach to risk management becomes essential to ensure supply chain stability and resilience (Fredson *et al*., 2023; Ogunmokun, Balogun, & Ogunsola, 2022).

1.2 Overview of emerging technologies

The integration of advanced technologies is revolutionizing procurement by enhancing transparency, security, and efficiency. Blockchain and robotic process automation represent two transformative innovations reshaping supplier risk management. Blockchain technology introduces a decentralized, tamper-proof ledger system that ensures data integrity, improves traceability, and facilitates smart contracts for automated procurement agreements. By reducing dependency on intermediaries, blockchain enhances transaction security and fosters trust in supplier relationships (ELUMILADE, OGUNDEJI, OZOEMENAM, ACHUMIE, & OMOWOLE, 2023; Jessa, 2023).

Meanwhile, robotic process automation automates repetitive procurement tasks such as invoice processing, purchase order generation, and compliance checks, significantly reducing human errors and processing times (Flechsig, Anslinger, & Lasch, 2022). The combined use of these technologies creates a seamless and efficient procurement ecosystem, where supplier verification, contract execution, and compliance enforcement occur with minimal manual intervention. This integration reduces operational costs, improves decision-making speed, and enhances overall procurement efficiency. As businesses strive to enhance resilience in procurement, these technologies provide a robust foundation for mitigating risks and optimizing supplier management strategies (Adefila, Ajayi, Toromade, & Sam-Bulya, 2023; ALONGE *et al*., 2023).

1.3 Research objectives and scope of the review

This paper aims to explore the transformative role of automation in procurement, with a particular focus on blockchain and robotic process automation. The objective is to examine how these technologies improve supplier risk management by increasing transparency, efficiency, and compliance. This review will analyze existing literature, industry applications, and case studies to understand the effectiveness of blockchain and automation in procurement workflows. It will also identify the challenges organizations face in integrating these technologies and propose strategies for overcoming them.

The scope of the review encompasses the theoretical foundations, real-world implementations, and future potential of blockchain and automation in procurement. By providing a comprehensive assessment, this paper will contribute to the growing discourse on digital procurement transformation, offering insights that can guide policymakers, industry leaders, and procurement professionals in adopting technology-driven risk management strategies. The findings will help shape future innovations in procurement automation, ensuring resilient and sustainable supply chains.

2. Theoretical foundations and technological overview

2.1 Overview of procurement risk management frameworks

Procurement risk management frameworks serve as a structured approach to identifying, assessing, and mitigating risks associated with sourcing goods and services. These frameworks are essential in managing uncertainties such as supplier defaults, financial instability, regulatory non-compliance, and geopolitical disruptions that can affect the flow of goods. Traditional risk management models emphasize risk identification, assessment, and the development of mitigation strategies based on historical data and human intuition (Abisoye & Akerele, 2022; Ogbuagu *et al*., 2023c).

However, modern frameworks have evolved to integrate advanced technologies that provide real-time data, predictive insights, and automated alerts. These frameworks typically employ risk assessment matrices, financial health assessments, and supplier audits to evaluate risk. The integration of technologies such as blockchain and automation adds an additional layer of security, transparency, and efficiency, ensuring that potential supplier risks are flagged early. The evolution of procurement risk management frameworks enables organizations to proactively respond to emerging risks, thereby maintaining a more resilient and sustainable supply chain (KELVIN-AGWU *et al*., 2023; Ogbuagu *et al*., 2023b).

Blockchain technology has emerged as a transformative force in procurement, providing an immutable, decentralized platform for securing transactions and ensuring data integrity. The core principles of blockchain—transparency, traceability, and decentralization—are particularly valuable in procurement, where trust and security are paramount (Althabatah, Yaqot, Menezes, & Kerbache, 2023). Through a distributed ledger, blockchain allows all parties involved in a transaction to access the same data in real time, eliminating the need for intermediaries and reducing the risk of fraud (Daramola, Apeh, Basiru, Onukwulu, & Paul, 2023; Elumilade, Ogundeji, Achumie, Omokhoa, & Omowole, 2022).

Each transaction is recorded in a "block" that is linked to the previous one, ensuring an immutable and transparent audit trail. This creates a tamper-proof record that can be accessed at any time for verification or compliance checks. For

procurement, this means enhanced supplier verification, faster contract execution, and a higher level of transparency in supplier relationships. Blockchain also facilitates the automation of complex procurement processes, improving efficiency and reducing operational costs (Nwokediegwu, Adeleke, & Igunma, 2023; Ogbuagu *et al*., 2022b).

2.2 Decentralization, immutability, and smart contracts

At the heart of blockchain's value in procurement lies its key attributes: decentralization, immutability, and smart contracts. Decentralization means that no single party controls the blockchain network; instead, data is distributed across multiple nodes, making it more resilient to manipulation and cyber-attacks. This is particularly important in supplier risk management, as it ensures that all parties in the procurement process have access to the same verified data without the need for intermediaries (Ogundeji, Omowole, Adaga, & Sam-Bulya, 2023).

Immutability refers to the fact that once a transaction is recorded on the blockchain, it cannot be altered or erased. This ensures that procurement records, such as supplier contracts and transaction histories, remain intact and secure. Smart contracts, which are self-executing contracts with the terms of the agreement directly written into code, automatically execute once predefined conditions are met. This eliminates human intervention and reduces the risk of errors, delays, or disputes in supplier relationships. Together, these features of blockchain enhance transparency, trust, and efficiency in procurement (Adeleke, Igunma, & Nwokediegwu; Charles *et al*., 2022).

Robotic Process Automation (RPA) plays a crucial role in automating repetitive and time-consuming procurement tasks, allowing organizations to improve efficiency, reduce human error, and ensure compliance. RPA uses software robots, or "bots," to carry out tasks that were traditionally done manually, such as processing purchase orders, generating invoices, and managing supplier communications. In procurement, this technology reduces the administrative burden on procurement professionals, enabling them to focus on more strategic activities (Adekunle, Chukwuma-Eke, Balogun, & Ogunsola, 2023c; Paul, Abbey, Onukwulu, Agho, & Louis, 2021).

Bots can operate 24/7, which ensures that procurement processes such as order approvals, invoice matching, and contract renewals are handled in real time without delays. Furthermore, RPA can be integrated with other procurement systems, such as Enterprise Resource Planning (ERP) platforms, to facilitate seamless data flow across the organization. This integration ensures that procurement processes are executed more swiftly and with fewer errors, thereby reducing operational costs and increasing productivity (Fiemotongha, Igwe, Ewim, & Onukwulu, 2023).

2.3 Process efficiency, error reduction, and compliance enforcement

RPA's primary benefits in procurement automation are its ability to improve process efficiency, reduce errors, and enforce compliance. By automating manual processes, RPA accelerates procurement cycles, from supplier selection to payment processing. This leads to faster decision-making and procurement outcomes. Additionally, RPA minimizes human errors, which can result from fatigue, oversight, or inconsistent application of procurement rules. By following predetermined workflows, bots ensure that each task is executed with precision and accuracy (EWIM, AZUBUIKE, AJANI, OYENIYI, & ADEWALE, 2023).

In terms of compliance enforcement, RPA ensures that procurement processes adhere to predefined rules and regulations by automating compliance checks, audit trails, and document retention. This is particularly important in industries with strict regulatory requirements, where non-compliance can result in financial penalties or reputational damage. Through these efficiencies, RPA helps create a more streamlined, cost-effective procurement process that meets organizational and regulatory standards (Kolawole *et al*., 2023b; Ogbeta, Mbata, & Katas, 2021).

The integration of blockchain and robotic process automation (RPA) creates a powerful synergy for enhancing supplier risk management in procurement. Blockchain's decentralized and immutable ledger ensures that all transactional data is secure, transparent, and tamper-proof, providing an accurate and up-to-date record of supplier activities. RPA, on the other hand, automates repetitive tasks, such as validating supplier data, processing payments, and generating reports (Govender *et al*., 2022; Ogbuagu *et al*., 2023a).

Together, these technologies streamline the procurement process, reducing the risks associated with manual errors, fraud, and compliance violations. For example, blockchain can automatically verify a supplier's financial status and contract terms, while RPA can process this information and initiate subsequent procurement actions, such as payment processing or order fulfillment (Ahmad, Saad, & Mohaisen, 2019). The result is a procurement ecosystem that is both secure and efficient, where risk is minimized, and decision-making is faster and more informed. By combining the strengths of blockchain and RPA, organizations can create a more resilient and transparent procurement process that reduces supplier-related risks (Adekunle, Chukwuma-Eke, Balogun, & Ogunsola, 2023b; Wear, Uzoka, & Parsi, 2023).

3. Application of blockchain and RPA in procurement automation

3.1 Smart contracts for automated supplier verification and compliance

Smart contracts are transforming procurement by automating key processes such as supplier verification and compliance monitoring. These contracts are self-executing agreements where the terms and conditions are directly written into code, eliminating the need for intermediaries to verify and enforce contract terms (Trautmann & Lasch, 2020). In the context of supplier verification, smart contracts can automatically validate a supplier's credentials, such as business registration, financial stability, and compliance with regulatory standards. This automation ensures that only qualified suppliers are selected, reducing the risk of partnering with unreliable or non-compliant vendors (Isibor, Ibeh, Ewim, Sam-Bulya, & Martha, 2022).

Furthermore, smart contracts can be programmed to automatically execute payment or initiate order fulfillment once predefined conditions, such as the delivery of goods or services, are met. This minimizes human intervention, ensuring that the procurement process is executed efficiently and consistently. By automating verification and compliance, smart contracts enhance the transparency, accuracy, and reliability of procurement activities, significantly reducing the risk of errors or disputes (Ewim, Omokhoa, Ogundeji, & Ibeh, 2021; Otokiti, Igwe, Ewim, Ibeh, & Sikhakhane-Nwokediegwu, 2022).

3.2 RPA-driven procurement workflows for risk mitigation

Robotic Process Automation (RPA) plays a crucial role in automating procurement workflows to mitigate risks such as delays, errors, and compliance breaches. RPA is designed to streamline repetitive tasks, such as processing purchase orders, invoice matching, and managing supplier contracts, which are traditionally prone to human error. In procurement, RPA bots can monitor supplier performance in real time, flagging issues like late deliveries, non-compliance with contractual terms, or discrepancies between ordered and delivered quantities (Hassan, Collins, Babatunde, Alabi, & Mustapha, 2023; Oteri *et al*., 2023a).

By automatically tracking supplier metrics and initiating corrective actions—such as notifying procurement managers or triggering supplier audits—RPA helps mitigate risks before they escalate into more serious problems. Additionally, RPA can be integrated with other enterprise systems, ensuring that data flows seamlessly between procurement, finance, and compliance departments. This integration enhances the consistency of risk assessments, enabling faster and more informed decision-making. By automating key aspects of the procurement process, RPA significantly reduces operational risks and improves supplier relationship management (Jessa, 2022; KOLAWOLE *et al*., 2023a).

3.3 Blockchain for supplier transparency and fraud prevention

Blockchain technology enhances supplier transparency and fraud prevention by providing a secure, immutable record of all transactions within the procurement process. With blockchain, each transaction, such as the purchase of goods or the signing of contracts, is recorded in a distributed ledger that is accessible to all authorized parties but cannot be altered or deleted (Banerjee, 2018). This transparency enables procurement teams to track the movement of goods and services, verify the authenticity of documents, and ensure compliance with contractual terms. For example, blockchain can verify the origin of materials, ensuring that suppliers meet ethical and sustainability standards (Elumilade, Ogundeji, Achumie, Omokhoa, & Omowole, 2021; Paul, Abbey, Onukwulu, Agho, & Louis, 2023).

Additionally, blockchain's decentralized nature eliminates the need for intermediaries, reducing the risk of fraud, bribery, or corruption. In the event of any discrepancies, blockchain's immutable record provides a clear audit trail that can be used to investigate and resolve issues. By enhancing transparency and preventing fraud, blockchain fosters trust between suppliers and organizations, ultimately leading to more secure and reliable procurement practices (Abbey, Olaleye, Mokogwu, & Queen, 2023a; Adewale, Olorunyomi, & Odonkor, 2023; BALOGUN, OGUNSOLA, & SAMUEL, 2023).

4. Challenges, limitations, and future directions

4.1 Technical and operational challenges in integrating blockchain and RPA

The integration of Blockchain and Robotic Process Automation (RPA) in procurement faces several technical and operational challenges. From a technical perspective, blockchain adoption requires significant changes to existing IT infrastructure, which may involve upgrading legacy systems or developing custom solutions to ensure compatibility (Flechsig *et al*., 2022). This can be costly and time-consuming, especially for organizations with complex procurement processes or limited technical resources. Moreover, while RPA can automate routine tasks, its integration with blockchain requires advanced programming to ensure that the two systems can communicate seamlessly (Alonge *et al*., 2021; Ogbuagu *et al*., 2022a).

Operationally, employees must be trained to work with these new technologies, and there is often resistance to change, particularly in established organizations. Furthermore, the implementation of blockchain and RPA can lead to workflow disruptions, especially if the automation process is not managed carefully. Overcoming these challenges requires a strategic approach, with clear planning, training, and a phased implementation strategy to ensure that the integration adds value without significant disruptions (Odunaiya, Soyombo, & Ogunsola, 2021; Oteri *et al*., 2023c).

While blockchain and RPA offer significant benefits to procurement, regulatory and compliance barriers remain substantial challenges. Different regions and industries are subject to varying legal requirements, particularly in data privacy, financial reporting, and cross-border transactions. Blockchain, with its decentralized nature, can complicate the enforcement of jurisdiction-specific regulations, such as the European Union's General Data Protection Regulation (GDPR), which mandates data privacy protections. Similarly, while RPA automates compliance tasks, ensuring that the bot adheres to evolving regulations requires continuous monitoring and updates to the automation rules (BALOGUN, OGUNSOLA, & SAMUEL, 2022).

Compliance with anti-money laundering (AML), know your customer (KYC), and other financial regulations becomes more complex when automated systems are involved. These regulatory complexities may delay or prevent the widespread adoption of blockchain and RPA unless clear guidelines are established. To overcome these barriers, organizations must work closely with legal and compliance experts to navigate the regulatory landscape and ensure that their automation strategies comply with local and international laws (Abbey, Olaleye, Mokogwu, & Queen, 2023b; Ogunsola, Balogun, & Ogunmokun, 2022).

4.2 Scalability and interoperability issues

Scalability and interoperability are significant concerns when integrating blockchain and RPA into procurement systems. Blockchain networks, while secure and transparent, can struggle with scalability due to the high computational power required for processing transactions. As transaction volumes increase, the time and resources needed to validate and record each transaction can lead to delays and inefficiencies, which could hinder the scalability of blockchain applications in procurement. Additionally, blockchain systems are often siloed, making it challenging to integrate them with other procurement systems, such as Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM) platforms (Oteri *et al*., 2023b). Similarly, RPA bots, when scaled across different procurement processes or departments, can face issues related to system compatibility, data quality, and the ability to handle complex, non-standard tasks. Interoperability between blockchain, RPA, and other enterprise systems is essential for streamlining procurement activities. Overcoming these issues requires investing in scalable blockchain networks, developing interoperable frameworks, and continuously improving the AI-driven

capabilities of RPA bots to adapt to diverse procurement tasks (Adekunle, Chukwuma-Eke, Balogun, & Ogunsola, 2023a; Myllynen, Kamau, Mustapha, Babatunde, & Adeleye, 2023).

Looking ahead, the future of procurement automation lies in the integration of Artificial Intelligence (AI) and predictive analytics alongside blockchain and RPA. AI can enhance blockchain's capabilities by enabling smarter decision-making in supplier selection, contract management, and risk mitigation. For example, AI-powered algorithms can analyze historical procurement data to predict potential supplier risks, such as financial instability or geopolitical factors that may disrupt the supply chain. This predictive capability would enable procurement teams to take proactive actions, such as identifying alternative suppliers before issues arise (Otokiti, Igwe, Ewim, & Ibeh, 2021; Sam-Bulya, Omokhoa, Ewim, & Achumie).

In combination with RPA, AI can automate more complex, judgment-based tasks that were traditionally handled by humans, such as negotiating contracts or evaluating supplier performance. Furthermore, AI can drive advanced analytics, allowing organizations to identify procurement trends, optimize supplier relationships, and improve overall supply chain performance. By incorporating AI into blockchain and RPA systems, organizations can create a dynamic, intelligent procurement environment that is capable of anticipating and responding to future challenges with greater efficiency and precision. This fusion of technologies represents the next step in evolving procurement practices towards more autonomous, data-driven solutions (Mustapha & Ibitoye, 2022a; Sikirat, 2022).

5. Conclusion

This review has highlighted the transformative potential of integrating Blockchain and Robotic Process Automation (RPA) in procurement practices. Blockchain’s decentralized, immutable nature ensures secure transactions, enhances transparency, and reduces fraud in supplier relationships. RPA, on the other hand, streamlines repetitive procurement tasks, such as purchase order processing and invoice matching, thereby improving efficiency, reducing errors, and enforcing compliance.

The integration of these technologies facilitates automated supplier verification, real-time risk assessment, and the creation of smart contracts, offering procurement teams a more agile and data-driven approach to managing supplier relationships. While these innovations present significant advantages, challenges such as technical integration, regulatory barriers, and scalability issues must be addressed for successful implementation. As procurement practices continue to evolve, the synergies between Blockchain and RPA will play a critical role in reshaping risk management strategies, driving cost savings, and improving overall procurement outcomes.

The integration of Blockchain and RPA brings significant strategic benefits to procurement transformation. Blockchain ensures that procurement processes are transparent and secure, creating a trusted environment for supplier interactions. This increased transparency can lead to better supplier relationships, as both parties have access to accurate, tamper-proof data, fostering collaboration and reducing disputes. RPA, by automating time-consuming tasks, frees up valuable resources and enables procurement teams to focus on more strategic activities such as supplier negotiation and risk management. T

he automation of routine processes also reduces human error and ensures compliance with contractual terms and regulations. Collectively, these technologies enable procurement teams to make faster, data-driven decisions, enhance supplier performance, and mitigate risks more effectively. This transformation results in cost savings, improved operational efficiency, and the creation of a more resilient, adaptable procurement system capable of responding to the dynamic demands of global supply chains.

To fully leverage the benefits of Blockchain and RPA in procurement, both policy makers and procurement managers need to adopt a strategic approach to technology integration. Policymakers should create clear regulatory frameworks that address the legal complexities of blockchain, particularly in relation to data privacy and cross-border transactions. By establishing guidelines for blockchain adoption, governments can provide organizations with the clarity needed to move forward with confidence. For procurement managers, the focus should be on selecting scalable, interoperable systems that integrate seamlessly with existing infrastructure.

Additionally, training and upskilling procurement professionals in emerging technologies is essential to ensure successful adoption and utilization. Managers should also foster a culture of innovation, encouraging the exploration of new technologies while addressing potential resistance to change within the organization. Finally, managers should prioritize the continuous monitoring and improvement of blockchain and RPA systems to stay ahead of emerging risks and maintain competitive advantages.

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