**Title: Integrating AI, Blockchain, and Data Science for Enhanced Decision-Making in Supply Chain Management**

**Abstract**

Artificial Intelligence (AI), Blockchain, and Data Science intersection present unprecedented opportunities for revolutionising supply chain management. This research proposal aims to develop an integrated framework leveraging these technologies to enhance supply chain transparency, efficiency, and decision-making. The proposed framework will employ AI in predictive analytics, Blockchain in secure and transparent transactions, and Data Science for data integration and analysis. The anticipated outcome is a robust, data-driven decision-making system that addresses current supply chain challenges and improves operational efficiency.

**Introduction**

Supply chain management is critical to business operations in today's globalised economy. However, traditional supply chains face numerous challenges, including a lack of transparency, inefficiencies, and vulnerability to fraud. Recent advancements in technology provide new avenues for addressing these challenges. AI, Blockchain, and Data Science offer complementary strengths that, when integrated, can transform supply chain management.

AI can be used to make predictive analytics to forecast demand, optimise inventory levels, and evaluate supplier performance. Blockchain technology ensures secure and transparent transactions, enhancing trust among supply chain partners. Data Science techniques facilitate the integration and analysis of large datasets, providing actionable insights for decision-making. This research proposes an integrated framework that leverages these technologies to enhance supply chains' transparency, efficiency, and decision-making capabilities.

**Literature Review**

**AI in Supply Chain Management**

AI has been widely adopted in supply chain management for various applications, including demand forecasting, inventory optimisation, and supplier evaluation. Ivanov et al. (2019) demonstrate the potential of AI to enhance supply chain resilience through predictive analytics and machine learning algorithms. AI models can analyse historical data and identify patterns that help predict future demand, reducing the risk of stockouts or overstock situations. AI can also optimise inventory management by determining optimal reorder points and quantities, leading to cost savings and improved service levels.

Another significant application of AI in supply chains is supplier evaluation. AI algorithms can assess suppliers based on various criteria, such as delivery performance, quality, and cost. This helps companies select the best suppliers and negotiate better terms, improving overall supply chain performance.

**Blockchain in Supply Chain Management**

Blockchain technology has gained considerable attention because of its potential to amplify transparency and security in the supply chain. Saberi et al. (2019) highlight Blockchain's role in improving traceability and reducing fraud in supply chains. Blockchain creates an immutable record of transactions, ensuring that all supply chain activities are verifiable and transparent. This is particularly important in industries where product authenticity and safety are critical, such as pharmaceuticals and food.

Blockchain can also streamline processes by reducing the need for intermediaries and manual record-keeping. Smart contracts, which are self-executing with the terms and conditions of the agreement directly transformed into code, can automate various supply chain activities, such as payment processing and compliance verification—leading to faster and more efficient transactions and reducing delays and costs.

**Data Science in Supply Chain Management**

Data Science techniques are crucial for analysing the vast amounts of data generated in supply chains. Waller and Fawcett (2013) discuss how Data Science enables the extraction of meaningful patterns and trends from large datasets, facilitating informed decision-making. Data Science can analyse data from various sources, such as IoT devices, transactional records, and historical data, to generate insights that improve supply chain performance.

For example, Data Science can identify supply chain bottlenecks, predict potential disruptions, and recommend corrective actions. It can also help optimise transportation routes, reducing delivery times and costs. Additionally, data science can analyse customer data to comprehend buying behaviour and preferences; by utilising the gathered data, companies can tailor their products and services to better align with customer demands.

**Methodology**

The proposed research will follow a multi-phase approach:

1. **Framework Development**: Design an integrated framework combining AI, Blockchain, and Data Science for supply chain management. The framework will outline how these technologies can address current supply chain challenges and improve decision-making.
2. **Data Collection**: Gather data from various sources, including IoT devices, transactional records, and historical supply chain data. This data will train AI models, validate Blockchain transactions, and perform Data Science analyses.
3. **AI Implementation**: Develop machine learning models for demand forecasting, inventory management, and supplier evaluation. These models will be trained on the collected data and validated using historical data.
4. **Blockchain Integration**: Implement Blockchain technology to ensure secure and transparent recording of supply chain transactions. This will involve setting up a Blockchain network, creating smart contracts, and integrating the Blockchain with existing supply chain systems.
5. **Data Analysis**: Data Science techniques analyse the collected data and generate actionable insights. This will involve data preprocessing, exploratory data analysis, and the development of predictive models.
6. **Framework Testing and Validation**: Test the integrated framework in a real-world supply chain environment and validate its effectiveness. This will involve implementing the framework in a pilot project, monitoring its performance, and making necessary adjustments based on feedback.

**Datasets**

The research will utilise the following datasets:

* **Transactional Data**: Records of supply chain transactions from Blockchain-enabled systems. This data will include information on product movements, payments, and compliance activities.
* **IoT Data**: Sensor data from IoT devices tracking inventory levels, shipment conditions, and other relevant metrics. This data will monitor supply chain activities in real-time and provide inputs for AI models.
* **Historical Data**: Historical supply chain data for training AI models and validating predictions. This data will include past demand, inventory levels, supplier performance, and transportation routes.

**Conclusion**

The research proposal aims to create a comprehensive framework that leverages the strengths of AI, Blockchain, and Data Science to address critical challenges in supply chain management. By integrating these technologies, the proposed framework will enhance transparency, efficiency, and decision-making, ultimately leading to more resilient and optimised supply chains. The anticipated outcome is a robust, data-driven decision-making system that can be applied to various industries, improving overall supply chain performance and competitiveness.

**Citations**

* Ivanov, D., Dolgui, A., Sokolov, B., Ivanova, M., & Potryasaev, S. (2019). "Blockchain-based supply chain dynamic control: An agency perspective." International Journal of Production Research, 57(7), 2028-2044. DOI: 10.1080/00207543.2018.1488086
* Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). "Blockchain technology and its relationships to sustainable supply chain management." International Journal of Production Research, 57(7), 2117-2135. DOI: 10.1080/00207543.2018.1533261
* Waller, M. A., & Fawcett, S. E. (2013). "Data Science, predictive analytics, and big data: A revolution transforming supply chain design and management." Journal of Business Logistics, 34(2), 77-84. DOI: 10.1111/jbl.12017