Full Process Artificial Intelligence and Blockchain based Supply Chain Risk Control Model and Operation Management System

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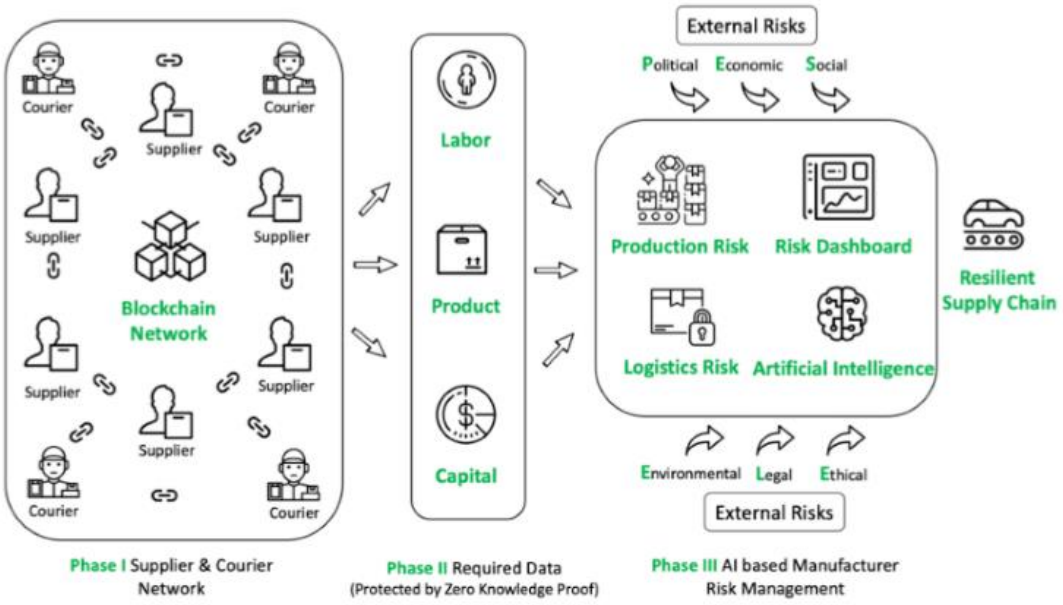

Figure 1: Full Process AI and Blockchain based Supply Chain Model and Operation System

1 Overview

Due to the Covid and unstable international situation, there is an increasing concern for the supply chain, especially for the automotive industry. According to Dabo Guan's team on Nature Human Behaviour, billions of economic loss has been caused by the Covid-19 [1]. Approaches to enhance risk management level in operational management are the industry's leading concerns.

Deep learning-based Artificial Intelligence tools are becoming more popular in the industrial domain for research purposes in a higher accuracy approach [2]. Additionally, the blockchain system offers an innovative approach for building a trustworthy data storage system [3]. Artificial Intelligence is building effciency improvement based on productivity, while the Blockchain brings effciency based on production relationships. Therefore, this research focuses on applying Blockchain and Artificial Intelligence's application in the supply chain logistics domain to identify and monitor potential supply

chain risks before directly impacting its production capabilities. For example, due to the unstable situation in Ukraine, the supplier's ability for production may be influenced [4]. In our system, the highly correlated determining factors of the production system will be selected. The associated risk prediction model will be based on the natural language processing techniques for determining the risk level for future delay of the operation. Furthermore, a real-life car manufacturing network has a long chain of suppliers. It is the supplier's supplier's delay that influences the whole system, and the benchmark network cannot accurately identify these deep layer-based bottleneck suppliers [5].

Specifically, the PhD studies will investigate state-of-the-art risk management systems to enhance supply chain resilience. To optimise the current strategy, the PhD candidate is determined to understand the variety of risks the company faces and how potential disruptions can most effectively be traced, predicted, and mitigated. Furthermore, in-depth company case studies and interviews could be conducted for the specific improvements.

The PhD candidate will first utilise Artificial Intelligence Techniques to build the automated decision-making and risk indicator prediction model. Then, a Blockchain-based mechanism will be established in the trustworthy decentralised supply network for dynamic ordering risk prediction and consensus [6]. The joint approach will enable a dive into the automotive supply chain. The scholar will identify leading technologies and data for risk management and benchmark how other companies and industries operate their supply chains. Furthermore, the researcher will also recommend how automotive manufacturers can optimise their supply chain and risk management in the automotive sector to strengthen a strong position in the market.

2 Objectives

The main goal of the PhD research is to identify best practices, systems, and data points for a set of supply chain risks that when combined with blockchain and artificial intelligence to establish an early warning system for an automative manufacturer's multi-tier supply chain enhancing its overall resilience. The researcher is expected to predict with reasonable confidence, when, how, and where a specific risk will materialise. Systematic literature review and corresponding risk management system will be designed. For the literature review, the existing solution of the domain for bringing the complex, multi-user supply chain is evaluated in the comprehensive search manner. For

the Risk Management Systems design, a detailed evaluation of the data sources from Automotive manufacturer to evaluate the corresponding for the real-world supply chain risks in the domain. Specifically, it is expected to identify and combine data sources and how to reduce them to the essential information.

3 Methodology

This research will introduce a combination of the quantitative and qualitative approaches since it is located right at the cutting edge between the technical and management domain. The quantitative research will be related to mathematical modelling, algorithm simulation, statistical analysis [7]. On the other hand, the qualitative approach will include interviews, case studies, and questionnaires, especially for researching and evaluating the stakeholders in the supply chain logistics domain, in gathering their actual requirements and feedback [8].

Concerning the fieldwork, it is expected to visit Caterpillar Inc., one of the world's largest machinery engines companies, to evaluate how the global supply chain logistics system pain point can be improved using this AI and Blockchain approach [9]. It is actually based on the connections from Veronica for this valuable opportunity. As for the industrial collaboration or sponsorship, currently, there is no offer yet, but I can always find my industrial collaboration, and I am expected to have one in the future if I keep on searching and researching. My approaches are divided into three steps, which are firstly exploring the potential connections from Veronica, then exploring the potential connections from ifm Engage, and finally exploring the potential connections from Engineering Department and Judge Business School.

4 System design (Figure 1)

Specifically, the Blockchain network is combined with automotive suppliers and couriers, as the Blockchain network in storing the confidential data in a trustworthy manner. On that network, the supplier should report labour, product, and capital status based on the data protection system based on Zero-Knowledge Proof System [10]. Specifically, the labour factor considers whether there is a lack of staff storage for itself or the upper stream supply chain. The product factor will report components and finished product status with the production cycle, technical specification, and quality control. Furthermore, the capital factor is divided into liquid assets and fixed assets to predict future system risk

[11]. Specifically for carrier nodes, it will provide the tracking-based location, including the means of transportation, GPS location, velocity, direction, and responsible person for a responsible risk assessment.

The production and logistics risk engines based on the Artificial Intelligence, Risk prediction models will be trained and deployed in the automotive manufacturer risk management division. The deep learning or decision tree-based models can be used as a production risk benchmark. The graphical neural network will provide the emerging solutions in a higher prediction estimation for the logistics risk. Finally, the corresponding risk visualisation dashboard will be demonstrated in assisting the manager's real-life decision making experiences. Finally, it will provide a resilient supply chain in the domain.

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