Cloud Computing and Digital Twins for Smart Logistics

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Introduction

The swift and ongoing advancement of digital technologies has had a profound impact on the operational dynamics of logistics and supply chain management (in Agriculture), significantly altering how these systems function. The confluence of cloud computing technologies and digital twin innovations within the realm of smart logistics has fundamentally transformed the methodologies employed in supply chain management, with notable enhancements observed in areas such as real-time monitoring capabilities, predictive analytics, and overall operational efficiency. Traditional logistics management systems frequently encounter substantial issues related to fragmented data, which hinders their overall effectiveness, as well as limited predictive capabilities and inefficient resource allocation mechanisms, all of which contribute to operational delays, escalated costs, and substantial environmental inefficiencies.

Methodology

Using a mixed-methods approach, this study investigates the implications of digital twins in logistics operations by combining quantitative and qualitative analysis. The quantitative component uses secondary data gathered from web sources that concentrate on cloud computing applications in logistics to evaluate important performance criteria, such as carbon footprint, cost savings, and delivery time efficiency. Expert interviews and industry case studies are included in the qualitative component, which incorporates responses from 250 respondents to guarantee a range of viewpoints. A breakdown of completed interviews and non-responses is used to ensure transparency. Predictive logistics algorithms (such as regression, time series forecasting), anomaly detection (such as k-means, DBSCAN, auto encoders, LSTMS), and optimisation (such as reinforcement learning, genetic algorithms) were also applied to enhance decision-making and operational performance.

Result and discussion

This conference paper delves into the intricate synergies that exist between cloud-based infrastructure and the emerging digital twin technology, specifically within the logistics sector, engaging in a comprehensive analysis of their critical roles in the optimisation of various logistical processes, including but not limited to transportation management, inventory oversight, and demand forecasting practices. Furthermore, the myriad challenges associated with their implementation outline effective strategies for overcoming these obstacles, and investigate potential future trends that are likely to shape this rapidly evolving and transformative domain.

Conclusion

The synergistic blend of cloud computing and digital twins is revolutionising intelligent logistics by establishing real-time visibility, operational efficiency, and predictive analytics. By transcending data security, interoperability, and cost hurdles through strategic rollout, organisations can tap into game-changing opportunities to build robust and dynamic supply chains. Future developments, including breakthroughs in AI, IoT, and 5G, will further enhance the functionality of these technologies, challenging logistics firms to embrace digital transformation to remain at the forefront. This study identifies the necessity for pioneering frameworks and comparative studies in pushing forward with the successful integration of cloud-hosted digital twins, finally yielding innovation, efficiency, and sustainability in global logistics operations.

Keywords: Cloud computing technologies, Digital twin innovations, Real-time monitoring, Predictive analytics, Smart logistics and Supply chain management,