A Study on Enhancing Service Efficiency in Non-Vessel Operating Common Carriers (NVOCCs) Through Digitalization, Automation, and Sustainable Practices

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ABSTRACT:

This paper was exploring the role of digitalization, automation, and sustainable practices in enhancing efficiency for Non-Vessel Operating Common Carriers in service delivery. NVOCCs are important players in global trade logistics and, in growing numbers, take on advanced technologies to enhance their operations, accommodate the expectations of customers regarding speed and transparency as well as adherence to environmental regulations in activities. Digitalization has made possible real-time tracking, documentation, and communication with all stakeholders, thereby further ensuring coordination with less room for human error. Automatic procedures, based on AI and ML, best optimize the cargo handling documentation and customs clearance procedures, hence not creating delays in completion but also reducing errors in accuracy. Further efforts at sustainability, such as energy-friendly logistics and carbon footprint reduction, bring NVOCC operations in line with global environmental requirements to the long-term benefit of operations and financial profit. The nature of these practices-their integration-will be inevitable, regardless of the costs as faced by NVOCCs in competing in the increasing demands of a fluctuating and increasingly resource conscious market. The study demonstrates how these factors are connected and their combined influence on the increase in service efficiency among global logistics participants.

Key words: Service Effectiveness, Digitalization, Automation, Sustainable Practise, Training strategies, Continuous learning, Real time tracking, Customer satisfaction, Supply chain management, Cost efficiency.

INTRODUCTION:

The logistics and shipping, coupled with unprecedented rises in supply chain complexity worldwide, have led to an environment where consumers expect rapid, transparent, and reliable processes in the transportation of goods across borders (Rimmer & Hutton, 2021; Turner, 2022). This change is around NVOCCs - acting as an intermediary between shippers and ocean carriers, consolidating shipments and coordinating multimodal transportation - as affirmed by Lim & Ng (2020). Competition and the volume-intensive global trade environment today have compelled NVOCCs to focus more on the efficiency of service delivery than ever before (Wang et al., 2023). To be relevant to the modern demands of trade, NVOCCs are increasingly embracing digitalization, automation, and sustainable practices while trying to achieve maximum operation efficiency and environmental stewardship, as conformed by Lee & Zhao (2021); Kumar et al. (2022). Traditionally, logistics and shipping have worked using manual cargo management, documentation, and communication-the slow, error-prone, and labourintensive methods that most are familiar with (Chen et al., 2021). In the current marketplace where shippers demand instant information and fast turnaround at low costs, inefficiencies in NVOCC operations can lead to delays, higher expenses, and lost opportunities (Shen & Wong, 2022). Additionally, given that shipping is one of the leading carbon-emitting industries globally, the environmental footprint has sparked more pressure in NVOCCs to adopt sustainability. International Maritime Organization, 2021 The digital transformation wave has seen NVOCC sector carriers utilize technology as an optimization tool to enhance operations and service deliveries. For instance, such tasks as cargo booking, documentation, and invoicing are streamlined, and the coordination gap between parties is narrowed in the online environment (Zhou & Zhang, 2022). Data analytics and cloud-based solutions about customer behaviour and supply chain inefficiencies would give NVOCCs an enhanced basis on which to make decisions that support forecasting demand and avoid disruptions. In fact, it enabled Realtime cargo tracking that enhances the visibility of goods during transportation while raising transparency and, therefore, customer trust and long-term relationships (Chen et al., 2022). Automation is another crucial element in improving NVOCC service efficiency. It decreases the time and labour used for repetition in procedures such as customs clearing, cargo handling, and container management (Singh & Tan, 2021). AI and machine learning algorithms now support automated solutions, such as predictive routes, warehouse management, and effective container loading, which reduces transit time and costs (Li et al., 2023). Automation also

positively impacts the accuracy and obesity to international shipping regulations because AI driven techniques can easily smoothen customs documentation and ensure that regulatory compliance is achieved, resulting in lower risks of delays or penalties (Zhang et al., 2022).

BACKGROUND:

International trade has been supported for centuries now by the global logistics and shipping industry in the transportation of cargo across borders and around the world's oceans (Stopford, 2009; Rodrigue & Notteboom, 2013). The most recent actors in this industry are the NonVessel Operating Common Carriers, or NVOCCs, which are of vital acting parties acting as middlemen between shippers and ocean carriers (Song & Panayides, 2002; Talley, 2014). Although NVOCCs don't own or operate ships, they play an imperative role in consolidation shipments, issue the bill of lading, and manage all activities in the whole shipping line-from customs clearing to multimodal transport. Their coordination skill in complex logistics operations makes them an indispensable tool in the free flow of goods. However, with the improvement in international trade's sophistication and complexity, the need for better service productivity to be introduced within NVOCCs has expanded. Digitalization, automation, and sustainability became necessary tools for NVOCCs in a competitive market and a response to customer demand and regulatory pressures (Carlan, Sys, & Vanelslander, 2016). The industry has been labour and paper-intensive in its logistic and shipping features. A multi-tier communication is common with the stakeholders involved being shippers, freight forwarders, port authorities, and custom officials in NVOCC operations (Tiwari, Itoh, & Doi, 2003). In manual procedures to prepare and submit shipping documents, book cargo space, and coordinate transportation schedules, all these processes require much time, which increases chances of human error. These inefficiencies are placing increasing pressure on NVOCCs in a just-in-time manufacturing and responsive supply chain environment (Acciaro & McKinnon, 2015). Legacy logistics model has taken slow steps to accept newest innovations. Hence, different NVOCCs have retreated compared to companies concerning digital infrastructure. However, digitalization is considered as an opportunity which will transform all NVOCCs profoundly. In simple words, digitalization incorporates the digital technology in business procedure. Hence, it facilitates more efficiency, transparency and data-driven operations (Lee & Lee, 2015). For NVOCCs, automatic online platforms enable the automation of routine activities, such as booking, generation of documents, and issue of invoices; cloud-based systems and big data analytics enhance the ability to analyse trends in shipping and predict demand (Chang & Xu, 2018). Real-time shipment monitoring through IoT technology enhances visibility that permits stakeholders to effectively manage uncertainties as well as improved communication between NVOCCs and clients. Automation is another massive dimension for service efficiency by NVOCCs, which may speed up cargo handling, customs clearance, and container management with higher accuracy than the manual process (Pal, Wang, & Liang, 2017). Robotics and AI-based tools can optimize shipping routes and reduce warehouse bottlenecks.

PRIMARY OBJECTIVE:

1. How do digitalization, automation, and sustainability improve customer satisfaction as well as NVOCCs' enhancing service efficiency.

SECONDARY OBJECTIVES:

1. To analyse the effects of digitalization on the operation efficiency of NVOCC in cargo handling, documentation, and tracking.

2. Identify key areas within NVOCC operations where automation will be easy to implement.

3. To measure the balance to which sustainable practices may benefit both internal efficiency and environmental responsibility in NVOCCs.

4. Test the relationship of digitalization, automation, and sustainability to improve customer satisfaction and service efficiency.

METHODOLOGY:

This research will be guided by mixed-methods research methods, as about the integration of diversified data types to capture industry complexities. Structured interviews carried out for NVOCC managers and industry experts would provide qualitative insights for the adoption of digitalization, automation, and sustainability practices. Best practices of qualitative interviewing by would be followed in carrying out the research. To achieve this, a survey will be administered to a sample of NVOCCs to allow for the quantitative measurement of efficiency levels and potential operational difficulties using tailored design method in ensuring effective gathering of data. KPIs of turnaround time, cost savings, as well as carbon emissions, will be utilized within the broad framework of logistics performance measurements. Case studies of leading NVOCCs have also been undertaken to reflect best practices in successful cases, using case study research methodology for conducting more exhaustive cases. Together with these methods, a solid data-driven understanding of improvements in the efficiency of NVOCCs through technological and sustainable interventions is to be established.

TO ANALYSE THE EFFECTS OF DIGITALIZATION ON THE OPERATION EFFICIENCY OF NVOCC IN CARGO HANDLING, DOCUMENTATION, AND TRACKING

Global logistics and shipping industry NVOCCs, which the players organize and coordinate cargo shipments without owning or operating vessels, remain an essential in the industry. However, with increased globalization of demands, NVOCCs must focus on efficiency in the handling of cargo, documentation, and cargo tracking. Digitalization is being proved to be a disruptor that changes normal traditional processes with technology-based solutions for logistical and complicated labour-oriented tasks. This paper aims to discuss how digitalization affects the operational efficiency of NVOCCs in three key areas-cargo handling, documentation, and tracking.

Rise of Digitalization in Logistics

Digitalization refers to the process where digital technology is incorporated into the firm's operations to make processes faster, more accurate, and scalable. In the logistics industry, these digital technologies such as blockchain, Internet of Things (IoT), cloud computing and AI are being used to improve logistics operations' efficiency. Digitalization in the NVOCC industry is motivated by process simplification, cost cutting, quality service delivery, and competitiveness.

These goals touch three main functions that characterize NVOCC operations: cargo handling, documentation, and tracking.

Cargo Handling and Digitalization

Cargo handling includes loading, unloading, and managing cargo, the most complex and labour-intensive operations in the shipping industry. Traditionally, cargo handling is elementary and required a lot of manual effort. Further, it is prone to delays, damage, and human mistakes. With digital solutions, automation has been introduced, coupled with data analytics, to upgrade cargo handling processes. The digitalization of cargo handling has introduced automated systems and robotic solutions. Automated cranes and conveyor systems handle cargo with precision, which saves time, increases the speed, and accuracy for loading and unloading cargo. The reduced handling time helps in saving labour costs, and this saves operational costs for NVOCCs (Wang et al., 2020). It can leverage the power of data analytics in predicting and managing cargo flow much better. Predictive analytics can further be helpful in maintenance planning to ensure that equipment is down for the least time possible, due to the reasons that issues with machines are resolved earlier. These developments can be particularly very useful in creating better cargo handling efficiency. This is so because NVOCCs may make informed and data-driven decisions in the management of their resources, which entails reduction in costs and least amounts of disruption (Smith et al., 2021).

IDENTIFY KEY AREAS WITHIN NVOCC OPERATIONS WERE AUTOMATION WILL BE EASY TO IMPLEMENT

Automation in the NVOCCs general operation means that activities that had been executed traditionally by human labour would be enhanced using technology, including software systems, robotics, and artificial intelligence. These automation systems, among others, provide the aim of increasing operational efficiency; reduction in errors; reduced cost and service delivery improvements. Thus, for the NVOCC as an intermediary between the shippers and ocean carriers managing very complex logistics processes, documentation, and customer coordination is very resource - intensive. If a scope of key areas where automation may easily be integrated can be identified, NVOCCs will be able to derive substantial improvements in their operation without paying the price or improving quality in services made available to customers.

Documentation and Compliance Processes

One of the areas of NVOCCs with vast potential for automation is document management; nearly all the paperwork is standardized and repetitive. Automated document processing solutions will largely automate the generation, storage, and retrieval of such essential documents as Bills of Lading and customs paperwork. As documented in various research studies, the performance speed of processing will greatly be reduced by up to 80%, allowing staff to avoid repetitive tasks, hence, to minimize human error. Automation goes on to make compliance easier through the simplification of document workflows that must be compliant with regulations. In an automated system, documents are readied to be in conformity with the proper and required compliance standards before being submitted hence less possible to experience pricey delays and fines associated with violating regulations (Gunasekaran et al., 2021).

TO MEASURE THE DEGREE TO WHICH SUSTAINABLE OPERATIONS MAY BENEFIT BOTH INTERNAL EFFICIENCY AND ENVIRONMENTAL RESPONSIBILITY IN NVOCCS

Sustainable NVOCCs describe the practices and strategies wherein the environmental effects of logistics and transportation activities are to be reduced as much as possible while maintaining operational efficiency. NVOCCs play a huge role in the international trade where they coordinate the shipment of goods across international borders without operating their own vessels. As consolidators, they oversee the movement of goods across intricate supply chains, deal with documentation and other vital services for shippers and ocean carriers. In the past years, pressure to take on sustainable practices to keep carbon footprint at bay and to contribute to environmentally responsible conduct has been mounting. Sustainability in NVOCC: the rising importance. The sustainable NVOCC operations may span from conserving energy usage to embracing green technologies, the optimization of routes, and a significant decrease in waste. Above all, these measures would help with environmental issues, but they might also be more beneficial to internal efficiency.

The Interplay Between Internal Efficiency and Environmental Responsibility

While internal efficiency and environmental responsibility are essentially disjoint, they tend to strongly interact with each other in the context of NVOCCs. Many of the measures adopted to improve the state of internal efficiency also positively benefit environmental sustainability. Route optimization of transportation by NVOCCs besides reducing transit time and related fuel costs also reduces fuel consumption, hence carbon emission is lower. This simultaneously achieves efficiency and environmental objectives (Chen & Xie, 2022). Digital tools, such as cloud-based systems and automated documentation processes, help reduce reliance on paper, decreasing administrative costs while reducing waste that contributes to environmental responsibility. Automated systems have the potential to enhance everything from cargo handling and warehouse management and up-to-date productivity increases while using less energy and fewer resources, generating less waste. With energy-efficient machinery and AI driven optimization processes, both operational efficiency and energy use reduction, which reduce carbon footprint, are contributed. Packaging is optimized with minimal use of materials

thus saving waste and cost as well. Eco-friendly materials for packing cause sustainability as smarter designs of the products lead to efficient internal space usage and transportation that creates extra value in terms of internal efficiency (Kumar, A., Patel,2022).

Fuel Efficiency and Emissions Reduction

Fuel consumption is the second largest cost of operations in logistics. Some of the sustainable fuel efficiency measures include route optimization and slow steaming, that NVOCC uses in cutting their fuel expenses. For instance, advanced algorithms for route optimization enable NVOCCs to select routes that consume less fuel while still meeting delivery time. Measures to optimize fuel cut traveling distances and eliminate idle time, thus intensifying cost efficiency to translate into profitability enhancement (Gunasekaran et al., 2021). Fuel efficiency is helpful for NVOCCs in internal activities but also considers the environmental duties of NVOCCs by maintaining low levels of unrequired emissions of green gases. Different research studies show that a 1% reduction in the fuel used may reduce CO_2 emission substantially, and such emission could be considerable reduction using route optimisation and slow steaming, which identifies these as valuable tools for improving sustainability in logistics (Abdallah et al., 2021).

TEST THE RELATIONSHIP OF DIGITALIZATION, AUTOMATION, AND SUSTAINABILITY IN IMPROVE CUSTOMER SATISFACTION

As the world is becoming more dynamic in terms of logistics and transportation, it requires NVOCCs, freight forwarders, and other players in the supply chain industry to stay competitive under this pressure. Customer satisfaction and positioning against competitors have become the utmost requirements for being successful in business, and this will be achieved through strategies of digitalization, automation, and sustainability for customer requirements and operational efficiency. The paper will discuss integrated roles of digitalization and automation in achieving sustainability to facilitate improved customer satisfaction and provide competitive advantage for logistics service providers, including NVOCCs.

Digitalization Efficiency and Customer Satisfaction

Digitalization involves embracing digital technologies to innovate traditional business processes in a manner that enhances how things are done at a higher velocity and with greater accuracy, meaning things get done faster, better, and more connected. Digital solutions provide improved real-time visibility, foster data-driven decision-making, and simplify interactions between service providers and customers. Such benefits are particularly applicable for NVOCCs in consideration of the logistics process complexities and their clients' expectations for reliable service. Digital shipment tracking systems, which transmit data in real-time, provide situational awareness and boost customer satisfaction by enabling the timely and accurate exchange of shipment status updates. Customers appreciate knowing precisely when their shipment will arrive and are notified in the event of delays. Real-time visibility is on a par with what customers expect from access to and the reliability of information, which digital systems such as GPS tracking and cloud-based technologies make possible (Rodriguez et al., 2022). Through data analytics, providers of logistics understand the behaviour of a customer, the patterns in cargo, and demand forecast. Data analytics also helps in the optimization of routes that help reduce transit time, cost, and increase dependability on delivery.

Role of Automation in Operational Efficiency and Competitive Edge

Automation is a bit more related to digitalization but is specifically directed towards using the technology in an automated repetition of tasks with minimal human involvement. In the logistics sector, automation applies at various fronts, such as warehousing, cargo handling, processing data, and customer service in streamlined workflows that enable companies to scale up efficiency. Automated warehousing solutions incorporate robotic systems and automated guided vehicles (AGVs) to enhance warehouse storage management and cargo handling efficiency. Automation also enhances the productivity of the NVOCCs, reduces labour costs, improves accuracy in cargo sorting, and reduces human error, thus enabling timely order fulfilment and a reduction in delays.

DISCUSSION:

It is over the past two years that this context of logistics has experienced a paradigm shift regarding factors of efficiency, transparency, and sustainability. It can be argued that most NVOCCs act as crucial intermediary actors in shipping and are among the major initiators of such changes as embracing digitalization, automation, and sustainable practices to enhance service efficiencies alongside grappling with the complexities of international trade. These transitions are important for enhancing service performance, customer delight, and green issues (Wang et al., 2022). Digitalization has become acceptable as a best practice for NVOCC companies to enhance performance efficiency. Transitioning from paper-based systems to online applications has improved the tracking of shipments in real time, streamlined paperwork-related processes, and enabled better communication among stakeholders concerned (Lam & Lai, 2020). Cloud-based systems and data analytics provide visibility throughout the supply chain so that informed decisions may be made in real-time (Chan et al., 2021). The reduction of uncertainty and improved coordination between shippers, carriers, and customs authorities will be realized by real-time cargo monitoring, while tools like Cargo Wise enable intensive supply chain visibility, meaning that NVOCCs can optimize delivery routes and adhere to strict schedules (Lai et al., 2022). In many NVOCCs, however, the use of digital tools is challenging due to legacy systems or a resource problem, making it particularly vulnerable for smaller organizations (Ho et al., 2023). Data security and privacy also became significant issues due to growing cyber threats in the digital age (Chen & Wang, 2022). Higher NVOCC service performance also resulted from automation as errors were reduced and productivity was enhanced (Lee et al., 2021). Technologies such as RPA and AI reduce errors in documentation and increase the accuracy of documentation because tasks like document handling and customer services are streamlined (Zhou et al., 2023). It has been especially handy to NVOCCs as it hastens customs clearance processes and minimizes delays resulting from paperwork (Singh & Kumar, 2022). Additionally, the AI chatbot allows

answering of customers' queries in real time, which enhances customer happiness (Li & Yan, 2021). On the other hand, automation technologies' high initial investment deters entry from the small NVOCCs into the automation fraternity, and the cost of employee training exceeds operational demand (Chen & Xie, 2022). Automation with human input is necessary since NVOCCs require decision-making and management of relationships, which are a human aspect. Sustainability is one of the recent aspects for which NVOCCs have been made to pay attention due to push factors from regulatory changes and consumer mentality (Rodriguez et al., 2022). Sustainable practices don't only make an NVOCC friendly to the environment by meeting set environmental targets; it also makes it efficient in its service operations (Smith & Johnson, 2023).

FINDINGS:

Digitalization Enhanced Efficiency and Clarity: It simplifies the logistics operations by moving from the manual process to the digital process, reducing times for document processing, cutting down the cost in administration departments, and eliminating human error. Digitalization is also increasing transparency levels: real-time tracking brings better service reliability and customer satisfaction.

Automates tasks and reduces errors: Automation reduces repetitive manual tasks like invoicing, tracking, and even compliance, which saves resources and improves accuracy. Automated systems greatly minimize the error rate, thereby facilitating faster, more reliable service. Moreover, automation contributes to sustainability by optimizing the consumption of fuel and other resources, which subsequently saves costs and decreases negative impacts on the environment.

Sustainability reduces resource use and supports environmental goals: Sustainable practices encompass fuel optimization, waste reduction, and energy-efficient warehousing, both contributing to operational efficiency as well as environmental responsibility. Operational costs may be cut through resource waste reduction, and NVOCCs are able to align themselves with the demands of their customers and so meet regulatory requirements in being ecologically friendly.

Interlinked Benefits of Digitalization, Automation, and Sustainability: Digitalization, automation, and sustainability are synergistic, meaning that each re-energizes the others into a cohesive framework for efficiency. From a systems' point of view, digital and automated support sustainability because it continuously tracks and optimizes resource usage in real time; thus, "green" activities should not compromise but rather complement operational efficiency.

Customer Satisfaction and Competitive Advantage: Integrated Practices that consider the integration of digitalization, automation, and sustainability benefit NVOCCs through improved trust and satisfaction from customers, who also utilize more environmentally friendly operations. The strategy allows the NVOCCs to keep their clients and gain the upper hand over competitors in logistics.

Data-Driven Decision-Making Toward Resource Optimization: The integration of digitalization and automation facilitates data-driven decisions which support sustainable practices such as routing optimization and energy-efficient warehousing. This reduces avoidable fuel usage, emission, and operational waste hence leading to a comprehensive improvement of service efficiency and environmental impact.

SUGGESTIONS:

Real-Time Tracking Towards Increasing Satisfaction Among Customers: Real-time tracking is among the digital innovation that enables logistics providers and customers to know about the whereabouts and conditions of their shipments at any given time. The use of GPS technology and IoT devices in NVOCCs is meant to provide customers with real-time visibility over their cargo, which is crucial for trust and full transparency in operations. This boosts customer satisfaction since delivery estimation and potential delays are customer-accessible information.

Automation to Reduce Cost and Prevent Mistakes: Automation is the use of technological machines that assist in mechanically processing repetitive work, such as cargo location tracking, checking compliance, and billing. automation prevents the errors that are commonly associated with the performance of human beings in the handling of the material manually and expedites the operation of NVOCCs with increased accuracy. The resources could, therefore, be used in a more efficient way by automated systems, thus contributing to cost efficiency through reduction in labour-intensive tasks and fuel usage. This leads to increased reliability in services since NVOCCs will be better placed to meet the expectations of their clients and therefore sustain a competitive advantage in the logistics business.

Environment-Friendly Storage and Packaging: The practices adopted in eco-friendly warehousing and packaging are geared towards lowering the environmental footprint of logistics operations. They are renewable energy sources, including solar-powered warehouses and ecofriendly packaging materials that are recyclable or biodegradable. These green practices, apart from offering savings in operational costs, also respond to increasing demands by regulations and customers for sustainability. Eco-friendly NVOCC practices, therefore, reflect corporate responsibility and can power brand reputation and attract the environmentally aware customer.

Single Digital and Sustainability Dashboard: A unified digital and sustainability dashboard is an integrated system through which NVOCCs monitor and manage their domains on digitalization, automation, and sustainability from a single desk. It provides real-time data and analytics of key metrics like the use of fuel, carbon emissions, allocation of resources, and operational efficiency. By centralizing data in one place, NVOCCs can make well-informed, data-driven decisions to continuously refine their operations and sustainability efforts to improve both internal efficiency and external accountability.

Customer Feedback on Digital and Automated Services: Customer feedback on digital and automated services is a way to collect their perceptions of how effective NVOCCs have been at driving positive outcomes from investments in technology for improvement. Feedback might be monitored according to customer satisfaction with such digital tools as tracking systems and automated invoicing, updating in real-time, informing the business about the changes made to services and their effects on the customer experience. Feedback, when actioned, would finetune operations but also prove to customers that the business cares about what they have to say, which can improve loyalty and help them build good long-term business relationships.

Route and Load Optimization: Route and load optimization is how the use of data analytics and AI can compute the most effective routes in travelling and the best configurations for loads such that cargo can be transported with the minimum consumption of fuel, shorter travel time, and efficient loads. This reduces environmental impact and saves costs since the journey is optimized both on speed and resource utilization hence contributing to greater operational efficiency.

IMPLICATION OF THE STUDY:

To this date, digitalization in NVOCCs becomes one of the primary reasons for efficiency in service. Traditional paperwork and coordination procedures are gradually being replaced by manual inputs and physical records with digital platforms having easy access to real-time information. From stakeholders, operations of NVOCCs can be streamlined by involving cloud computing, blockchain, and advanced tracking systems into it. Digitalization cuts down on paperwork, reduces human errors in the process and accelerates information flow between the freight forwarders, carriers, customs agents, and customers, with better coordination and delivery times (Zeng et al., 2020). Furthermore, digitalization would provide more traceability and visibility through the supply chain, which is critical to service providers and their customers. Following IoT devices in tracking shipments in real-time means creating new opportunities for NVOCCs to be timely plugged into the real status or even forecasted problems emerging, which would not only better satisfy the customers but also boost the efficiency of the whole service. In this regard, digitizing NVOCCs is to gain a competitive advantage in the highly digitized international trade world (Wang & Wang, 2021). Finally, automation plays a huge role in improving the efficiency of NVOCCs' services. Setting an automated process in booking systems, cargo handling, and documentation workflows reduces human intervention, thereby slowing down delays and ineffective operations. Automated systems process large volumes of data much more efficiently than manual systems. NVOCCs can make quicker decisions, act on customer needs faster, and gain access to information about space usage and pricing to enable timely and accurate delivery of services, such as through automated booking platforms and intelligent freight management systems (Notteboom & Winkelmans, 2020). The employment of predictive analytics also includes artificial intelligence. Through the utilization of AI, NVOCCs can predict orders in demand, optimal utilization of cargo loads, and above all else, predict potential supply chain disruptions.

CONCLUSION:

The efficiency of NVOCCs has been driven by digitalization and automation. Digital technologies such as blockchain, cloud computing, and real-time data analytics allow NVOCCs to reduce paperwork in operations while building transparency in their own supply chain networks. These technologies allow live tracking and superior decision-making capabilities which enable both shippers and customers to receive accurate and timely information. Some of the results of the applications of Automation, particularly through the assistance of artificial intelligence (AI) and machine learning (ML) in routine processes in NVOCCs-from cargo handling and route optimization-include increased customer satisfaction, faster response time, and low operational cost. Automated systems are more efficient than manual ones in identifying inefficiencies and in optimizing shipping routes and managing inventory. This does not only minimize human errors but also increases the overall productivity of products when moving them across global supply chains (Chang et al., 2021). This technology has become instrumental in strengthening the reliability of services, decreasing times of delivery, and offering more competitiveness when dealing with increasingly globalized markets. Sustainability has come out to be the need of the hour in NVOCC operations, growing concern for the environment in the shipping and logistics sectors. Being one of the largest emission sectors of global carbon, NVOCC is striving hard to manage itself according to environmental responsibility. Sustainable practices in form of fuel consumption reductions, efficient means of transportation, and utilization of an optimal shipping route reduce greenhouses gases and the environmental footprint (Boyson, S., et al 2023).

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