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Forecasting the Future of Autonomous Supply Chains: Readiness of Nigeria vs. the U.S

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Abstract
The future of autonomous supply chains is rapidly evolving, driven by advancements in artificial intelligence (AI), machine learning, and automation technologies. This development explores the readiness of Nigeria and the United States in adopting autonomous supply chain models, considering factors such as technological infrastructure, regulatory frameworks, and market dynamics. The U.S., with its established technological ecosystem and robust infrastructure, is positioned at the forefront of this transformation, boasting significant investments in AI, automation, and logistics technology. Leading the way are businesses like UPS and Amazon, who are using AI-powered systems and driverless cars to improve efficiency, save costs, and streamline operations. Nigeria, on the other hand, has unique difficulties putting autonomous supply chain solutions into practice. Even while the nation has made great progress toward digitization, there are still major obstacles to overcome, including a lack of adequate technological infrastructure, erratic electricity supplies, and unclear regulations. Nonetheless, there is hope for future advancements in Nigeria's developing tech environment, which is driven by startups and innovation hubs. Opportunities to close gaps in logistics and automation are also presented by the expansion of mobile connectivity and internet access, especially in the retail and agriculture industries where autonomous solutions have the potential to significantly increase productivity. This study emphasized how both countries must modify their regulatory frameworks to support the deployment of autonomous technologies in a way that is ethical, sustainable, and safe. This entails strengthening data privacy regulations and enhancing the incorporation of automation into current supply chains for the United States. For Nigeria, creating an environment that is favorable to the adoption of autonomous supply chains will require a customized strategy that emphasizes infrastructure development, workforce training, and legislative reforms. In the end, even though the United States might be more prepared, Nigeria has the ability to innovate and leapfrog, which offers both countries a great chance to influence how supply chain management is done globally in the future.

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Introduction

Autonomous supply networks have been a disruptive factor in supply chain management and worldwide logistics in recent years (Ezeamii *et al*., 2022). These systems have the potential to completely transform the way that commodities are made, supplied, and transported because they make use of cutting-edge technology like blockchain, robotics, artificial intelligence (AI), and the Internet of Things (IoT). From inventory control to distribution and transportation, autonomous supply chains allow automated operations to be seamlessly integrated throughout the supply chain, minimizing human intervention and increasing efficiency

(Francis Onotole, *et al*., 2022). In the end, autonomous technologies reduce costs, increase customer satisfaction, and support sustainability goals by improving decision-making through predictive analytics, improving real-time tracking and visibility, and enabling greater control over logistics operations (Olanipekun, 2020).

The use of AI-driven systems that can learn from data, adjust to changing circumstances, and make decisions with little human intervention is at the core of autonomous supply chains. While IoT devices provide constant monitoring and communication throughout supply chain networks, robotics is crucial in automating repetitive processes. Blockchain ensures the integrity and traceability of commodities as they travel through the supply chain by offering safe, transparent, and unchangeable transaction records. When combined, these technologies help build supply chain ecosystems that are incredibly responsive, flexible, and efficient—capable of managing the intricacies of contemporary logistics (Ogunyankinnu, *et al*., 2022, Kolade, *et al*., 2022). The purpose of this is to examine how prepared the US and Nigeria are to implement autonomous supply chains. Although both countries are working to integrate these cutting-edge technologies, there are notable differences in their readiness to do so because of things like socioeconomic situations, legislative frameworks, and technological infrastructure. The US is ideally positioned to take the lead in the adoption of autonomous supply chains thanks to its sophisticated technological environment and well-established regulatory frameworks (Ilori & Olanipekun, 2020). Nigeria, on the other hand, has a distinct set of problems, such as a lack of adequate technology infrastructure, uneven laws, and socioeconomic issues including the digital divide and worker displacement. Understanding these differences is crucial for forecasting how each country will navigate the challenges and opportunities presented by autonomous technologies (Ajibola & Olanipekun, 2019, Olanipekun & Ayotola, 2019). Examining and contrasting the current status of autonomous supply chain technology in Nigeria and the US is the aim of this review. The strengths and limitations of each nation's preparedness for deploying autonomous systems will be highlighted by examining its technological, infrastructural, regulatory, and socioeconomic aspects. The objective is to pinpoint the main issues and viable fixes that could enable both nations to use autonomous technologies to optimize their supply networks. The adoption obstacles, the state of technology development at the moment, and the prospects for future expansion in both settings will be the main topics of discussion (Kolade, *et al*., 2021).

Methodology

The PRISMA methodology for this paper *"Forecasting the Future of Autonomous Supply Chains: Readiness of Nigeria vs. the U.S."* involves a comprehensive and systematic approach to analyzing the readiness of the two countries for implementing autonomous technologies within their supply chains. The methodology was designed to assess the key factors influencing the adoption of autonomous supply chains, including technological infrastructure, regulatory environments, socio-economic conditions, and the capacity of each country to foster innovation and manage challenges related to autonomous systems.

The first step in the process was the identification of relevant studies and reports that address the adoption of autonomous technologies in the supply chain context, specifically focusing on the U.S. and Nigeria. Sources were selected based on their relevance to the topic, with a particular emphasis on technological advancements, policy frameworks, and industry practices. Academic articles, government reports, industry publications, and case studies were included to provide a comprehensive view of the landscape in both countries. The search was conducted using a variety of databases, including Google Scholar, Scopus, and industry-specific publications, ensuring a wide range of sources was considered.

After initial screening, the studies were assessed for quality and relevance to the paper's focus on the autonomous supply chain. Inclusion criteria required that the studies discuss AI, autonomous vehicles, drones, robotics, and supply chain technologies in relation to both the U.S. and Nigeria, with particular attention to technological infrastructure, regulatory challenges, and socio-economic factors. Articles or reports that did not directly address autonomous supply chains or those that focused solely on one country without making comparative analyses were excluded.

Data from the included studies were then extracted and synthesized to identify key themes across the U.S. and Nigeria. These included technological readiness (e.g., advancements in AI, IoT, and automation technologies), regulatory frameworks (e.g., safety, data privacy, and policy landscape), socio-economic conditions (e.g., labor market impacts and workforce readiness), and challenges such as infrastructure gaps and investment needs. The synthesis focused on understanding how each country's current status influences the adoption of autonomous supply chains and identifying potential barriers to widespread implementation.

In parallel, a comparative analysis was conducted between the U.S. and Nigeria to examine their relative readiness for autonomous supply chains. The comparison considered the strength of technological infrastructure, the existence and enforcement of regulatory policies, and the economic and social factors that could either facilitate or impede AI and automation adoption. The analysis was framed around the specific needs and challenges of the oil and gas, manufacturing, and logistics sectors in each country, as these are key drivers of supply chain innovation.

Finally, the methodology aimed to draw conclusions about the future prospects of autonomous supply chains in both countries. By forecasting the likely trajectories of adoption based on current trends, the study sought to identify opportunities for each country to advance in this area. These forecasts were informed by the analysis of current technological capabilities, government support, and international collaborations, particularly focusing on how each country might address the challenges posed by data security, workforce transformation, and investment in infrastructure.

This methodology provides a structured approach to assessing and forecasting the future of autonomous supply chains in two distinct national contexts. By utilizing a systematic review of the existing literature and combining it with a comparative analysis, this presents insights into the readiness of the U.S. and Nigeria for implementing autonomous supply chains, highlighting the unique opportunities and challenges faced by each country.

Current state of autonomous supply chains

Global supply chains and logistics are changing due to the

quick development of autonomous technology (Olanipekun, Ilori & Ibitoye, 2020). By increasing productivity, cutting expenses, and increasing accuracy as shown in figure 1, these technologies—which include drones, driverless trucks, and AI-powered systems—have the potential to completely transform conventional supply chain procedures. However, due to a variety of technological, legal, and financial considerations, the adoption and integration of autonomous supply chains differ significantly amongst nations. This looks at how autonomous supply chains are developing globally, how ready the US is to adopt these technologies, and how difficult it is for Nigeria to make comparable strides.

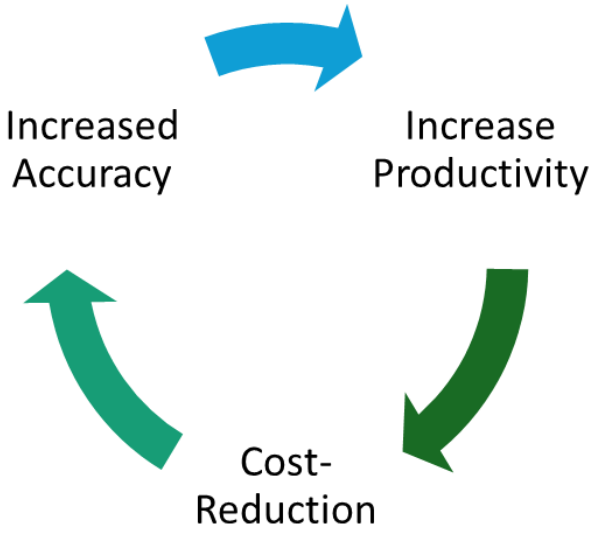

Fig 1: Schematic of merit of Supply Chain

Autonomous technology usage in supply chains and logistics has been accelerating globally. Reduced human involvement in transportation through autonomous vehicles, such drones and self-driving trucks, lowers labor costs and boosts efficiency. In an effort to improve delivery speed and circumvent conventional delivery infrastructure, companies such as Amazon and Google are also investigating the use of drones to deliver items directly to customers.

AI-powered solutions are being used to expedite inventory management in addition to driverless cars. These solutions make sure that firms never run out of stock or deal with excess inventory by using machine learning algorithms to estimate demand, optimize stock levels, and automatically replenish products. To further improve supply chain efficiency, robotic process automation (RPA) is also essential in automating repetitive processes like order fulfillment and sorting (Belot, 2020; West, Kraut & Ei Chew, 2019). All things considered, the widespread use of autonomous systems is a significant step toward supply chains that are more effective, robust, and scalable and that are better equipped to handle interruptions and market demands.

Thanks to its strong technological infrastructure, encouraging government regulations, and large business expenditures, the United States is a global leader in the development and application of autonomous supply chain systems. Significant developments in 5G networks, robots, and artificial intelligence are preparing the way for the broad use of autonomous supply chains. At the vanguard are businesses like Amazon, UPS, and FedEx, who use AI-powered systems to manage inventory, optimize delivery routes, and even use drones and autonomous delivery vehicles for last-mile delivery (Ramdoo, *et al*., 2021; Talla, 2022).

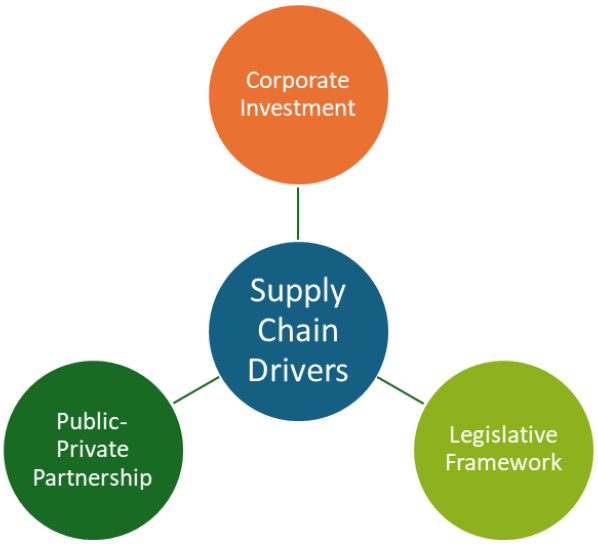

Fig 2: Schematic of drivers of Supply Chain in the USA

Figure 2 shows the drivers of Supply Chain in the USA. The integration of autonomous systems into supply chains is made possible in large part by the U.S. technical infrastructure. The high-speed connectivity needed for real-time data transfer between supply chain management systems and autonomous vehicles is made possible by the extensive deployment of 5G networks (Ezenwa, 2019; Otokiti, *et al*., 2022; Yang and Hua, 2019). Furthermore, supply chains can anticipate changes in demand, make better judgments, and improve inventory management thanks to developments in AI and machine learning.

Through legislative frameworks and public-private partnerships, the U.S. government has also taken the initiative to assist autonomous technologies. For example, standards for the testing and implementation of autonomous vehicles have been released by the National Highway Traffic Safety Administration (NHTSA). The goal of regulations pertaining to autonomous vehicles is to promote innovation while maintaining safety. Additionally, the U.S. has a robust cybersecurity and data privacy legislative framework, which is essential for the safe implementation of AI-powered autonomous supply chain systems (Akang, *et al*., 2019; Oyewola, *et al*., 2022).

Another important factor influencing the U.S.'s autonomous supply chain readiness is corporate investment. While well-known logistics firms like UPS and Walmart are integrating AI, drones, and robotics into their operations, tech behemoths like Tesla and Alphabet (Google's parent company) are making significant investments in autonomous vehicle technologies. The United States is now a pioneer in autonomous supply chain innovation thanks to a combination of private sector investments, supportive regulations, and technological infrastructure (Lee *et al*., 2021; Joglekar *et al*., 2022).

While the United States is making quick strides in deploying autonomous technologies, Nigeria is having a difficult time keeping up. Nigeria's technology infrastructure is still lacking, especially when it comes to 5G connectivity and internet access, which are both necessary for the real-time data processing needed in autonomous supply chains. Although the use of mobile phones has increased, especially

in cities, internet connection is still uneven, especially in rural areas, which makes autonomous system deployment difficult (Cavalcante *et al*., 2021; Onoja and Ajala, 2022).

Furthermore, Nigeria's regulatory environment for cutting-edge technology like artificial intelligence and driverless cars is still developing. The government has not yet created thorough regulations that particularly concern the application of AI-powered logistics systems or driverless cars. Because of this, there aren't many precise rules or structures for effectively testing and implementing autonomous systems. Nonetheless, through programs like the National Digital Economy Policy, which seeks to encourage innovation in industries like logistics, Nigeria's government has demonstrated interest in advancing digital transformation (Ufua *et al*., 2021; Madichie *et al*., 2021).

Nigeria is advancing logistics innovation in spite of these obstacles. Numerous firms aimed at resolving supply chain inefficiencies can be found in the nation's expanding digital environment, especially in locations like Lagos. Technology is being used by startups like Flutterwave and Jumia to enhance logistics and e-commerce procedures, opening doors for additional investment in automation and artificial intelligence (Ochinanwata, 2019; Negi, 2021; Otuoze, Hunt & Jefferson, 2021). However, legal ambiguity, the requirement for large investments in technology development, and infrastructure deficiencies continue to impede the scalability of autonomous supply chain solutions in Nigeria.

In some places of the world, especially in the United States, where government support, business investment, and technology infrastructure are coming together to promote innovation, the state of autonomous supply chains is developing quickly. However, due to constraints in technological infrastructure, regulatory frameworks, and investment, countries such as Nigeria confront substantial obstacles in their readiness for the adoption of autonomous supply chains (Ijeomah, 2020; Qi, *et al*., 2017). To fully achieve the potential of autonomous supply chains, both nations must address the issues of infrastructure, regulation, and scale as they strive to adopt these technologies. While the U.S. is well-positioned to lead, Nigeria's growing tech ecosystem provides an opportunity for leapfrogging and innovating toward more autonomous and efficient supply chains in the future (Dosso *et al*., 2021).

Technological infrastructure and capabilities

Strong technological infrastructure and capabilities are essential for the integration of autonomous systems into supply chains. Examining how cutting-edge technologies are implemented and the difficulties encountered in various national settings is crucial as nations progress toward supply chain automation (Danese, Romano & Formentini, 2013; Khalifa, Abd Elghany & Abd Elghany, 2021). Due to differences in technological infrastructure, innovation investment, and the accessibility of auxiliary technologies such as cloud computing, robotics, artificial intelligence (AI), and the Internet of Things (IoT), the United States and Nigeria present different environments for the adoption of these technologies.

When it comes to the creation and application of autonomous technology in supply chains, the US leads the world. Significant progress has been achieved in important fields including artificial intelligence (AI), robotics, driverless cars, and the Internet of Things (IoT), all of which are essential to the development of contemporary supply chain management and logistics. From machine learning algorithms that improve route optimization and inventory management to predictive analytics that forecast demand, artificial intelligence (AI) is being used in a variety of ways to optimize logistics (Richey, *et al*., 2022; Simchi-Levi, Wang & Wei, 2018). Self-driving trucks and other autonomous vehicles are being tested and used more frequently in an effort to increase transportation efficiency, lower labor costs, and reduce safety hazards. A strong infrastructure that includes dependable internet access, extensive 5G coverage, and the availability of high-performance computer systems that can handle massive data volumes underpins these developments (Qrunfleh & Tarafdar, 2014; Wang, *et al*., 2016).

IoT technologies are extensively used in U.S. supply chains to enable real-time tracking, monitoring, and data exchange between connected equipment, in addition to artificial intelligence and driverless cars. More visibility and control over the whole supply chain are made possible by IoT sensors integrated into transportation and inventory systems, which empower operators to make well-informed decisions based on real-time data (Khan *et al*., 2022; Tan *et al*., 2022). This ecosystem is further improved by cloud computing, which offers the infrastructure required for scalability, real-time analytics, and data storage. These technologies allow for the development of smart warehouses, where robots handle inventory management and automated systems coordinate the movement of goods, significantly increasing operational efficiency.

Furthermore, the United States has created advanced automated transportation networks that incorporate AI-powered solutions and driverless cars, such as ports and rail systems. The Port of Los Angeles, for instance, has implemented cutting-edge robots and AI-powered systems to increase cargo handling efficiency and cut wait times, setting an example for other areas. Large corporations like Amazon, Tesla, and Google are at the forefront of autonomous technology research, and this cutting-edge technological environment is backed by significant investment from the public and private sectors (Jacobides *et al*., 2021; Rikap and Lundvall, 2022).

Nigeria, on the other hand, has a lot of technological obstacles when it comes to establishing autonomous supply chains. Nigeria has made considerable strides in embracing technology, especially in the fintech and mobile industries, but its logistical infrastructure is still lacking, especially when considering sophisticated supply chain automation. One major obstacle to the adoption of cloud computing, IoT systems, and AI-driven technologies in the logistics industry is the absence of universal access to dependable internet and electricity (Mwangi, 2019; Zohuri & Moghaddam, 2020). Technology-based systems are disrupted by poor connectivity and sporadic power supplies, which reduces the possibility of automated decision-making and real-time data monitoring.

Furthermore, Nigeria has difficulties implementing important technology like AI, IoT, and driverless cars. Although these technologies have been widely adopted in industrialized nations, large-scale deployment is challenging in Nigeria due to its inadequate technological infrastructure and resources. Specifically, AI is still in its infancy in the nation, since few local businesses are creating AI-powered logistics solutions. The expansion of AI capabilities is further hampered by a shortage of research and development resources, as

businesses and governmental organizations find it difficult to build the frameworks and skills required for AI integration. Similar to this, Nigerian infrastructural constraints including bad road conditions, heavy traffic, and insufficient regulatory frameworks prevent autonomous vehicles—including self-driving trucks and drones—from becoming commercially feasible at this time (Bathla *et al*., 2022; Dong, *et al*., 2020; Tien, *et al*., 2019).

Another major issue facing Nigeria's supply chain is the sluggish deployment of IoT technology. Because the logistical infrastructure is not ready to support these systems, there are few IoT devices that could allow real-time tracking of shipments and inventory. Furthermore, Nigeria lacks the automated systems and technology required to enable autonomous vehicles in its transportation network, which consists of shoddy roads and unreliable ports. Although the Nigerian government has started programs to modernize the transportation sector, the lack of a cohesive national policy on automation and artificial intelligence (AI) and financial limitations have hampered the scope and speed of these attempts (Javaid, *et al*., 2022; Lu, 2019; Zhang & Lu, 2021). Additionally, the technical barrier is made worse by the socioeconomic disparity between urban and rural communities. The deployment of autonomous technologies is further hampered by the fact that rural areas in Nigeria are left behind, even though some urban centers are beginning to experience advancements in their technological infrastructure. The possibility for nationwide adoption of autonomous supply chain technologies is hampered by this gap since rural regions with little access to contemporary technology might not be able to take advantage of automation and artificial intelligence (Duan, Edwards & Dwivedi, 2019; Korteling, *et al*., 2021; Tien, 2017).

The success of autonomous supply chains is largely dependent on technological capabilities and infrastructure. With its highly established transportation networks, strong investments in AI, robots, and IoT, and its sophisticated technology ecosystem, the US is well-positioned to take the lead in autonomous supply chain optimization. Nigeria, on the other hand, has significant technological obstacles that prevent autonomous systems from being widely used (Affognon, *et al*., 2015; Balana, Aghadi & Ogunniyi, 2022). These difficulties include a lack of infrastructure to handle cutting-edge technology like artificial intelligence (AI) and driverless cars, insufficient regulatory frameworks, and restricted access to dependable internet and electricity. Despite these barriers, Nigeria has opportunities to overcome these challenges by investing in infrastructure development, forging international collaborations, and implementing policies that support the growth of autonomous technologies in logistics (Jarrahi, 2018; Terziyan, Gryshko & Golovianko, 2018).

Regulatory and policy frameworks

Numerous regulatory and policy frameworks have been established in response to the growth of autonomous supply chains, which now include drones, AI-driven logistics systems, and autonomous vehicles. These frameworks aim to address potential risks, foster innovation, and ensure safety (Dhaliwal, 2022). Although Nigeria is making progress, it still has difficulties creating comprehensive laws, and the United States is at the forefront of regulatory initiatives. These regulatory frameworks differ greatly between countries. This study looks at the legal frameworks in both nations, examining current laws, policies tailored to certain industries, and difficulties in implementing autonomous supply chain systems (Akande & Diei-Ouadi, 2010; Morris, Kamarulzaman & Morris, 2019).

The United States has a relatively mature and robust regulatory environment when it comes to the adoption of autonomous supply chain technologies. At both the federal and state levels, regulations have been developed to address the use of autonomous vehicles, drones, and AI systems in logistics, ensuring safety while encouraging innovation (Ahiaba, 2019; Hodges, Buzby & Bennett, 2011).

The National Highway Traffic Safety Administration's (NHTSA) guidelines for autonomous vehicles are among the most prominent frameworks; they establish safety requirements for both testing and deployment. These standards include important topics such data recording techniques, manufacturer certification, and the safe operation of autonomous vehicles (AVs). With a focus on public safety and stringent safety requirements, the NHTSA's advice permits manufacturers to test and implement Avs (Jagtap, *et al*., 2020; Sibanda & Workneh, 2020).

The Federal Aviation Administration (FAA) oversees drone laws in addition to vehicle safety. The FAA's Part 107 regulations, which govern commercial drones, center on flight limitations, operator certification, and the safe integration of drones into national airspace (Marshall, 2021; Chaudhuri, *et al*., 2018; Stathers & Mvumi, 2020). These rules are essential for the use of drones in logistics, especially for monitoring and last-mile delivery. The FAA is constantly updating its regulations to take into account new use cases, including drone deliveries, as the use of drones in the supply chain industry grows.

Several U.S. rules also address the cybersecurity and data privacy aspects of autonomous supply chains. To prevent breaches and exploitation of sensitive data, businesses that employ AI and drones in their supply chain operations must make sure that data protection rules are followed. Furthermore, a key component of the regulatory framework is the issue of culpability in the event of accidents using autonomous systems. States like California have created frameworks that set insurance and liability protections for autonomous vehicle operations, despite the lack of a clear national standard for responsibility (Babatunde, 2019; Nahr, Nozari & Sadeghi, 2021; Olukunle, 2013).

Policies that promote innovation at the industry level include subsidies, tax breaks, and research funds for the creation of autonomous technologies. But there are still difficulties. State rules are inconsistent, which is a significant problem, especially when it comes to the testing and use of autonomous vehicles. The regulatory environment is fragmented because certain states, like California and Arizona, have more lenient laws governing autonomous vehicle testing, while others have stricter laws (Petruzzi, 2021; Freemark *et al*., 2022).

On the other hand, Nigeria's autonomous technology regulatory framework is still in its infancy. As of yet, the nation lacks a thorough national policy framework that addresses drones, autonomous cars, and other AI-driven logistical technology. Nigeria is making quick strides in innovation and digitization, but businesses looking to invest in autonomous systems are concerned due to unclear regulations.

Nigeria currently lacks the regulatory clarity and infrastructure necessary for the widespread use of drones and

autonomous cars in the supply chain industry. For example, local laws governing drone use are still in their infancy. The Nigerian Civil Aviation Authority (NCAA) has issued some guidelines, but they mainly address drone operator safety and registration rather than providing a thorough framework for logistics applications. Drones are subject to restricted airspace and must comply with regulations around commercial operations, but the legal landscape remains unclear regarding their use for delivery purposes or surveillance in supply chains (McTegg *et al*., 2022).

Nigeria does not have any national policies that specifically address the use of autonomous cars. It is unclear how autonomous vehicles should be included into Nigeria's road network due to safety issues surrounding autonomous systems, including traffic laws, driver behavior, and road safety. Therefore, it is difficult for private sector businesses to implement such technologies in logistics and transportation since there is no clear legal road for autonomous vehicles (Mahdavian *et al*., 2021; Taeihagh *et al*., 2021).

In Nigeria, public-private partnerships, or PPPs, have been essential to promoting innovation in the logistics industry. These collaborations play a key role in promoting the adoption of new technologies and creating legal frameworks for them. For instance, digital platforms and AI-driven systems have been investigated by Nigerian entrepreneurs specializing in logistics innovation, like Flutterwave and Jumia (Alam, *et al*., 2022; Kumar, *et al*., 2022; Misra, *et al*., 2020). However, they encounter difficulties because of legal ambiguities. To promote innovation in autonomous logistics, a more organized and encouraging regulatory environment is necessary, as are strategic partnerships between public and private sectors.

Nigeria has begun to move toward establishing a more favorable environment for autonomous technologies in spite of these governmental obstacles. Policies that eventually address autonomous technologies in logistics may be based on recent initiatives such as the National Digital Economy Policy, which aims to accelerate digital transformation in important sectors, including transportation (Nosova *et al*., 2021).

With an emphasis on safety, liability, and data privacy, the United States has made great strides in creating a legislative framework that encourages the use of autonomous technologies in supply chains. Innovation is also encouraged by industry-specific regulations and corporate investments. But there are problems with the disjointed state-by-state strategy. Nigeria, on the other hand, lacks comprehensive national rules that particularly handle drones and autonomous cars, and its regulatory environment is still in its infancy (Krishnan, Banga & Mendez-Parra, 2020; Raja Santhi & Muthuswamy, 2022). The nation is making progress in digital innovation, but in order to fully realize the potential of autonomous supply chains, legislative clarity is required. In order to overcome the obstacles presented by regulatory uncertainty and create a strong autonomous logistics ecosystem, public-private partnerships will be essential (Das Nair & Landani, 2020; Lin, Lin & Wang, 2022). The capacity to strike a balance between safety, innovation, and scalability will determine how autonomous supply chains develop in the future as both nations continue to negotiate these regulatory environments.

Socio-economic and workforce considerations

Both the Nigerian and American labor markets would be significantly impacted by the adoption of autonomous technologies in supply chains. Accordingly these ramifications go beyond job displacement and include the necessity of reskilling, upskilling, and adjusting to new work environments. Each nation must handle the complex socioeconomic issues raised by the shift to autonomous supply chains in order to guarantee that workers can adjust to these changes and that the advantages of automation are shared fairly across all societal sectors (Dauvergne, 2022; Yue, You & Snyder, 2014).

The emergence of autonomous technologies in supply chain management and logistics in the US is probably going to result in job displacement, especially in industries that depend significantly on human labor. One of the most well-known professions that autonomous cars have the potential to disrupt is truck driving. Over 3 million truck drivers are thought to work in the United States, and if autonomous vehicles proliferate, many of them may lose their jobs. Similar to this, it is anticipated that the use of robotics and AI systems would significantly automate warehouse management, which employs hundreds of thousands of people in positions like material handling and inventory control (Shah, Li & Ierapetritou, 2011; Urciuoli, *et al*., 2014). The United States is, meanwhile, also acting proactively to lessen the adverse effects of automation on the labor force. To prepare people for new responsibilities in industries associated to autonomous technology, federal and state governments are implementing reskilling and upskilling projects (An, Wilhelm & Searcy, 2011; Kuang, *et al*., 2021). These initiatives concentrate on training workers for jobs in domains like robotics, data analysis, cybersecurity, and AI development, which are predicted to rise significantly as supply chain automation advances.

The impact on the job market is also significantly shaped by public opinion and the speeds at which American companies and consumers are adopting autonomous technologies. Although some companies, especially those in e-commerce and logistics, have welcomed automation because it can save money, workers and customers are worried about job displacement and the moral ramifications of extensive automation (Kandziora, 2019; Sircar, *et al*., 2021). However, public opinion is expected to change as autonomous technologies continue to demonstrate their dependability and effectiveness, and companies may progressively increase their use of these technologies, further altering the labor market (Ogunyankinnu *et al*., 2022).

Nigeria's reliance on low-skilled labor, especially in industries like manufacturing, logistics, and agriculture, creates special issues for the labor market impact of autonomous supply chains in that country. Workers in manual labor positions, many of whom have no access to opportunities for education and skill development, are anticipated to be disproportionately impacted by Nigeria's deployment of AI and automation technologies. Because Nigeria's economy has historically relied on manual, low-skilled labor-intensive industries, the shift to automated systems may result in a large loss of jobs (Ekeruche *et al*., 2022; Helo & Hao, 2022; Koroteev & Tekic, 2021).

This is particularly troubling in a nation where millions of workers operate outside recognized job structures and unemployment rates are already high. The socioeconomic gap may widen as autonomous technology become more

widely used, especially for people without the money or abilities to move into new occupations.

In light of the possible loss of jobs resulting from automation, one of Nigeria's most urgent challenges will be to create new jobs. Nigeria needs a framework for incorporating these new positions into the workforce as the need for personnel to manage, maintain, and create autonomous systems increases. However, the nation will probably find it difficult to replace the jobs lost to automation unless a concentrated effort is made to develop technological infrastructure and make education and training accessible. Furthermore, Nigeria is especially susceptible to the social effects of automation because of its reliance on the informal sector, where employees frequently lack access to social benefits and formal training (Kelikume, 2021; Cieslik *et al*., 2022).

The skills gap is another important problem. Nigeria's educational system has not kept up with the world's rapid technological advancements, and the skills that modern companies require and the abilities that the current workforce can provide differ significantly. Nigeria must fund educational and training initiatives that emphasize acquiring the requisite skills for automation, robotics, and artificial intelligence if it is to reap the potential advantages of autonomous supply chains (Truby, 2020; Yigitcanlar, Mehmood & Corchado, 2021). In order to create curricula that give the workforce skills in data science, machine learning, programming, and robotics, the government, business community, and educational institutions have partnered. Furthermore, local and international businesses can play a pivotal role in providing training programs that focus on emerging technologies in logistics and supply chain management.

Autonomous supply chains have a significant impact on the labor market in both Nigeria and the United States, although their effects vary depending on the socioeconomic circumstances of each nation. The emphasis in the United States is on upskilling and reskilling workers who have been replaced by automation in fields such as warehouse management and truck driving. Both the public and private sectors are making a concerted effort to train workers for new positions in technology-driven businesses. Nigeria, on the other hand, has more serious issues, such as a large skills gap, a high reliance on low-skilled labor, and the possibility of job displacement in physical work (Djeffal, Siewert & Wurster, 2022; Yigitcanlar, *et al*., 2021). To address these challenges, Nigeria must invest in education and training, and create opportunities for new job creation to mitigate the social and economic risks associated with automation. Both countries must approach the adoption of autonomous supply chains strategically, ensuring that their workforces are prepared for the changes ahead.

Future prospects and key opportunities

Autonomous technologies are anticipated to become more and more important in revolutionizing operations, increasing sustainability, and improving efficiency as the global logistics and supply chain industries continue to develop. Nigerian and American autonomous supply networks face particular potential and difficulties in the future. This examines the two nations' possibilities for autonomous systems in the future, emphasizing important opportunities as well as the varying degrees of acceptance and implementation readiness (Gianni, Lehtinen & Nieminen, 2022; Kankanhalli, Charalabidis & Mellouli, 2019).

The United States is well-positioned to maintain its position as a leader in the implementation of autonomous supply chain technologies. The nation is at the forefront of logistics innovation thanks to its strong regulatory frameworks, business investments in AI, robotics, and autonomous vehicles, and its strong technology infrastructure. A few major trends will shape autonomous supply chains in the United States in the future (Zali *et al*., 2022).

First off, the transportation scene will continue to change as autonomous vehicles (AVs), such as drones and self-driving trucks, become more widely used. Autonomous delivery systems are already being tested and implemented by major logistics businesses such as UPS and Amazon. Drone deliveries, AI-powered route optimization, and warehouse automation are anticipated to become commonplace over the course of the next ten years. Automation will become more affordable as these technologies advance, opening it up to more businesses, particularly small and medium-sized businesses (SMEs).

Furthermore, the U.S. government is probably going to encourage autonomous logistics technologies more, especially as 5G networks grow and artificial intelligence advances. The logistics industry will gain from more advanced predictive analytics as artificial intelligence develops further, which will enhance everything from risk mitigation to demand forecasting and inventory management. Additionally, the United States will have the chance to continue leading the world in autonomous logistics. U.S. businesses can contribute to the creation of international standards for autonomous systems and guarantee that their innovations are at the forefront of global supply chain solutions by investing in R&D and establishing international relationships (Al-Besher & Kumar, 2022; Taeihagh, 2021). The United States is in a strong position to establish the global standard for autonomous logistics as the need for effective and sustainable supply chains increases.

Nigeria is still in the early phases of implementing autonomous technologies, in contrast to the United States, but it has a great deal of potential to close technological gaps, especially in the logistics industry. Autonomous supply chains can help Nigeria overcome a number of issues, such as inadequate infrastructure and ineffective supply chain and transportation management.

Leapfrogging technologies represent one of Nigeria's most promising prospects. The nation has the opportunity to directly adopt cutting-edge solutions and avoid traditional technology because it does not have the legacy systems that other countries have constructed.

Furthermore, the development of frameworks and laws that promote autonomous supply chains is a crucial task for the Nigerian government. Nigeria can support the expansion of its autonomous logistics industry by giving priority to digital infrastructure, investing in 5G networks, and leveraging AI capabilities. Since they would bring together private sector experience and government support, initiatives like public-private partnerships (PPPs) could be crucial in fostering innovation (Fowdur *et al*., 2022). Nigeria might also take advantage of global partnerships by joining forces with top tech companies from more developed countries like the U.S. and Europe. Through these partnerships, Nigeria may be able to quickly create and put into place the infrastructure, technological know-how, and legal frameworks required to support autonomous supply chains (Androutsopoulou, et sl., 2019; De Almeida, dos Santos & Farias, 2021).

Nigeria's agriculture industry presents yet another noteworthy opportunity, as autonomous technology has the potential to alleviate inefficiencies in the production, distribution, and storage of food. Drones and AI-driven systems may be able to assist farmers with crop production forecasting, soil health monitoring, and agricultural product delivery route optimization. This promotes sustainability and food security in addition to increasing supply chain efficiency.

There are a number of significant distinctions between Nigeria and the United States in terms of their preparedness to establish and expand independent supply chains. Because of its well-established technological infrastructure, kind regulatory framework, and substantial business expenditures, the United States is at the forefront of autonomous supply chain technology worldwide. American businesses have already made significant progress in implementing autonomous technologies, especially in the e-commerce and logistics industries. Furthermore, the regulatory environment in the U.S. supports innovation through clear safety standards for autonomous vehicles, drones, and AI applications in logistics (Truby, 2020; Yigitcanlar, Mehmood & Corchado, 2021). These factors make the U.S. highly prepared to scale autonomous supply chains and to continue leading in global supply chain innovation.

On the other hand, Nigeria's implementation of independent supply chains is fraught with difficulties. With restricted access to 5G networks, high-speed internet, and artificial intelligence (AI) capabilities, technological infrastructure continues to be a significant obstacle. Furthermore, the deployment of autonomous cars and drones is at danger due to the absence of established regulatory frameworks and safety requirements. Nigeria offers a special opportunity, though, because of its capacity to advance beyond conventional supply chain models (Affognon, *et al*., 2015; Balana, Aghadi & Ogunniyi, 2022). Nigeria may avoid legacy inefficiencies and build a more contemporary and sustainable logistics infrastructure by eschewing antiquated technologies and investing directly in autonomous solutions.

Despite these challenges, both countries have opportunities to innovate. The U.S. will likely continue to lead in the adoption of autonomous supply chains, setting the global standard, while Nigeria's path forward will require a combination of government support, private-sector innovation, and international partnerships to realize its potential.

The future of autonomous supply chains presents tremendous opportunities for both the U.S. and Nigeria, although their paths forward are shaped by different levels of readiness and technological infrastructure (Abubakar *et al*., 2022; Jarrahi, 2018; Terziyan, Gryshko & Golovianko, 2018). The U.S. is poised to continue leading the charge in autonomous logistics innovation, while Nigeria, with the right investments and collaborations, has the chance to leapfrog traditional supply chain models and create a more sustainable and efficient logistics network. As both nations pursue these opportunities, the key to success will lie in strategic investments, regulatory alignment, and international collaboration, ensuring that both the U.S. and Nigeria can leverage autonomous technologies to optimize supply chains and meet the demands of an increasingly digital and globalized economy.

Conclusion

There are several potential and obstacles associated with the creation and deployment of autonomous supply chains, especially when contrasting nations such as Nigeria and the United States. The integration of cutting-edge technologies like artificial intelligence (AI), robotics, and driverless cars—which call for a strong infrastructure and investments in digital systems—is one of the main technological challenges. Another important factor is the regulatory environment; the United States has more developed frameworks for automation and artificial intelligence, whereas Nigeria struggles to establish precise laws governing these new technologies. Socio-economic challenges are evident in both countries, with the U.S. addressing job displacement through reskilling initiatives and Nigeria facing greater socio-economic risks due to its reliance on low-skilled labor and the need for extensive workforce development.

International cooperation, investment, and innovation will determine the direction of autonomous supply chains in the future. Further supply chain optimization will be fueled by ongoing advancements in AI, robotics, and autonomous systems in the United States, opening up new avenues for cost and efficiency reduction. Setting global norms will require international cooperation in the interim, especially in fields like environmental sustainability, algorithmic fairness, and data privacy. The United States can share its knowledge with other countries like Nigeria and set the standard for ethical AI integration best practices.

The creation of transparent regulatory frameworks to promote innovation and guarantee the ethical application of AI is one of the policy and investment suggestions for both the United States and Nigeria. In order to address worker displacement, the United States should prioritize reskilling initiatives in addition to ongoing investments in AI and automation education. Strategic investments in labor development, technological access, and infrastructure are crucial for Nigeria. In order to help Nigeria overcome technological and legal obstacles and prepare its workforce for the future of autonomous supply chains, partnerships with international stakeholders can offer both financial support and knowledge transfer.

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