Exploring Artificial Intelligence for Supply Chain Resilience and Organization Performance in Developing Country: A Case of Nigeria

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Abstract
Increase in complexity, the development of economic changes and the globalization of business environment lead inevitably to an increase in exposure to predictable and unpredictable events, highlighting supply chain vulnerabilities, Nigeria as a country is facing alot of challenges in electricity, oil and food security issues. Shocks arising from within and outside the supply chain in the country increase in frequency and severity. Furthermore, there are many reasons behind the increase vulnerability of supply chains to disruptions, but, as pointed out by Grant (2015), the main sources of supply chain risk can be traced back. Many supply chains have faced disruption in the organization especially in Nigeria. Artificial intelligence is one mechanism that can be used to improve supply chain resilience by developing business continuity capabilities. This study examines how organizations in Nigeria can adopt artificial intelligence and considers the opportunities for artificial intelligence to enhance supply chain resilience by developing visibility, risk, sourcing and distribution capabilities. Methodology: the study have gathered rich data by conducting semi-structured interviews with five (5) experts from the e-commerce supply chain. The study have adopted a systematic approach of coding using open, axial, and selective methods to map and identify the themes that represent the critical elements of artificial intelligence to enabled supply chain resilience. The findings of the study highlight the emergence of five critical areas where artificial intelligence can contribute to enhanced supply chain resilience;(i) transparency,(ii) ensuring last-mile delivery, (iii) offering personalized solutions to both upstream and downstream supply chain stakeholders, (iv) minimizing the impact of disruption, and (v) facilitating an agile procurement strategy. Originality: The study presents the dynamic capabilities for supply chain resilience through the employment of artificial intelligence. Artificial intelligence can contribute to readying supply chains to reduce their risk of disruption through enhanced resilience. Implications: The study offers interesting implications for bridging the theory practice gap by drawing on contemporary empirical data to demonstrate how enhancing dynamic capabilities via artificial intelligence technologies further strengthens supply chain resilience. The study also offers suggestions for utilizing the findings and proposes a framework to strengthen supply chain resilience through artificial intelligence.

Keywords: *Supply Chain Design; Supply Chain Resilience, Organization Performance, Artificial intelligence.*

Introduction

In recent years, many organizations are folding due to the disruption of supply chain in creating a competitive advantage, competition between organizations has become competition between their supply chains. Lack in Electricity, Oil, and food security are lack in both human and industrial sector because they play a crucial roles in the global market, according to Natalie and colleagues (2005), they argued that the processes and the system involved in the producing and distributing these resources are highly complex and capital -intensive which involve huge investment in modern technology. Therefore, strong supply chain management is a key factor in the success of organizations. A variety of developments as a result of unexpected events are an integral part of the supply chains of today's organizations that operate in conditions of uncertainty.

Artificial intelligence is concerned with the perfunctory of intelligent behavior. It is a system's ability to interpret external data correctly, and to learn from such data to achieve specific goals and task. (Baryannis et al., 2019a; Spieske & Birkel, 2021). Artifical intelligent approach to supply chain management has been developed to deal with these sudden breakdowns in the supply chain and rapid recovery and return to the original state before the event. The impact of the bad economic, social and political situation continues to affect the electricity, food, oil and security these worsening the efforts made by governments, the public sector, and individual businesses to halt its detrimental effect on the economy (Craven et al., 2020; Sarkis, 2020). It has caused significant disruptions to the supply chains of countless different industries (Handfield et al., 2020). Many companies have reported significant supply chain disruption and openly share their stories of struggling to reconfigure distribution chains and networks (Mahajan & Tomar, 2021). Manufacturers failed to develop contingency plans that could address the types of supply chain disruption caused by phenomena and hence organizations in Nigeria have reported the unpredictable delays experienced in receiving electricity, food, oil and security due to inadequate supply chain information (Paul & Chowdhury, 2020). Other factors including consolidation of suppliers, reducing the cost of production and minimizing the risk have decreased available inventories and has led to the current state of scarcities (Dolgui & Ivanov, 2020; Wang Mlynek & Foerstl, 2020). It is important to recognize the challenges in today's supply chains that have led industries to this level of crisis. For instance, manufacturing of all these items has become extremely complex in terms of outsourcing components from multiple locations to assemble a single product.

Consequently there is a substantial reliance on logistics, import, and export that in turn poses challenges in the case of disruption and highlights the requirement for smart decision makings (Choi, 2020; Wamba et al, 2020b, Wamba et al., 2020c). Other challenges for sourcing organizations include distribution risk and shortages in the network (Dolgui & Ivanov, 2020). Distribution is a critical area where staffing of warehouses, direct distribution, and responsive allocation have become important considerations (Butt, 2021). Retail supply chains have also been impacted, where in the demand for essential items has increased, and this further challenges operating margins and existing business models (Pantano et al., 2020). On the consumer side, stocking essential supplies and over-the-counter have stressed supply chains to their limits (Mahajan & Tomar, 2021; Muniz et al., 2020). This unnatural and unpredictable increase in demand and supply and the continually fluctuating environment, affect the economic which makes it difficult to respond adequately.

However, the study examines the capabilities required to manage supply chains and the learning opportunities that the current situation of the economic offers that can help firms to increase visibility and control in their supply chains. The study have chosen artificial

intelligence as a technological enabler to help to proffer solutions to problems associated with supply chain resilience, and to offer potential avenues to assist organizations in their journey towards long term sustainability. The reason for choosing artificial intelligence is that it encompasses the features of machine learning, big data, and deep learning (Gupta et al., 2021; Wamba et al., 2020). For instance, machine learning helps to automate the contractual agreements with suppliers and thus strengthen the procurement strategy of the organization. Big data helps to improve the decision making capabilities of an organization and therefore avoid redundancy throughout the supply chain (Baryannis et al., 2019; Dubey et al., 2020). Additionally, artificial intelligence is capable of developing agent-based systems, genetic algorithms, and expert systems to facilitate demand planning, order fulfilment, network design, and inventory planning in conjunction with supplier systems (Muniz et al., 2020). The situation of the economic has forced many organizations to re-think and transform their supply chain models (Ivanov, 2020). Adam (2019) categorizes the energy sectors into three key areas.

1-**Upstream**: Is the exploration and production which involves the search for underwater and underground natural crude oil fields and the drilling of exploration wells and drilling into established wells to recover oil.

2 **Midstream:** This entails the transportation, storage, and processes of oil once resources are recovered, it has to be transported to a refinery which is often in a completely different geographical region compared to the oil reserves, transportation can include anything from tanker shops to pipelines and trucking fleets.

3-**Downstream**:This refers to the filtering of the raw materials obtained during the upstream phase, it means refining crude oil. The marketing and commercial distribution of these products to consumers and end-users in a number of forms including oil, petrol, natural gas, diesel, gasoline, lubricants, kerosene, jet fuel, asphalt, heating oil, LPG (Liquified Petroleum Gas) as well as a number of other types of petrochemicals. Hintsa (2010) provides a comprehensive taxonomy of possible crimes that may be perpetrated in a supply chain. In the context of oil supply chains, many of the security threats identified could be attacks by perpetrated while oil is transported by sea (e.g.sea piracy, hijacking), in pipelines (e.g. theft, sabotage and vandalism) or while it is being extracted from platforms or stored in facilities. In summary, bad economic situation has exposed a myriad of weaker elements in the supply chain (Queiroz et al., 2020). The study suggest that many of these can be addressed by using intelligent and logical technologies to improve existing supply chain capabilities in Nigeria. The dynamic capabilities of an organization help to strengthen its supply chain. It is the “ability of an organization to integrate, build and reconfigure in-house and outside competences to address the environment that is regularly changing”(Teece et al., 1997). However, there is a paucity of studies that apply dynamic capabilities as an approach to solve large scale supply chain disruption, for example disruption caused due to change in economic (van Hoek, 2020).

Therefore, the study, have adopted the theoretical lens of dynamic capabilities to bridge the research-practice gap that currently exists in supply chain. Previous studies have focused on supply chain disruptions (Ivanov et al. 2017), causes of the supply chain disruptions (Craighead et al. 2007), effects on supply chain disruptions on organizational performance (Hendricks and Singhal, 2005) and management of supply chain risks (Ivanov and Dolgui, 2018). The study has found that artificial intelligence and supply chain visibility, has significant effects on supply chain resilience. However, little attention has been paid to understand how organizations employ artificial intelligence on supply chain analytics

in the wake of supply chain disruptions (van Hoek, 2020). Therefore, in this study, we have gathered and analyze empirical data from supply chain
professionals to present a framework that can help in enhancing supply chain capabilities.

Research questions

The study have developed the following two research questions to frame the study:

a) What are the social, economic and political factors influencing the electricity, oil and food security management in Nigeria ?
b) How can Artificial intelligence capabilities be leveraged to improve supply chain resilience?

Research Objectives

(a) To examine the social, economic, and political factors influencing the electricity, oil and food security management in Nigeria.
(b) To find out how artificial intelligence capabilities be leverage to improve supply chain resilience.

Literature Review

Electricity, oil and food security supply chains are critical assets for our societies. A disruption could have major economic impacts on companies dealing with the production and distribution of these products. Similarly, the impacts on society as well as on other sectors of our economy could be tremendous (Halldo´rsson and Svanberg, 2013). Likewise, all supply chains rely on the access to energy in the form of electricity or fuel to ensure the performance and reliability of manufacturing and transport processes. Lack of access to energy could either interrupt or increase the costs of manufacturing and transportation processes, causing negative consequences to other economic ectors and a decay of our quality of life (Halldo ´rsson and Svanberg, 2013).

Power shortages also cause machine breakdowns leading to production stoppages and poor customer delivery performance. Organizations Inventory Manager stated: “Power goes off and you have an order but the generator can run only one machine. This means delaying the customer: sometimes there is no power for a full week.”Power shortages also lead to quality problems as reported by the managers Procurement and Logistics Officer: “we send products in the market and they are found to be of poor quality due to poor processing. In brewing, sometimes power goes off, it affects the product and after bottling there are problems. This threat of power shortages also shows how certain conditions specific to a developing country especially Nigeria context can produce threats to supply chain resilience. These has shown that threats and conditions external to the supply chain, not only disrupt the supply chain, but can also cause other threats both internal and external to the supply chain. This shows how threats are interrelated. Nigeria joined the Organization of Petroleum Exporting countries in 1971 and established the Nigeria National Petroleum Company (NNPC), a state owned and controlled company which is a major player in both the upstream and downstream sectors to prosper, produce and market oil and began to acquire an equity stake in the oil companies , from 33.33%(in ElF) in 1971, these stakes rose progressively in all the companies to 55-60% in 1978, 80% in the case of Shell-BP in 1979. Thus, the state had become the owner, producer and marketer of oil Ejobono (2000). Organizations have long recognized the importance of contingency planning, organizing, co-ordinating mitigating supply shocks, demand volatility, and making the workplace safer than ever to derive efficiency and effectiveness in supply chains (Ivanov, 2020).

Food security

Food insecurity is a problem for most developing countries especially in Nigeria. To achieve food security, traditionally, the solutions are directed to a focus of improving production to build national targets of self sufficiency level, coordinating world food stocks and implementing stabilization policies of imports (United Nations 2020). Many developing countries like Nigeria associate food security with food self sufficiency, widespread evidence shows that hunger may still coexist with the availability of abundant food supplies. Especially in the era of Industries, a thinking shift to expand analysis of food security moving from a narrow focus merely on food supplies, to a wider range that includes an access dimension of households and individuals is indeed necessary. Empirical evidence demonstrated that access to food by individuals is often the greater constraint than the availability of the food itself. Food access often depends on individuals "income, which is also influenced by their access to resources, markets, technology, social networks and government support through food transfer programs or subsidy. Improved food security can be achieved through increased availability by extending staple food production area, improved productivity, better post harvesting practices; enhanced access as a result of more stable prices, improved income earners and rural income; and increased stability through improved and sustained competitive advantage of the member firms (Campbell et al., 2009).

Food security is clearly a public domain. It is an essential feature of a country"s food sustenance and independence. However, food security is also a highly emotive issue, as chronic hunger, local food shortages, and sudden increases in food prices can strongly influence public sentiment and reaction. Thus, while the public's view of food security can be some what vague it still operates as an emotionally powerful concept with regard to what the public expects in this regard. Therefore, the ability to provide assurance that on a long-term basis food systems can provide all people with access to a reliable, timely and adequate supply of nutritious food is the responsibility of every government especially in Nigeria. To achieve food security, government in developing economies (Nigeria) traditionally should apply price stabilisation policy to ensure that the price of a staple food, e.g., rice, yam garri, fruits and other nutritional food in one hand, should be affordable for consumers while on the other hand, the price of paddy should be high enough to give incentive for producers. Government intervention to stabilise domestic prices for staple foods, is feasible in the context of expanding economic growth and the functioning of the marketing sector.

Many consumers are opting for in store purchases over online shopping as they could see, touch, and compare items. Unsurprisingly, online purchases have soared during economic crisis and supply chain visibility is therefore arguably more important than ever (Butt, 2021; Queiroz et al., 2020). However, many organizations are not prepared for the practicalities of fulfilling online orders, and planning processes were ill-equipped to respond to the sudden increase in demand as a consequence of economic crisis For many supply chains it therefore rapidly became apparent that an increased level of supply chain resilience was required (Ivanov, 2021; Queiroz et al., 2020; van Hoek, 2020). Increasing supply chain resilience in response to disruption poses challenges; on the one hand there is large amount of uncertainty and on the other a significant amount of data is generated (Wamba et al., 2020). Hence, due to uncertainty and vast data it becomes very difficult for supply chains to achieve their desired degree of resilience (Ivanov, 2021). In consequence, many organization are making short term predictions and focusing on strengthening their supply chain capabilities (Sundarakani et al., 2020). To do this Organization need to regularly assess their levels of risk across multiple parameters (Dolgui & Ivanov, 2020). In addition, beyond efficiency, the new

evaluation framework should also incorporate sustainability and impact. Sustainability emerges as the other key issue for consideration, and in this regard concerns have multiplied around increasing artificial intelligence technology and developing long term solutions to promote both environmental sustainability and competitive advantage. The impact of the food system is probably best approached of welfare, and valuable lessons learnt from the poverty literature.

Organizations involvement in the application of intelligent technologies like Artificial intelligence can help to strengthen their supply chain resilience position. This is because the adoption of artificial intelligence can act as a critical capability to devise better control mechanisms and to identify areas of disruption (Gupta et al., 2020:Wamba et al., 2020). Artificial intelligence based innovations can assist in real time coordination and collaboration to enable supply chains to have improved visibility (Wamba et al., 2020, Remko, 2020).

Another critical issue is network planning and mapping in the supply chain, and this is a further area in which artificial intelligence can assist the supply chain in terms of production, distribution, routes, and other linking point (Ivanov & Dolgui, 2020). Artificial intelligence can further improve the collaboration between contractors and suppliers in shaping the supply chain in unprecedented times. It offers the visibility of routes and accordingly, promises can be made to consumers (Datta, 2017). Artificial intelligence utilizes data science principles to handle the volume, velocity, variety, veracity, value, variability, and visualization of data for critical insights (Wamba et al., 2020). Further, artificial intelligence helps in tracking the performance of warehouses in terms of demand and shelf life. Inventory management has become critical in ensuring continuous supply during economic changes (Butt, 2021; Queiroz et al., 2020). Artificial intelligence offers a robust examination of stock levels and aligns associated activities accordingly. Supply chains are continuously expanding their geographic reach, particularly into areas that they have not served previously due to the economic changes and therefore the examination of traffic, weather, and the optimal route is also a concern for Organizations. With the help of artificial intelligence, companies can navigate different markets remotely and can take strategic decisions more accurately. The technologies of artificial intelligence also help top management and employees to be up to date in terms of the skill set needed to mitigate emergencies and cross cultural management in an organization (Dubey et al., 2018).

Supply Chain Resilience and organizational performance Supply chain resilience and organizational performance In the present study, supply chain resilience refers to the ability to anticipate and address disruptions and to recover operations (El Baz and Ruel, 2021; Yao and Fabbe-Costes, 2018). Supply chain resilience is the capability of a supply chain to cope with unforeseen, disrupting events and to recover quickly to its original level of performance, or to a new level required to maintain the expected operating, financial, and market performance (Adobor, 2020; Ponomarov & Holcomb, 2009). To build a resilient supply chain, organizations need to identify and assess the nodes for risks, their severity, and the likelihood of occurrence, and how these risks can be detected (Dubey et al., 2017; Chang et al., 2015). Companies do adopt multiple strategies to keep their supply chains resilient. Organizational performance refers to the ability to maintain the flow of available products and services and ensure on-time delivery in line with customer demand (Gu et al., 2021). Owing to the disruptions exacerbated by the economic changes, interest in the resilience of supply chains has gained momentum over the last few years (Fjellström et al., 2023; Gillani et al., 2022).The combination of internal and external resources can support the creation of operational resilience (Li et al., 2022) and, consequently, improve organizational performance. Some actions related to resources for risk management (i.e., risk capture and

assessment) can enable resilience and support organizational performance (Wulandhari et al., 2022). In large-scale disruptive contexts, the resilience of supply chains, enabled by other variables, is critical for the performance of supply chains (Shen and Sun, 2021).
Supply chain resilience is an adaptive capability that enables preparation for unexpected events, counters disruptions and returns operations to a stable state through continuity of operations at the expected level of connectedness and
control over structure and function.

Resilience is not only reactive but also a proactive, structured and an incorporated consideration of proficiencies that a supply chain possesses to deal with unforeseen events. Supply chain disruption impacts are perceived as a negative and unforeseen discontinuation of the regular stream of supply and demand in the supply chain (Ambulkar et al., 2015; Craighead et al., 2007). Furthermore, supply chains can suffer severe setbacks mainly due to ripple effects (Dolgui et al., 2018). Recent literature on supply chain resilience has agreed on its importance in directly and indirectly supporting performance (Bahrami and Shokouhyar, 2022). Moreover, in the context of supply chain disruptions, El Baz and Ruel (2021), found that supply chain risk management, including resilience, directly and indirectly contributes to the
performance of operations and recovery actions in severe disruptive contexts. In this regard, it is clear that risk management can enable different types of resources and support performance during a severe crisis (Mertzanis, 2021). Accordingly, the study suggest that, during a disruptive crisis scenario, supply chain resilience plays a decisive role in supporting performance, enabled by key capabilities. In this way, local supply chains facilitate more control over inventory and transfer the product to the customer more quickly (Sundarakani et al., 2020). The more local the network, the more opportunities exist for the technology used in production to be harmonized more effectively to facilitate a seamless flow of products across the network (Singh et al., 2020). Hence, standardization of components for different products, especially those that are not critical and visible to the customer, simplify sourcing and thus enhance the degree of resilience. Aside from the core components, the supply chain ecosystem partnerships with contract manufactures and third-party logistics play a critical role in its resilience.

Supply chain resilience is an adaptive capability that enables preparation for unexpected events, counters disruptions and returns operations to a stable state through continuity of operations at the expected level of connectedness and control over structure and functions. Resilience is not only reactive but also a proactive, structured and an incorporated consideration of proficiencies that a supply chain possesses to deal with unforeseen events. The impact of risks is determined through the effects on the performance indicators of an organisation such as profitability and productivity. Examples of the impacts of risks include poor delivery performance, low-quality products and delivery of raw materials with wrong specifications. It is important to consider whether a risk has a low or high probability of occurrence as well as low or high impact on the Organization Critical risks such as a vital component supplied by one supplier may need increased safety stock to mitigate the possibility of a risk, whereas an inessential component may
not need a high amount of safety stock. Therefore, each risk requires separate assessments to identify a feasible strategy to avoid failure during mitigation. Risk assessment tools that can be employed and supply chain simulations to aid the visibility on the impact of a risk on financial, production, logistics and trade performance is the artificial intelligence.

Artificial Intelligence

Many organizations have been trying to adopt digitization of their processes for the last two decades, and recently Industry 4.0 has emerged as a business buzzword (Wollschlaeger et al., 2017). Artificial intelligence has long been recognized as one of the prominent technologies capable of enabling communication among devices and machines (Guzman & Lewis, 2020; Dwivedi et al., 2019; Schutzer, 1990). Since the supply chain involves a series of complex tasks, it can simplify operations by solving problems at higher levels of speed and accuracy while simultaneously handling large volumes of data (Schniederjans et al., 2020). Artificial intelligence is not new, but its potential for vast applications, including supply chain management has only been recognized more recently (Huin et al., 2003). Artificial intelligence has the potential to facilitate smart decision making in the supply chain to anticipate problems. Hence, a proactive system of artificial intelligence helps in enhancing the quality of service and in delighting customers through on-time and undamaged deliveries (Toorajipour et al., 2021; Wamba et al., 2020). It facilitates automated compliance that results in lower costs and the efficient functioning of a value chain network (Treleaven & Batrinca, 2017). It also has a significant impact on enhancing the predictive capabilities required for demand forecasting in today's dynamic business environment.

Artificial intelligence can be very efficient in the engagement of customers as interactions can be personalized by artificial intelligence driven bots. These bots can help in tracking the delivery status of an item and are further supported by echo users assisted by acustomer support team (Huang & Rust, 2020). It can help in simplifying tedious tasks in warehouse operations through automation. In the supply chain ,every minute and every mile matter and artificial intelligence uses algorithms that can help in reducing time and costs by optimizing routes and deliveries(Wen et al., 2018).

Artificial intelligence can also be as a measures for Supply Chain Security. Supply chain security is considered important for reducing vulnerability especially arising from threats of intentional acts e.g. terrorism, theft and food contamination (Zhang et al., 2011;Speier et al., 2011). Supply chain security management is the application of policies, procedures, and technology to protect supply chain assets (product, facilities, equipment, information, and personnel) from theft, damage, or terrorism, and to prevent the introduction of unauthorised contraband, people, or weapons of mass destruction into the supply chain. Pfohl et al. (2010). Supply chain security as the protection of the supply chain against attacks and disturbance with a criminal intent, or as an aftermath of juridical consequences in the case of liability and perpetuation of the companies under those kinds of circumstances.

Theoretical Framework

Resource Based Therory (RBT), The Resource Based Theory postulates that internal organisational resources that are valuable, inimitable, rare and non substitutable are a source of competitive advantage (Barney, 1991). According to the findings of Omodadepo and Akanni (2013), the resource based theory argument says that natural resource rich countries tend to grow at a slower pace while countries with little or no natural resources grow at a faster rate. Supply chains received from natural wealth country should generate economic progress and bring wealth to a resource rich country.

However, economic realities and empirical studies seem to be a variance with theoretical explanations. Many resource-rich countries appear to have experienced a worse performance in terms of economic progress and poverty reduction than countries without such apparent "benefits" (Steven, 2003). While some cross country studies establish only a statistical connection between large resources and poor economic growth. Resource Based

Theory is a classical organizational theory that directs attention toward the resources required for organization to effectively leverage their capabilities, thereby enhancing their performance (Dubey et al., 2019; Huang et al., 2023). Notably, the theory focuses on the firm's resources to support the creation of capabilities to attain a competitive advantage (superior performance) when its resources possess rarity, value, non-imitability, and non-substitutability (Barney, 1991). It suggests that an organization is comprised of both the tangible and intangible resources, which, for example, may combine to create capabilities that determine its reaction to several internal and external threats as well as to opportunities (Barney, 1991).

In supply chain research, the resource based theory has been used to explain the resources and capabilities that are considered antecedents of resilience, such as logistics capabilities (Ponomarov & Holcomb, 2009), human, organisational and inter-organisational capital resources (Blackhurst et al., 2011), redundant resources and flexible capabilities (e.g. Park, 2011). Other studies (e.g. Ponomarov, 2012) have incorporated the related dynamic capabilities perspective, arguing that capabilities for enhancing supply chain should be dynamic to match changes in the environment (e.g. Teece, 2007).

The transparency of a supply chain can build resilience when supply chain actors are capable of tracking their shipments, have the correct invoicing to drive the operations and utilizes artificial intelligence to forecast demand (Ivanov, 2021; Queiroz et al., 2020). Further, artificial intelligence can be viewed as a tool in understanding market and consumer requirements, which can assist in designing and offering personalized solutions. As procurement and strategic sourcing are often perceived as the backbone of a supply chain, artificial intelligence can support in effective contract management, thus developing understanding and reducing the impact of supplier risk management (van Hoek, 2020; Sundarakani et al., 2020). However, the theory has encountered criticism (Sirmon et al., 2011), primarily due to the need to further elucidate how resources are transformed into capabilities. The literature pertaining to general business management and the supply chain has successfully investigated resilience using the theory (Brusset and Teller, 2017; El Baz andRuel, 2021) as well as other resource approaches, such as resource dependence (Jiang et al., 2023) and supply chain resources (Qi et al., 2023). In this regard, resource based theory has proven to be useful in comprehending disruptions and resilience (Bag et al., 2021; El Baz and Ruel, 2021). Thus, it is clear that resources (internal and/or external) can play a decisive role in building the resilience of organizations and supply chains (Li et al., 2022).

Research Methodology

The study design utilizing qualitative approaches. The study measured artificial intelligence use and the control variables at one point in time and measured Organization resilience and firm performance at a second point in time. Of 225 respondents who completed the first survey, a total of 107 respondents completed the second survey for an effective response rate 47.5 percent. Our unit of analysis is an organizational level. Only firms that had adopted AI systems (i.e., virtual agents, machine learning platforms, deep learning platforms, robotic process automation) in their supply chain and business processes at the time of the survey were eligible to participate.

Questionnaires were electronically distributed to members of an online panel managed by a market research company. Companies located in Nigeria were the target of our surveys. A total of 107 respondents completed survey Y1 and survey X2. Given the questions being asked were related to artificial intelligence and its consequences, the study targeted either organization managers with high levels of shared domain knowledge (i.e., high

business and IT knowledge). Demographic information collected suggested that the respondents were reliable sources. On average, respondents' levels of business and IT knowledge were 4.55 and 4.35, respectively (on a 5point Likert Scale); had more than 10 years of experience in their managerial positions, and more than 84 percent of the respondents had at least an undergraduate degree or higher. The demographics of our sample reveal that over 68 percent of organizations head office were based in Lagos Nigeria. The median firm size was 100 - 150 employees, and the median firm age was over 25 years. To assess potential nonresponse bias in survey one, the study employed wave analysis. Responding organizations were grouped into first and second respondents, and comparisons were made along respondent's age, gender, education, firm size, and firm age. The analysis demonstrated that no significant differences between First and second respondents. Responding and nonresponding organizations were compared along the same criteria for the second survey. Again, there were no significant differences between responding and nonresponding organizations. Based on these findings, the study conclude that nonresponse bias is not a major concern in this study.

Data Analysis and Results

The study analyzed the survey data using partial least square (PLS) with a two-step analytic approach. First, the measurement model was evaluated to assess the validity and reliability of the measures. Second, the structural model was evaluated to test the instrument. The psychometric properties of all scales were assessed within the context of the structural model through an assessment of discriminant validity and reliability.

Measurement Model

Artificial intelligence use as a reflective, second order construct. A reflective second-order measurement model was

estimated to arrive at a representative holistic construct using coordination, learning, and strategic competitive response capabilities as first order constructs. The psychometric properties of the scales are assessed in terms of item loadings, internal consistency, and discriminant validity. Item loadings and internal consistencies greater than .80 are generally considered acceptable. As summarized in Table 2, the scales used in the study largely meet these guidelines. All indicators also loaded more strongly on their corresponding constructs than on other constructs, suggesting high discriminant validity.

Table 2. Item Loadings, Compositive Reliability, and AVE

Item	CR	AVE	AI Use	OR	FTP
Coordination_tl	.95	.67	.96	.43	.35
Learning_tl			.91	.37	.30
Comp Response_tl			.92	.46	.28
OrgResilience1_t2	.92	.71	.15	.70	.24
OrgResilience2_t2			.37	.83	.35
OrgResilience3_t2			.32	.86	.48
OrgResilience4_t2			.48	.91	.47
OrgResilience5_t2			.44	.89	.51
FPI_t2	.92	.69	.28	.48	.84
FP2_t2			.14	.39	.80
FP3_t2			.29	.49	.84
FP4_t2			.32	.32	.77

FP5_t2			.33	.43	.90

CR = Compositive Reliability; AVE = Average Variance

Extracted; t1 = Measured at the first stage of survey; t2 = Measured at the second stage of survey. To further assess discriminant validity, the average variance extracted (AVE) should be larger than the inter-construct correlations. As shown by the comparison of interconstruct correlations and AVE (bold numbers on the leading diagonal) in Table 3, the constructs meet this guideline, pointing to the discriminant validity of the constructs in the model.

The findings showed that artificial intelligence use had a direct effect on organizations resilience to supply chain disruptions. The study performed a mediation test to examine the mediation role of organization resilience. The indirect effect of artificial intelligence use on firm performance through their resilience was significant (.22, $p<.001$), However, the direct effect (after organization resilience was added, it was not significant ($\beta = .14$, $p = .10$). These results suggest that firm resilience fully mediated the relationship between artificial intelligence use and organizations performance. Further, the study contributes to the dynamic capability literature. We conceptualize artificial intelligence use as a dynamic organizational information processing capability that can influence key aspects of organization resilience to supply chain disruptions. Unlike technology in the past, artificial intelligence has greater autonomy and deeper learning capacity. Such artificial intelligence capabilities could revolutionize industries and change a organization's competitive environment. Our study demonstrates that when firms are able to direct artificial intelligence information processing to coordinating/integration, learning, and strategic competitive responses, they become more flexible to meet the demands of surviving in a changing environment.

Transparency

Transparency was identified as critical by respondents of the study, and refers to the visibility of data related to inventory, delivery, etc. across supply chain partners to ensure efficiency and the reduction of the impact of possible disruption. The exchange of data and timely information increases the coordination and trust among supply chain partners. The transparency and visibility of the data are important and it affect the performance of asupply chain, and can be responsible for both building and breaking the supply chain relationship (Murfield & Tate, 2017). The study are focusing on an artificial intelligence tool that tells the demand of the end retailer. From there we can predict the demand of the customers and map with the product planning.

Scanning of barcode data at the retailer can be used for predictive analysis. Open Code: Retailers' demand can be mapped using smart technology and can be used for better product planning. Artificial intelligence is helping in the supply chain as it can forecast the Forecasting demand in a much accurate way. It helps in analyzing the data and converting it into an intelligent forecast and even helps in improving sales strategies. Open Code: Artificial intelligence brings an accurate forecast to Organization. Invoicing artificial intelligence is helping to send the invoicing details automatically to the customer once the invoice is generated and also the customer can see the live status of the truck with the delivery time counting various factors like traffic and weather in long-distance. Open Code: Smart technology brings automation in invoicing.

Personalized solutions

Personalization helps Organization in reaching out to a greater number of market segments and in solidifying their brand. Customers tend to purchase from firms that consider their preferences and deliver the product of their choosing. It also develops trust between the buyer and the seller. New communication mechanisms like virtual chatbots are being

deployed to enhanced the communication between parties. Brands that personalized and take into consideration the customer's preferences tend to generate greater return on investment and 10per cent more sales than those that do not personalize (McKinsey, 2018).

Artificial intelligence helps in installing a virtual chatbot to solve the customer query without being engaged with the employee, be it the live status of the order, the sending of an order, or the tentative delivery time of the order. Also, Organization take the benefit of fetching exact customer requirements and preferences using this medium. Open Code: Digital communication mediums resolve customer queries and help Organization in understanding customer choices. Personalization is carried out using artificial intelligence helps to understand the next buying pattern, whether bulk purchase to keep stock in advance is necessary or smaller inventory would suffice. Open Code: AI-enabled personalization leads to effective inventory planning.

Procurement Strategy

An effective procurement strategy brings better control of resources, cost optimization, and efficient supplier management. A procurement strategy refers to identifying the right supplier, designing supply contracts, supplier management, etc. An effective procurement strategy not only brings the cost of procurement down but also enhances trust among supply chain partners by managing the relationship with suppliers, and controls overall inventory. Using artificial intelligence, spend visibility of the Organization increases, helps in expediting the decision making process by using classified spend data, and saves both time and money by reducing the human intervention. Open Code: Spend analysis saves time and cost, hence increases efficiency and speed.

Last mile delivery

The most critical part of logistics is last mile delivery where in the customer evaluates the service quality based on the timely delivery of items (Mangiaracina et al. 2019). The key objective of last mile delivery is to deliver the product in the fastest means to the consumer. Last mile delivery is often less efficient and more expensive (Macioszek, 2017) due to maintaining the required services levels and to achieve target set. In last mile delivery, artificial intelligence plays a great role by accurately managing the most complex data related to routes, network, traffic, etc. It may also produce data models focused on predictive analysis. This way it will help to ensure quick fixes and safe last mile delivery as well. Open Code: Predictive analysis model helps in route planning and ensures quick last mile delivery.

Disruption and impact reduction

Supply chain disruption can be caused by various factors including delivery delay, demand and supply related problems, disruption can lead to the poor performance of a supply chain (Alora and Barua, 2020). It is therefore essential to identify the potential risks and types of disruptions that may occur in the future and can lead to the most severe outcomes. Reducing the impact of disruption can be achieved by making the system capable of matching market demand or supplying what is demanded (Papadopoulos et al. 2016).

Practical implications

The results of this study have several important implications for managerial practices. First, as adoption of artificial intelligence continues to increase and many organizations now use artificial intelligence systems to generate some business value, they are still struggling to build artificial intelligence capabilities that can lead to increased firm performance multilevel-challenge. (Ransbotham, etal 2020). Interestingly, our findings show that the effect of artificial intelligence use on organizations performance is mediated by firm resilience to supply chain disruptions. Senior-level managers and decision makers should take note of the

importance of establishing firm resilience using artificial intelligence. Artificial intelligence use can be a starting point for establishing firm resilience as it assists management in establishing and reconfiguring critical resources. Organizational decision makers should also focus on directing artificial intelligence use to build dynamic capabilities. It is not artificial intelligence use itself that leads to organization performance, but the ways organizations use artificial intelligence to coordinate resources, learn, and respond to opportunities during disruptive events that matter. Organizational decision makers should be aware that embedding artificial intelligence systems into business operations and supply chain activities can drive firm resilience a firm's situational capability acquire through continuous learning and adaptations (Belhadi, etal 2021).

Therefore, policy makers are expected to contribute to reducing vulnerabilities and enhancing resiliency in supply chain. Our analysis revealed that critical antecedents to build and enhance resiliency in supply chain and the benefits artificial intelligence techniques have in reducing vulnerabilities and fostering resiliency in supply chain resilience. Artificial intelligence techniques have the potential to clarify uncertainties from information gaps in this complex and dynamic business environment. Regarding the critical antecedents of supply chain resilience, policymakers should consider public digital and other related infrastructure to be utilized by supply chain to strengthen the collaboration among the supply chain members and to enhance transparency and end-to-end supply chain visibility. In order to facilitate resilient sourcing, policymakers can come up with alternative national sourcing strategies and even can relax stringent national sourcing strategies that hinder the degree of flexibility during disruptions times. Artificial intelligence and related digital technologies, policymakers can subsidize investment in developing new and innovative AI techniques and algorithms that can benefit resiliency in supply chains. This can provide Supply chains practitioners with affordable, innovative digital technologies. Policymakers are also expected to cultivate and enforce the culture of data collection that enable supply chains to clarify future uncertainties by implementing ML algorithms.

Conclusion

The primary objective of this study was to capture the current state of research and practice and potential applications of artificial intelligence techniques for developing and enhancing supply chains resilience. The study focuses on investigating how artificial intelligence influences organization resilience to supply chain disruptions and, in turn, organization performance. Majority of times, it is argued that firm could face difficulty to reconfigure its processes and capture opportunities within the market place, without even suspecting such opportunities earlier. Market sensing shows the routines of organization which are associated with quick learning about competitors, customers, business environment, and supply chain members, enabling to understand market conditions for the purpose of forecasting. Thus, this study is interested in examining the relationship between supply chain performance and firm performance in the presence of firm performance. Through a longitudinal study of organizations that had adopted artificial intelligence in their business practices, we show that firm resilience to supply chain disruptions mediates the relationship between artificial intelligence use and firm performance. We hope that this paper lays the groundwork for future research concerning the business value of artificial intelligence. The study investigates the role of artificial intelligence for supply chain resilience and organizations performance. The study have gathered the data through a semi-structured approach of interviews and transcribed them into main content to further analyze them. We used the thematic analysis approach, where we first identified the gaps in the

traditional information systems leading to how artificial intelligence can help develop a strong architecture of resilient information systems. Furthermore, we identified the challenges of artificial intelligence in achieving resilient information systems. Our study proposes how artificial intelligence elements can offer an ecosystem support to modern and resilient information systems. Our study provides a framework, where architectural components used together can help reduce supply chain disruptions and prepare it for dynamic scenarios.

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