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The Effect of Supply Chain Agility on Service Quality in Selected Liquefied Petroleum Gas (LPG) Firms in Lagos State, Nigeria

[1]Ezeh Chidinma Felicity & [2]Makinde Olubisi Grace

[1&2]Department of Business Administration and Marketing, School of Management Sciences, Babcock University, Ilishan –Remo, Ogun State, Nigeria

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Corresponding Author:
Ezeh Chidinma Felicity

Abstract

Service quality constitutes a critical determinant of competitiveness and sustainability in Small and Medium Enterprises (SMEs) especially in Liquefied Petroleum Gas (LPG) firms particularly within the highly dynamic and resource-constrained business environment of Nigeria. However, many firms within the sector continue to experience persistent challenges such as slow delivery systems, this challenge suggest inadequate development and integration of supply chain agility capabilities within the operational frameworks of LPG downstream firms. While existing studies have examined supply chain agility in relation to service quality, empirical evidence remains limited in emerging economies such as Nigeria, especially within the LPG downstream sector. This study therefore examined the effect of supply chain agility on service quality in selected LPG downstream firms in Lagos State, Nigeria. Survey research design was adopted for the study. The population consisted of 2,800 employees directly involved in supply chain activities within selected LPG downstream firms in Lagos State, Nigeria. A sample size of 455 respondents was determined using the Taro Yamane formula, and data were collected using a structured questionnaire administered through simple random sampling. The reliability and validity of the instrument were established through Cronbach's alpha, construct validity, Kaiser-Meyer-Olkin measure, and Bartlett's test. Data were analysed using descriptive and inferential (multiple linear regression analysis) statistics, at a 5 percent level of significance. The finding revealed that supply chain agility had a significant effect on service quality ($Adj.\ R^2 = 0.362$, $F(4, 388) = 56.526$, $p < 0.05$) in selected LPG downstream firms in Lagos State, Nigeria. The study concluded that supply chain agility enhanced service quality in LPG downstream firms in Lagos State, Nigeria, It is therefore recommended that LPG downstream firms adopt holistic supply chain agility strategies in order to enhance service quality, and overall organisational performance.

Background to the Study

Service quality is a critical determinant of operational success in the downstream segment of the Liquefied Petroleum Gas (LPG) sector, reflecting firms' ability to achieve significant level of performance. Many LPG downstream firms, however, face challenges such as inconsistent service delivery, and poor performance which undermine their competitiveness and long-term sustainability. In this context, supply chain agility strategies are regarded as a powerful tool for addressing these challenges and enhancing organisational performance through effective service delivery quality. This study investigated the effect of supply chain agility on service delivery in selected LPG downstream firms.

Globally, the downstream Liquefied Petroleum Gas (LPG) sector has experienced substantial growth in recent years, driven by increasing demand for cleaner energy alternatives, rising residential penetration, and expanding industrial applications, with global LPG demand reaching approximately 366 million tonnes in 2024 and supply growing to 370 million tonnes in the same period (Ogbonna & Chukwuemeka, 2024; Litvinenko, 2020). The global LPG market was valued at USD 191.23 billion in 2025 and is projected to grow steadily, reaching an estimated USD 198.5 billion in 2026 and USD 277.67 billion by 2035, reflecting ongoing market expansion (Eftekhar, 2020; Navarro, 2022). Despite these growth prospects, the downstream LPG sector continues to confront persistent organisational performance challenges that detract from service quality.

In America, the United States, the downstream Liquefied Petroleum Gas (LPG) sector demonstrates a strong market presence but continues to face several challenges that affect organisational performance indicators such as service quality, customer retention, market share growth, and operational efficiency. The U.S. LPG market is projected to record modest growth over the coming decade, with consumption expected to reach approximately 30 million tonnes by 2035 at a compound annual growth rate of about 1.1 percent, reflecting a relatively slow expansion compared with earlier periods (Ogbonna & Chukwuemeka, 2024; Patidar et al., 2023). Recent market trends also reveal fluctuations in demand, as U.S. LPG consumption declined to an estimated 27 million tonnes in 2024, representing a significant reduction from the previous year, while market revenues contracted to roughly USD 12.2 billion, indicating challenges in demand stability and end-user uptake (Acosta-Amado, 2024; Ndunagu et al., 2022).

In Europe, Germany stands out as a major contributor to the Liquefied Petroleum Gas (LPG) downstream market, accounting for a significant share of regional consumption and distribution. In 2024, Germany was the largest contributor to the European LPG market with an estimated 23.4 percent regional share, supported by extensive industrial applications and a well-developed distribution network (Market Data Forecast, 2026). Despite these strengths, the downstream LPG sector in Germany faces persistent challenges that negatively impact organisational performance outcomes, particularly service quality, customer retention, market share growth, and operational efficiency (Huo et al., 2024; Mogaka & Njururi, 2024). In France, the downstream LPG sector

represents a critical component of residential heating and industrial fuel supply, with the country consuming approximately 3.2 million tonnes of LPG in 2024, reflecting stable demand driven by both household and commercial applications (Market Data Forecast, 2025). Despite this established market, downstream LPG firms in France face persistent organisational performance challenges that directly affect service quality, customer retention, market share growth, and operational efficiency (Huo et al., 2024; Mogaka & Njururi, 2024).

In Asia, India represents one of the largest and fastest-growing downstream markets for Liquefied Petroleum Gas (LPG), with the country consuming approximately 28.4 million tonnes in 2024 and serving over 250 million domestic households through government-supported distribution programs such as the Pradhan Mantri Ujjwala Yojana (PMUY) (Indian Ministry of Petroleum & Natural Gas, 2025; Statista, 2025). Despite this extensive reach, downstream LPG firms in India face persistent organisational performance challenges that affect service quality, customer retention, market share growth, and operational efficiency (Ndunagu et al., 2022; Almutairi et al., 2025). Distribution inefficiencies, particularly in rural and remote regions, contribute to delayed deliveries and intermittent supply, which undermines service reliability and reduces customer satisfaction (Bahrami et al., 2022; Bag et al., 2023).

In Africa, South Africa's downstream Liquefied Petroleum Gas (LPG) sector illustrates both the opportunities and performance challenges characteristic of emerging energy markets, with national LPG consumption estimated at approximately 380,000 tonnes in 2024 and forecasted to grow steadily as both residential and industrial demand expand (Business Monitor International, 2025). Despite this growth trajectory, LPG downstream firms in South Africa continue to grapple with organisational performance constraints that adversely affect service quality, customer retention, market share growth, and operational efficiency (Ndunagu et al., 2022; Almutairi et al., 2025). Logistical inefficiencies, particularly in last-mile distribution across widely dispersed rural regions, contribute to delayed deliveries and inconsistent supply reliability, weakening customer satisfaction and diminishing perceived service quality (Bahrami et al., 2022; Bag et al., 2023). Kenya's downstream Liquefied Petroleum Gas (LPG) sector has experienced significant growth over the past decade, with consumption estimated at approximately 220,000 tonnes in 2024 and increasing adoption in both urban and peri-urban households (Kenya Energy Regulatory Commission, 2025; Bag et al., 2023). Despite this growth, downstream LPG firms in Kenya face persistent organisational performance challenges that impact service quality, customer retention, market share growth, and operational efficiency (Ndunagu et al., 2022; Almutairi et al., 2025).

Nigeria's downstream Liquefied Petroleum Gas (LPG) sector plays a critical role in the country's energy mix, with national consumption estimated at 1.5 million tonnes in 2024 and expected to rise steadily due to government initiatives promoting clean cooking fuels and household adoption (NNPC, 2025; Statista, 2025; Bahrami et al., 2022). Despite this growth, downstream LPG firms in Nigeria face persistent organisational performance

challenges that negatively affect service quality, customer retention, market share growth, and operational efficiency (Ndunagu et al., 2022; Bag et al., 2023). Inadequate storage facilities, fragmented distribution networks, and transportation bottlenecks contribute to frequent delivery delays and inconsistent supply, undermining service reliability and customer satisfaction (Almutairi et al., 2025; Alfalla-Luque et al., 2023). Enhanced supply chain agility also enables firms to mitigate the impact of infrastructural and regulatory constraints, better absorb market shocks, and respond rapidly to consumer expectations in an increasingly competitive and dynamic energy market (Bahrami et al., 2022; Mensi et al., 2021). Consequently, the development of agile supply chain processes is not merely an operational consideration but a strategic imperative for sustaining growth and competitiveness in Nigeria's downstream LPG sector (Li et al., 2023; Huo et al., 2024). In response to the persistent organisational performance challenges faced by downstream LPG firms in Nigeria, supply chain agility has emerged as a strategic approach to improving service quality,

Several studies have investigated the relationship between supply chain agility and service quality in various organisational contexts, producing mixed findings and highlighting inconsistencies in outcomes (Akhil et al., 2025; Dubey et al., 2019; Al Humdan et al., 2020; Aslam et al., 2020; Koç et al., 2022). However, the extent to which supply chain agility contributes to improved service quality in firms operating in Nigeria, particularly in sectors such as downstream LPG, remains underexplored, representing a critical research gap. In practice, firms continue to experience persistent service quality challenges, including inconsistent delivery of products, delayed order fulfillment, errors in transactions, limited responsiveness to customer inquiries, and inadequate mechanisms for addressing service failures (Al-Douri et al., 2022; Candeias, 2024; Faturrahman and Nursyamsiah, 2024; Huo et al., 2024). These deficiencies often result in reduced customer satisfaction, diminished loyalty, negative word-of-mouth, and weakened trust in service reliability, limiting the ability of firms to achieve high organisational performance and sustain competitive advantage.

The aforementioned has led to the objective of this study: The study examined the effect of supply chain agility on service quality in selected downstream LPG firms in Lagos State, Nigeria. To achieve this objective, research question and hypothesis were formulated as stated below:

Research Question: How does supply chain agility affect service quality in selected downstream LPG firms in Lagos State, Nigeria?

Research Hypothesis

H_0: Supply chain agility does not have a significant effect on service quality.

Literature Review

This section deals with the review of conceptual, empirical and theoretical views of both

independent and dependent variables of this study.

Service Quality

Service quality refers to the degree to which an organization consistently meets or exceeds customer expectations in the delivery of its products and services (Acosta-Amado, 2024). It reflects the organization's ability to provide reliable, timely, and accurate services while maintaining high standards of professionalism, responsiveness, and customer satisfaction (Arikat, 2024). Service quality is not a singular concept but a multidimensional construct encompassing several facets that collectively influence customers' perceptions of value and effectiveness. In addition to reliability and responsiveness, service quality includes assurance, empathy, and tangibility, which shape how customers evaluate the overall service experience (Aniebo and Mogbo, 2024). The centrality of service quality to organisational success stems from its direct influence on customer satisfaction, loyalty, retention, and market competitiveness, making it a critical driver of long-term organisational performance. Firms that fail to maintain consistent service quality often experience reduced customer trust, lower retention rates, and diminished competitive positioning, highlighting the importance of continuous evaluation and improvement of service delivery processes.

Key characteristics of service quality further define its operational dimensions. Reliability captures an organization's ability to deliver promised services consistently and accurately, ensuring that commitments made to customers are fulfilled without errors or delays. Responsiveness refers to the speed and willingness with which employees address customer inquiries, complaints, or special requests, which directly impacts perceived service efficiency. Assurance encompasses the competence, knowledge, and professionalism of employees, instilling confidence in customers regarding the firm's ability to meet their needs. Empathy emphasizes personalized attention, active listening, and understanding of unique customer circumstances, enhancing the relational aspect of service delivery. Tangibility pertains to the physical and observable aspects of service provision, including the quality of facilities, equipment, and presentation, which influence customers' perceptions of credibility and professionalism (Altay et al., 2023; Chandra, 2023). High service quality requires systematic attention to these dimensions, as deficiencies in any area can compromise customer perceptions and reduce the overall effectiveness of service delivery. Organizations increasingly rely on tools such as customer relationship management (CRM) systems, service analytics, and structured feedback mechanisms to monitor, measure, and enhance service quality, ensuring that organisational processes align with evolving customer expectations (Fahmi et al., 2023; Hemachandiran et al., 2023).

The advantages of maintaining high service quality are extensive and extend beyond customer satisfaction. High-quality service fosters loyalty and repeat patronage, creating a dependable revenue base while minimizing the cost of acquiring new customers (Abdelilah et al., 2025). It strengthens brand reputation and differentiates firms in competitive markets, especially in sectors where product offerings are commoditized

and customer experience becomes a key differentiator (Assyifa et al., 2025). Superior service quality also contributes to operational efficiency by reducing errors, rework, and customer complaints, thereby allowing resources to be allocated more effectively and processes to be streamlined (Fullonton et al., 2025). Moreover, consistent service excellence encourages positive word-of-mouth and referrals, which can drive market share growth, enhance competitive positioning, and generate sustainable revenue streams (Goswami et al., 2025). In the context of the LPG downstream sector in Nigeria, for example, firms that maintain timely cylinder delivery, responsive customer support, and reliable availability of LPG are more likely to retain customers and expand their market presence in both urban and peri-urban areas.

Despite its clear advantages, achieving and sustaining high service quality presents significant challenges. Continuous investment in employee training, technological infrastructure, and process improvements is necessary to maintain service standards and adapt to changing customer expectations (Ivanov et al., 2025). Variability in employee performance, unpredictable customer demands, supply chain disruptions, and infrastructural constraints can compromise service reliability and responsiveness, impacting customer satisfaction and loyalty (Khan et al., 2025). Over-standardization, while improving process consistency, may reduce flexibility and limit the firm's ability to provide personalized services, diminishing its capacity to respond to unique customer needs (Kim et al., 2025). Furthermore, firms operating in resource-constrained or highly competitive environments must balance the cost of service quality initiatives with operational efficiency, ensuring that investments in quality do not inadvertently strain financial or human resources. These challenges underscore the need for robust monitoring, continuous feedback, and adaptive service strategies to achieve sustainable improvements in service quality, which, in turn, directly enhance organisational performance and customer-centric outcomes (Alfaqiyah et al., 2025; Akhil et al., 2025). This study therefore defines service quality as the consistent provision of superior services that meet or exceed customer expectations, enhancing satisfaction, loyalty, and overall organisational competitiveness.

Supply Chain Agility

Supply chain agility refers to an organization's capability to rapidly sense, respond to, and adapt to changes in market conditions, customer requirements, and environmental uncertainties within its supply chain network (Abutu, 2024). It emphasizes speed, flexibility, and responsiveness across supply chain activities, including sourcing, production, distribution, and information flows. In an increasingly volatile business environment characterized by fluctuating demand, shorter product life cycles, technological disruptions, and global shocks, supply chain agility has become a critical strategic capability for firms seeking to maintain competitiveness and operational continuity (Dubey et al., 2019). The advantages of supply chain agility are well documented in the literature. Agile supply chains enable firms to improve service levels by meeting customer demands more quickly and reliably, thereby strengthening customer satisfaction, loyalty, and retention (Jawabreh et al., 2023). In highly competitive

markets, supply chain agility supports market share growth by allowing firms to exploit emerging opportunities, introduce products faster, and respond more effectively to competitors' actions (Akhil et al., 2025).

Despite its benefits, supply chain agility is associated with notable challenges and limitations. Developing and maintaining agile supply chains often requires significant investments in information technology, digital infrastructure, and advanced analytics, which may strain organisational resources, particularly in cost-sensitive industries (Al Humdan et al., 2020). High levels of agility can also introduce operational complexity, as managing multiple suppliers, flexible production systems, and dynamic logistics arrangements increases coordination demands and managerial burden (Koç et al., 2022). Moreover, excessive emphasis on agility may lead to higher operating costs, as maintaining flexible capacity, safety buffers, and rapid-response capabilities can reduce economies of scale and cost efficiency (Aslam et al., 2020).

In this study, supply chain agility will be measured using four sub-variables: delivery speed, lead time reduction, supplier flexibility, and demand responsiveness. These dimensions are critical for evaluating how effectively organisations adapt their supply chain operations to changing market conditions, customer requirements, and environmental uncertainties within selected LPG downstream firms in Lagos State, Nigeria. Hence, the study defines supply chain agility as the organisation's capability to rapidly sense, respond to, and adapt its supply chain processes and relationships through enhanced delivery speed, reduced lead times, flexible supplier arrangements, and responsive demand management in order to sustain competitiveness and operational effectiveness.

Delivery Speed

Delivery speed refers to the capacity of an organization to move products from suppliers through production, warehousing, and distribution channels to the end customer in the shortest possible time without compromising quality or operational standards (Al-Douri et al., 2022). It is a critical dimension of supply chain agility because it directly affects the organization's ability to respond to customer needs promptly, maintain high service quality, and compete effectively in dynamic markets. In sectors like the LPG downstream industry, where timely delivery of products can influence customer satisfaction, operational efficiency, and market positioning, delivery speed becomes a key driver of organisational performance. Firms that maintain high delivery speed can reduce stockouts, prevent production delays, and mitigate the risks of losing customers to competitors, while also improving the overall efficiency of their supply chain operations (Candeias, 2024).

The advantages of focusing on delivery speed are substantial. Faster delivery enables firms to enhance service quality, ensuring that customers receive products when needed, which directly improves customer satisfaction and retention (Kim et al., 2025). It also reduces the need for excessive inventory holding, lowering storage costs, and mitigating

the risk of product obsolescence, especially for LPG products where safety and timely availability are critical (Bag et al., 2023). Despite these benefits, achieving and sustaining high delivery speed can present challenges. It often requires significant investment in infrastructure, technology, and skilled personnel to manage logistics and transportation processes effectively (Abdan and Çetindaş, 2023). Additionally, rapid delivery may increase transportation costs, create dependency on external logistics partners, and increase the complexity of coordinating activities across multiple supply chain nodes. Environmental factors, such as traffic conditions, weather disruptions, and regulatory constraints, can also negatively impact delivery speed, making continuous monitoring and flexibility essential.

Lead Time Reduction (LTR)

LTR refers to the systematic efforts undertaken by organizations to shorten the total time required to complete supply chain activities, from order placement and procurement of inputs to production, distribution, and final delivery to customers (Mundia et al., 2021). It focuses on minimizing delays and inefficiencies across supply chain processes to ensure faster response to customer demand and changing market conditions (Munir et al., 2025). In highly competitive and time-sensitive industries, lead time reduction is a critical dimension of supply chain agility, as it enables firms to respond promptly to customer requirements, reduce uncertainty, and improve overall service performance (Munoz & Gutierrez, 2025). Lead time reduction is characterized by several defining features. One key characteristic is process integration, which involves aligning procurement, production, and distribution activities to operate seamlessly and reduce idle time (Nwankwo et al., 2024). Another characteristic is flexibility, as organizations must be capable of adjusting production schedules and logistics plans in response to fluctuating demand or supply disruptions (Nguyen, 2024).

The advantages of lead time reduction are significant for organisational performance. Reduced lead times enhance service quality by enabling faster and more reliable order fulfillment, which improves customer satisfaction and loyalty (Oyeyemi et al., 2024). Shorter lead times also lower inventory holding costs, as firms can operate with reduced safety stock and work-in-progress inventory, thereby improving cost efficiency (Park et al., 2025). Furthermore, lead time reduction strengthens competitive advantage, as agile firms are better positioned to respond to market changes, introduce new products more quickly, and meet customer expectations in dynamic business environments (Patel & Sambasivan, 2022). Improved lead time performance also contributes to better coordination across supply chain partners, enhancing overall operational efficiency. Despite these benefits, lead time reduction presents notable challenges. Achieving shorter lead times often requires substantial investments in technology, process redesign, and employee training, which may strain organisational resources, particularly in developing economies (Princewill et al., 2023). Excessive emphasis on speed can also result in operational risks, including quality lapses, increased error rates, and employee stress if processes are accelerated without adequate controls (Queiroz et al., 2022). Additionally, dependency on external suppliers and logistics partners can limit a firm's

ability to sustain reduced lead times, especially when disruptions occur beyond its direct control (Rahat, 2022). Hence, this study defines lead time reduction as the strategic capability of an organization to minimize the total cycle time of supply chain activities, thereby enhancing responsiveness, service quality, and overall supply chain agility.

Supplier Flexibility

Supplier flexibility refers to the ability of suppliers to adapt promptly and effectively to changes in buyer requirements, including variations in order volume, product specifications, delivery schedules, and market conditions (Rashid et al., 2024). It reflects the extent to which suppliers can adjust their operations without significant disruptions to cost, quality, or delivery performance (Rasool et al., 2025). Within the context of supply chain agility, supplier flexibility is a critical capability that enables firms to respond to demand uncertainty, environmental turbulence, and competitive pressures (Sachin & Rajesh, 2022). Organizations operating in volatile markets increasingly depend on flexible suppliers to maintain continuity, responsiveness, and service reliability.

Several scholars conceptualize supplier flexibility as a multidimensional construct. Supplier flexibility encompasses volume flexibility, mix flexibility, and delivery flexibility, all of which determine how well suppliers can accommodate changes in customer needs (Sadeghi Shahdani et al., 2025). Supplier flexibility is strengthened through long-term collaborative relationships, trust, and effective information sharing between buyers and suppliers (Sahin & Tekin, 2025). The integration of suppliers into planning and forecasting processes allows firms to align production schedules and inventory levels more efficiently, thereby reducing uncertainty and enhancing responsiveness (Sahoo et al., 2025). Advanced communication technologies and digital supply chain platforms further support supplier flexibility by enabling real-time data exchange and faster decision-making across organisational boundaries (Shah et al., 2026).

The advantages of supplier flexibility are substantial for organisational performance and supply chain agility. Flexible suppliers enhance a firm's ability to respond quickly to market changes, thereby reducing lead times and improving service quality (Singh & Kumar, 2020). Supplier flexibility also contributes to cost efficiency by minimizing the need for excessive safety stock and reducing the risks associated with demand forecasting errors (Şişman & Demirci Orel, 2024). Furthermore, organizations with flexible suppliers are better positioned to innovate, as suppliers can accommodate design changes and support rapid product development initiatives (Sivadass et al., 2025). These benefits collectively strengthen competitive advantage and long-term supply chain resilience. Despite its benefits, supplier flexibility presents notable challenges. Achieving high levels of flexibility often requires suppliers to invest in adaptable production systems, skilled labor, and advanced technologies, which can increase operational costs (Soliman et al., 2026). Smaller suppliers may lack the financial or technical capacity to sustain flexibility, leading to uneven performance across the supply chain (Sriboonlue et al., 2024). Additionally, excessive reliance on highly flexible suppliers may create dependency risks, particularly if alternative sources are limited or switching costs are high (Stanescu

et al., 2026). Hence, the study defines supplier flexibility as the capability of suppliers to adjust production, delivery, and service processes in response to changing buyer requirements, thereby supporting supply chain agility and enhancing organisational responsiveness.

Demand Responsiveness

Demand responsiveness refers to an organization's ability, together with its supply chain, to sense, interpret, and react promptly and effectively to changes in customer demand patterns (Mundia et al., 2021). It reflects the speed and accuracy with which firms can adjust production volumes, inventory levels, distribution activities, and service delivery in response to fluctuations in market demand, evolving customer preferences, and emerging consumption trends (Munir et al., 2025). Demand responsiveness is characterized by speed, flexibility, and customer orientation. Speed reflects the organization's ability to adjust production output, service capacity, or delivery schedules quickly in response to sudden demand shifts without disrupting operational flow (Oyeyemi et al., 2024). Flexibility denotes the capacity to reallocate resources, modify supply routes, and adjust service channels to accommodate evolving market needs (Murshed et al., 2021). Customer orientation underscores the focus on meeting demand reliably, maintaining product and service availability, and ensuring timely fulfillment, all of which directly influence customer perceptions of value and satisfaction (Munoz & Gutierrez, 2025).

The advantages of demand responsiveness are substantial for organisational performance, competitiveness, and long-term sustainability. Responsive supply chains reduce the incidence of stockouts and excess inventory, improving inventory efficiency and lowering holding costs (Park et al., 2025). Firms that are highly demand-responsive enhance customer satisfaction and loyalty by consistently delivering on expectations and adapting quickly to changing preferences (Patel & Sambasivan, 2022). Furthermore, demand responsiveness supports market share growth, as firms can exploit emerging opportunities, respond effectively to competitive actions, and maintain a reputation for reliability and service excellence (Princewill et al., 2023). In the context of downstream LPG firms in Lagos State, demand responsiveness can be particularly impactful, ensuring consistent product availability across distribution networks and strengthening customer trust in highly competitive urban and peri-urban markets. Despite its benefits, demand responsiveness presents operational and strategic challenges. Developing responsive supply chains requires substantial investments in technology, data analytics, workforce capability, and cross-functional coordination, which can be financially and managerially demanding, especially for small and medium-sized firms (Queiroz et al., 2022). Inaccurate demand signals, poor-quality data, or weak coordination with supply chain partners can compromise responsiveness, resulting in delays, stock imbalances, or lost sales (Rahat, 2022). Moreover, an excessive focus on rapid responsiveness without sufficient process alignment and control can increase operational complexity and costs, potentially undermining efficiency and reliability. This study thus defines demand responsiveness as the capability of an organization to rapidly sense and respond to

changes in customer demand through timely adjustments in production, inventory, and distribution activities, thereby enhancing supply chain agility and organisational performance.

Supply Chain Agility and Service Quality

Recent studies such as Patel and Sambasivan (2022), Al Humdan et al. (2020), Alfalla-Luque et al. (2023), Aslam et al. (2020), and Shukor et al. (2021) have increasingly highlighted the relationship between supply chain agility (SCA) and service quality in various industry contexts. Aldhaheri and Ahmad (2023) conducted an empirical investigation into factors affecting organisational supply chain agility and competitive capability. Their findings reveal that firms can improve service responsiveness and overall operational quality by developing strong supply chain leadership, enhancing flexibility, increasing speed and visibility in the supply chain, and fostering innovation in supply chain operations. The study emphasizes that SCA enables companies to respond rapidly to market changes, thus improving service delivery and customer satisfaction. Similarly, Irfan et al. (2020) examined the influence of process integration and supply flexibility on supply chain agility within the fashion industry. Their results demonstrate that supply flexibility mediates the effect of process integration on SCA, which in turn significantly enhances a firm's ability to meet service-level expectations. The study further highlights that product complexity moderates this relationship, indicating that SCA's impact on service quality is contingent on the nature of the products offered and the operational challenges faced. In a related study, Cadden et al. (2022) explored the role of intangible supply chain analytical capabilities in unlocking supply chain agility and enhancing performance outcomes.

In the context of resilience and operational continuity, Hsieh et al. (2023) argue that supply chain agility strengthens the firm's ability to maintain high service standards under environmental uncertainties. Their study reveals that SCA positively impacts supply chain resilience, which mediates improvements in performance outcomes including service quality. By anticipating disruptions and flexibly reallocating resources, firms with higher SCA are better able to meet customer expectations consistently. Do et al. (2021) investigated SCA in the UK food supply chain during the COVID-19 crisis, finding that agile responses through sensing and seizing capabilities allowed firms to maintain service levels despite unprecedented operational challenges. Sensing activities enabled companies to identify emerging risks to service delivery, while seizing capabilities ensured timely adjustments in resources, processes, and supply chain configurations. Moreover, Mukhsin et al. (2022) developed a mediation model demonstrating that supply chain agility serves as a critical intermediary between supply chain orientation and organisational performance, including service quality. Their empirical results validate that firms with agile supply chains can integrate upstream and downstream processes more effectively, resulting in higher customer satisfaction and service reliability. Similarly, Tarigan et al. (2021) highlight that internal integration, supply chain partnerships, and agility collectively enhance sustainable service advantages in manufacturing contexts. Their findings indicate that firms adopting SCA practices

experience improved operational responsiveness, enabling consistent, high-quality service provision.

Dynamic Capabilities Theory (DCT)

Dynamic Capabilities Theory (DCT) was primarily developed by David J. Teece, Gary Pisano, and Amy Shuen in 1997 as a framework for understanding how firms can achieve and sustain competitive advantage in rapidly changing environments. The theory builds on the Resource-Based View (RBV) but goes further by emphasizing the importance of a firm's ability to adapt, integrate, and reconfigure internal and external competencies in response to dynamic market conditions. According to Teece et al. (1997), dynamic capabilities comprise processes, routines, and skills that enable firms to sense opportunities and threats, seize market opportunities, and transform resources and operations to maintain competitiveness. Supporters of DCT argue that the theory provides a powerful lens for explaining how firms achieve sustained performance in contexts characterized by rapid technological change, evolving customer demands, and global competition. Eisenhardt and Martin (2000) contend that dynamic capabilities allow firms to systematically adapt existing processes and develop new routines to respond effectively to emerging challenges and opportunities. Helfat et al. (2007) further support DCT by highlighting its ability to explain differences in firm performance over time based on variations in the capacity to reconfigure assets and competencies.

Critics of DCT, however, point to challenges related to conceptual clarity and operationalization. Some scholars, such as Peteraf et al. (2013), argue that the boundaries of what constitutes a dynamic capability are often ambiguous, making empirical measurement and testing difficult. Others contend that the theory may overemphasize internal processes while underplaying the influence of external factors such as regulatory environments, institutional frameworks, and competitive ecosystems (Winter, 2003). For this study, DCT provides a valuable theoretical foundation for examining the effect of supply chain agility on service quality enhancing organizational performance in the LPG downstream sector. The theory frames dimensions of agility such as lead time reduction, supplier flexibility, delivery speed, and demand responsiveness as dynamic capabilities that enable firms to sense market opportunities, reconfigure supply chain processes, and respond to fluctuations in demand or supply disruptions.

Methodology

The positivism research philosophy was adopted in this study. Positivism emphasizes observable and measurable phenomena and seeks to establish relationships between variables through empirical evidence and systematic scientific procedures (Tarigan et al., 2021). The quantitative research approach was adopted in this study to examine the relationship between supply chain agility and organisational performance in selected Nigerian LPG downstream firms. Quantitative research involved the systematic process of collecting and analyzing numerical data to generalize about a population based on a representative sample (Tarigan et al., 2021). Survey research design was adopted for the study. The population consisted of 2,800 employees directly involved in supply chain

activities within selected LPG downstream firms in Lagos State, Nigeria. A sample size of 455 respondents was determined using the Taro Yamane formula, and data were collected using a validated structured questionnaire administered through simple random sampling. The reliability and validity of the instrument were established through Cronbach's alpha reliability coefficients which ranged from 0.70 to 0.78. Data were analysed using descriptive and inferential (multiple linear regression) statistics, at a 5 percent level of significance.

Analysis: Data Presentation and Analysis
The descriptive analysis of the variables was done using the percentage analysis, mean and standard deviation to describe the dependent and independent variables of the research. From the variables used, each respondent was requested to respond based on their level of agreement with the statements which was done on a six-point Likert-type scale.

Response Rate: A total of four hundred and fifty-five (455) copies of the questionnaire were administered to the respondents for the purpose of this study. Out of this number, three hundred and ninety-three (393) copies were retrieved and found to be properly completed and usable for analysis, representing a response rate of approximately 86.0%.

Table 1 presents the detailed response rate distribution.

Table 1: Response Rate

Particulars	Frequency	Percentage
Completed and Usable copies of questionnaires	393	86
Not returned/Declined filling	62	14
Total		100%

Source: Field Survey Data (2026)

Restatement of Research Objective and Research Question
Objective: Examine the effect of supply chain agility on service quality of selected liquefied petroleum gas firms in Lagos State Nigeria

Research Question: What is the effect of supply chain agility on service quality of selected liquefied petroleum gas firms in Lagos State Nigeria?

Respondents were requested to share their views on various enquiries presented in the questionnaire regarding supply chain agility strategies and service quality. Six-point Likert type scale was used to analyse their responses. These points formed the weights for calculating the score for each item. The findings were presented in various tables not enabled here as a result of limited pages required by the publishing institution followed with analysis and interpretations.

Restatement of Research Hypothesis

H_o: Supply chain agility does not have a significant effect on service quality.

To test the hypothesis that Supply chain agility does not have a significant effect on service quality, Multiple linear regression was utilised and the results are presented in Table 2 below

Table 2: Summary of Results of Multiple Regression Analysis for the Effect of Supply Chain Agility Dimensions on Service Quality

N	Model	B	T	Sig	R	Adj. R^2	F (4,388)	ANOVA (Sig.)
393	(Constant)	4.315	3.211	0.001	0.607a	0.362	56.526	0.000b
	Delivery Speed	0.123	2.656	0.008				
	Lead Time Reduction	0.095	1.762	0.079				
	Supplier Flexibility	0.323	6.397	0.000				
	Demand Responsiveness	0.282	5.323	0.000				
	Predictors: (Constant), Demand Responsiveness, Delivery Speed, Supplier Flexibility, Lead Time Reduction							
	Dependent Variable: Service Quality							

Table 2 presents the multiple regression analysis results examining the effect of supply chain agility dimensions (Delivery Speed, Lead Time Reduction, Supplier Flexibility, and Demand Responsiveness) on Service Quality. The results indicate that three of the four dimensions of supply chain agility showed a positive and statistically significant effect on service quality. Specifically, Supplier Flexibility had the strongest positive and significant effect on service quality ($B = 0.323$, $t = 6.397$, $p < 0.05$). This implies that an increase in supplier flexibility, such as the ability to adjust to order changes, responsiveness to urgent demands, flexibility in supply quantities, adaptation to product customization, and quick adjustment to supply disruptions, leads to a corresponding improvement in service quality. This is the strongest predictor in the model. Demand Responsiveness also showed a positive and significant effect on service quality ($B = 0.282$, $t = 5.323$, $p < 0.05$). This indicates that greater ability to react rapidly to changes in customer demand, timely adjustment of production schedules, accurate demand forecasting, responsiveness to market fluctuations, and coordination with sales for demand changes contribute positively to service quality.

Delivery Speed showed a positive and significant effect on service quality ($B = 0.123$, $t = 2.656$, $p = 0.008$, $p < 0.05$). This suggests that speed of fulfillment, timeliness of product delivery, rapid response to urgent orders, meeting promised delivery timelines, and

accuracy of delivery scheduling enhance service quality. Lead Time Reduction did not show a statistically significant effect on service quality (B = 0.095, t = 1.762, p = 0.079, p > 0.05). This indicates that reduction in order processing time, efficient supply chain planning, shortening procurement cycles, timely production scheduling, and faster coordination with suppliers do not significantly influence service quality in this model, though the p-value approaches significance. Among the predictor variables, Supplier Flexibility recorded the highest beta coefficient (B = 0.323), indicating that it is the strongest predictor of service quality, followed by Demand Responsiveness (B = 0.282), and Delivery Speed (B = 0.123). Lead Time Reduction (B = 0.095) was not statistically significant. The constant value of 4.315 indicates that when all supply chain agility dimensions are held constant at zero, service quality would still stand at 4.315. This value is statistically significant (t = 3.211, p = 0.001).

The correlation coefficient (R = 0.607) indicates a moderately strong positive relationship between supply chain agility dimensions and service quality. The coefficient of multiple determination (Adj. R^2 = 0.362) shows that approximately 36.2% of the variation in service quality is explained by the dimensions of supply chain agility, while the remaining 63.8% is attributed to other factors not captured in the model. The standard error of the estimate is 1.701, which represents the average distance between observed service quality values and the values predicted by the regression model. This relatively low standard error indicates that the model predicts service quality with reasonable precision. The ANOVA result showed that the overall regression model is statistically significant (F = 56.526, p = 0.000, p < 0.05), indicating that the independent variables jointly have a significant effect on service quality.

Regression Equation
Service Quality = 4.315 + 0.123(DS) + 0.095(LTR) + 0.323(SF) + 0.282(DRS) + Ui Predictive Model:

Service Quality = 4.315 + 0.123(DS) + 0.095(LTR) + 0.323(SF) + 0.282(DRS) + Ui Prescriptive Model:

Service Quality = 4.315 + 0.123(DS) + 0.323(SF) + 0.282(DRS) + Ui

Where:
DS = Delivery Speed
LTR = Lead Time Reduction (not significant)
SF = Supplier Flexibility
DRS = Demand Responsiveness

The null hypothesis states that "Supply chain agility dimensions (delivery speed, lead time reduction, supplier flexibility, and demand responsiveness) have no significant effect on service quality." Based on the regression results, the p-value (0.000) is less than the significance level of 0.05. Therefore, the null hypothesis is REJECTED. However,

when examining individual predictors, Supplier Flexibility, Demand Responsiveness, and Delivery Speed have significant effects, while Lead Time Reduction does not. Therefore, the null hypothesis is partially rejected for Supplier Flexibility, Demand Responsiveness, and Delivery Speed, while it is accepted for Lead Time Reduction. There is sufficient evidence to conclude that Supplier Flexibility, Demand Responsiveness, and Delivery Speed have significant positive effects on service quality. Lead Time Reduction does not have a statistically significant effect on service quality in this model. The regression results indicate that three of the four explanatory variables are statistically significant; therefore, they are retained in the prescriptive model. Lead Time Reduction (LTR) is excluded from the prescriptive model due to its non-significant effect ($p = 0.079$). This implies that improvements in supplier flexibility, demand responsiveness, and delivery speed will lead to corresponding increases in service quality. Specifically, a one-unit increase in supplier flexibility, demand responsiveness, and delivery speed will increase service quality by 0.323, 0.282, and 0.123 units respectively, with supplier flexibility having the greatest effect.

Discussion of Findings

The results of the multiple regression analysis for the hypothesis revealed that supply chain agility and three of its sub-dimensions supplier flexibility, demand responsiveness, and delivery speed positively and significantly influenced service quality among selected LPG firms in Lagos State, Nigeria ($\beta = 0.323, 0.282, 0.123$; $t = 6.397, 5.323, 2.656$; $p < 0.05$; $R = 0.607$, Adj. $R^2 = 0.362$). Lead time reduction, however, showed a positive but non-significant effect on service quality ($\beta = 0.095$; $t = 1.762$; $p > 0.05$). This indicates that increases in supplier flexibility, demand responsiveness, and delivery speed are associated with improved service quality, with supplier flexibility emerging as the most influential predictor. The findings suggest that when LPG firms invest in developing agile supply chain capabilities, particularly those related to flexibility and responsiveness, they are better positioned to deliver consistently high-quality services to their customers.

These findings are consistent with prior empirical studies on supply chain agility and service quality. Aldhaheri and Ahmad (2023) demonstrated that firms can improve service responsiveness and overall operational quality by developing strong supply chain leadership, enhancing flexibility, and fostering innovation in supply chain operations, reinforcing the importance of agility in driving service delivery outcomes. Irfan et al. (2020) found that supply flexibility mediates the effect of process integration on supply chain agility, which in turn significantly enhances a firm's ability to meet service-level expectations, directly supporting the significant role of supplier flexibility observed in this study. Hsieh et al. (2023) further argued that supply chain agility strengthens a firm's ability to maintain high service standards under environmental uncertainties, with agility positively impacting supply chain resilience, which in turn mediates improvements in service quality outcomes. Do et al. (2021) similarly found that agile responses through sensing and seizing capabilities allowed firms to maintain service levels despite unprecedented operational challenges, corroborating the significant effect

of demand responsiveness and delivery speed found in the present study. Mukhsin et al. (2022) and Tarigan et al. (2021) further reinforced that firms with agile supply chains can integrate upstream and downstream processes more effectively, resulting in higher customer satisfaction and service reliability. These studies collectively support the finding that supply chain agility, particularly through supplier flexibility and demand responsiveness, positively enhances service quality outcomes.

The findings are also consistent with the assumptions of Dynamic Capabilities Theory (DCT). DCT, as developed by Teece et al. (1997), posits that organisational performance is not solely dependent on resources owned but critically on the firm's ability to sense opportunities and threats, seize opportunities, and reconfigure assets and processes to maintain competitiveness. In this study, the significant positive effects of supplier flexibility, demand responsiveness, and delivery speed on service quality reflect the operation of these dynamic capabilities within the supply chain context. Firms that develop the capacity to flexibly adjust supplier arrangements, respond promptly to shifts in customer demand, and accelerate delivery processes demonstrate the kind of reconfiguration and seizing capabilities that DCT describes as essential drivers of competitive performance. Conversely, the non-significant effect of lead time reduction may suggest that, in isolation, reducing lead times does not constitute a sufficiently developed dynamic capability to meaningfully improve service quality, particularly where other structural and operational factors moderate its impact.

The R value of 0.607 indicates a moderately strong positive relationship between supply chain agility and service quality, while the adjusted R^2 of 0.362 shows that approximately 36.2% of the variation in service quality is explained by the dimensions of supply chain agility. This suggests that other factors, such as workforce competence, technology adoption, organisational culture, and customer relationship management, may also play a substantial role in shaping service quality outcomes within SMEs. The F-statistic ($df = 4, 388) = 56.526$, $p < 0.05$, confirms that the overall model is statistically significant, leading to the rejection of the null hypothesis that supply chain agility does not have a significant effect on service quality in selected SMEs in Lagos State, Nigeria. The findings highlight that while supply chain agility can meaningfully enhance service quality, its effectiveness is most pronounced when firms deliberately cultivate supplier flexibility and demand responsiveness as core operational competencies, underscoring the need for LPG firms to embed agility as a strategic priority within their supply chain management frameworks.

Conclusion and Recommendations

The study examined the effect of supply chain agility on service quality in selected liquefied petroleum gas firms in Lagos State Nigeria. Supply chain agility had a significant effect on service quality in selected LPG firms in Lagos State, Nigeria (Adj. $R^2 = 0.362$, $F(4, 388) = 56.526$, $p < 0.05$). The findings revealed that supply chain agility, operationalised through delivery speed, lead time reduction, supplier flexibility, and demand responsiveness, significantly affected service quality.

Based on the findings, the following recommendations are made:

1. LPG managers should invest in strengthening supplier flexibility by developing robust and diversified supplier networks that can adapt swiftly to changes in order volumes, product specifications, and supply disruptions. Establishing flexible supplier agreements and maintaining strategic supplier relationships will enhance service quality and market share growth, thereby improving overall organisational performance.
2. Organizations should prioritize demand responsiveness as a core supply chain capability by deploying advanced demand forecasting tools, strengthening coordination between sales and supply chain functions, and building the capacity to rapidly adjust production schedules in response to market fluctuations. Given that demand responsiveness emerged as the strongest predictor across all performance dimensions, its development should be treated as a strategic priority for SMEs seeking competitive advantage.
3. Management should implement systematic lead time reduction initiatives by streamlining procurement cycles, improving supply chain planning processes, and enhancing coordination with suppliers to reduce order processing delays. Reducing lead times contributes significantly to customer retention and market share growth, enabling SMEs to meet customer expectations more consistently and competitively.
4. LPG firms should enhance delivery speed by optimizing logistics and distribution processes, leveraging technology for real-time order tracking, and building the operational capacity to respond rapidly to urgent customer orders. Improving delivery speed strengthens service quality and customer retention, reinforcing the firm's reputation for reliability and responsiveness in a competitive market environment.
5. Supply chain agility should be integrated into the overall strategic management framework of LPG firms, aligning agility-building initiatives with broader organisational goals, including investments in technology, workforce training, and process innovation, will maximize the collective impact of all four supply chain agility dimensions on overall organisational performance, enabling LPG firms to achieve sustained competitiveness in a dynamic business environment.

References

Abutu, D. I. (2024). *Deregulation of the downstream oil and gas in Nigeria: Application of blockchain as a solution* [Preprint]. ResearchGate. https://www.researchgate.net/publication/378680257.

Abdelilah, B., El-Korchi, A., & Balambo, M. A. (2025). The dynamics behind the performance outcomes of agile supply chains: a comparative study, *Business Process Management Journal*. https://doi.org/10.1108/BPMJ-12-2023-0928.

Acosta-Amado, R. J. (2024). Optimization of petroleum products distribution via pipeline systems: Modeling and computational challenges. *Heliyon, 10*(14), e33947. https://doi.org/10.1016/j.heliyon.2024.e33947.

Akhil, N. S. B., Raj, R., Kumar, V., Gangaraju, P. K., & De, T. (2025). An agility and performance assessment framework for supply chains using confirmatory factor analysis and structural equation modelling, *Supply Chain Analytics, 9*, 100093. https://doi.org/10.1016/j.sca.2024.100093.

Aldhaheri, R. T., & Ahmad, S. Z. (2023). Factors affecting organisations' supply chain agility and competitive capability. *Business Process Management Journal, 29*(2), 505–527. https://doi.org/10.1108/BPMJ-11-2022-0579

Al-Douri, A., Halim, S. Z., Quddus, N., & Kazantzi, V. (2022). A stochastic approach to evaluating the economic impact of disruptions in feedstock pipelines on downstream production. *Process Safety and Environmental Protection*, *167*, 452–466. https://doi.org/10.1016/j.psep.2022.09.018

Alfalla-Luque, R., et al. (2023). Supply-chain agility and performance: Evidence from a meta-analysis, *International Journal of Operations & Production Management, 43*(10), 1587–1633. https://doi.org/10.1108/IJOPM-05-2022-0316

Alfalla-Luque, R., Luján García, D. E., & Marin-Garcia, J. A. (2023). Supply chain agility and performance: Evidence from a meta-analysis, *International Journal of Operations & Production Management, 43*(10), 1587–1633. https://doi.org/10.1108/IJOPM-05-2022-0316

Alfaqiyah, E., Alzubi, A., Aljuhmani, H. Y., & Öz, T. (2025). How Industry 4.0 technologies enhance supply chain resilience: The interplay of agility, adaptability, and customer integration in manufacturing firms. *Sustainability, 17*(17), 7922. https://doi.org/10.3390/su17177922.

Al Humdan, E., Shi, Y., Behnia, M., & Najmaei, A. (2020). Supply chain agility: A systematic review of definitions, enablers and performance implications, *International Journal of Physical Distribution & Logistics Management, 50*(2), 287–312. https://doi.org/10.1108/IJPDLM-06-2019-0192.

Almutairi, A., Alfaqeeh, F., Collier, Z. A., & Lambert, J. H. (2025). Quantifying the influence of future disruptive scenarios to priorities of energy supply chains systems of liquified petroleum gas. *International Journal of Industrial and Systems Engineering*, *50*(4), 555-578. https://doi.org/10.1504/IJISE.2025.147718

Altay, N., Navaei, M., & Hartley, J. (2023). Supply chain agility and sustainability performance: A configurational approach to sustainable supply chain management practices. *Journal of Cleaner Production, 414*, 137493. https://doi.org/10.1016/j.jclepro.2023.137493.

Aniebo, I. N., & Mogbo, O. (2024, August). Energy economics of midstream and downstream petroleum sectors in Nigeria: A review of potential optimizations. In *SPE Nigeria Annual International Conference and Exhibition* (p. D031S015R003). SPE. https://doi.org/10.2118/221747-MS

Arikat, Z. M. A. (2024). The role of business intelligence in enhancing the performance of supply chains in Jordan. *Journal of Eco humanism*, *3*(8), 2040-2053. https://doi.org/10.62754/joe.v3i8.4885

Aslam, H., Khan, A. Q., Rashid, K., & Rehman, S. U. (2020). Achieving supply chain resilience: The role of supply chain ambidexterity and supply chain agility. *Journal of Manufacturing Technology Management, 31*(6), 1185–1204. https://doi.org/10.1108/JMTM-07-2019-0263.

Assyifa, M. R. A., Kusrini, E., Mansur, A., & Purnomo, R. A. (2025). Examining Sustainable Logistics indicator for Monitoring System in Liquified Petroleum Gas: An Integrated DEMATEL-Fuzzy Grey VIKOR Framework. *Process Integration and Optimization for Sustainability*, 1-32. https://doi.org/10.1007/s41660-025-00639-z

Bag, S., Dhamija, P., Luthra, S., & Huisingh, D. (2023). How big data analytics can help manufacturing companies strengthen supply chain resilience in the context of the COVID-19 pandemic. *International Journal of Logistics Management, 34*(4), 1141–1164. https://doi.org/10.1108/IJLM-02-2021-0095

Bahrami, M., Shokouhyar, S., & Seifian, A. (2022). Big data analytics capability and supply chain performance: The mediating roles of supply chain resilience and innovation. *Modern Supply Chain Research and Applications, 4*(1), 62–84. https://doi.org/10.1108/MSCRA-11-2021-0021.

Cadden, T., McIvor, R., Cao, G., Treacy, R., Yang, Y., Gupta, M., & Onofrei, G. (2022). Unlocking supply chain agility and supply chain performance through the development of intangible supply chain analytical capabilities. *International Journal of Operations & Production Management, 42*(9), 1329–1355. https://doi.org/10.1108/IJOPM-06-2021-0383

Candeias, T. D. J. (2024). *A comprehensive overview and classification of upstream oil and gas contracts* (MPRA Paper No. 121849). Munich Personal RePEc Archive. https://mpra.ub.uni-muenchen.de/121849/.

Chandra, T. (2023). Law enforcement against criminal acts of subsidized liquefied petroleum gas abuse in Indonesia, *Research Horizon*, *3*(4), 410-420. https://doi.org/10.54518/rh.3.4.2023.150.

Do, Q. N., Mishra, N., Wulandhari, N. B. I., Ramudhin, A., Sivarajah, U., & Milligan, G. (2021). Supply chain agility responding to unprecedented changes: Empirical evidence from the UK food supply chain during the COVID-19 crisis, *Supply Chain Management: An International Journal, 26*(6), 737–752. https://doi.org/10.1108/SCM-09-2020-0470.

Dubey, R., Gunasekaran, A., & Childe, S. J. (2019). Big data analytics capability in supply chain agility: the moderating effect of organisational flexibility. *Management decision*, *57*(8), 2092-2112. https://doi.org/10.1080/00207543.2020.1806017 .

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal, 21*(10–11), 1105–1121. https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E.

European Market Data Forecast, (2026) Outlook Insights

Faturrahman, M. A., & Nursyamsiah, S. (2024). The influence of supply chain integration, agility, and innovation on company performance, *Asian Journal of Economics, Business and Accounting, 24*(5), 382–399. https://doi.org/10.9734/ajeba/2024/v24i51317

Fullonton, A., Lea-Langton, A. R., Madugu, F., & Larkin, A. (2025). Green ammonia adoption in shipping: Opportunities and challenges across the fuel supply chain. *Marine Policy, 159*, Article 106143. https://doi.org/10.1016/j.marpol.2024.106143.

Fahmi, M. F., Handogo, R., & Sutikno, J. P. (2023). Plant design and techno-economy analysis of floating liquefied natural gas (FLNG) in Masela Block. *Jurnal Riset Kimia dan Pendidikan Kimia*, *5*(1), 45–56.

Goswami, S. S., Mondal, S., Sarkar, S., Gupta, K. K., Sahoo, S. K., & Halder, R. (2025). Artificial intelligence-enabled supply chain management: Unlocking new opportunities and challenges. In *Artificial Intelligence and Applications, 3*(1), 110-121. https://doi.org/10.47852/bonviewAIA42021814.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., & Winter, S. G. (2007). *Dynamic capabilities: Understanding strategic change in organizations*. Blackwell Publishing.

Hemachandiran, S., Siddharth, R., & Aghila, G. (2023). A digital image colorimetry approach for identifying fuel types in downstream petroleum sector. *International Journal of Information Technology, 15*(3), 1443-1452. https://doi.org/10.1007/s41870-023-01206-w.

Hsieh, C. C., Chen, S. L., & Huang, C. C. (2023). Investigating the role of supply chain environmental risk in shaping the nexus of supply chain agility, resilience, and performance. *Sustainability, 15*(20), 15003. https://doi.org/10.3390/su152015003

Huo, B., Li, D., & Gu, M. (2024). The impact of supply chain resilience on customer satisfaction and financial performance: A combination of contingency and configuration approaches. *Journal of Management Science and Engineering*, *9*(1), 38-52. https://doi.org/10.1016/j.jmse.2023.10.002.

Indian ministry of petroleum and natural gas demand (2025) Ministry of Petroleum and Natural Gas (no. 76).

Irfan, M., Wang, M., & Akhtar, N. (2020). Enabling supply chain agility through process integration and supply flexibility: Evidence from the fashion industry. *Asia Pacific Journal of Marketing and Logistics, 32*(2), 519–547. https://doi.org/10.1108/APJML-03-2019-0122.

Ivanov, D., Dolgui, A., & Sokolov, B. (2025). Ripple effect in the supply chain: Definitions, frameworks and future research perspectives. In *Handbook of ripple effects in the supply chain*. 1-34. Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-85508-5_1.

Jawabreh, O., Baadhem, A. M., Ali, B. J., Atta, A. A. B., Ali, A., Al-Hosaini, F. F., & Allahham, M. (2023). The influence of supply chain management strategies on organisational performance in hospitality industry. *Appl. Math. Inf. Sci*, *17*(5), 851-858. http://dx.doi.org/10.18576/amis/170511.

Kenya energy (2025) The energy management regulations, legal notice 18 of 2025

Khan, T., & Emon, M. M. H. (2025). Supply chain performance in the age of Industry 4.0: Evidence from manufacturing sector. *Brazilian Journal of Operations & Production Management, 22*(1). https://doi.org/10.14488/BJOPM.2434.2025

Kim, S. H., Gupta, S., & Pradhan, Y. K. (2025). How collaborative systems affect organisational agility and performance in pharmaceutical supply chains. *International Journal of Pharmaceutical and Healthcare Marketing, 15*(5). https://doi.org/10.1108/IJPHM-05-2025-0086

Koç, E., Delibaş, M. B., & Anadol, Y. (2022). Environmental uncertainty, supply chain agility, and competitive advantage. *Sustainability, 14*(14), 8928. https://doi.org/10.3390/su14148928.

Litvinenko, V. (2020). The role of hydrocarbons in the global energy agenda: The focus on liquefied natural gas. *Resources, 9*(5), Article 59. https://doi.org/10.3390/resources9050059.

Li, Y., Li, D., Liu, Y., & Shou, Y. (2023). Digitalization for supply chain resilience and robustness: The roles of collaboration and formal contracts. *Frontiers of Engineering Management*, *10*(1), 5-19. https://doi.org/10.1007/s42524-022-0229-x.

Mensi, W., Rehman, M. U., & Vo, X. V. (2021). Dynamic frequency relationships and volatility spillovers in natural gas, crude oil, gas oil, gasoline, and heating oil markets: Implications for portfolio management. *Resources Policy*, *73*, 102172. https://doi.org/10.1016/j.resourpol.2021.102172.

Mundia, C., Nyaoga, R., Ngacho, C., & Auka, D. (2021). Mediating effect of le-agile supply chain strategies on the effect of supply chain management practices on operational performance of large manufacturing firms in Kenya. *IOSR Journal of Business and Management (IOSR-JBM, 23*(07), 01-08. https://doi.org/10.9790/487X-2307040108.

Munir, M. A., Abbas, M. M., Qamar, A., & Farooq, M. (2025). Managing volatile markets: A dynamic capability approach to analytics-driven performance in fast-moving supply chains for sustainable development. *Sustainable Futures*, 101338. https://doi.org/10.1016/j.sftr.2025.101338,

Munoz, C., & Gutierrez, L. (2025). Customer retention through supply chain responsiveness: Empirical evidence from retail sectors. *Journal of Retailing and Consumer Services, 77*, 103024. https://doi.org/10.1016/j.jretconser.2025.103024

Murshed, M., Alam, R., & Ansarin, A. (2021). The environmental Kuznets curve hypothesis for Bangladesh: The importance of natural gas, liquefied petroleum gas, and hydropower consumption. *Environmental Science and Pollution Research, 28*(31), 41784–41798. https://doi.org/10.1007/s11356-020-11976-6.

Mogaka, C. O., & Njururi, A. (2024). A systematic review and conceptual framework of supply chain agility as a strategic enabler of firm competitiveness. *Journal of Sustainable Development of Transport and Logistics*, *9*(2), 109-125. https://doi.org/10.14254/jsdtl.2024.9-2.8

Mukhsin, M., Taufik, H. E. R., Ridwan, A., & Suryanto, T. (2022). The mediation role of supply chain agility on supply chain orientation–supply chain performance link. *Uncertain Supply Chain Management, 10*(1), 197–204. https://doi.org/10.5267/j.uscm.2021.9.008.

Ndunagu, P. U., Joel, O. F., Akuma, O., & Alaike, E. E. (2022). Production of natural gas and liquefied petroleum gas from flare gas using methanol based process. *Nigerian Journal of Technological Development*, *19*(1), 60-67. https://www.ajol.info/index.php/njtd/article/view/226309.

Nguyen, T. (2024). The organisational impact of agility: A systematic literature review. *Management Review Quarterly*. https://doi.org/10.1007/s11301-024-00446-9.

NNPC, (**2025).** NNPC monthly report

Ogbonna, A., & Chukwuemeka, L. (2024). Liquified Natural Gas (Lng) Downstream marketing and business growth in Nigeria: An empirical evidence small and meduim scale enterprises. *Journal of Management and Science*, *14*(2), 39-49. https://www.jmseleyon.com/index.php/jms/article/view/738.

Oyeyemi, O. P., Anjorin, K., Ewim, S. E., & Igwe, A. N. (2024). The influence of supply chain agility on FMCG SME marketing flexibility and customer satisfaction. *International Journal of Applied Research in Social Sciences, 6*(10), 2546–2563. https://doi.org/10.51594/ijarss.v6i10.1665.

Park, J., Lee, S., & Kim, H. (2025). *Agility, analytics, and firm performance: Evidence from cross-industry field studies.* Journal of Business Research, 140, 312–325.

Patel, B. S., & Sambasivan, M. (2022). A systematic review of the literature on supply chain agility. *Management Research Review, 45*(2), 236–260. https://doi.org/10.1108/MRR-09-2020-0574.

Patidar, A. K., Agarwal, U., Das, U., & Choudhury, T. (2023). Understanding the oil and gas sector and its processes: Upstream, downstream. In *Understanding data analytics and predictive modelling in the oil and gas industry*, 1–20. CRC Press. https://doi.org/10.1201/9781003357872-1.

Peteraf, M. A., Di Stefano, G., & Verona, G. (2013). The elephant in the room of dynamic capabilities: Bringing two diverging conversations together. *Strategic Management Journal, 34*(12), 1389–1410. https://doi.org/10.1002/smj.2078

Princewill, N. C., Ubasom, K. A., & Chibuike, O. (2023). Liquefied petroleum gas (LPG) storage boil-off gas generation and management–Review. *International Journal of Advanced Science and Engineering, 10*(1), 123–135. https://mahendrapublications.com/Document/MP170422.pdf.

Queiroz, M. M., Ivanov, D., & Dolgui, A. (2022). Impacts of end-to-end visibility and agility on operational performance. *Transportation Research Part E: Logistics and Transportation Review, 162*, 102726. https://doi.org/10.1016/j.tre.2022.102726.

Rahat, A. A. M. (2022). *Sustainable procurement in LPG industry* [Bachelor's thesis, BRAC University]. BRAC University Institutional Repository. http://hdl.handle.net/10361/25000 electric vehicle sector. *International Journal of Supply Chain Management, 12*(1), 45–58. https://doi.org/10.1051/e3sconf/202341201039

Rashid, A., Rasheed, R., Ngah, A. H., & Marjerison, R. K. (2024). A nexus of multiple integrations and business performance through supply chain agility and supply flexibility: A dynamic capability view. *Journal of Science and Technology Policy Management*. https://doi.org/10.1108/JSTPM-08-2023-0124.

Rasool, M., Murtza, M. H., Rasheed, M. I., Leong, A. M. W., Okumus, F., & Bai, J. (2025). Information technology competency and supply chain performance: Role of risk management orientation and supply chain agility. *Journal of Hospitality and Tourism Technology, 16*(1), 158–173. https://doi.org/10.1108/JHTT-08-2023-0240.

Sachin, N., & Rajesh, R. (2022). An empirical study of supply chain sustainability with financial performances of Indian firms. *Environment, Development and Sustainability*, *24*(5), 6577-6601. https://doi.org/10.1007/s10668-021-01717-1

Sadeghi Shahdani, M., Zahedi Vafa, M. H., Godarzi, G., & Rahiminasab, M. (2025). Institutional analysis of Iran's liquefied petroleum gas (LPG) industry with an emphasis on providing implications for reforming the industry's value chain. *Industrial Economics Researches, 9*(31), 35–58. https://doi.org/10.30473/jier.2025.75316.1503

Sahoo, S., Islam, N., Kumar, A., & Mangla, S. K. (2025). Exploring the relationship between digital dexterity, supply chain quality management, supply chain agility, and performance: Empirical evidence from Indian B2B manufacturers. *Industrial Marketing Management, 115*, 103876. https://doi.org/10.1016/j.indmarman.2025.03.008 .

Shah, S. Z., Liu, A., Nusrat, A., Chen, L., Li, X., & Lu, H. (2026). Big data analytics powered by AI for enhancing supply chain agility and customer relationship performance. *Operations and Supply Chain Management, 19*(1), 145–163. https://journal.oscm-forum.org/journal/journal/download/20260118153839_Paper_10_Vol._19_No_._1,_2026_.pdf

Singh, R. K., & Kumar, R. (2020). Strategic issues in supply chain management of Indian SMEs due to globalization: an empirical study. *Benchmarking: An International Journal*, *27*(3), 913-932. https://doi.org/10.1108/BIJ-09-2019-0429.

Şişman, G., & Demirci, O, F. (2024). The impact of e-commerce supply chain agility and logistics service quality on repurchase intention in a business-to-consumer context: Evidence from an emerging market. *The International Journal of Logistics Management, 36*(4), 1301–1325. https://doi.org/10.1108/IJLM-07-2024-0413

Sivadass, L., Rahim, N. A. A., & Ismail, E. M. (2025). Prudent molecular management in upstream. In *SPE Asia Pacific Oil and Gas Conference and Exhibition* (p. D011S005R006). SPE. https://doi.org/10.2118/226445-MS

Soliman, K. M., Mater, E. O., Moneib, H. A., & Abdulnaim, A. M. (2026). Optimization of thermal and combustion performance for diesel-LPG cofiring in a novel double swirl burner. *Fuel*, *367*, Article 133456. https://doi.org/10.1016/j.fuel.2025.133456.

Sriboonlue, O., Sriboonlue, U., & Onputtha, S. (2024). The impact of strategic agility on operational responsiveness and firm performance of import, export, and logistics enterprises. *Asian Administration and Management Review, 7*(1), 145–158. https://doi.org/10.14456/aamr.2024.14 (ThaiJo)

Stanescu, V., Pérez-Cedeño, R., Hernández, J. C., & Batista, T. (2026). *Global transition of energy vectors in the maritime sector: Role of liquefied natural gas, green hydrogen, and ammonia in achieving net zero by 2050* [Conference presentation or preprint]. Repositório Digital de Publicações Científicas da Universidade de Évora. https://doi.org/10.3390/en19020568

Statista reports, (2025). The statistics portal for market research and consumer trends

Shukor, A. A. A., Newaz, M. S., Rahman, M. K., & Taha, A. Z. (2021). Supply chain integration and its impact on supply chain agility and organisational flexibility in manufacturing firms. *International Journal of Emerging Markets, 16*(8), 1721–1744. https://doi.org/10.1108/IJOEM-04-2020-0418.

Tarigan, Z. J. H., Siagian, H., & Jie, F. (2021). Impact of internal integration, supply chain partnership, supply chain agility, and supply chain resilience on sustainable advantage. *Sustainability*, *13*(10), 5460. https://doi.org/10.3390/su13105460

Teece, D.J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-ZDigital Object Identifier (DOI)

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal, 24*(10), 991–995. https://doi.org/10.1002/smj.318.