
Citation:

Oke, A and Osobajo, OA and Taylor, S (2024) Addressing the Trilemma of Challenges: The Need for More SC Strategic Collaborations in the UK Oil and Gas Sector. *Sustainability*, 16 (2). p. 570. ISSN 2071-1050 DOI: <https://doi.org/10.3390/su16020570>

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Article

Addressing the Trilemma of Challenges: The Need for More SC Strategic Collaborations in the UK Oil and Gas Sector

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Abstract: This study conceptualises the extent of supply chain collaboration in the oil and gas (O&G) sector using the evidence from the literature and the primary data collected from supply chain practitioners across various companies in the UK O&G sector. The goal is to establish how the sector can address its traditional narrow and adversary relationships that undermine the sector's ability to be resilient and competitive considering the volatility of global oil prices and the trilemma (i.e., energy transition, energy security, and energy diversification) of issues facing the sector. Using exploratory quantitative online surveys, data were collected from 82 supply chain practitioners across Tier 1, 2, and 3 companies in the UK O&G sector. The collected data were analysed thematically, providing deeper insights into supply chain collaboration, including its motivations and barriers in the UK O&G sector. The findings show that the pattern of collaboration in the O&G sector is transient, situational, and mostly influenced by the sector's performance and global economic situations. The findings further show that the nature of the relationship in the O&G sector is mostly dependent on how it contributes to the performance of each business rather than the supply chain. This study argues that businesses in the oil and gas sector need to re-examine their relationships to enhance their competitiveness. It proposes that the sector should embrace strategic collaborations as the sector faces many disruptions, particularly from energy transition and the decommissioning of assets.

Keywords: oil and gas; collaboration; trust; information sharing; supply chain relationships; agency theory



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Academic Editors: Gheorghita Dinca and Mirela Camelia Baba

Received: 9 November 2023

Revised: 19 December 2023

Accepted: 5 January 2024

Published: 9 January 2024



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1. Introduction

Within the last 50 years, the United Kingdom (UK) offshore oil and gas (O&G) industry has grown and evolved to become the economic powerhouse [1], with the industry generating about GBP 330 billion in production tax, supporting over 280,000 jobs in the UK, and facilitating the UK's transition to a low-carbon economy [2]. In 2022 alone, the contribution of the oil and gas (O&G) industry to the UK economy was estimated at GBP 28 bn gross value added (GVA) and created over 200,000 jobs across the UK [1].

The recent global economic climate, coupled with the pandemic and the war in Ukraine, affected the industry negatively, resulting in price volatility and supply shortages and consequently affecting businesses globally. With oil prices increasing by more than USD 80 per barrel in 2021, it has been reported that the UK oil reserve is depleting at a faster rate [3]. This was contrary to the 2016 estimates, when the crash of oil prices from USD 100 per barrel to below USD 40 was reported, with Brent crude declining to a 13-year low at about USD 28 a barrel in January 2016 [4]. This situation forced businesses in the O&G industry to reconfigure their operations strategies to reduce their overhead by withholding investment, selling assets, and reducing their workforce while putting pressure on their suppliers and contractors to cut rates. At the same time, it was predicted and reported that there would be a mismatch between demand and supply for many years ahead, particularly due to production disruptions in Russia [3].

Before the pandemic and the ongoing war in Ukraine, the economic climate of the UK O&G sector was not encouraging due to extreme weather conditions and the challenging

drilling activities in the United Kingdom Continental Shelf (UKCS). As a result, unit operating costs were reduced by half from around USD 30 barrels of oil equivalent (boe) in 2014 to USD 15/boe in 2017 to ensure stability. The stability of unit operating costs at around USD 15–16/boe and the projected increase of global oil demand by 2 mb/d in 2023 to 101.9 mb/d [5] provided opportunities for new investment while reducing the uncertainties between supply and demand in the O&G market. With the oil price trading around USD 90 per barrel in the international market and an indication of stability, renewed optimism is gradually returning to the sector, suggesting positive signs of capital investment for UKCS. For example, about GBP 4 bn was invested in O&G projects in 2020, with around GBP 21 bn of investment forecasted over the next five years to deliver about three bn boe [2]. These projects were timely considering that many recent events with rising energy costs and declining energy security have shifted the discussion on energy resilience and affordability from renewables back to fossil fuels [6]. This paradigm shift indicates that the energy transition agenda may not offer practical solutions to energy issues in the short term due to the economic contributions of the O&G sector. For example, many businesses in the upstream O&G industry declared the highest profits in 2022 compared to previous years, despite the observed negative effects of disruptions on the global economy. The global O&G upstream industry generated its highest-ever free cash flows of USD 1.4 trillion in 2022 at an assumed average Brent oil price of USD 106/bbl [7].

The volatility of global oil prices [5] and the trilemma (i.e., energy transition, energy security, and energy diversification) of concerns [7] suggest that O&G firms cannot continuously depend on narrow and adversary relationships to remain competitive and attract investments. With the inflationary pressures due to the recent pandemic and global political uncertainties, there is a need for firms across the O&G supply chain (SC) to be more creative and innovative to attract viable investments to the UKCS. Focusing on SC is necessary, considering that the total SC spend represents larger capital expenditures (CAPEX) and operational expenditures (OPEX) for energy companies, indicating the need for the sector to re-examine its SC relationships and strategies for cost reduction and enhanced operational efficiency [8].

The approach may require a new perspective, cultural shift, and mindset reset within a reinvigorated, realigned, and competitive global SC, which is fundamental to the industry's long-term survival and competitiveness as nations move away from the O&G-driven economy. Although the collaborative efforts could maximise operational efficiency and add value to the sector's SC [8], the question of whether the UK O&G can change the traditional norms and adopt a more strategic collaborative approach should be explored. Despite the proliferation of research efforts on SC relationships across many industries [9,10], there is a knowledge deficit and a dearth of empirical research on SC relationships in the O&G industry [11], particularly in the UKCS. The study, therefore, conceptualises how the idea of SC collaboration can be engrained within the UK O&G sector for the sector to address the trilemma of concerns (energy transition, energy security, and energy diversification) and achieve operational efficiency. With many unsuccessful and ineffective SC relationships in the UK O&G sector [8], this study answers the question of relationships and provides insights into the current level of collaboration in the O&G sector, including its drivers and barriers. By answering this question, the study proposes how SC collaboration can be embraced and add value to the O&G operations beyond the ongoing cost reduction activities. This knowledge allows the industry to reinvent itself, making it more attractive for investment while striving towards sustainability and a circular economy for the UK O&G industry to remain relevant and competitive.

2. Literature Review and Theoretical Underpinning

2.1. An Overview of the UK Oil and Gas Sector

Since 1975, the rate of investment and production in the UKCS has increased exponentially, attracting hundreds of installations and millions of barrels of oil produced daily. The UKCS has established itself as one of the most important regions of the world's O&G

sector for many years and is the largest offshore O&G producer. However, the operations (exploration, drilling, construction, and logistics) of extracting oil in the UKCS are increasingly cost-intensive [2], forcing many operators to maintain adversarial relationships with suppliers to achieve cost reduction and shift risks to their suppliers. Also, investors face new challenges as discoveries are generally smaller and more expensive to exploit. While the availability of O&G resources is not considered the main issue [2], the industry's major problem is exploration and drilling, which may reduce the prospect of capital investment in the UKCS. Although O&G firms are reporting increased revenue, the current challenges, especially the volatile oil prices and the trilemma of concerns facing the O&G sector, cannot be addressed with the current adversarial relationships and cost reduction strategies. Instead, the industry should focus on how businesses can promote collaborative relationships across the SC to drive operational efficiency and innovation.

2.2. Supply Chain Management—Processes and Approaches

Supply chain management (SCM) has been construed and described differently by many authors, such as [12,13]; however, the process of adding value and achieving customers' expectations by enhancing operational efficiency remains the dominant theme [10,14]. With this definition, SCM encompasses a mutual understanding and cooperation from disparate organisations in coordinating, managing, and improving their resources and capabilities to achieve SC surplus. According to Chopra and Meindl (2010), SCM involves a dynamic network of organisations, activities, and resources, including people and information, to produce and distribute products from conception to consumption.

The process involves configuring, coordinating, and continuously improving a sequentially organised set of operations to achieve and maximise customers' expectations at a minimum cost [15]. Meeting customers' expectations is central to SCM; however, the dynamic business environment exposes SCs to increasing vulnerability [16]. Although SCM has previously been limited to producing and distributing goods and services, many recent high-profile events are reshaping the strategic roles of SC in firms' competitiveness.

Due to the volatility, uncertainty, complexity, and ambiguity (VUCA) of the business environment, there is now a renewed interest in how SCM can enhance firms' competitive advantage and meet customers' expectations by building and embedding resilience through collaboration [16,17]. Contrary to the common knowledge in the literature, firms are no longer competing; however, it is evident that SC competes to secure a competitive advantage and improve organisational performance [15] and sustainability [13]. The interconnectivity of the global SCs, particularly in the O&G sector and the manufacturing industry, suggests that micro or macro disruption(s) in any part of the network can affect the entire network, preventing businesses from meeting customers' expectations. Therefore, businesses across sectors should reconsider their SC strategies and processes to remain resilient and competitive [18]. Rethinking their SC strategies allows businesses to sense opportunities and develop capabilities to enhance their operational effectiveness and competitiveness. While this approach requires innovation, businesses can pursue innovation through SC collaboration involving internal and external stakeholders [8]. Accordingly, firms must ensure superior SCM strategies, processes, resources, and dynamic capabilities underpinned by trust and commitment across the SC for firms to remain competitive and resilient.

2.3. Collaboration in the Supply Chain

Studies have emphasised the need for SC collaboration; however, there is no distinct clarity about the term "collaboration" [19], and it opens to many interpretations [8]. While there are different relationship types in the SC, Soosay and Hyland [19] argued that these relationships do not necessarily equate to collaboration, thus increasing confusion on how businesses collaborate to improve their operational and SC performance. According to Scholten and Schilder [20], SC collaboration consists of interdependent buyer-supplier relationships across the products and/or services value chain. Buyer-supplier relationships

require more clarification as they can involve arm's length, transactional relations, cooperative agreements, coordination mechanisms, partnerships, strategic alliances, joint ventures, and vertical integration [20].

Although collaboration can be internal or external, a firm's innovation and technological advancement are introducing a new dimension of collaboration within and beyond the firm's physical operations environment. Consistent with Solaimani and van der Veen [8], this study perceives SC collaboration as strategic. It involves enduring partnerships between customers, integrating their activities, concepts, structures, and processes to achieve the SC strategic intent(s). In other words, SC collaboration involves long-term inter-firm partnerships based on trust and requires firms to maintain a consistent flow of resources across the SC.

Trust between customers (i.e., buyers and suppliers) in the SC is necessary to enhance the flow of resources, including materials, funds, and information, to improve efficiency and customer experience. It should be noted that the traditional approach of purchasing and supplying goods and services is adversarial to attaining the lowest possible transactional cost [14,15]. This tactical approach, where multiple suppliers are engaged through short-term contractual arrangements, often results in a win-lose rather than a win-win situation. This type of relationship is not fit for purpose in the O&G sector, particularly in engaging drilling contractors mainly involved in long-term, high-risk, and high-value projects that characterise O&G drilling operations [2]. The adversarial relationship may undermine the firm's performance due to transaction uncertainty and lack of asset specificity, increasing market competition, the unwillingness of parties to share risk, and their inability to manage operations beyond their organisational boundary [7,21].

Although firms depend on relationships to satisfy their business needs and customers' requirements, partners must manage the inherent complexity of SC collaboration. In addressing the complexity, many factors, such as information sharing, trust, and long-term commitment, should be considered to facilitate a positive strategic relationship [22]. Many relationships are structured based on the needs of each partner; however, a collaboration that extends beyond a normal commercial relationship, that is, a strategic relationship, may be required when managing this complexity. Collaboration requires a mutual association between parties in executing SC operations to achieve common goals and benefits [9,11]. Collaboration across the SC network involves a collective determination to achieve a common objective [16,18]. A collaborative partnership should involve a long-term approach through a joint effort by each partner to create unique value that neither can create independently [19]. This approach may involve sharing resources, knowledge, and capabilities between parties to improve operational performance while enhancing competitiveness and economies of scale.

The instability of the O&G industry calls for collaboration with partners to ensure that its SC is efficient, effective, and responsive to dynamic market needs. The operating environment of firms must be sufficiently assessed to understand the motivations and barriers to effective and strategic collaboration [16,23].

2.4. Toward Supply Chain Collaboration: The Agency-Based Perspective

The multitudes of players and the complexity of relationships in the O&G sector indicate that the extent of collaboration in the sector can be perceived from the agency theory, explaining the inter-firm relationships in the SC. According to the theory, the relationship is contractual and incentivised, demonstrating a relationship between the principal(s) and agent(s) where the principal engages the agent to undertake some prescribed business activities on its behalf [24,25]. While the need to understand the key elements of SC collaboration has been emphasised in the literature [13,19], agency theory provides a sound theoretical lens for demystifying the complex SC relationships in the O&G sector across its SC. For example, O&G operators can be classified as principals and their suppliers and contractors as agents; however, it is worth noting that suppliers and contractors can be principals to other customers further up in the SC. Understanding this complexity and

the interplay between competing interests of principals and agents across the SC fosters mutually beneficial relationships to improve firms' performance and productivity [13].

Consistent with the agency theory, SC collaboration should be built on trust, commitment, communication quality, information sharing, joint planning, and joint problem solving [20,22], eliminating the self-interest and opportunism of agents [25]. This school of thought perceives agents as good stewards [25], contributing to the SC's effective functioning and competitiveness, which may be different in the O&G sector. The main objective is to fulfil common goals and mutual benefits across the SC, creating a competitive advantage for all players in the chain [9,19]. For SC collaboration to achieve common goals and mutual benefits, governance structure and processes for managing change, cross-functional activities, process alignment, joint decision-making, and SC performance metrics should be jointly designed and implemented. These require firms to move beyond the siloed mentality of opportunity maximiser through behavioural change, innovations, and rethinking of SC priorities.

2.5. Motives for Supply Chain Collaboration

It is evident that SC collaboration enhances the overall performance of a SC; however, many companies are reluctant to start formal collaborative arrangements [26]. The reluctance may be due to agency problems due to information asymmetry and power imbalances between SC players. The need for a better understanding of the motives for SC collaborations and long-term partnerships, including their impacts on profit earnings, could incentivise agents and principals, preventing them from engaging in opportunistic activities.

Trust is a major issue for many businesses in SC, which explains why businesses often feel reluctant to share important information due to the competitive business environment [26]. Firms in the O&G sector often fail to share important information with their SC partners due to a lack of trust and fear of losing competitive advantage through information disclosure [27], making strategic collaborative relationships challenging. While the global SCs are fragile and vulnerable, there is a need for knowledge sharing, enhanced capacity and flexibility for collective actions, better decision-making, and increased revenue [9,20].

Resource synergy and innovation through combining and cross-pollinating ideas between SC partners can lead to cost reduction and competitive advantage. The product is the same for all competing firms in the oil exploration and production business, meaning that firms can only differentiate themselves to gain a competitive advantage if they involve their SC partners in the value-creation process. For firms in the O&G industry to differentiate themselves and remain competitive, they must adopt economically viable ways to explore and produce more than their competitors [15,21]; however, innovations through SC collaborations can sustain competitiveness [8].

3. Material and Methods

3.1. Data Collection

The data used for this study were collected from SC professionals in the UK O&G industry using a web-based quantitative survey [28]. Respondents were selected from the three main levels of the upstream O&G SC. These levels (Figure 1) are explored to gain holistic views of the industry and to understand the extent of collaboration using different perceptions of key actors across the industry's SC.

Due to the lack of access to employees' contact email addresses, O&G companies were randomly selected from First Point Assessment Limited (FPAL), a database for accredited and reliable global O&G companies, including suppliers and buyers. Having selected domiciled organisations in the UK, the survey link, including the introduction letter, was sent to their contact email for them to send the link to the relevant employee in the organisation for completion. To ensure data integrity and quality, the survey was designed such that only relevant people could complete the survey by screening respondents through

the gate question that requested respondents identify the type of O&G company, whether Tier 1, 2, or 3, where they are currently employed.

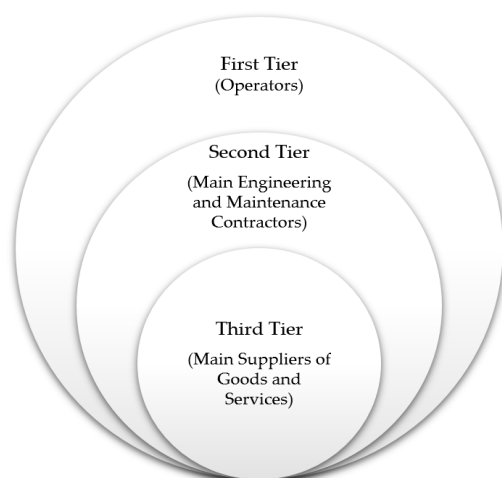


Figure 1. Tiers and hierarchy of businesses in the O&G industry.

3.2. Questionnaire Design

This study is exploratory to gauge the perceptions and extent of collaboration in the UK O&G industry. The survey instrument included quantitative checklist questions and qualitative questions using free/open-text formats. The inclusion of open questions allowed respondents to provide more details to substantiate the checklist questions. According to Fink [29], open-text questions enable respondents to tap into their experiences in explaining their perceptions of issues under discussion. The quantitative questions adopted dichotomous (yes/no) measures and a 5-point Likert scale from strongly agree to strongly disagree. The questionnaire was piloted using 15 samples of O&G professionals in Aberdeen, leading to some amendments in the wording and structure of the questions. For instance, the feedback informed the decision to include screening questions and the definition of ‘collaboration’ from academic literature at the start of the survey. The final survey comprised nine quantitative questions and two open-text questions to gauge respondents’ perceptions about the level of collaboration in the UK O&G.

The survey was designed to classify respondents into subgroups (Tier 1, 2, and 3 companies) in the sector. The screening question allowed respondents to identify a subgroup relevant to their employer, whether Tier 1 (Operator), Tier 2 (Main Engineering and Maintenance Contractor), or Tier 3 (Main Suppliers of Goods and Services). This approach was to understand any nuances in attitude and motivation in the different groups. Respondents were also asked if their firms are currently in a long-term collaborative relationship with suppliers, including questions on the benefit and importance of collaboration and whether SC collaboration is important to their firm.

Although O&G firms were randomly selected through First Point Assessment Limited (FPAL), a database of O&G suppliers and purchasers, we used convenient sampling to recruit respondents through the selected firms. The survey was sent to companies due to the lack of access to employees’ contact email addresses, making it impossible to estimate the response rate. The exploratory nature of this research suggests that the response rate is not a significant issue and has no impact on the research outputs. Classifying respondents using the SC’s tier ensured data quality and integrity, providing a better understanding of nuances in perceptions of collaboration across SC stages.

3.3. Data Analysis

The survey questionnaire generated three main types of datasets. These include simple yes/no responses, Likert-scale and multiple-choice questions, and open-text qualitative data. The collected data lends itself to exploratory rather than correlational analysis,

which was consistent with the goal of this study. As a result, the quantitative data were analysed using descriptive statistics to understand the type of relationships and the extent of collaborations in the UK O&G sector, while thematic analysis was applied to analyse the open-text data. The approach was adopted to identify common themes [30] in the collected data to understand current perceptions and the nature of collaboration in the UK O&G, including its motivations and barriers.

4. Findings

In total, 82 respondents from different O&G companies completed the web-based questionnaire survey. Considering the exploratory nature of this study, the sample size is considered sufficient to gain insights into the idea of collaboration, including its motivations and barriers in the UK O&G, using the perceptions of key informants and practitioners in the sector.

4.1. Completion Rate by Tier

According to the results (Figure 2), 30 professionals from the O&G operators (Tier 1 companies), representing about 37% of the respondents, completed the survey. Also, 21 professionals from the main engineering and maintenance contractors (Tier 2 companies), representing about 26% of the respondents, and 31 respondents from Tier 3 companies (suppliers of goods and services), representing about 38% of the study respondents, completed the survey.

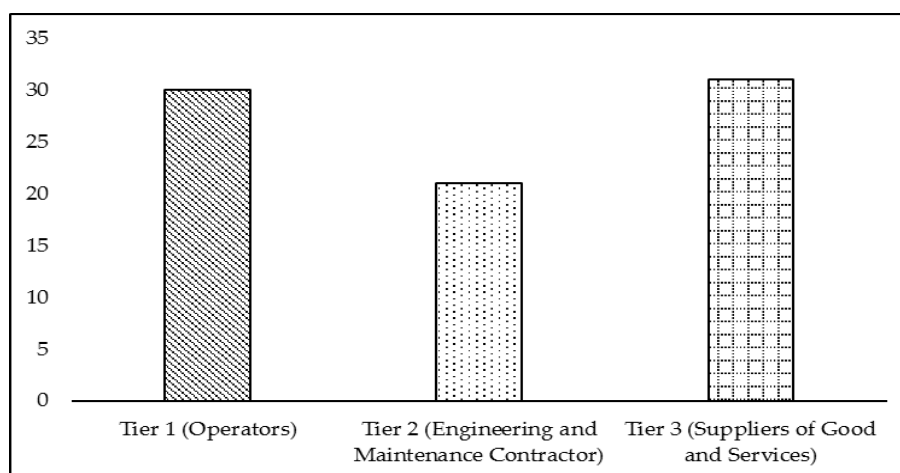


Figure 2. Survey completion rate by tier.

4.2. Current Level of Collaboration in the O&G Industry

Knowledge of the current level of collaboration within the O&G sector is important following the oil crash and subsequent optimism gradually returning to the sector, coupled with the fact that nations are gradually moving away from an oil-dependent economy. Respondents were asked a simple “yes or no” question to establish if their company is currently in a long-term collaborative relationship with other firms in the sector. According to the results, most respondents (about 79%) reported that their company is currently collaborating, while about 21% believe their company is not collaborating. Further analysis was performed using cross-tabulation to classify firms under Tier 1, Tier 2, and Tier 3. Out of the 79% of firms that are reported to be currently collaborating, the highest portion are Tier 1 companies (42%), followed by Tier 3 (35%), and Tier 2 (23%).

A further breakdown of about 21% of the respondents who felt their companies were not collaborating shows that about 47% were from Tier 3 companies (suppliers of goods and services). While 35% were from Tier 2, only 18% were Tier 1 companies (O&G operators). Consistent with the agency theory, these results suggest that relationships with suppliers in the O&G sector are more contractual and adversarial [7,25] than the strategic collaboration

that adds value to all partners in the SC. Although there is an indication that companies are collaborating to some extent, the results corroborate Deloitte's [7] observation on the level of collaboration in the O&G sector. The results further show the disparities in how partners across the O&G SC engage and collaborate, indicating that collaboration among engineering and maintenance contractors is lower than in other SC tiers.

4.3. Importance of Collaboration in the Oil and Gas Sector

While many respondents felt their companies were collaborating, this finding provides no information on whether the collaboration was of strategic importance to their business operations. Respondents were asked about the extent to which SC collaboration is important to their company using a Likert-scale question to gauge their level of agreement. As presented in Figure 3, most respondents (87%) believed that SC collaboration was important to their operations. About 12% of the respondents were indecisive about the importance of collaboration, and only 1% disagreed that SC collaboration is important to their company.

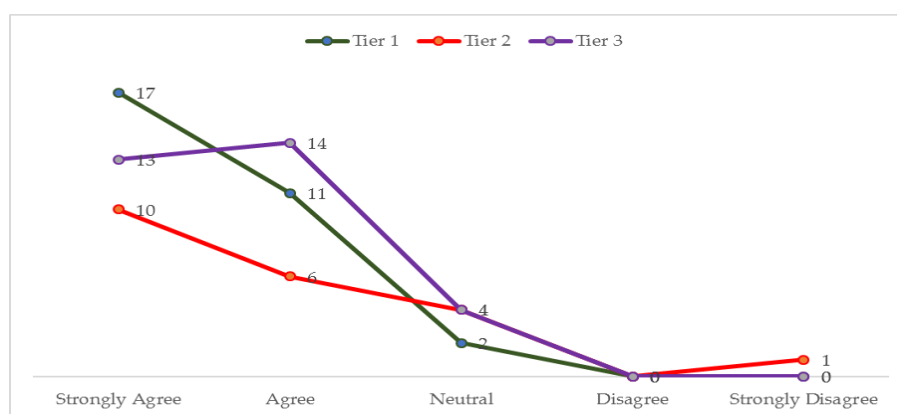


Figure 3. Importance of supply chain collaboration per tier.

These results reinforce the concern that true inter-firm collaboration is difficult to achieve in an SC [8,19]. Further exploration of the data shows that most respondents who perceived that collaboration was important were from Tier 1 and Tier 3 companies. The only 1% who disagreed were from Tier 2 companies. These results further suggest that engineering and maintenance contractors (Tier 2 companies) may be unwilling to collaborate with other Tier 2 companies, possibly due to the competitive nature and the volatility of the O&G market. If more than half of the collaboration in the O&G sector is unsuccessful [8], firms, especially engineering and maintenance contractors, that undertake complex and high-risk maintenance operations may not engage in a true collaboration. This is often the case if the actual costs and risks of collaboration outweigh its benefits. In other words, firms, particularly engineering and maintenance contractors, may not be receptive to a long-term collaborative relationship if it is of no significant value to their strategic intents as the industry embraces energy transition and a circular economy. Although it is pertinent for firms to consider their individual strategic goals, collaboration is required across the entire O&G value chain for the sector to remain resilient and competitive, creating an SC surplus instead of individual gains.

4.4. Motivations for Supply Chain Relationships in the Oil and Gas Sector

From the results presented above, companies in the UK O&G sector are likely to collaborate if there are benefits from the relationship. Understanding the benefits and drivers of SC collaboration in the sector is imperative. Respondents were further asked to rank the seven main motivations/benefits of SC collaboration based on their importance, using a rank order from one (most important) to seven (least important). These motivations/benefits are cost reduction, risk reduction, operational efficiency, innovation,

complementary resources, competitive advantage, enhanced health, safety, environment, and quality performance.

The scorings were analysed on a weighted average score; the element with the highest ranking is given the highest weighting, and the lowest ranking assumes the lowest weighting. In other words, the highest weighting was ranked as the most important, and the lowest ranking was the least important motivation/benefit. From the results (Figure 4), achieving operational efficiency is the most important motivation, followed by cost and risk reduction, while innovation is the least important motivation for SC collaboration.

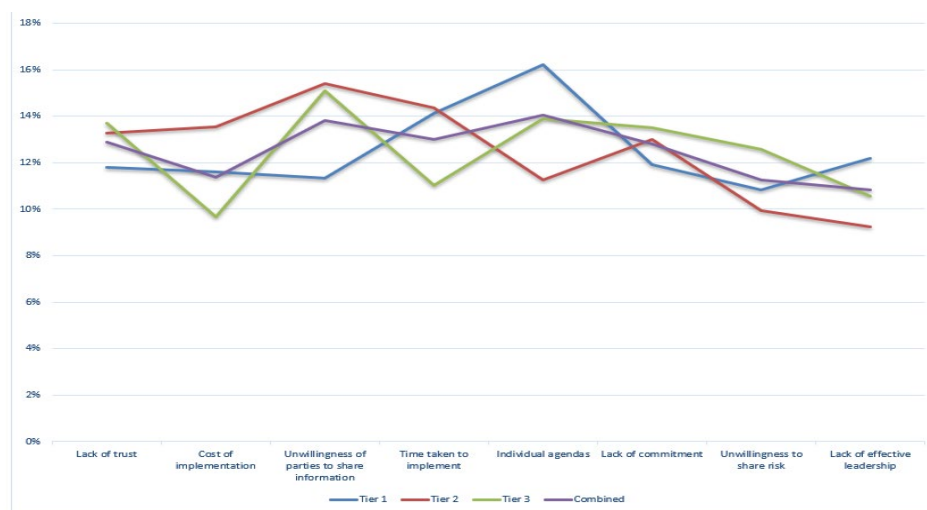


Figure 4. Drivers/motivations of supply chain collaboration.

The results were compared across the three tiers to understand the current pattern in the O&G sector. Surprisingly, “Enhanced Health, Safety, Environment and Quality (HSEQ) performance” is the most common and least important motivation for all the tiers of companies to collaborate. This result is concerning considering the high-profile accidents and health and safety issues, including the sustainability performance of the sector. On the contrary, it could mean that standards, policies, and regulations around HSEQ in the O&G sector are now more stringent since the Piper Alpha disaster in 1988 and have been embedded into the sector’s culture with the expectation that firms should align with the industry’s operations and norms.

Further analysis of the open-text responses showed that respondents mentioned “*cost*” 12 times, “*operational efficiency*” five times, and “*risk*” once when explaining why businesses in the sector collaborate. There is a need for collaborative relationships and dynamic capabilities for innovation, leading to enhanced operational efficiency [8] and resilience [18] through SC collaboration for the industry to reduce costs and attract investments.

4.5. Barriers to SC Collaboration in the O&G Sector

Similarly, respondents were asked to rank eight barriers identified from the literature based on their level of importance, with 1 being the most important and 8 being the least important. According to studies, such as [15,19], these barriers are implementation cost, lack of trust, unwillingness to share information, time taken to implement collaboration, individual agenda, lack of commitment, unwillingness to share risk, and lack of effective leadership. The scores were ranked, weighted, and analysed on a weighted average score. The weighted average score was compared across the tiers to show the relationship between the responses and respondent types. According to the results (Figure 5), respondents generally perceived individual agendas as the most obvious barrier to SC collaboration in the UK O&G sector. This barrier is followed by the unwillingness of parties in the SC to share information, time to implement, and lack of trust.

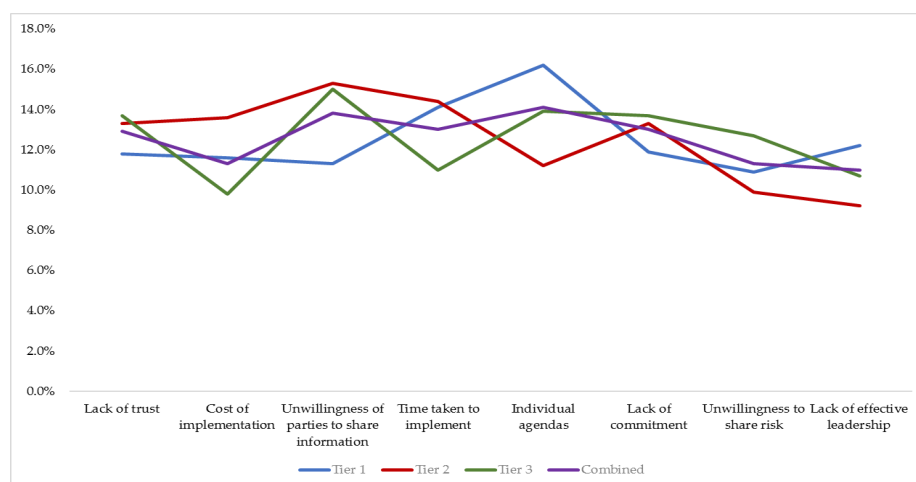


Figure 5. Barriers to supply chain collaboration.

While companies might prioritise personal benefits/agendas, respondents believe that effective collaboration involves cost and time investment, which is a real issue for many companies in the industry. According to a respondent, for example,

“The Operator always moves the goalposts, so despite fantastic improvements in performance, once another service company offers a lower price, they swap.”

[Tier 2 respondents]

Considering that lack of effective leadership is not a significant barrier, it can be argued that internal SC structure and leadership are effective, resulting in firms pursuing activities that benefit their individual competitiveness and market share instead of fostering joint responsibilities and initiatives within the SC and across the industry.

4.6. Value-Adding Capability of SC Collaboration in the O&G Sector

To establish whether SC collaboration adds value, respondents were asked about their perceptions of the value-adding capability of their company’s collaboration. Using Likert-scale questions to understand if collaboration adds value to companies, 81 respondents responded to the question, while only one respondent declined. From the results, about 73% of the respondents believed that SC collaboration adds value to their companies, while only 2% perceived no value in SC collaboration. Further analysis (Figure 6) shows that Tier 3 companies perceived more value than other tiers, particularly Tier 2 companies.

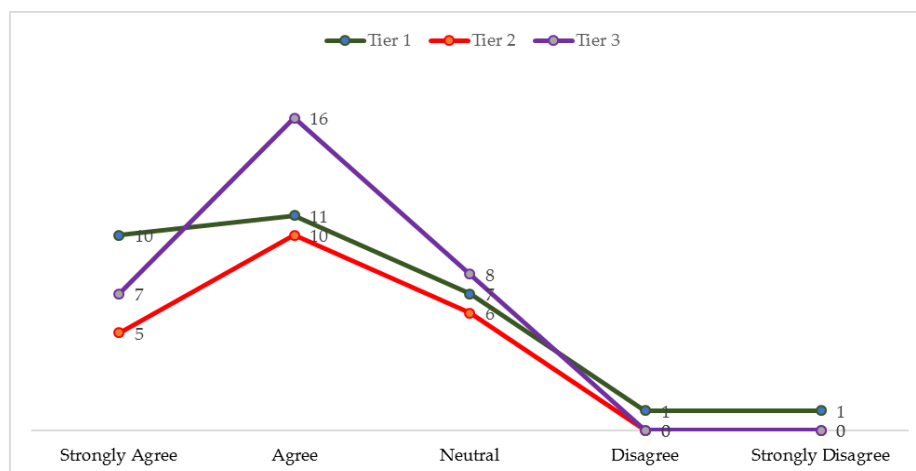


Figure 6. Value-adding of supply chain collaboration.

However, 2% of the respondents who perceived no value in SC collaboration were Tier 1 companies.

Comments from the open-text box support the results. On the one hand, respondents, especially Tier 1 businesses, perceived collaboration as ineffective. For example,

“In my experience, I have found collaboration to be ineffective and lacking any benefit.”

[Tier 1 respondent]

“... not worth the time and trouble.”

[Tier 1 respondent]

On the other hand, respondents from Tier 2 and Tier 3 businesses perceived that collaboration demonstrates good value for money and is worth the time and effort. For example,

“...collaborative relationships demonstrate good results in my experience and have been worth the investment. Efficiencies realised with things like integrated systems and process, and team structures alone can generate great savings.”

[Tier 2 respondent]

“...implementing a suitable collaboration would allow us to expand and grow into other markets.”

[Tier 3 respondent]

“In the oil and gas industry, if the Tier 2 and 3 can collaborate, it provides better value for Tier 1, which ultimately drive the investment in the industry. The ability to negotiate, remain competitive and develop value-driven proposals, instead of offering single sources, enables Tier 2 and Tier 3 to group together and offer better value-driven proposals.”

[Tier 3 respondents]

4.7. Future of SC Relationships within the O&G Sector

It is imperative to understand the future of relationships across the O&G industry's SC, considering the current global economic outlook with energy transition and many other issues, such as COVID-19, sustainability, and political instability affecting the performance of businesses. Respondents were asked if they thought their company could collaborate more than the current efforts and collaborate more in the future or revert to the traditional arm's length relationships. Respondents were provided with the opportunity to expand their perceptions using open-text comments.

The results (Figure 7) show that about 81% of the respondents, with the majority from Tier 1 and Tier 3 companies, believed that companies could collaborate more than their current efforts.

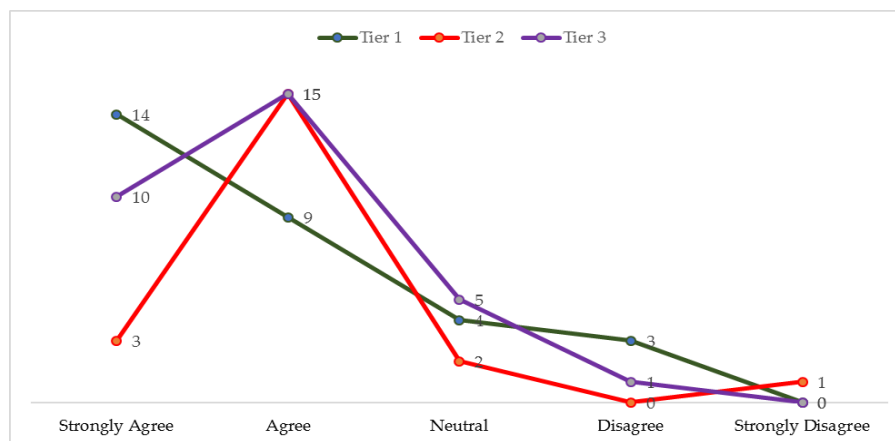


Figure 7. Profiling collaboration in the O&G sector.

While further analysis shows that about 40% of the respondents believed that companies could not revert to arm's length relationships, around 27% were pessimistic about the future relationship of O&G companies, and 33% were uncertain. It was observed that many of the respondents from Tier 3 companies believed that SC relationships may likely return to transactional rather than maintaining and enhancing collaborative relationships when the sector stabilises. These divergent views are further explained by open-text comments, for example,

"Industry only seems to pull together when times are hard; it is ironic that even in hard times, companies still could not share helicopters and boats to make the supply chain more effective."

[Tier 1 respondent]

"The benefits realised are too great to go backwards. This is, of course, dependent on the supply chain also if the steady oil price increases their customer base, they will need to keep their end of the deal."

[Tier 2 respondent]

"I believe that a lesson was learned in the downturn, and companies will still be very wary of how they proceed to prevent getting their fingers burned."

[Tier 1 respondent]

Despite the conflicting perceptions of collaborations in the O&G sector, future collaboration is more important for the industry to remain competitive and achieve sustainability, especially in the decommissioning phase of ageing facilities and O&G assets. According to respondents, for example,

"... [there may be] more of an opportunity to collaborate in a Decom environment as there aren't the race and time pressures to get first oil. Decom is about reducing the cost to a minimum without the time pressure to investigate options and innovation."

[Tier 1 respondent]

"Even though the oil and gas environment is more stable, we still face challenges due to the decommissioning phases that many of us are now entering. This means that we will need to look for more innovative techniques to decommission our assets in a quicker, lower-cost way, so collaboration is vital for making this happen."

[Tier 2 respondents].

Firms in the UK O&G industry should re-examine their strategies to achieve the benefits of working collaboratively as the industry is going through a transition. Although relationships in the O&G SC can be complex and ill-defined due to the multitudes of players in the sector, embracing SC collaboration, where partners collaborate strategically and tactically to address operational issues, provides firms with the opportunity to enhance their operational efficiency and meet customers' needs. By accessing joint creativity capacities, joint organisational learning, knowledge sharing, and joint problem-solving between partners, firms in the O&G sector can align incentives through risk-sharing, enhance operational efficiency, and improve product and service delivery.

5. Discussion and Conclusions

This study explored the current level of SC collaboration in the O&G industry to understand the perceived value of collaboration, including the main benefits and barriers, providing insights into whether collaboration is important to businesses in the O&G industry. The results established that the current level of SC relationships in the sector is transient and complex (Figure 8) and perceived differently by practitioners depending on the tier of their organisation in the sector. As depicted in Figure 8, the results show that O&G firms are more willing to collaborate under disruptive economic conditions due to a lack of power and information asymmetry. The reported collaborative relationships during turbulent economic situations are motivated by the desire to reduce operational costs rather than build strategic

and sustainable relationships. The relationships are often short-lived and may return to the status quo once the economy, including the sector, regains confidence. This suggests that relationships in the O&G sector are temporary and primarily underpinned by the stability of the sector, which may explain whether strategic and sustainable collaborations are possible in the future, considering the trilemma of concerns facing the sector. With countries transitioning away from O&G-dependent economies, the O&G sector can remain competitive and contribute importantly to the circular economy and sustainability agenda of nations if strategic collaborations underpinned by information sharing and trust are embraced.

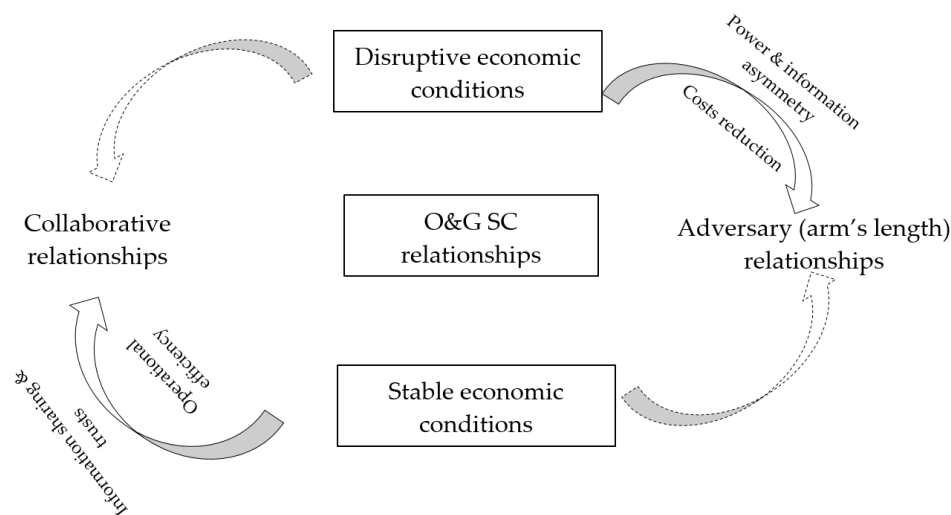


Figure 8. Transient pattern of SC relationships in the O&G industry.

According to the results, Tier 1 firms are more likely to collaborate in the future than Tier 2 and Tier 3 firms; however, Tier 1 firms perceive the current collaboration as ineffective. Consistent with the tenets of the agency theory, Tier 2 and 3 firms undertake contractual activities on behalf of Tier 1 firms, although our study shows that the relationship between firms is underpinned by incentives to align with the expectations of the agents (i.e., Tier 2 and 3 firms) and the principals (i.e., Tier 1 firms). To prevent the agency problem, incentives must commensurate with the needs and expectations of agents and principals [24,25]. However, this study has shown that this situation is not often the case in the O&G industry due to a lack of trust, information asymmetry, and power asymmetry (Figure 8), with Tier 1 companies often shifting risks and costs to Tier 2 and Tier 3 firms, especially during unpleasant economic regimes.

In addition, SC collaboration in the UK O&G industry is influenced by firms' structure, culture, and the assessment of whether there is a strategic fit between partners. Structure and culture are fundamental to information sharing within and across firms, enhancing SC visibility and facilitating internal and external collaboration [9]. Enhanced SC visibility through trust and information sharing can prevent agents and principals from withholding valuable information, which can provide undue advantages/power to either the agent or the principal in the SC. For the O&G industry to be resilient and competitive, firms must understand their SC partners' needs and capabilities, including their motivations for collaboration. Nonetheless, this study demonstrates that collaborative relationships across the entire SC are required for businesses in the industry to maximise production at the lowest cost and create value for the industry. The results are consistent with many studies that reported collaboration as a strategic function for companies to reduce operating costs [7,10]. The perception that collaboration is important for the industry reflects the state of the global O&G sector, see [7], for example, as many nations are moving away from the oil-dependent economy. According to the open-text comments, respondents described SC collaboration as "vital", "key", "good for business", and "simply, together we are stronger". Further analysis shows that most respondents perceived SC collaboration as

worthy of time and effort. This belief system is encouraging for the future of the UK O&G sector, considering that SC collaboration involves time, commitment, trust, and information sharing across the SC [17,22].

Consistent with the literature, such as [9,23], cost reduction and the opportunity to maximise the recovery of O&G reserves are reported as the key motivations for collaboration. While costs, operational efficiency, and risk reduction are pertinent for the industry to recover and be competitive, innovation is important, especially in Tier 2 and Tier 3 companies. The fact that Tier 2 and 3 companies are service-based operations may contribute to how they perceive the importance of innovation to their competitiveness. The ability to innovate would enhance their capacity to achieve the expectations of Tier 1 companies, suggesting why Tier 1 companies value collaboration more than other tiers.

Considering the high-profile incidents in the industry, it is surprising that improving HSEQ benefits is not considered by respondents as an important area for collaboration. The only explanation is that HSEQ is not perceived as an SC issue but should be managed at the operational level of the individual business. Improving HSEQ performance is highly regulated in the UK O&G industry and is likely associated with improved operational efficiency, which is SC collaboration's main benefit and driver.

While some benefits and drivers are identified by respondents, pursuing individual agendas, unwillingness to share information, time to build relationships, and lack of trust are the key barriers to SC collaboration in the UK O&G industry. The failure of businesses to understand that SC competes, not individual businesses, may contribute to the lack of willingness to cooperate or share important information. This lack of willingness to cooperate suggests the failure of the SC to attain lower costs and higher returns on assets [12]. As a result, sourcing and resourcing must be carefully performed based on the contribution and relevance of partners to the SC for the relationship to create a win-win situation. Building trust across the SC would facilitate the willingness to cooperate and share important information, creating an SC surplus. The extent to which these factors, especially trust, information sharing, and willingness to cooperate, interact for companies to collaborate and enhance their competitiveness should be further explored.

The likely higher level of corporate governance and more rigid approval processes by Tier 1 and 2 companies suggest that collaboration may take more time to implement in Tier 1 and 2 than in Tier 3 companies. The findings of this study show that collaboration can drive up the internal costs of procedural changes, internal processes, and time spent dealing with collaboration partners. This observation that Tier 1 companies perceive collaboration as ineffective despite its relative importance further supports Solaimani and van der Veen's [8] argument that collaboration in the O&G industry is mostly unsuccessful.

Nonetheless, the results further show that businesses in the UK O&G industry could collaborate more and are willing to collaborate to enhance their operational efficiency and competitiveness. Many respondents argued that the industry had learned lessons from the economic downturn, suggesting that the benefits of collaboration are too great for the industry to revert to traditional arm's length relationships. Despite the uncertainty and the external factors facing future collaborative relationships, it is apparent that the industry has embraced the idea of SC collaboration. Considering the willingness of firms to collaborate, there is a need to embed collaboration, particularly through trust and information sharing, into the SC culture of the O&G industry in the UK.

It is evident from the findings that many businesses in the O&G industry collaborate to create benefits for their organisation rather than achieving SC surplus. Although collaboration contributes positively to SC performance [8,19], collaboration provides more opportunities for the O&G industry, particularly due to the challenges facing the O&G SC. Collaboration is fundamental to the resilience and survival of the industry as nations are moving away from an oil-dependent economy coupled with the net-zero agenda of many countries. The ongoing energy transition indicates huge opportunities for SC collaboration as the O&G industry is undertaking the decommissioning of assets. However, SC collaboration between stakeholders, including operators and suppliers, across the upstream

and downstream sides of the O&G industry is required to add value to the industry and address the trilemma of concerns facing the industry. The importance of SC collaboration suggests the need for more clarity on how it can be adopted and achieved [11,15] for the O&G industry to maximise its competitiveness in the global market.

6. Research Implications

The risk of entering a relationship may outweigh the overall cost reduction in the short term due to transaction uncertainties induced by asset specificity, competition in the supplier's market, and the reluctance of parties to share information and risks [21]. Information- and risk-sharing facilitate a collaborative relationship [17] but can be difficult to coordinate, especially in the O&G sector, where investments are huge, costly, and risky. The O&G sector must reduce the complexity of information sharing and risk management to prevent an imbalance of risk sharing, particularly during turbulent economic situations, which may negatively affect the effectiveness of collaborations.

Businesses in the O&G sector need to conduct environmental scanning to understand whether forming an enduring relationship with suppliers is worth the effort. By analysing their portfolios, businesses in O&G may reduce the complexity of collaboration by identifying and implementing the best collaborative and sourcing strategies. Based on Kraljic's [31] perspectives, a portfolio analysis that segments suppliers into four different strategic quadrants in developing supplier relationships and strategies may be required to determine the type of relationships and alliances to adopt with suppliers across the value chain. The portfolio approach is based on the idea that, since suppliers represent different interests to the focal organisation, it makes business sense to develop different strategies and contractual arrangements for suppliers, aligning incentives to their expectations and needs [20]. Understanding that bottlenecks and critical goods/services may involve a limited supply base due to the high level of risk and complexity could inform appropriate sourcing strategies for businesses in the sector, and this requires further investigation. The O&G sector should adopt a collaborative approach rather than the traditional adversarial relationship, particularly when managing critical operations, to ensure that the SC is efficient and responsive. With the trilemma of concerns facing the O&G sector, achieving efficiency and responsiveness in the O&G sector should be further explored in future studies for the industry to remain resilient and competitive.

Author Contributions: Conceptualization, A.O., O.A.O. and S.T.; Methodology, A.O. and S.T.; Data Collection, S.T.; Formal analysis, A.O. and O.A.O.; Writing—original draft, A.O.; Writing—review & editing, A.O. and O.A.O. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institution Ethics Committee) of Aberdeen Business School (10 November 2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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