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Service Company's Adaptation of Supply Chain to Cope with Volatile Oil and Gas Market

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Master in Management of services and technology

Supervisor:

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Associated Professor in the Department of Marketing, Operations and General Management,

ISCTE Business School

October 2020



**BUSINESS
SCHOOL**

Department of Marketing, Operations and General Management

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Acknowledgments

The conclusion of this stage seems unrealistic. After so many years, so many expectations, with so much effort, it finally came to an end. Throughout this process, several people contributed in different ways, for the realization of this dissertation and the end of this stage of my life.

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Resumo

O mercado petrolífero é muito importante a nível mundial, mas a imprevisibilidade nesse setor é um grande desafio que afeta todas as cadeias de abastecimento presentes neste mercado. Tais condições tornam o mercado competitivo e diversificado, onde as empresas prestadoras de serviços têm dificuldades em manter a produtividade em época de crise. Esta tese reúne dados sobre a indústria de serviços e explora a literatura existente sobre a agilidade na cadeia de suprimentos para descobrir a aplicação de estratégias que podem ser implementadas na indústria petrolífera.

As principais dificuldades e riscos enfrentados durante uma crise do petróleo foram identificados por meio de análises a principal prestadora de serviços (Schlumberger). A mobilidade global e os desafios relacionados aos fornecedores são os principais factores que prejudicam a capacidade de lidar com as oscilações do mercado. Tdesenvolvidas pela Schlumberger foram usadas como a base deste estudo.

Por meio de entrevistas e revisão da documentação interna e relevante literatura evidenciámos que a agilidade na Schlumberger foi alcançada estabelecendo a visibilidade na cadeia de suprimentos e o desenvolvimento de políticas e processos flexíveis. Assim, ao alavancar recursos internos e soluções digitais para melhorar as atividades de compras e superar os riscos inerentes.

Um conjunto de recomendações foi apresentado a fim de servir como referência para gestores da Cadeia de suprimentos. Este destaca práticas que podem ser aplicadas ao nível da gestão de fornecedores, capacidades internas e clientes por forma a contribuir para uma maior agilidade na Cadeia de suprimentos onde a empresa alvo está inserida.

Palavras-chave: Cadeia de suprimentos, Compras, Agilidade, Volatilidade, Empresa de serviços. Petróleo e gas

Abstract

The oil and gas market has great significance across the globe, but the unpredictability in this industry is a huge challenge that affects all the supply chains in this market. These conditions contribute to a competitive and diverse market where service firms struggle to keep productivity in order to lower costs and boost operating performance. This paper gathers data on the oilfield service industry and explore existing literature on service supply chain agility to discover empirically the application of strategies that can be implemented within the sector.

The major difficulties and risks faced during an oil crisis were identified through analyses on the performance of the leading global service provider (Schlumberger). Global mobility and supplier related challenges were found to be the main factors that harm the company's capacity to deal with market fluctuations. And the constructive tactics developed to achieve a strategic edge over competition have been used as the foundation of this study.

Through executives' interview, internal documentation research and relevant literature review it was discovered that agility in Schlumberger was attained by establishing supply chain visibility and the development of flexible policies and processes. By leveraging internal capabilities and digital solutions to enhance the procurement activities and overcome the looming risks it's possible to successfully operate in complex market.

A recommendation framework was presented as supply chain managers' benchmarking scheme. This framework highlighted approaches that can be taken in terms of suppliers, internal capabilities and customers as a way to contribute to greater supply chain agility.

Keywords: Supply chain, Procurement, Agility, Volatility, Oil and Gas, Service Company

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1. Chapter 1- Introduction

1.1 Research context

The oil and gas market has great significance globally, as it is considered one of the most profitable business sectors. Its performance affects most countries in the world as it promotes the development of new technology, and it has been at the core of various economic and political negotiations. It relies on natural resource production for energy use.

Oil prices have always been used as a barometer of the worldwide economy. Historically, oil prices have undergone significant ups and downs, and such phenomena have attracted scholars and industrial communities (Wu and Zhang, 2014). Recently, the sector has suffered the effects of the global oil price volatility triggered by the impact of COVID-19 on the world economy, both by reducing demand and by preventing expectations of global growth. As tension increases, global lockdowns and border restrictions obstruct suppliers' capacity to deliver on schedule and on budget.

The instability in the oil and gas industry hurts the entire chain. As a result, oil firms aim to gain comparative superiority over their rivals, much like firms in any industry, to thrive over the long term. This competitive advantage comes from firms' ability to deliver superior goods or services to rivals in a particular market (Johnson, Scholes & Whittington, 2009).

Over the last few decades, the supply chain has been recognized as the new front of gaining a competitive edge (Hasini 2008). Therefore, oil companies are pushed to put in place supply chain practices that guarantee efficiencies to cut prices and maximize their processes. It is required to overcome oil shocks caused by the oil fluctuations to protect the margin in times of downturns and engage the capability to benefit from upturns.

1.2 Research problem

Due to growth in demand, reduced trade barriers, and technology development, there has been heavy competition between oil firms (Himola, 2011). The petroleum industry, in comparison to other sectors, it entails a highly complex supply chain (Hussain, Assavapokee, & Khumawala, 2006). The entire oil supply chain is divided into upstream, midstream, and downstream divisions based on pre-and post-refining operations. It is mainly made up of equipment, service, and production firms (known as operators) who supply oil and gas to end consumers.

Players depend on the availability and demand of these natural resources to determine the price of the market. Oil and gas operators insist that services firms often slash rates. To reduce both operational and capital costs, which makes services more prone to the adverse impact of the downturn when compared to upstream production companies (Zhu, Balakrishnan, & da Silveira, 2019).

As profitability within the sector depends on effective management and adaptation to the supply chain dynamics (Saad, Udin, & Hasnan, 2014). In this volatile and diverse sector, agility is a significant source of competitive advantage (Hussain et al., 2006). However, there are some inflexible features of the oil supply chain, such as long lead time, rigid take-off, or pay purchase, which must be anticipated and studied.

Several studies call for a better understanding of this apparent paradox where this industry guarantees its competitiveness because it is stable and predictable but requires that the relationship of its procurement base act in dynamic and agile logic. This thesis, therefore, seeks to answer the call to look in-depth for the industry supplier's stratum in search of a better understanding of the critical factors that impact and determine the agility of their respective supply sub-chains.

For the supply chain to effectively monitor and control the numerous relationships, service providers communicate with a wide number of suppliers. Yenikeeff (2011) studies concluded that procurement activities are the petroleum backbones of progress. A study on the market landscape and identification of proactive procurement and sourcing solutions to obtain a comparative competitive advantage is of great importance.

1.3 Author positioning and study

The supply chain in the oil and gas sector was not taken into consideration for quite a while. According to Mohammad 2008, it was only when companies experienced a crisis and realized that 80% of the expenses were allocated to supply chain systems that this topic attracted the attention of scholars and practitioners. Nowadays, it is found in literature a number of studies have been conducted on the common challenges and practices within the sector to cope with the market uncertainty.

Such studies include management issues (Chima, 2011), value changes, and multicultural complexity (Mohammad, 2008), and the impact of the Bullwhip effect (Zhu, Balakrishnan, and da Silveira, 2019). Furthermore, there has been an outline of the traits of resilient companies and strategies for transformation to remain competitive (Yusuf et al., 2014) and the use of technology and Information systems as means to attain flexibility (Piya, Shamsuzzoha, Khadem, & Al-Hinai 2020; Triaa, Gzara, & Verjus, 2016).

Additionally, sustainability and dynamic capability as a means to obtain competitive advantages have also been investigated by using single and multiple case studies of oil production in both upstream and downstream segments. (Anis & Siddiqui, 2015). Despite the extensive articles available during the search for relevant articles and documents, it became evident that there is a void in the literature is limited to how the service industries adapt to the volatility.

Case in point, the available literature is analytical reports by leading consultancy companies. As a result, the body of knowledge is limited, and no developed frameworks for companies to deal with the imminent changes. It thus becomes critical to undertake studies that focus on the industry to provide a better understanding of the service companies.

Therefore, the following thesis seeks to provide a deeper understanding by examining the impact of supply chain agility in the oil and gas industry by focusing on how service companies have adapted their global structure to remain competitive in such a complex market, using a case study of Schlumberger to form the basis of the analysis.

1.4 Aims and objectives

The proposed thesis aims to investigate oilfield service companies' practices that ensure adaptation of the supply chain to cope with the volatile market. Analyzing the main difficulties, trends and patterns within these companies. Focusing particularly in the case of the number one oilfield service provider in efforts to understand how competitive advantage has been sustained.

The objectives of this thesis, however, are:

- a) To understand the impact of volatility in the market for oilfield services companies;
- b) To recognize supply chain challenges in the oilfield service companies;
- c) Define strategies and innovations that can be leveraged to improve supply chain performance;

1.5 Research Questions

To examine the ways the service companies, adapt their structure to remain competitive amidst the challenges of volatility, three overarching research questions will be used to give study direction:

RQ. 1 How is Schlumberger performance impacted by the oil price oscillations?

RQ. 2 What are the main supply chain challenges schlumberger encounter?

RQ. 3 Which strategies can be implemented by service companies to attain supply chain agility?

1.6 Outline

The methodology implemented in the study is mixed methods. An in-depth understanding of the issue under investigation by qualitatively and empirically (Schoonenboom & Johnson 2017) and secondary and primary data were collected.

- a)** The primary data gathered through personal, in-depth interviews with ten Schlumberger staff members, including five critical officials of the organization responsible for international supply management in efforts to understand the strategies for adapting to volatility.
- b)** The secondary data entails reviewing the literature on the supply chain agility and oilfield service sector practices. The literature will be limited to journal articles, financial statements from the company under study, and reports from consulting firms analyzed and written reports on the sector.

This report would address the problems posed by oilfield firms in attempts to recognize methods used to deal with market fluctuations. This will provide knowledge to gain a more in-depth view of adaptive supply chain technologies against internal and external businesses' plans and decision-making capabilities. From a managerial perspective, this study would greatly benefit supply and chain managers. The findings of this analysis would display the leading company's performance in the field. They would allow business leaders to understand success and potential steps that might strengthen their competitiveness.

The thesis will be divided into two main sections. The first part provides a macroeconomic overview of the oil and gas industry, examining the historic growth of petroleum markets, reviewing drivers, and presenting a vision of the industry. Additionally, this section also provides a literature review on service supply chain agility.

In the second section, this document examines the effect of fluctuating oil prices on service providers, focusing on SLB 's adopted and intended methods to boost procurement and sourcing. The study discusses strategies that have been employed by SLB and ultimately, provides managers with advice to increase the companies.

2. Chapter 2 - Oil and gas industry outlook

The oil and gas industry is based on a network of players along the chain from the exploration, drilling to the manufacture of the final products. In the oil and gas industry is categorized into three sub-industries that are interrelated, the upstream, midstream, and downstream. In these three categories there are various stakeholders that make up the for a complex supply chain which is dominated by five types of companies (see Table 1).

Table 1: *Oil industry types of companies*

Type	Activity	Companies
International oil companies (IOCs) also known as operators	Companies integrated vertically with global oil operations. These companies' activities are the development and production of oil resources and selling them to the global market.	E.g. BP, ExxonMobil, Total, Shell, and Chevron
National oil companies (NOCS)	Ownership is mainly by the government and hold exclusive or near-exclusive control of oil production. Their goals is to usually provide fuel to citizens at discounted prices.	E.g. China National Petroleum Corporation (CNPC), Aramco (Saudi Arabia)
NOCs with strategic and operational autonomy	Corporate entities but not extensions of the government. The objectives of the companies are both market-oriented and meeting country/s needs. The companies are commercially driven but still balance the profit orientation with the concerns of the country's development	E.g. Petrobras (Brazil) and Statoil (Norway).
Independents	Are engaged in the exploration and production segment in the supply chain, and they do not engage in marketing, transportation, or refining	E.g. ConocoPhillips, Repsol.
Oilfield service companies (OFS)	Offers exploration and production services by delivering specific technical expertise such as drilling, geophysical survey, leasing of equipment, and drilling.	E.g. Schlumberger, Haliburton, Baker Hughes

Source: (EIA, 2014)

2.1 Volatility in the market

The oil industry performance affects most countries in the world as oil is a crucial energy source that guarantees the development of modern industry and economy. Furthermore, the industry promotes the development of new technology and it has been in the core of various economic and political negotiations.

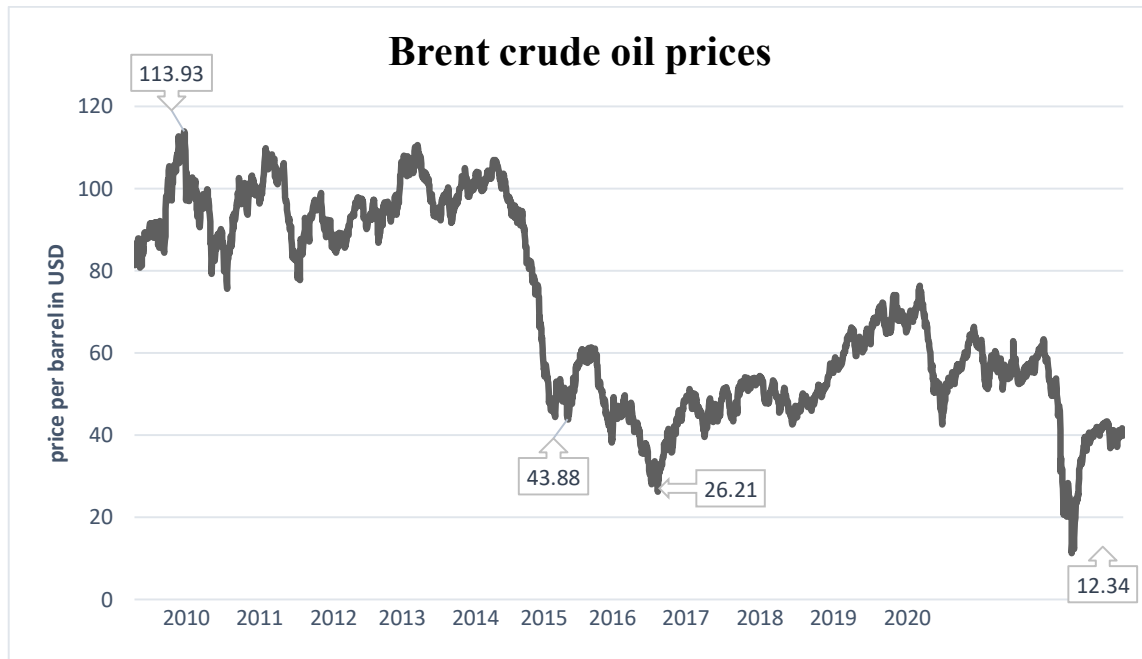


Figure 1: Adapted graph of Crude oil price from 2010 to 2020

Source: (Macrotrends.net, 2020)

As indicated in the graph above (Figure 2), crude prices experienced constant oscillation from 2010 to 2020. Oil was valued at around \$113 per barrel. However, in 2014, the price of crude oil in Brent dropped by 40%, contributing to one of the drastic falls in oil prices in modern years due to the booming U.S shale oil production. Another moment in history was in mid-2020, when oil prices dropped to \$12 due to the spread of coronavirus worldwide in the last months. Global demand for commodities had collapsed, and OPEC countries have refused to negotiate a supply cut with non-OPEC nations.

2.1.1 Main drivers

The main challenge in the oil and gas supply chain is the price volatility influenced by many factors. Many experts claim that crude worldwide's price is mainly dependent on supply and demand (Du, 2006). According to Yan (2012), many other factors can go beyond supply and demand, and that the competition between world economies and geopolitical events play an important role in determining oil prices. According to Sun, Liu, Chen, and Li, (2017), high volatility in the oil and gas sector can be attributed to different macroeconomic factors. The several macroeconomic factors that drive oil and gas supply chain volatility include:

- Demand and supply
- State and regional regulations
- Activities of oil-producing countries
- infrastructure and environmental constraints such as weather.

For instance, to illustrate how state and regional activities influence oil volatility (Zhu, Balakrishnan & da Silveira, 2019) cited the Persian Gulf War that affected crude oil production and distribution. Specifically, the Gulf War resulted in a total collapse of oil production in Kuwait and Iraq. Considering that 9% of the total oil consumption in the world came from Kuwait and Iraq, there was a significant shortage of the commodity in different parts of the world (Zhu, Balakrishnan and da Silveira, 2019).

Consequently, oil prices doubled in less than four months and took another five months to stabilize. This illustrates a typical oil and gas volatility factor since there was a sudden drop in production, causing a sudden shortage of oil and gas in different parts of the world. The changes unfavorably affect the margins of the companies in the supply chain. According to Q. Zhu and Singh (2016), volatility in the oil process causes uncertainties concerning profitability, investment decisions, and valuations.

Hence, it is critical for the companies in the supply chain to have strategic investment decisions to cushion the companies from shocks caused by downturns. The volatility in the oil and gas industry negatively affects the companies' stock returns (Ulusoy & Özdurak, 2018). After the 2014-2016 downturns, the markets are recovering with a certain degree of stability. Despite the recovery, uncertainty is still a major issue.

2.2 Oilfield Services Companies outlook

The successful operation of the oil and gas sector (OGS) partially relies on service companies, which offer different services (Kryukov & Tokarev, 2018). Service companies typically facilitate the successful assessment, exploration, actual extraction, processing, and distribution of oil and gas products (Kryukov & Tokarev, 2018). According to Kryukov and Tokarev (2018), service companies in the OGS have specialized in offering services, hence improving the sector's general efficiency.

The size of the companies differs. For instance, Schlumberger is a giant company that provides 90% of the services required to explore, develop, and produce oil and gas basins (Kennedy & Thompson, 2016). Also, single service companies such as Geolog engage in the logging of surface data for drilling projects, both international and offshore.

The oilfield service companies are unique actors in the petroleum sector. They serve as the industry's key players by leading in operations and innovation (Kennedy & Thompson, 2016). Case in point, they offer the required technical support to NOCs and Independents.

The companies' growth is based on innovation and technological solutions and devising strategies to overcome cost challenges faced by oil operators (Deloitte, 2017). The specialization and repeated use of the services have allowed the companies to realize economies of scale in developing technologies that the IOCs and NOCs cannot replicate. As such a result, the service companies are outsourced to offer support.

The dynamics in the gas and oil industry and the oilfield service industry's role presents a different context in which volatility and uncertainty are rife in the industry. The job losses, dwindling stock returns, and low margins are a big challenge for the shareholders. During the 2014 and 2016 downturn, 36% of the oilfield service sector companies ceased operations. The revenues decreased by nearly 55%, and job losses were above 50% in some sectors (Deloitte, 2017).

The oilfield service sector companies remain in a precarious situation that needs a delicate balance to ensure that they can adapt to the volatility (Shuen, Feiler, & Teece, 2014). A downturn affects the entire supply chain due to the interdependencies created by the complex supply chain. However, the impact of oil prices usually falls severe for oilfield service companies (T. Zhu, Balakrishnan, & da Silveira, 2019).

3. Chapter 3 - Literature review

This study aims to examine the strategies for improving supply chain efficiency and agility in the oil and gas service sector. This research aim emanated from a preliminary review of the literature and a discovery of a gap of how service companies in the oil and gas sector manage volatility and attain agility. The researcher commences with a brief description of the concept of the supply chain for service industries. The preliminary analysis of supply chain agility, versatility, and risk management allowed an understanding of terms and defined the most critical and interesting elements to improve supply chain agility for petroleum and gas service firms. The analytical research undertaken supports the importance of the elements selected.

3.1 Supply Chain Agility concept

In contemporary supply chain and logistics research, the concept of agility has gained much attention from researchers. However, the notion of agility has received more attention in manufacturing research as compared to service industry research (Blome, Schoenherr, & Rexhausen, 2013). According to Blome et al. (2013), since the emergence of the concept of supply chain agility, it has been perceived as a strategic weapon for navigating the highly competitive global market.

While the concept has received much attention, it was pioneered by Fisher's (1997) 's seminal work, who argued that a firm's responsiveness to the external business environment is an important capability that enhances competitiveness. Various principles discuss the adaptation of the supply chain to these complexities and fluctuations. There seems to be no consensus about the precise concept of agility in the literature. Different meanings thus call for the set of the following complementary dimensions:

- Accessibility: Describes the significance of appropriate data and knowledge structures for exchanging data across the supply chain for improved collaboration (Gligor, Holcomb, & Stank, 2013). In order to rapidly understand and respond to industry shifts, Gligor et al. (2013) access to in-house information through the introduction of virtual supply chains could become crucial.

- Alertness: Describes how shifts can be read and observed. This factor concentrates on monitoring systems through market analysis to detect both demand and supply patterns, risks, and opportunities (Gligor et al., 2013). The definition represents the willingness to overcome unforeseen problems, withstand severe environmental risks, and turn changes into opportunities.
- Decisiveness: Denotes the capacity to act with determination and certainty. The concept refers to the power to control the pace at which businesses will shift direction (Gligor et al., 2013).
- Flexibility: or adaptation is associated with incorporating new procedures and strategies to satisfy the organization's needs. It is also seen as a core feature of an agile enterprise (Lau & Hurley, 2001). Flexibility incorporates the robustness of the supply chain, the capacity to adjust current capacities, and the flexibility to re-align or redesign the supply chain in response to market developments (Stevenson & Spring 2007).
- Leanness: The process of elimination of excess, i.e., the reduction of non-value-added activities. The definition can be used as a steppingstone to the rapid reconstruction of the supply chain (Yusuf et al., 2014). Leanness is recommended to apply where demand is reasonably constant with little variation, while agility exists in less consistent environments with numerous consumer requirements (Christopher, Peck, & Towill, 2006).
- Quickness: The desire to operate as soon as possible (Gligor et al., 2013). The concept encompasses the pace and responsiveness of executing decisions to adapt to economic upswings and downswings while investing less time handling the crisis (Geissbauer & Householder, 2011). Focus is placed on an agile supply chain's constructive component that makes for a successful recovery from market volatility (Lin, Chiu, & Chu, 2006).

The six agility measurements can be divided into two categories. The cognitive category encompasses the aspects of information processing, including alertness, accessibility, and decisiveness. The physical category encompasses action-taking measurements, including quickness, flexibility, and leanness. The difference between knowledge and the steps allows increasing or minimizing the capability needed to achieve the optimal agility in the supply chain and remove vulnerabilities (Gligor et al., 2013).

For businesses to remain relevant in such an environment, high flexibility and responsiveness to business-wide demands are necessary. The multidisciplinary definition of supply chain agility includes several interrelated facets: organization, information systems, logistic operations, environment, and mindset (Lau & Hurley, 2001). This wide context underlines the value of investigating and improving supply chain capabilities to overcome uncertainties and outperform less agile rivals (Yusuf et al., 2014). Besides, the assessment of the existing agility capacity can uncover potential synergies to improve the supply chain (Swafford, Ghosh, & Murthy, 2008).

In a study conducted by Piya, Shamsuzzoha, Khadem, and Al-Hinai, (2020) to examine the association between agility and competitiveness of businesses in the OGS, initially conceptualized agility in terms of the four agile dimensions using existing literature. The four dimensions conceptualized by (Piya et al., 2020) included Cooperation, Mastering Change and uncertainty, Customer Enrichment, and Leveraging people and information's impact. Cooperation.

Their findings (Piya et al., 2020) reported mastering change and uncertainty and leveraging the impact of people and information as the strongest measures of agility in the oil and gas sector. Similarly, other researchers such as Venugopal & Saleeshya (2019) and Triaa et al. (2016) also reported similar findings.

According to Venugopal and Saleeshya (2019), agility in the OGS significantly depended on organizations' capability to manage change and uncertainties that are common in the oil and gas sector. According to Mubarik and Zuraidah (2019), attaining agility requires adequate planning and accurate forecasting to minimize any organizationally induced errors that may undermine supply chain agility.

A system that switches rapidly between product versions or across product lines (with agility and high responsiveness) is said to be flexible. Flexibility also means responding in an almost timely manner to consumer demand. Nowadays, companies are rapidly investing in agility production in supply chains to adapt rapidly to unpredictable market shifts. Swafford, Ghosh, & Murthy (2008) suggest that supply chain resilience impacts an organization's ability to manufacture and distribute new goods to its consumers in a timely and cost-effective manner.

3.2 Service Supply Chain

A normal supply chain entails linking upstream and downstream players to allow synergies in the capital, labor, technology, financial assets, and resources flow. In the past decades, Supply chain management has gained a lot of attention among managers in many industries. It's at the core of globalization, technological advances, diversification, lean, and sustainable supply chain (E. John, T. Margaret, O. Anyandike, & M. Ortencia, 2019).

The concept of the supply chain is complex and depends on the industry. Countless studies have been carried out on the supply chain and measures that can be put in place for companies to remain competitive in the supply chain, which has mainly been focused on manufacturing supply chains. However, there is still a research gap for studies that consider service-oriented business.

The concept of SCM is very similar in both industries. However, for instance, inputs vary from service to manufacturing, which involves an input of physical work (packaging, distribution), and the service sector needs the input of work in the form of relationships or "manipulation of data." Also, Wang, Wallace, Shen, and Choi (2015) stated that the SSC could be categorized as a service only supply chain and a product service supply chain.

Compared to the manufacturing industry, services are not uniform because they are different and lack specific features. The lack of a common structured management system is perceived to be one of the key problems impacting SSC activities' efficiency and efficacy (Zhang & Chen, 2015).

Additionally, Prater, Biehl, and Smith (2001) reiterated that it is difficult to find a company that possesses all the resources required to produce goods or services. The firm must rely on other industry players such as suppliers, distributors, and wholesalers. Since no single firm owns the supply chain, successfully SCM necessitates a coordinated approach among the key entities contributing to the production and distribution of the goods or services.

Before a product or service arrives at its final consumption point, it normally goes through different entities such that each of them contributes their value addition to the product/service. The service supply chain is typically correlated with a high degree of consumer engagement and the dominant position of the supplier (Aliakbari Nouri et al., 2019).

Efficient customer and service provider management is also highly necessary for intangible convergence services and visible goods (Hussain, Khan, & Al-Aomar, 2016).

The OFS companies fall under the product service category as the equipment is acquired from a third-party supplier, transformed to provide services to the end customers (i.e., the operator). This is an example of the interconnected supply chain that involves managing and exchanging knowledge up and down the network.

Baltacioglu et al. (2007) state that customer-supplier duality ensures that demand flows from manufacturers to consumers and from consumers to manufacturers. Output flow is thus bi-directional and is a crucial element in relating conventional supply chain models to the business process's complexity.

Many OFS businesses will need product deployment, but these products are not the subject of services directly but become part of the delivery channel. Brand ownership is becoming less significant. Focus has shifted from the importance of the particular commodity in an interconnected sense to the product's value, the so-called value of use. The model presented by Baltacioglu et al. (2007) illustrated in Figure 2, the SSC model reveals that the service provider produces the service as a hub of the chain.

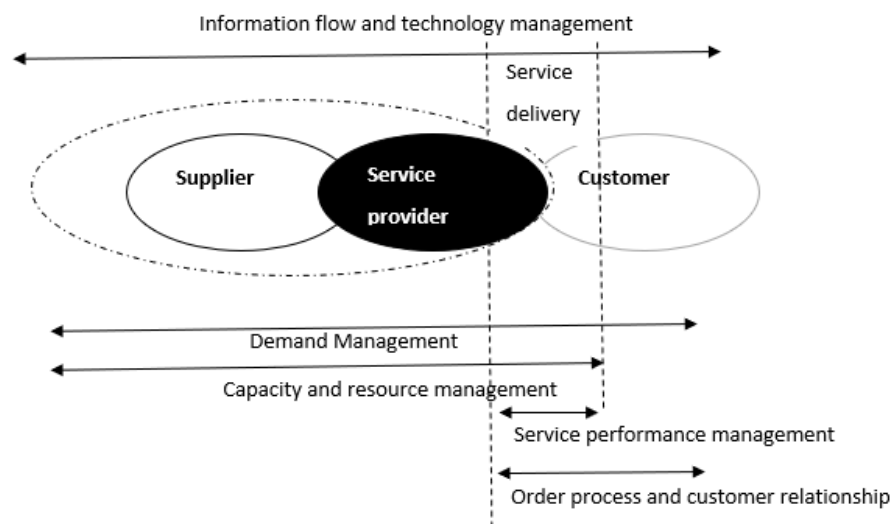


Figure 2: Adapted service supply chain

Source: (Baltacioglu et al., 2007)

Baltacioglu et al. (2007) described the service supply chain as "a network of suppliers, service providers, users and other support units performing the roles of the resource transaction necessary for the manufacture of services; the transformation of these resources into support and core services; and the distribution of these services to customers." Based on this concept, service supply chain management will concentrate primarily on managing knowledge, procedures, resources, service efficiency, and funds through the SC from the initial supplier to the end customer (Ellram, Tate, & Billington, 2004).

Networks with necessary service providers are essential for providing comprehensive business services as a solution for a client. These networks must be complex in their structure because of the uncertainty of specific markets. It is incredibly necessary to coordinate these networks, specifically in business processes. Due to the structure of the service supply chain within the oilfield service companies, it is fair to assume that customer and supplier relationships are the most critical aspects of the supply chain as the value is a co-creation product between both entities.

3.3 Service supply chain agility

3.3.1 Relationship with suppliers

Suppliers account for a substantial share of business costs (inputs purchased) and are vital team members that assist in the production, technology, and quality of goods (Carr & Pearson, 2002). Supply versatility incorporates the opportunity to identify alternative suppliers and create a diverse suppliers' network that best handles demand volatility.

It may be used to remove external factors (accuracy of market uncertainty and forecasting) or internal factors (accessibility and capability of production) (Tachizawa & Thomsen, 2007). These two factors seem to be impacting service providers that use external suppliers' equipment to meet their unpredictable consumer requirements. Therefore, it is essential to assess the actual business environment for that product and the expected competitive potential role for individual vendors and supplier panels to create an acceptable partnership with the established or new vendor for a product.

The suppliers can be categorized according to the supply risk and profit impact utilizing the Kraljic matrix (Caniëls & Gelderman, 2005). Suppliers' risk is measured based on a number (single, dual, and multiple suppliers), swapping costs, and supply of goods (Caniëls & Gelderman, 2005). The supplier can be categorized as routine, bottleneck, leverage, or strategic, as seen in Figure 3.

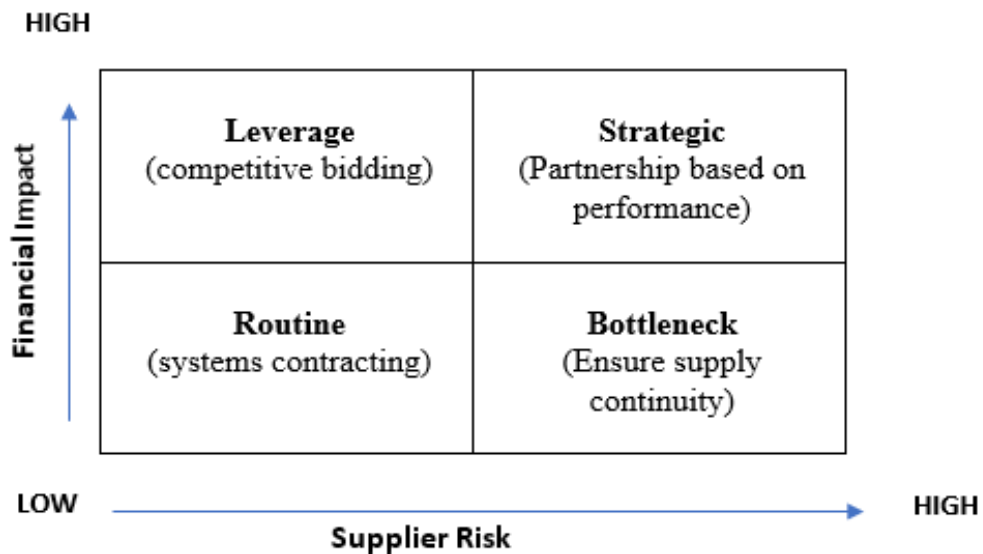


Figure 3: Adapted Kraljic matrix

Source: (Caniëls & Gelderman, 2005)

Additional assessment factors such as the company's dependence on vendors, the consistency and durability of the produced component or product can also be added. The supplier classification system will also lead to the right individual operational strategy to accomplish the strategic target and satisfy customer needs.

It may be retained, established, and/or phased out (suggesting greater cooperation) or indicates the need to identify new providers. Provider administrators have the job of determining the right solution. Often with a more intimate and long-standing partnership, strategic collaboration with the provider will deliver more benefits (Liao, Hong, & Rao, 2010).

Another aspect to consider is the market business environment. The oil and gas sector consists of several SMEs that provide machinery and services to sustain operations. The decreased level of operation may lead to financial pressure or a lack of interest to certain suppliers in decline and may provide more competitive demand to other industries.

For instance, greater flexibility has been accomplished in the health industry by splitting the supply chain into networks based on demand characteristics—a network-based on steady demand, volumes, and highly trustworthy suppliers. The low capacity, highly personalized, and unpredictable demand was allocated to the other network (Geissbauer & Householder, 2011). For oil and gas producers, a single network for regular product development (standards equipment and accessories) and a network for experiments and personalized goods may be used to differentiate the supply chain.

Additionally, for firms perceived to be significant players in their sector, decisions to innovate in supply chain technologies, functionalities, or procedures may directly affect suppliers. Since they represent a substantial share of their vendors' sales, as new supply chain strategies or initiatives are introduced, vendors can be forced to synchronize their activities to keep in line with one of their key clients. As a result, major competitors in the market will have the ability to enforce new goals outside the firm's boundaries (Duclos, Vokurka, & Lummus, 2003).

A more precise understanding of the relationship between businesses and their suppliers (needs, market, and strategy) can help boost competitiveness and cope with the emerging complexities of the integrated market world (Yusuf et al., 2014). Coordination with key suppliers will increase the efficiency and maneuverability of the supply chain.

It may also generate collaborative production opportunities for improved scheduling of supply, greater protection of essential products, and potential developments (Geissbauer & Householder, 2011).

3.3.2 Alternative contractual arrangements

Contracts form the legal framework of a supplier-purchaser partnership. Supply contracts formalize agreements on all aspects of the procurement environment, including product prices, inventory size, supply time, and consistency of products (Li & Kouvelis, 1999). Since both suppliers and buyers will gain, contracts are a reasonably simple means of achieving greater agility in the supply chain. To adapt to market volatility, they should provide suppliers with greater consistency and customers with greater versatility (Stevenson & Spring, 2007).

According to Li and Kouvelis (1999), versatile and risk-sharing arrangements under market volatility can be compared to the following type of contracts:

1. **Time-flexible** contracts allow a company to decide how many units it can buy without determining the exact moment to buy (Li & Kouvelis, 1999)
2. **Quantity-flexible** contracts enable a business to buy amounts within a pre-defined window (Li & Kouvelis, 1999).

For OFS firms, due to the wide variety of resources available and the worldwide footprint, orders are typically given when there is a genuine need. Thus, the majority of transactions with suppliers do not include a particular time. Although a time-flexible contract helps a company gain clarity on the potential selling price (no adjustment for a limited period) (Li & Kouvelis, 1999), the volatility of demand encountered by oil and gas service providers makes it impossible to agree to a certain quantity in advance.

Quantity-flexible contracts enhance cooperation with suppliers by quality products and knowledge flows, helping suppliers prepare accordingly (Lao et al., 2010). In some industries, overall minimum quantity obligations are commonly used. This enables the consumer to retain a minimum total quantity on a fixed calendar, often extracted from "periodical obligations" or "period-by-period refilling plans" (Li & Kouvelis, 1999).

This allowing the supplier more exposure and will help reduce the likelihood of supply delays by a minimal degree of operation (Stevenson & Spring, 2007). The minimum sum helps the supplier pay their operating costs and retain the capacity required to prevent financial pressure.

As oil and gas service providers typically produce highly customized goods in-house or depend on production companies to supply much of their equipment with flexible contracts, the risk of supply interruption can be reduced, and the supply chain's agility increased.

On the one hand, long-term procurement arrangements will help to minimize uncertainty, create trust, and promote progress. On the other hand, spot buying contracts can favor short-term flexibility by allowing orders to be changed in the face of business shifts and, where requested, to leave the partnership (Stevenson & Spring 2007). This understanding should be considered by supply chain management to determine the plan for its suppliers.

In conclusion, having supply chain administrators strengthen their provider table, contractual features will make them more involved. Preventing the risk of losing vendors will help preserve ties with critical suppliers and reduce the likelihood of losing supply (Chung, Talluri, & Narasimhan, 2010). Planning capability by increased knowledge-gathering initiatives and promoting cost-reduction creativity.

3.3.3 Digitalization

Researchers agree that agility entails attaining high speed and responsiveness of the supply chain in the existing literature. One central theme that emerged about addressing high volatility and attaining agility in the OGS was integrating technology. Triaa, Gzara, & Verjus (2016) reported that the use of technology in managing uncertainty in the contemporary OGS could be achieved by using technological solutions such as big data and smart order tracking system.

Distinguishing data and measurements enable the capacity to be strengthened or reduced to achieve the desired agility in the supply chain and eliminate vulnerabilities (Gligor et al., 2013). By incorporating and leveraging information technologies across the supply chain, businesses can gather more significant data volumes called Big Data.

Although still unstructured and massive yet turning the extensive data into market intelligence will improve knowledge and insight in the real-time cycle for improved decision-making (Milliken, 2015). Big Data is of great essence in attaining agility in the new OGS supply chain, as it may enhance the structure of the supply chain in different ways (Table 2).

Table 2: Big Data contributions

Functions	Big data contributions
Procurement	Better procurement decision can be made if more data is available.
Supply chain collaboration	Higher sense of partners reaction under certain circumstances.
Supply chain execution	Consolidate several sources of data to achieve effective supply chain execution
Supply chain planning	Improve demand forecasting & supply planning with advanced performance variables & "what if" scenarios
Inventory control	Enhance market forecasts & production preparation with advanced output factors & "what if" scenarios.
Marketing & Sales support	Adopting analytics to promote sales forces by segmenting customers
Tracking locations	Predict potential traffic situations by matching current and historical evidence, temperature, traffic trends, etc.
Personalized service	Using analytics to enhance forecasts of individual customer behavior

Source: (L. Wang & Alexander, 2015)

According to Sumbal, Tsui, & See-to (2017), big data allows the collection of data from almost all variables likely to impact supply chain volatility and subsequent real-time analysis of these variables such that any alterations in these variables can be readily detected and their impact on supply chain volatility be observed.

Mubarik and Zuraidah (2019) sought to examine the impact of Big Data Analytics on supply chains' performance using a sample of 166 participants from oil and gas marketing companies. Their findings reported that big data significantly enhanced the five dimensions of the OGS supply chain names planning, supplying, procurement, production/processing, and inventory management.

A business may analyze alternate outcomes using a scenario review to compare specific routes or transport (plane or shipping). Big data will provide greater insight to help schedule and predict capability and spending (favoring alertness, availability, and speed).

Besides, efficient information systems can process large quantities of data using optimization-like analysis of specified objectives. For example, an optimization model will optimize the usage of human and physical resources under such ability and inventory constraints (considering the equipment and expertise available).

In the case of OFS struggling with volatility, Big Data Analytics may offer greater insight by modeling and scenario analysis. A statistical model focused on current and historical data collection will produce improved predictive outcomes (Milliken, 2015). For example, since the oil price can be a powerful activity level predictor, a prediction will provide the oil price. In this way, service providers have improved the flexibility to handle the resources needed to satisfy consumer demand (Milliken, 2015).

Apart from Big Data, the overall digitization of the OGS supply chain is another important theme that emerged from the literature review. Digitization of the OGS supply chain improves visibility and is crucial in planning and forecasting demand and supplies based on the available information. Gezdur and Bhattacharjya (2017) described that digitization of the OGS supply chain typically entails using sensors in drillers, compressors, and tanks, and the subsequent real-time transmission of this information to control rooms for further analysis.

For instance, any parts that are not performing to maximum capacity may be easily spotted and rectified using real-time data from sensors. As such, delivery delays can easily be overcome using digitization (Gezdur & Bhattacharjya, 2017).

However, apart from sensors, Nadkarni and Prügl (2020) noted increased drones and robots' usage in new OGS supply chains. Drones, for instance, are useful tools used for surveying oil fields in the exploration phases. As compared to manual methods, these technologies can speed up the exploration process, allowing oil drilling companies to meet up the high demand for oil and gas in the global market.

4. Chapter 4 - Company profile: Schlumberger

Schlumberger is the leading global company that offers upstream technology and services to national and international petroleum companies—providing intellectual know-how, technology, software systems, and integrated project management to extract energy from the field and cover the entire lifecycle of its clients' oil and gas reserves.

Established in 1926 by Conrad and Marcel Schlumberger, it is a global leading petroleum-field company having nearly 85 000 employees in more than 120 countries, representing over 170 nationalities. The company is the first truly multinational company in its business, with headquarters offices in Paris, Houston, and The Hague. Operations of SLB are organized geographically in regions and Geomarkets (consisting of one or more of them).

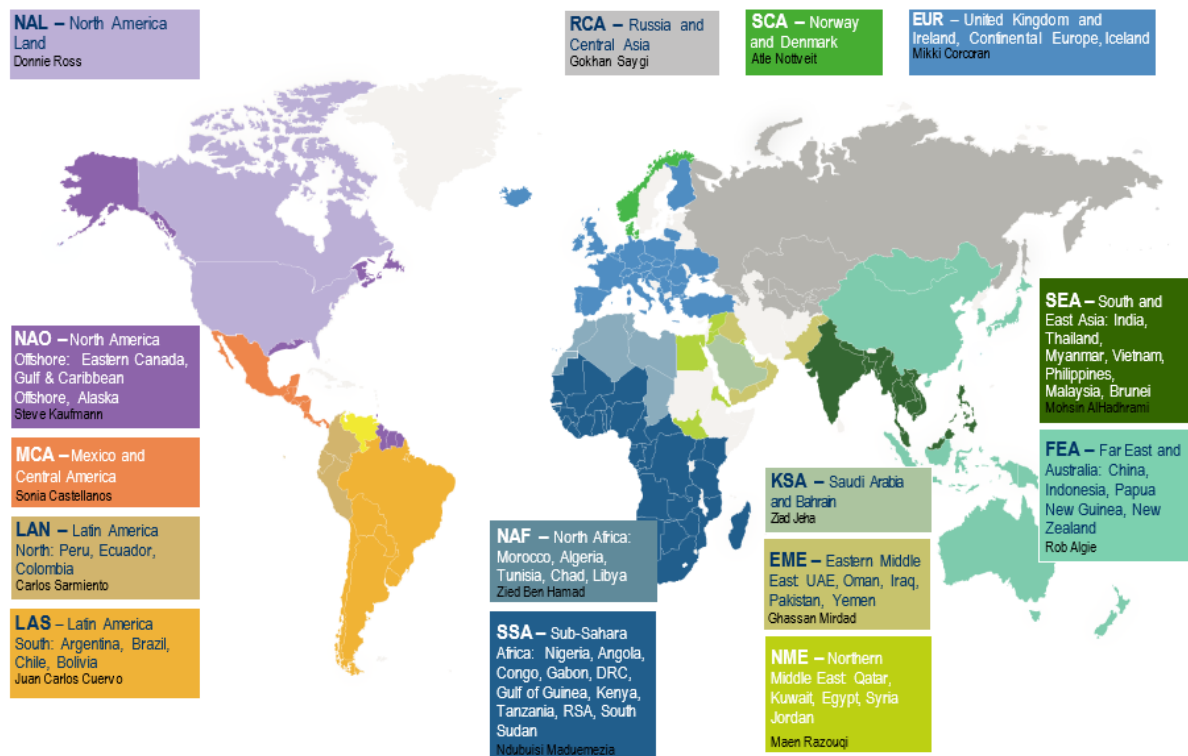


Figure 4: Geomarket distribution

Source: (schlumberger internal documentation, 2019)

Schlumberger offers a wide variety of services to multinational explorers such as ExxonMobil, regional energy companies such as Sonangol, and independent producers such as Chesapeake. Additionally, it offers intellectual knowledge, technology, information systems, and integral project management. In order not only to draw the resources of the Earth but also to support the whole life cycle of its customers' oil and gas storage tanks.

The company was operating across the following market segments: Reservoir Characterization, Drilling, Production, Cameron. Every category comprises various segments related to the activities that SLB provides to its clients, covering the full spectrum of products and services. In total, SLB has in its portfolio 18 product lines.

- The **Reservoir Characterization Unit** incorporates the key technologies involved in the exploration and identification of hydrocarbon resources.
- The section of the **Drilling Division** covers the drilling and placement of oil and gas wells, along with bits and drilling tools, D &M (drilling and measurements), land rigs, and integrated drilling services.
- The **Production Unit** offers the technology for the lifelong processing of oil and gas wells, like completions, artificial lift, well intervention, water service, integrated production services, etc.
- The **Cameron Unit** section comprises pressure and flow management for drilling and intervention devices, oil and gas wells, and production facilities.

All the product lines are organized based on Geomarkets and supported by sales and Commercial Marketing, Legal, Finance, Health safety, and environment.

4.1 Technology and equipment operations

Behind the operations, at customer sites, Schlumberger develops a variety of software and equipment. This company provides a broad range of primary research activities, patented technology development, integration, and product testing. The technology developed by it offers Schlumberger a vital source of distinction.

The provision of top-notch technology falls within the control of Research, Engineering, Manufacturing, and Sustaining (REMS), an organization that is structured to meet all the different product lines' technology needs. REMS consists of centers of development and engineering. Schlumberger's profile revolves around exploration and production operations, where most of the activities are repetitive. It is also imperative to ensure that each part of the supply chain reacts rapidly to material demands and should have reputable suppliers because the instability and volatility of demand and supply within SCM are major challenges.

To solve these problems, Schlumberger has vertically integrated backward to the degree to manufactures some of the products used for various exploration and processing activities by in-house processing in numerous manufacturing centers in different geographical areas. As a result, Schlumberger has both internal and external clients.

Internally and externally, Schlumberger designs and manufactures its equipment. In its Research and Development centers internally, the company designs and produces patented instruments and equipment from its product center worldwide. Schlumberger is known for investing more in R&D, particularly when compared with its two nearest rivals.

In addition, Schlumberger uses other manufacturers' products. Suppliers produce goods, for example, engines and transmissions, in compliance with the exact standards provided by Schlumberger. As reliability and protection are key, suppliers undergo a rigorous screening procedure. Performance, durability, and safety requirements are measured. There's no limit to monitoring. Since passing the Schlumberger test, one of the manufacturers works with the Schlumberger engineer to ensure the equipment is assembled reliably to the high requirements of Schlumberger.

4.2 Supply chain function

When all these commodities, such as products, facilities, infrastructure, manpower, and some other properties, flow across various regional borders, effective management and control through the supply chain require the SCM to be a well-integrated and organized method, and the timely distribution of these services is important because the output of one operation is the input of the second. At SLB, the Supply and Chain structure forms the core of a performance management organization which operates in various segments and sectors to exploit its scale and international presence, improving internal service quality and productivity to field operations by merging the following divisions into a single team:

- Operational Planning & Resource Management (OPRM)
- Technology Lifecycle Management (TLM)
- Product & Service Delivery (PSD)
- Operations System (OS)
- Information Technology (IT)
- Supply and Chain
- Global Business Services (GBS)

Performance management organization standardizes ways to work and exploit best practices by delivering these services to all product lines through GeoMarkets throughout Schlumberger. The association aims at enhancing the consistency and economic performance of support provided to the field operations by the different departments, facilitating the improvement of the quality of services delivered to its customers by Schlumberger.

Supply Chain function assists product lines by organizing the end-to-end process, together with automation and analytics, combining planning, procurement and distribution capabilities to simplify and maximize the presence company's and global footprint. This function is divided into **global procurement, facilities, distributions, operations integrity and trade and customer compliancy.**

5. Chapter 5 – Methodology

This section explains how an empirical study was performed. It contains the study's description, the technique used to accurately capture the data, the sources used, and the credibility and drawback of the applied methodology.

Research Design

The research design to be used in the study is mixed methods in a case study approach. The mixed methods provide an in-depth understanding of the issue under investigation by providing both qualitatively and empirically (Schoonenboom & Johnson 2017). For the current research proposal, secondary and primary data will be collected. The primary data will be from specific personnel in the industry who understand the dynamics caused by volatility. This will mainly come from the Schlumberger management and procurement team to get an in-depth understanding of the challenges and strategies for adapting to volatility.

The secondary data will entail a review of the literature on the oilfield service sector. The literature will be limited to journal articles, financial statements from the company under study, and reports from consulting firms analyzed and written reports on the sector. The primary data will be from specific personnel in the industry who understand the dynamics caused by volatility. The primary data will also be collected from the Schlumberger management team to get an in-depth understanding of the strategies for adapting to volatility.

Sampling

The sampling design to be used for the primary sources of data will be non-randomized, i.e., purposive sampling in which the researcher will identify respondents who can give the required information. The target sample size is ten respondents. For the articles, they will be systematically selected based on inclusion and exclusion criteria, which give preference to the documents' authenticity. Each article/document will be subjected to analysis to establish its suitability—no predefined number of study articles/reports. The reliance on secondary data implies that both quantitative and qualitative data will be collected.

Data Collection

The empirical research was carried out using a single case. The case study approach was selected because it is an analysis technique that aims to explain the current complexities of particular situations and is the most suitable way to discuss "how" and "why" problems. (Schoonenboom & Johnson 2017) concerning a collection of facts. The primary data will be collected through interviews with the identified study participants. The interviews will be via teleconferencing. Also, the author has observed company's practices since it has been a member of the staff for the past year. For the secondary data, financial statements, articles, and reports will be collected from accessible and reliable databases. Traditionally, qualitative analysis methods have been preferred by case studies where the key research goal is to enhance the perception of a phenomenon, especially where this phenomenon is nuanced and deeply rooted in its context.

Data Analysis

Considering that the research design is a mixed-method, both inferential and descriptive statistics will be used. The descriptive data will be analyzed thematically to answer the research questions. On the other hand, inferential statistics will be achieved by using empirical methods to denote the situation and make predictions on probable strategies to enhance adaptability in the service industry.

Limitations

Any of the information used for the analysis, namely principles and provider names, is not given for confidentiality purposes. Nevertheless, the information given about suppliers and developments posed is adequate to illustrate the effect on the business results of SLB of the market fluctuations and highlight risks and challenges caused by declining oil prices. While the fusion of qualitative and quantitative analysis makes it easier to accomplish a rigorous study with deeper comprehension and stronger outcomes, it also poses other obstacles, including efficiency, validity, and distance restriction. For quantitative statistics, different documents, including annual financial reports, were used for cross-checking the statistics—data validity and trustworthiness. In terms of quality knowledge, reports, and papers, knowledge is used to formulate the conclusions that show the claims' robustness converged.

6. Chapter 6 - Schlumberger Case Study

The oilfield services industry is now dealing with organizational problems, as businesses are sprinting to protect workers. Simultaneously, attempts are being made to maintain organizational stability amid a substantial decrease in the expected capital expenditure in the upstream market. As OFS businesses continue to respond to this new crisis, they must set goals for future action.

Given that the recession produces fewer operations and sales, it is a chance to reassess the current crisis and transform the business's supply chain process to reduce the effect of future drops. The evidence-based study aims to explain SLB 's response to fluctuations in oil prices and examine the difficulties faced by oil-crisis supplies. The goal is to find ways to develop procurement and sourcing capabilities to take advantage of the volatile world and maximize the competitive advantage of the business.

6.1 Impact of market volatility in schlumberger

Oil and gas studies say that the effect of oil price volatility on their operations can be interpreted sequentially by service providers. The relationship illustrated between Schlumberger revenues and the Brent crude oil price shows that between 2005 and 2019 there was a strong connection to the price of crude oil.

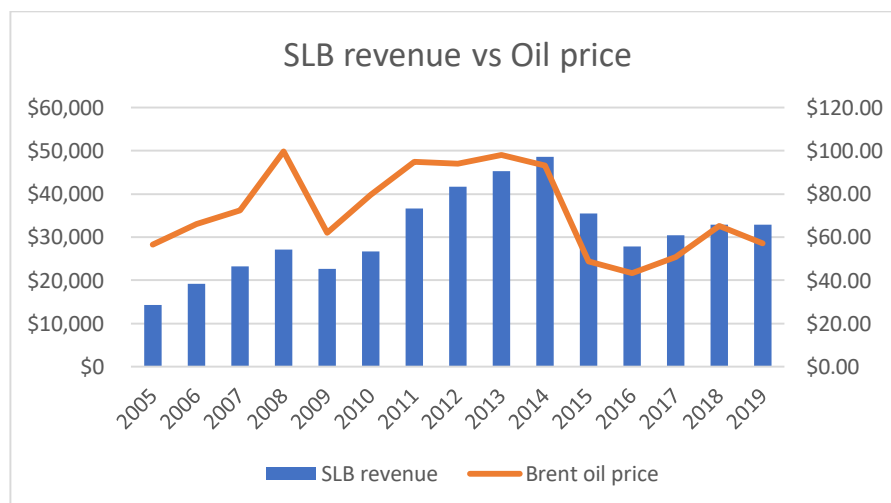


Figure 5: SLB revenue vs oil price

Source: Data extracted from Schlumberger yearly report from year 2005-2019; (macrotrends, 2019)

The analysis shows that while lower (higher) oil prices reduce (increase), the revenues of the four members, delays do not confirm the planned series. Therefore, other drivers are more likely to impact the series by offsetting or accentuating movements. This driver may have geographic specifics, contractual specifics, or high management bonuses.

SLB revenues come from 3 main components:

1. **Long-term field development contracts** (from research to production) typically roughly three years
2. Monthly **payments** (regardless of the number of jobs complete)
3. Spot **operation** (prompt jobs)

Long-term contracts typically prevail, but the proportion of each income stream varies from division to division. For example, Drilling sales can come from 45% long term contracts, 30% spot market, and 25% monthly charges.

Since operators usually slash investments as the price of oil falls, they aim to restrict or postpone local operations and renegotiate monthly and long-term contracts. Contract variations from one operation to another can also pollute the effect of changes in SLB groups' revenues.

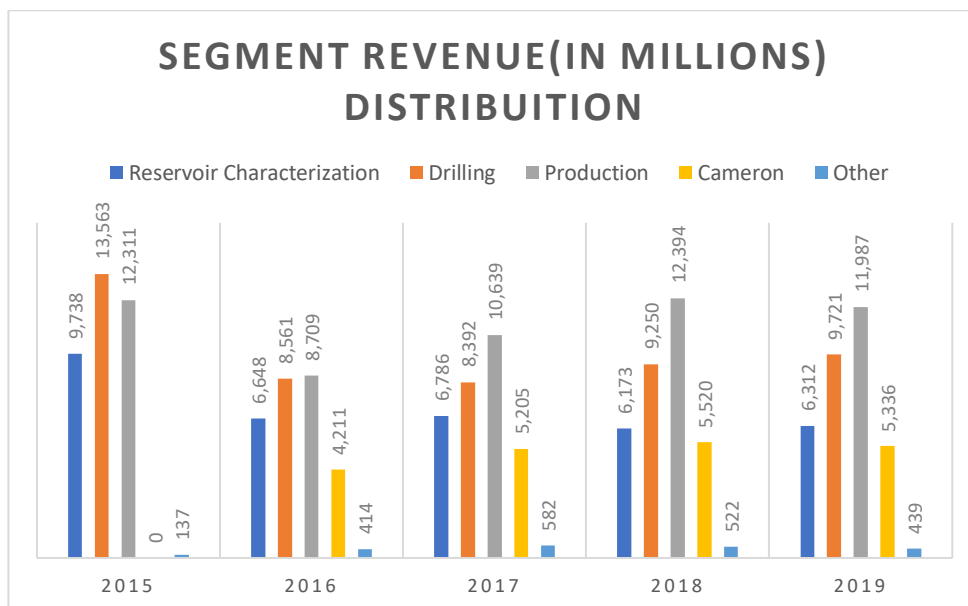


Figure 6: Revenue per SLB segment

Source: Data extracted from Schlumberger yearly report from year 2015-2018

From analyses on both the Figure 5 and 6, it is possible to see that during oil declines period (2015 to 2017), Schlumberger will generate less revenue in general but the impact changes from segment to segment. For instance, drilling operations have the highest decline rate of around 37% and only recovering after two years. On the other hand, the production group has suffered the lowest impact and quickest recovery.

Table 3: Revenue growth rate calculated from figure 6 (in percentage)

Segment	2015-2016	2016-2017	2017-2018
Reservoir Characterization	-31.73	2.08	-9.03
Drilling	-36.88	-1.97	10.22
Production	-29.26	22.16	16.50
Cameron	N/A	23.60	6.05
Other	202.19	40.58	-10.31

Source: Data extracted from Schlumberger yearly report from year 2015-2018

The fact that the production has more growth than reservoir characterization might be explained by the fact that the discovery of smaller deposits could limit profits from exploration operations. Revenue from extraction operations (exploitation of existing wells) could rise as producers concentrate on established fields and then decline due to a lack of interest in new fields and the degradation of existing reserves (disposed or closed).

The top management guidelines can also vary from one section to another based on the operation's business climate. For example, the segment's Headquarters may lay down a budget limit on capital expenditure (CAPEX). Currently, the latest collapse in oil prices due to COVID-19 had brought a major blow to the already troubled oil field services (OFS) market as Schlumberger was recovering from their balance sheets and profitability following the crash in prices in 2014 and the ensuing fallout when the oil price crash struck in early March, free-falling rates reaching negative values.

According to Schlumberger Ltd (2020), the 3rd quarter financial report shows that revenue values of 2020 represented a decrease of 38% of last year's results. Additionally, during downturns, the company faces extreme challenges in preserving financial efficiency. SLB has cut jobs, adopted furloughs, cut dividend payments by 75%, and reduced its capital investment spending by around 30 percent to \$1.2 billion. Today, the business aims to protect staff; the organization is facing operational problems. At the same time, it strives to ensure organizational continuity despite a substantial decrease in running costs.

6.2 Supply chain challenges

Due to the increasingly changing market structure of the oil field sector and the organization's international presence covering different geographical areas, Schlumberger is faced with a range of global obstacles in terms of handling and maintaining the supply chain. As a part of this study, five managers within the supply chain function were interviewed and were asked about the areas of major concern. (see **Appendix 1** for detailed transcript) Such issues can be divided into the following categories:

- Global operations mobility challenges
- Downturn suppliers' challenges

6.2.1 Global operations mobility

Due to the company's global nature, when asking executives about their major challenges when managing the supply chain, the challenges associated with global operations mobility were often highlighted. The challenges are present in the following activities:

Procurement

Different types of technologies and materials would be needed for specific operations at all well sites after service begins. Such equipment must be supplied by Schlumberger product centers and other supplies from third-party suppliers; Hence, orders must be placed months in advance. In specific locations, due to country specificity, local suppliers are not available. However, even in regions where certain products do not take much time because they can be locally produced, they would still need a rigorous certification procedure to maintain credibility, representing challenges.

Logistics

The company carries out several logistical operations daily for its clients, whether in France or the USA offshore deep waters. However, few logistical firms are set up to travel to areas as distant as Angola. Schlumberger will then manage its transportation, send vehicles, charter aircraft, and commercial air and ensure that it arrives in time and commence operations on the date specified by the client. In some instances, Schlumberger has often hired structural engineering firms to construct roads where the roads are not operational, and governments have strict policies.

Human Resources

Having workers accessible at the site will present many more challenges. In the case of a traditional customer project, workers are taken from a local or national center of operations. Recruitment and training can be even more complicated in individual nations. The talent pool is limited because there is no oil and gas industry or even no educational infrastructure. So, Schlumberger takes workers from other areas to arrange all facets of their transfer, such as visas and work permits. The day-to-day operation of mobile workers worldwide is a logistical task itself.

Mobility issues during covid-19

The possible implications are significant. Lack of on-site staff can reduce disruptions and interruptions in the supply of equipment, resources, and network activities. Logistics companies may be diverted or unwilling to deliver materials to offshore installations. This could result in a pause or cessation of different platform operations, such as servicing, reviewing, restoration, and replacing equipment and drilling activities. This has significant ramifications for conformity with health and safety and, fundamentally, for electricity output.

In places like Africa, that depends heavily on oilfield technology and immigrant oil managers from North America and Europe to grow their oil and gas industries. Restriction on workers' flow and maritime transport has provided a challenging period for procurement managers in African countries. Suppliers and sub-suppliers of many oil and gas producers worldwide are located in the impacted regions, like China, Italy, Spain, and South Korea. Also, businesses that do not import products directly from China have Tier 2 and 3 vendors. Single or sour supply from one field has contributed to delays in the offshore oil and gas production process.

Additionally, when operating on platforms, Schlumberger employees will have to follow their clients' specific COVID-19 regulations. This often requires tests and self-isolation before boarding, all of which can represent additional difficulties to the processes. Essentially, the lack of sufficient workforce both on and off the coast could be compelled to stop.

6.2.2 Downturn suppliers' challenges

Upon identification that suppliers do represent major risks to business continuity. Five specialists of the Procurement and Sourcing function were asked to provide real case examples of suppliers' challenges during the downturn. They appointed that substantially reduced sales and decreased levels of production in the crisis have been causing big problems for suppliers: (1) suppliers are bankrupt due to reduced levels of operation and (2) suppliers are losing trust and loss of faith in the oil and gas sector, moving the consumer base to sectors with more robust demand. (3) suppliers are unable to deliver their products due to COVID-19 restrictions.

The cases discussed during the sessions are showcased in Table 4. Furthermore, include oil and gas-centric suppliers (directly influenced by oil prices or relying solely on the oil and gas industry) and non-oil and gas-centric suppliers (indirectly affected by oil prices or by the availability of other industries). This shows the many types of manufacturers and sectors involved. Besides, cases are taken from different countries, which raises the international reach of these challenges.

In the context of the continuing decline in the sector due to the concerns listed below, there is a need for a comprehensive review and more aggressive management of the supplier base to maintain fair prices while simultaneously proactively controlling the supplier's risk. Often suppliers across SLB are not segmented by strategic positioning. Due to the company's global existence, there is a considerable variety of rules among supplier managers about how to segment their supplier portfolios without an overall perspective of category or geography segmentation.

If an established suppliers' strategic roles run the risk of being redundant, it might leave SLB vulnerable to suppliers that had gone or end up leaving without an early warning sign, which in certain situations left the business struggling to find appropriate substitutes when a supplier filed for bankruptcy. The end effect was incomplete or incorrect supplier strategic positioning knowledge that led to supplier management's negligence correlated with supplier value degradation and cost savings over time.

Table 4: Supplier problematic situation

Supplier profile	Situation	Future complications
Supplier 1 (Electronics) is a medium-sized French company with High Mix/Low Volume of operations and it is not oil and gas centric. It had a history of long-term relationship with joint-development programs for specific goods.	<p>2008: SLB canceled a big order that put Supplier 1 in financial hardship. Having to decide to branch out its client base to firms with a more secure market (Aeronautics & Biomedical).</p> <p>2014: SLB decreased its reliance on Supplier 1, leading to a sharp decrease in spending. Supplier 1 lowered its flexibility and carried out a plan to diversify its client base further away from oil and gas.</p>	<p>Judicial proceedings may have been taken following cancelation of the contract under the French Contractual Law.</p> <p>The move would require SLB to establish new vendors, taking time and effort to produce the same standard. Lack of contact will harm the relationship and the credibility of SLB with other suppliers.</p>
Supplier 2 (Electronic) is a small-sized French company with high mix / low volume Important commodity single source.	Due to a strong decrease in spending and poor estimates, has limited capacity. So, the turnaround time will be longer until the demand begins, so the supplier must hire staff to purchase new equipment.	Supplier 2 has no infrastructure and competencies. And it decreased SLB goods expenditure and growth activities.
Supplier 3 (Machinery) Small- Sized Singaporean firm focused in Oil and gas Market	Supplier 3 faced a dramatic decline in sales (up to 80 per cent). While it has the financial resources to maintain a low level of business. It will not be able to survive with a long-term slowdown and the failure to establish new customers.	Supply disruption due to the bankruptcy and inability to present quality as a result of headcount reduction.
Supplier 4 (Machinery) Large-scale Chinese Heavy Mix / Heavy Volume not sole focused in oil and gas The state-owned aeronautical provider is made up of several firms. Supplier has been chosen by Global procurement and built by SLB.	<p>SLB equipped Supplier 4 with experience and know-how (quality and technology) while they spent heavily in dedicated factories to satisfy SLB 's high specifications. Because downturn of SLB has delayed much of its orders instead of canceling them.</p> <p>Although SLB has tried to sustain its function SLB is not on the priority list in the case of capability conflicts.</p>	The long-lasting slowdown would compromise the postponement of orders and the expected expenditures.
Supplier 5 (Tubing) Large-scale/ Ukrainian firm Volume not sole focused in oil and gas	A major order was placed to Supplier 5. But, because of the interdependency of the Chinese market and the current COVID 19 situation the supplier had a delay of 6 weeks on the delivery of the product.	This resulted in postponement of the project and Non-productive time for the client as a result.

Source: Procurement specialists' testimony

6.3 Global supply chain strategies

The rethinking of the supply chain policy has already started before the current pandemic, but COVID-19 would intensify the need for decentralized global supply chains for several businesses. The path ahead for firms is enhanced supply chain resilience and collaborative supplier partnership management. The aim is to reduce expenses at low oil rates and to concentrate on quality services. Schlumberger has remained resilient on various occasions throughout history, and it has been holding the leading position through the process. In this section, an analysis of their strategic approach will be made.

6.3.1 Supply chain categories

The company supply chain manages the transactional activities required to purchase products or services. It requires a full sequence from the field request to the receipt at the site to pay the invoice. For REMS operations, sourcing involves the purchasing of raw materials and equipment to produce goods. It is also responsible for the management of the Suppliers' Panel, which involves the discovery, procurement, and tendering of new suppliers and the evaluation and tracking of results and risks of suppliers.

SLB has an enlarged and diversified supply base. The business depends on small, medium, and large businesses, some of which are vital, face organizational or financial problems or depend on SLB. Four types of spending have been developed to promote the tracking of suppliers. A group consists of subcategories, also referred to as classes, making for a more comprehensive division of expenditure (Figure 7).

	Chemicals & Logistics (C&L)	Drilling & Evaluation (D&E)	Surface Equipment & Services (SE&S)	Indirect
Sub-Category (Family)	<ul style="list-style-type: none"> • Base Fluids & Brines • Bulk Chemicals • Ocean & Air Freight • Proppants & Minerals • Specialty Chemicals 	<ul style="list-style-type: none"> • Tools and Accessorizes • Electronics • Machined Parts • Raw Materials • Oilfield Services Companies, & Alliance • Rig Management 	<ul style="list-style-type: none"> • Field Support Equipment • Integration, Pressure Containment Equipment, Air & Steam, & Inspection Services • Maintenance & Repair • Vehicles 	<ul style="list-style-type: none"> • Engineering & Construction • IT Hardware and Telecom • IT Services • IT Software • Staffing • Travel Agencies • Cards & Reallocation

Figure 7: Category organization for expenditures

Source: Schlumberger internal documentation, 2020

Categorization through operations and regions makes it easier to secure volume reductions with vendors that contribute to improved savings. If the price of oil declines, operators prefer to slash spending in geological exploration and concentrate on the development of mature fields. Therefore, the profits from the reservoir (geology and seismic) should first occur in the oil and gas service firms.

By categorizing costs, the organization promotes the recognition of costs and procurement choices around the supply chain within each segment and considers which categories will need fewer expenditures. This strategy can also help define effective measures, such as identifying a different supplier, updating the requirements, and adjusting the contract conditions. The following Figure 8 illustrates the typical category management life-cycle process.

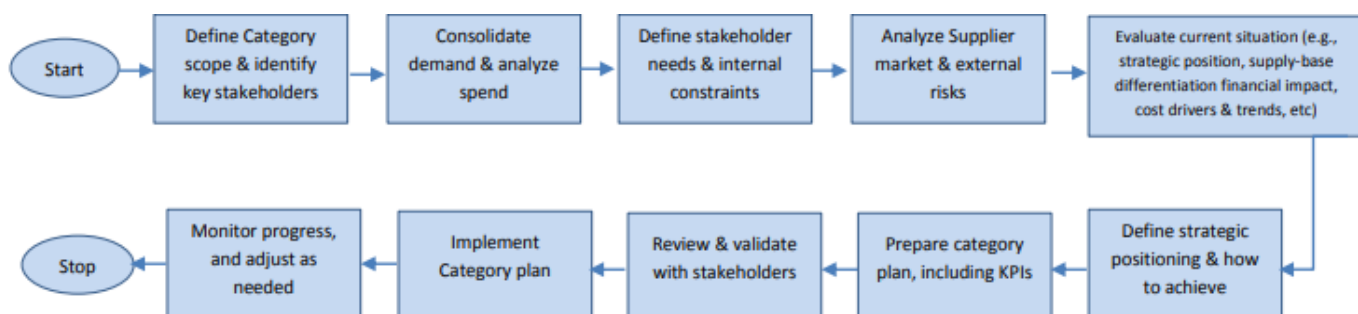


Figure 8: Category management life cycle

Source: Schlumberger internal documentation, 2020

6.3.2 Supplier risk assessment

Supplier risk assessment is the practice of assessing existing and potential procurement threats, concentrating on the application of the market-sector approach, and allowing companies to correctly predict and react to shifts in the external marketplace (Geissbauer & Householder, 2011). It is a way of alleviating the associated risks, mainly if the business is excessively reliant on one country or geography.

The method requires detailed knowledge of the vendors, their global and local sites and subcontractors, and the products they are originating or moving through. Schlumberger, which has implemented these techniques, has an edge as disturbances arise, so it is easier to deduce if their production chains will be disrupted in the short to medium term. Equipped with this information,

they have the time to incorporate the preventive and reduction techniques, such as alternate procurement, systematic inventory distribution, and de-bottlenecking of the vital supply chain.

This methodology was first introduced by the Procurement and Sourcing (P&S) team in 2015, who recognized an opportunity to enhance, simplify and systematize the entire supply base's supplier segmentation by incorporating system data and integrating it with supplier managers to assist in strategic supplier management. Management teams collaborated to develop an instrument that provides strategic positioning as described by regulations, guidelines, and procedures for P&S. The following ten variables have been strategically processed in the supplier positioning model:

The Risk Stake axis considers

- probability of failure
- HSE risk level
- supplier quality assessment
- Dependency on the supplier
- the number of suppliers providing each commodity
- the commodity price index published by governments.

The Financial Stake axis considers

- Supplier spend
- transaction volume
- the number of SLB segments impacted
- the supplier's dependency on SLB.

The supplier segmentation method has been a new form of competitive supplier targeting and is now being utilized by the whole business to recognize opportunities and track their supply base. The final result was a segmentation method that offers structured segmentation to ensure continuity of ratings between suppliers. Moreover, a hybrid model that considers risks in a fast-changing context. Data automation was used as a framework for maintaining a stable, sustainable model that is simultaneously flexible and centrally managed. In this way, it has a tremendous risk-avoidance opportunity by alerting the company of increasing the provider's risk before filing for bankruptcy.

Given the ongoing pandemic, the company introduced a robust outbreak response strategy that supports operational stability while also supporting personnel and operations. As managing this aid globally requires several urgent actions, a specialized cross-function Crisis Management Team (CMT) has been set up. The CMT partners with the Distribution, GeoMarket, and Product Line teams to resolve various immediate concerns proactively, such as ensuring shipping power, alleviating risk to vendors, and retaining cash.

Reductions in delivery capability, boundary controls, and supply shortages may affect lead times. Despite the Schlumberger interruption, over 50,000 deliveries have been performed since the beginning of the outbreak of COVID-19 early this year. Also, Global hubs stayed functional, meeting all HSE instructions, to continue helping operations. This shows that Schlumberger's resilient organization and procedures help them handle these obstacles.

6.3.3 Custom procurement process

A successful and reliable supply chain is key to Schlumberger's growth. The ultimate goal is to optimize the value of the business through good preparation and procurement. This is done by the efficient utilization of systematic and integrated processes for the selection, development, and management of the supplier base.

The business partners with its vendors in a socially conscious and ethical fashion and continuously tries to enhance its functions. The goal is to buy, where possible, goods and services without faults and at the lowest overall cost of ownership and its supplier base. All workers are expected to comply with this strategy as it forms the foundation on which SLB successfully controls their supply chain and leads to Schlumberger's long-term market performance. The typical procurement process follows the following

Procurement & Sourcing efficiency is measured against the standards of consistency, delivery, expense, availability, and consumer satisfaction. Established indicators are used to assess operating efficiency and define areas for change within Schlumberger a structure:



Figure 9: SLB Typical procurement process

Source: Schlumberger internal documentation, 2020

Specific commodity areas or Categories segment the organization of the Procurement Service Center (PSC). Orders in the PSC scope represent all items listed in the catalog at a pre-negotiated price; special requests; equipment rental; repair services; and non-purchase orders that can be purchased with a credit card due to low value. Recently in 2017, Schlumberger introduced a new procurement model.

This project aimed to centralize the costs and create synergies in terms of the company's global procurement and sourcing operations. Schlumberger has replaced its processes in order to simplify and speed up the whole procurement activity. Previously, purchasing supplies and equipment was always a lengthy, complicated procedure that involved much staff, a lot of documentation, and permission.

All across the supply chain, Schlumberger has replaced its processes to simplify and speed up the whole procurement activity. Employees are also working as their purchasing managers, making orders directly from their computers and obtaining the products they need even more efficiently.

Any SLB employee is provided access to the HUB where they can position their requests by utilizing the 1-Click software. 1-Click was developed to position the order conveniently. After a 1-click creation, the assigned purchaser can assist the consumer by placing the purchasing order as per company procedure. To obtain the product in time, the end-user should still keep track of his order, contact the expediting team or the procurement specialist.

Additionally, expenses such as traveling, business expenses, and day-to-day logistics activities are generally managed through 3rd-party providers or reimbursed upon receipts' presentation. This is done by using a single mechanism around the company that allows them to simplify transactions and maximize the number of discounts from our suppliers.

6.3.4 Contractual management solutions

Schlumberger's regular default billing conditions available internationally to all suppliers are 70 days after invoice receipt. (Except when the exemptions are made). The supplier only submits one invoice each month unless otherwise decided in writing. If by chance, the goods are faulty or refuse to meet with the warranties or specifications given, the company SLB will withhold payment until the dispute is resolved.

Because the standard conditions are rigorous and can present financial stress and impact suppliers, alternative contractual solutions have been implemented. In very particular situations where the supplier is considered a Priority Payment Supplier, part of the Citi-Bank Financing Scheme, a Low Tier Local Supplier, or due to Public Order / Local law Obligations.

Priority Payment Suppliers

Schlumberger understands and recognizes that market players are supplying a variety of goods where standard practice payment is immediate or charged within 1 to 2 weeks. These Suppliers fall under the category of Priority Payment Suppliers. Furthermore, details of their specific payment terms are agreed upon and managed as per regional agreements for each Geomarket.

Low Tier Local Suppliers

Suppliers in this segment are typically seen as small local-based businesses with an annual turnover in USD 300 K regions where default payment conditions will bring significant financial disruption to their continued activity and company existence. Therefore, the payment conditions negotiated with these vendors will be within 30/45 days, with the decision formalized by an exemption.

Public Order / Local law Obligations

Concerning payment conditions, attention must be provided to local regulating laws and public orders in all countries where Schlumberger works. Many countries may have few to no laws regulating such terms and would leave them to be strictly negotiated by the parties, although there are some countries where those laws need to be enforced and the risks of non-compliance with such mandatory payment terms in such countries will lead to significant fines and penalties.

Since late payments have been rendered to certain firms' bankruptcies in recent years, the European Union has recently tightened its rules (2011 Directive), and the Member States have late payment conditions and levied significant penalties for non-compliance with local payment terms, which usually range from 30 days to 60 days.

In France, for example, companies can incur an administrative fine of 2 M Euros (amendment to the Loi Sapin) that could be doubled for a second violation within two years, in addition to required late payment interest that would immediately occur and one-off restitution costs. In the UK, regulations give suppliers the ability to offer their consumers statutory compensation, plus interest of 8 percent.

The supply chain financing scheme

Supply Chain Financing (SCF) is a market-based financing approach used as an external method to control working capital efficiently. SCF can be described as "using finance and risk management technologies to leverage working capital, liquidity, and the supply chain, allowing suppliers to boost their cash flow by reducing their conditions of payments at a small cost of financing, which will increase payment terms and liquidity, eventually leading to better suppliers and corporate jobs."

SCF's primary goal is to reduce the cash conversion cycle (CCC) by increasing Days payable outstanding (DPOs) without putting our suppliers at a disadvantage. In addition to the decline in Days sales outstanding (DSO), expanding the expenditure adjustment period (DPO) leads significantly to the free cash flow production. In conventional trade terms, SLB and its

vendors can have opposing priorities. Though SLB can pay close to the end, vendors tend to obtain their payments as quickly as possible. SCF can ease this stress by delinking the final payment at the date of collection.

The SCF is also known as Payables Finance. SLB introduced the scheme at the end of 2014 and internationally selected Citibank for the scheme. The scheme aims to boost SLB's working capital by expanding the supplier's payment terms, enabled by the early payment funded by Citi to its suppliers.

Sixty-nine vendors have joined the program, with the launch of the supply chain financing initiative by Citibank. SLB gain a combined \$120 million increase in working capital with a \$500 million annual investment and a 20-day average invoice clearance. The goal is to make it possible for more multinational vendors, in line with the ERM receivables management project, to benefit from a support scheme that contributes to successful business continue initiatives and thereby dramatically increase the production of SLB cash flow.

Covid-19 contract Lifecycle Management Program

Due to the ongoing pandemic, a Contract Life-cycle Management Program (CLMP) framework was developed to handle and secure contracts more efficiently. It is an interactive system that compiles guidelines and the company's best practices to help workers manage realistic contractual problems currently or are expected to be faced in the immediate future as the corporate world gets increasingly complex.

It presents step by step solutions for issues with both suppliers and customers. If the solution has not been listed through an interactive questionnaire, the appropriate entity contact is displayed for appropriate support. As financial strength, security is now highly necessary by optimizing the overall contract value.

6.4 Digital transformation

Various IT applications customized to the needs of SLB were initially used to complete Supply and Chain operations. As part of the Transformation project, significant investments have been made to merge all IT technologies into one enterprise program.

This would enable greater collaboration and alignment within the inter-organizational internal supply chain structure. And synergy and a superior capacity to identify prospects for mobility and to make smarter strategic choices. The current IT systems are continually undergoing new experiments to increase performance (Table 5).

Table 5: Existing IT systems and corresponding projects

System	Functionality
Approved supplier list (ASL)	SLB approved suppliers and related information list. Purpose: To enhance supplier panel. By List the suppliers profile highlighting product criticality and dependency.
Ariba	Contract management & savings system Purpose: To provide visibility and immediate access to contract and savings ventures
Global Oilfield Logistics and Distribution (GOLD)	Logistic network of SLB hubs management system. Purpose: To provide logistic solutions to distribute
Oracle Reporting	Cost and performance monitoring reporting tool. Purpose: To provide access to analytics of all IT systems.
Schlumberger Web Interface for Supplier (SWPS)	e-Procurement method integrating the goods, facilities and requirements of the retailer. Purpose: to enhance the acquisition of goods and services at an optimum price. By evaluate the procurement procedure and expand the use of agreed brochures to benefit from cheaper costs from suppliers
Others (Rite and iDistrict)	Planning tools and management of assets. Purpose: To improve the visibility on the asset usage, forecast and status

Source: (Schlumberger internal documentation, 2020)

Schlumberger is utilizing its digital investment internally, though integrating sustainability into infrastructure and organizational practices. Several technological solutions have been developed prior to COVID-19 that can now be used to minimize risk, increase productivity, and reduce the pandemic's negative impact. For example, remote digital checks and prognostic health surveillance of field equipment may be performed, which eliminates the required site visits, to ensure business continuity and protects employees at the same time.

As part of digital transformation for its clients, Schlumberger has eliminated manual processes and downtime by leveraging the Internet of Things (IoT) systems. Building edge computing, for example, by Agora, a Schlumberger start-up company centered on providing edge computing and IoT applications to the oil and gas industry, allowing production engineers to quickly evaluate rod pump condition data and take corrective action without pause.

Another example of a digital solution that has been leverage during this pandemic is the DELFI system. As it involves advanced data mining and artificial intelligence, relying on various sources of data, automating processes, and enabling domain teams to interact seamlessly. Many more oil and gas producers, suppliers, and partners from all over the world will be able to operate from the industry's digital ecosystem built on a standard, open framework where they can 'write and run anywhere' while developing new software.

Furthermore, Schlumberger, IBM, and Red Hat recently revealed a significant partnership to drive digital transformation through the oil and gas sectors. The joint venture would have global connectivity to Schlumberger's leading cloud-based ecosystem and cognitive applications by leveraging IBM's hybrid cloud infrastructure, developed on Red Hat OpenShift container framework.

In conclusion, SLB is challenged with a complex market in which the supply chain role needs to increase productivity and reduce costs constantly. The organization supports local activities while leveraging at the global stage, enhancing cost monitoring, and promoting IT convergence. However, there is space for growth, and, as a major factor in the market, SLB has the strategic power to affect the results of the agreements and set trends.

7. Conclusions and Recommendations

The dynamic and uncertain oil and gas sector is creating a significant challenge for oil and gas service companies. The presented study addressed the demand for an in-depth look at the oilfield service market by analyzing the leading company performance during a crisis. The significant challenges faced by supply chain managers identified, and mitigating strategies explored. Additionally, the thesis contributes to expanding the understanding of suppliers' risk management and the essential factors that affect and decide their respective supply chains' agility.

RQ. 1 *How is Schlumberger's performance impacted by the oil price oscillations?*

This analysis indicates that the variations in oil markets have a direct impact on SLB's sales. However, such reduction affects each division differently. Drilling and Reservoir Characterization were found to be the groups of higher impact and lower recovery rate. This could be due to the high risk that it represents to the operator. In addition to sales, capital expenditures reductions are implemented across the organization to minimize the crisis impact, which is the basis of human capital reduction and supplier distress.

RQ. 2 *What are the main supply chain challenges Schlumberger encounter?*

The study's findings reveal that Schlumberger faces significant difficulties and threats associated with **global mobility** and **supplier management**. Also, nowadays, with new constraints and **COVID-19 concerns**, both variables' effect has been maximized. Furthermore, it has been determined that global operations management can be problematic in terms of procurement, logistics, and human resources since many operations require international mobility.

Correspondingly, during downturns, substantial budget cuts cause major problems for suppliers, including bankruptcy due to decreased levels of activity and loss of trust in oil and gas due to the reduced revenues earned from SLB. These problems pose major threats to SLB's activities, capacity, credibility, and the emergence of future legal risks.

RQ. 3 *Which strategies can be implemented by service companies to attain supply chain agility?*

The company has worked in previous years on strategies to attain agility and minimize the impact of a crisis. Identifying threats, **understanding suppliers' risks**, and selecting the best plan are crucial measures to determine where to strengthen procurement capacity to deal with complexity. SLB has now put in place ways to optimize the function, **categorize expenditures, and strengthen internal procedures.**

However, the supply chain agility literature offers some additional means to resolve these looming threats and improve agility. Those include implementing **alternative contra contractual arrangements** and the developments of tools targeted at increasing the **visibility of IT processes** to help interact internally and externally with vendors (analytics and Big Data).

Even though guidelines should be enforced on a case-by-case basis, considering the appraisal of the current panel of vendors, the business climate, the global policy, and the economic effects of future uncertainties. Considering and focusing on the current COVID-19 pandemic the current thesis will contribute with a detailed set of recommendations for scholars and practitioners to adapt their supply chain to the instabilities in the oil and gas market.

7.1 Recommendation

The double challenge of COVID-19 and the fall of oil prices will continue to raise concerns and trigger the OFS sector's decisions over the coming months and maybe even years. The current situation is extremely important to keep the employees safe and ensure operations continuity during a pandemic. However, cautious measures are required when managing the supply chain, as virus-related limitations can hinder suppliers' delivery times. Although the outlook is unclear, setting goals now and concentrating agility to restructure the organization, OFS companies should look for opportunities to integrate versatility into their business model. This will allow them to rotate with precision and pace through instability and avoid excessively blunt or unduly big adjustments to the company.

Supplier relationship

Awareness of the supplier's problems emerging from the oil crises and the resulting uncertainties likely to impact the OFS sector's performance must be taken into consideration when determining a plan with the suppliers. First, as articulated in the literature and verified by a case study on SLB suppliers, access to more knowledge will contribute to better decision-making and better contact with suppliers. To develop a scalable and agile supply chain, better coordination and cooperation within the enterprise (cross-segment) or with suppliers are required to achieve a competitive advantage over competitors. Cost controls, useful insights on supply patterns, and strong partnerships with relevant suppliers can maintain continuity between skills and competitive advantage (Carr & Pearson, 2002).

Categorizing and assessing the success of the supplier panel is crucial to determining the right approach. Supply chain managers and scholars can assure that greater value can be produced by closer cooperation with suppliers. Also, provided the time, quality, and cost of a supplier going bankrupt or losing trust in the oil and gas sector, opportunities to create closer cooperation with suppliers will boost the supply chain's capacity to handle the competitive business climate. This partnership may be accomplished by incorporating the contractual functions. For instance, risk-sharing by inventorying or enforcing a complete minimum quantity contribution deal obliges SLB to retain a minimum buying order through downturns to deter a supplier from going bankrupt.

Also, service providers depend on small strategic suppliers for most of their equipment. Provided that the value of oil and gas firms is expected to collapse through the downturn, it is an incentive to opt for vertical integration by purchasing strategic suppliers and internalizing crucial products' output. In addition to reducing reliance on external suppliers, the internalization of goods can allow a certain degree of operation to be retained. Manufacturing of previously outsourced goods may minimize headcount reduction and improve the opportunity to keep talent at home.

Internal capabilities

The oil crisis can also be used as an incentive to reshape the supply chain function by questioning the existing status quo and concentrating on creativity. Rethinking existing technology, operational processes, and facilities will also contribute to better cooperation with partners by creating collaborative venture projects with key stakeholders. In the ever-changing oil and gas climate, attempts to develop are expected to have long-term savings.

By the research on supply chain agility, a business must rely on having greater visibility in order to be able to adapt better to the consumer climate. It is also important to build the IT architecture and the opportunities for utilization throughout the whole enterprise. There are increasing prospects for businesses who are already transforming their market infrastructure onto a global network to profit from Big Data. Interconnected IT structures can integrate analytical techniques, such as asset optimization algorithms or scenario analysis, to improve internal visibility.

As a consequence, businesses would be able to enhance their alertness and minimize their usage of properties. This suggestion is aligned with the goal of the SLB to maximize the usage of resources by redeploying current fleets more effectively. Besides, with forecasting models, improved planning and modification of spending would be necessary to minimize expenses and improve operating performance.

In the hurry of cost-cutting, some decision-makers cut too deeply or cut around the board firms can accidentally be left with no recognizable skills that won them success in the first place. If the industry continues to grow, it will be necessary to maintain and develop the capacity to handle these changes. The matching of skills with the policy and the market would then require understanding what roles and skills make the enterprise unique. It is important to ensure that they have demand-sensing capabilities that can lead to a better understanding as market conditions and consumer expectations change so that the organization can change with them.

Customers relationship opportunities

Unfortunately, many of the clients of OFS firms are already facing industry challenges. Ensuring that businesses maintain and strengthen customer relationships would be important as the company shifts from the current state of shock to recovery. In order to better sustain and improve client relationships, businesses should consider focusing on the following:

1. Engage with consumers in the COVID-19 crisis to create protocols, plans, and procedures to ensure smooth, stable operations for business and consumer employees.
2. Understand the value proposition given to clients. In tough times, consumers often hurry to put costs above all else but make deliberate attempts to use value proposition to find ways to move the customer's attention from price to value. When marketers clarify how their value proposition benefits their consumers, they will also change their preferences from price to value.
3. Seek ways to partner with consumers to build demand and reduce prices in and around goods and services. Efforts such as this have shepherded businesses to rebound from the slowdown in 2015 and have also triggered improvements. Demonstrate business involvement in its clients' performance and let customers know that businesses in the industry have gone through this before.

7.2 Further studies

Additional cases and section analyzes can be performed to enhance the analysis's coverage and expand the scale of the analysis. As the conclusions are focused on individual events, there is space for further research to complete the results presented. This can include further study of the effect of oil price volatility on specific SLB operations (segments), further case studies on suppliers, observational studies on other oil and gas service providers, or the effect of other related oil and gas factors, such as metal pricing, such as steel, commonly used as raw materials for oil and gas machinery.

8. References

- Aliakbari Nouri, F., Shafiei Nikabadi, M., & Olfat, L. (2019). Developing the framework of sustainable service supply chain balanced scorecard (SSSC BSC). *International Journal of Productivity and Performance Management*, 68(1), 148–170. <https://doi.org/10.1108/ijppm-04-2018-0149>
- Anis, M. D., & Siddiqui, T. Z. (2015). Issues Impacting Sustainability in the Oil and Gas Industry. *Journal of Management and Sustainability*, 5(4), 115. <https://doi.org/10.5539/jms.v5n4p115>
- Baltacioglu, T., Ada, E., Kaplan, M. D., Yurt And, O., & Cem Kaplan, Y. (2007). A New Framework for Service Supply Chains. *The Service Industries Journal*, 27(2), 105–124. <https://doi.org/10.1080/02642060601122629>
- Blome, C., Schoenherr, T., & Rexhausen, D. (2013). Antecedents and enablers of supply chain agility and its effect on performance: a dynamic capabilities perspective. *International Journal of Production Research*, 51(4), 1295–1318. <https://doi.org/10.1080/00207543.2012.728011>
- Caniëls, M. C. J., & Gelderman, C. J. (2005). Purchasing strategies in the Kraljic matrix—A power and dependence perspective. *Journal of Purchasing and Supply Management*, 11(2–3), 141–155. <https://doi.org/10.1016/j.pursup.2005.10.004>
- Carr, A. S., & Pearson, J. N. (2002). The impact of purchasing and supplier involvement on strategic purchasing and its impact on firm's performance. *International Journal of Operations & Production Management*, 22(9), 1032–1053. <https://doi.org/10.1108/01443570210440528>
- Chima, C. M. (2011). Supply-Chain Management Issues In The Oil And Gas Industry. *Journal of Business & Economics Research (JBER)*, 5(6). <https://doi.org/10.19030/jber.v5i6.2552>
- Christopher, M., Peck, H., & Towill, D. (2006). A taxonomy for selecting global supply chain strategies. *The International Journal of Logistics Management*, 17(2), 277–287. <https://doi.org/10.1108/09574090610689998>
- Chung, W., Talluri, S., & Narasimhan, R. (2010). Flexibility or Cost Saving? Sourcing Decisions with Two Suppliers. *Decision Sciences*, 41(3), 623–650. <https://doi.org/10.1111/j.1540-5915.2010.00283.x>
- Du, W. (2006). The Determinant and the Future Trend of International Oil Price. *Economic Theory and Business Management*, 9, 70.
- Duclos, L. K., Vokurka, R. J., & Lummus, R. R. (2003). A conceptual model of supply chain flexibility. *Industrial Management & Data Systems*, 103(6), 446–456. <https://doi.org/10.1108/02635570310480015>
- E. John, N., T. Margaret, E.-W., O. Anyandike, T., & M. Ortencia, M. (2019). Supply Chain Disruption in Nigeria Oil and Gas Sector: Some Mitigation Strategies. *International Journal of Scientific and Research Publications (IJSRP)*, 9(2), p8611. <https://doi.org/10.29322/ijsrp.9.02.2019.p8611>
- EIA. (2014). Where our oil comes from - U.S. Energy Information Administration (EIA). Retrieved October 30, 2020, from www.eia.gov website: http://www.eia.gov/energy_in_brief/article/world_oil_market.cfm
- Ellram, L. M., Tate, W. L., & Billington, C. (2004). Understanding and Managing the Services Supply Chain. *The Journal of Supply Chain Management*, 40(4), 17–32. <https://doi.org/10.1111/j.1745-493x.2004.tb00176.x>

- Fisher, M. L. (1997). What is the right supply chain for your product? *Harvard Business Review*, 75, 105+.
- Geissbauer, R., & Householder, B. (2011). Achieving flexibility in a volatile world. *Supply Chain Management Review*, 15.
- Gezdur, A., & Bhattacharjya, J. (2017). *Digitization in the Oil and Gas Industry: Challenges and Opportunities for Supply Chain Partners*. Presented at the IFIP Advances in Information and Communication Technology.
- Gligor, D. M., Holcomb, M. C., & Stank, T. P. (2013). A Multidisciplinary Approach to Supply Chain Agility: Conceptualization and Scale Development. *Journal of Business Logistics*, 34(2), 94–108. <https://doi.org/10.1111/jbl.12012>
- Hassini, E. (2008). Supply Chain Optimization: Current Practices and Overview of Emerging Research Opportunities. *INFOR: Information Systems and Operational Research*, 46(2), 93–96. <https://doi.org/10.3138/infor.46.2.93>
- Hilmola, O. (2011). Logistics sector development potential of world's oil exporters. *International Journal of Energy Sector Management*, 5(2), 256–270. <https://doi.org/10.1108/17506221111146011>
- Husain, R. A., Assavapokee, T., & Khumawala, B. (2006). Supply Chain Management in the Petroleum Industry: Challenges and Opportunities. *International Journal of Global Logistics & Supply Chain Management*, 1, 90–97.
- Hussain, M., Khan, M., & Al-Aomar, R. (2016). A framework for supply chain sustainability in service industry with Confirmatory Factor Analysis. *Renewable and Sustainable Energy Reviews*, 55, 1301–1312. <https://doi.org/10.1016/j.rser.2015.07.097>
- Johnson, G., & Scholes, K. (2005). *Exploring corporate strategy*. (pp. 221–251). Harlow: Financial Times/Prentice Hall.
- Kryukov, V. A., & Tokarev, A. N. (2018). Spatial Dynamics of the Oil and Gas Field Services Sector: Global Trends and Lessons for Russia. *Regional Research of Russia*, 8(3), 248–257. <https://doi.org/10.1134/s2079970518030036>
- Lau, R. S. M., & Hurley, N. (2001). Creating Agile Supply Chains for Competitive Advantage. *South Dakota Business Review*, 60, 1–7.
- Li, C.-L., & Kouvelis, P. (1999). Flexible and Risk-Sharing Supply Contracts Under Price Uncertainty. *Management Science*, 45(10), 1378–1398. <https://doi.org/10.1287/mnsc.45.10.1378>
- Liao, Y., Hong, P., & Rao, S. S. (2010). Supply Management, Supply Flexibility And Performance Outcomes: An Empirical Investigation Of Manufacturing Firms. *Journal of Supply Chain Management*, 46(3), 6–22. <https://doi.org/10.1111/j.1745-493x.2010.03195.x>
- Lin, C.-T., Chiu, H., & Chu, P.-Y. (2006). Agility index in the supply chain. *International Journal of Production Economics*, 100(2), 285–299. <https://doi.org/10.1016/j.ijpe.2004.11.013>
- Macrotrend.net. (2020). Energy Commodity Charts and Data | MacroTrends. Retrieved October 29, 2020, from www.macrotrends.net website: <https://www.macrotrends.net/charts/energy>
- Mendonça Tachizawa, E., & Giménez Thomsen, C. (2007). Drivers and sources of supply flexibility: an exploratory study. *International Journal of Operations & Production Management*, 27(10), 1115–1136. <https://doi.org/10.1108/01443570710820657>
- Milliken, A. L. (2015). Transforming Big Data into Supply Chain Analytics. *Journal of Business Forecasting*, 33(23).

- Mohammad, M. F. (2008). *Procurement strategies for the oil and gas industry: to capture changing values and dealing with multi cultural complexity*. Presented at the International Conference on Construction and Building Technology, UNITEN, Malaysia.
- Mubarik, M., & Mohd Rasi, R. Z. binti R. (2019). Triad of Big Data Supply Chain Analytics, Supply Chain Integration and Supply Chain Performance: Evidences from Oil and Gas Sector. *Humanities and Social Sciences Letters*, 7(4), 209–224. <https://doi.org/10.18488/journal.73.2019.74.209.224>
- Nadkarni, S., & Prügl, R. (2020). Digital transformation: a review, synthesis and opportunities for future research. *Management Review Quarterly*. <https://doi.org/10.1007/s11301-020-00185-7>
- Piya, S., Shamsuzzoha, A., Khadem, M., & Al-Hinai, N. (2020). Identification of Critical Factors and Their Interrelationships to Design Agile Supply Chain: Special Focus to Oil and Gas Industries. *Global Journal of Flexible Systems Management*, 21(3), 263–281. <https://doi.org/10.1007/s40171-020-00247-5>
- Prater, E., Biehl, M., & Smith, M. A. (2001). International supply chain agility - Tradeoffs between flexibility and uncertainty. *International Journal of Operations & Production Management*, 21(5/6), 823–839. <https://doi.org/10.1108/01443570110390507>
- Schoonenboom, J., & Johnson, R. B. (2017). How to Construct a Mixed Methods Research Design. *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie*, 69(S2), 107–131. <https://doi.org/10.1007/s11577-017-0454-1>
- Sumbal, M. S., Tsui, E., & See-to, E. W. K. (2017). Interrelationship between big data and knowledge management: an exploratory study in the oil and gas sector. *Journal of Knowledge Management*, 21(1), 180–196. <https://doi.org/10.1108/jkm-07-2016-0262>
- Sun, X., Liu, C., Chen, X., & Li, J. (2017). Modeling systemic risk of crude oil imports: Case of China's global oil supply chain. *Energy*, 121, 449–465. <https://doi.org/10.1016/j.energy.2017.01.018>
- Swafford, P. M., Ghosh, S., & Murthy, N. (2008). Achieving supply chain agility through IT integration and flexibility. *International Journal of Production Economics*, 116(2), 288–297. <https://doi.org/10.1016/j.ijpe.2008.09.002>
- Triaa, W., Gzara, L., & Verjus, H. (2016). *Organizational agility key factors for dynamic business process management*. Presented at the 18th IEEE Conference on Business Informatics CBI 2016, Paris, France.
- Ulusoy, V., & Özdurak, C. (2018). The Impact of Oil Price Volatility to Oil and Gas Company Stock Returns and Emerging Economies. *International Journal of Energy Economics and Policy*, 8(1, 144–158), 144–148.
- Venugopal, V., & Saleeshya, P. G. (2019). Manufacturing system sustainability through lean and agile initiatives. *International Journal of Sustainable Engineering*, 12(3), 159–173. <https://doi.org/10.1080/19397038.2019.1566411>
- Wang, L., & Alexander, C. A. (2015). Big Data Driven Supply Chain Management and Business Administration. *American Journal of Economics and Business Administration*, 7(2), 60–67. <https://doi.org/10.3844/ajebasp.2015.60.67>
- Wang, Y., Wallace, S. W., Shen, B., & Choi, T.-M. (2015). Service supply chain management: A review of operational models. *European Journal of Operational Research*, 247(3), 685–698. <https://doi.org/10.1016/j.ejor.2015.05.053>

- Wu, G., & Zhang, Y.-J. (2014). Does China factor matter? An econometric analysis of international crude oil prices. *Energy Policy*, 72, 78–86. <https://doi.org/10.1016/j.enpol.2014.04.026>
- Yan, L. (2012). Analysis of the International Oil Price Fluctuations and Its Influencing Factors. *American Journal of Industrial and Business Management*, 02(02), 39–46. <https://doi.org/10.4236/ajibm.2012.22006>
- Yenikeyeff, S. (2011). *Oxford Energy Comment BP, Russian billionaires, and the Kremlin: a Power Triangle that never was*. Retrieved from <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2011/11/BP-Russian-billionaires-and-the-Kremlin.pdf>
- Yusuf, Y. Y., Gunasekaran, A., Musa, A., Dauda, M., El-Berishy, N. M., & Cang, S. (2014). A relational study of supply chain agility, competitiveness and business performance in the oil and gas industry. *International Journal of Production Economics*, 147, 531–543. <https://doi.org/10.1016/j.ijpe.2012.10.009>
- Zhang, R., & Chen, H. (2015). A Review of Service Supply Chain and Future Prospects. *Journal of Service Science and Management*, 08(04), 485–495. <https://doi.org/10.4236/jssm.2015.84049>
- Zhu, Q., & Singh, G. (2016). The impacts of oil price volatility on strategic investment of oil companies in north america, asia, and europe. *Pesquisa Operacional*, 36(1), 1–21. <https://doi.org/10.1590/0101-7438.2016.036.01.0001>
- Zhu, T., Balakrishnan, J., & da Silveira, G. J. C. (2019). Bullwhip effect in the oil and gas supply chain: A multiple-case study. *International Journal of Production Economics*, 107548. <https://doi.org/10.1016/j.ijpe.2019.107548>

9. Appendix 1

Interviews 1 (Transcript)

1- Which location are you based on?

Huston, USA

2- How long have you been working in this company?

I would say a total of 11 years because I have been working at Cameron for 7 years prior to schlumberger merger.

3- What do you consider to be the greatest challenge faced by supply chain managers? And why?

Maintaining lasting relationship with valuable suppliers. Because of dependency on the client we often have to postpone or even cancel certain orders which weaken our relationship with suppliers.

4- How dependent is schlumberger of its suppliers?

Schlumberger is highly dependent of suppliers in general but not a single supplier. We have got a wide network of suppliers that includes critical and no-critical suppliers.

5- Which tools/strategies are used to predict customer demand?

There is a dedicated department of Sales and operation planning that is responsible for the forecast. It is often as accurate as it can be but due to instability of the industry it is also very difficult to predict.

6- How are inventories effectively managed?

Because of the nature of our business inventories normally are not an issue. Many of our contracts include the purchase of the equipment and spare parts. Thus, it reflects on the customer inventory rather than ours. But if we are talking about manufacturing centers which is where, we have considerable amounts of material and equipment. It is again dependent on the operation and planning department.

7- Are IT/ data driven solutions implemented along the supply chain and if so, how do they impact the overall performance?

Yes. I would say there are the core of the supply chain as everything from supplier management to the purchasing of products as well as managing third party logistics is based on a software. SLB has initiated some years ago a digital transformation program so that we are up to date on technologies.

8- As a service company, knowledge provided by employees is one of the key products the company has to offer. Are employees seen as component of supply chain? if so, what are the biggest challenges associated with it and how are they managed.

Although employees are part of the supply chain they are not seen in the same level as our equipment. But due to the global aspect of the company having an employee spread all over and having to commute does represent great challenges.

9- Which supply chain strategies have been used by schlumberger in order to remain resilient during Downturns?

Usually during downturns, the first objective is to reduce costs. All our expenditures are categorized and based on the industry and the company objectives a cap is applied to the relevant categories. Apart from that we analyze ways to share assets between product lines and geomarkets.

10- Can you say schlumberger has an agile supply chain structure?

Yes. SLB as a company has always been recognized by its agility. We develop many systems and methods that turn the organization very flexible.

11- How has COVID-19 affected negatively the organization in terms of supply chain?

Teleworking has represented various challenges such as certification of equipment and site inspection to suppliers. Also, many of our partner have been failing for bankruptcy which disrupt the entire chain.

12- What are the supply chain innovations/opportunities that emerged during this pandemic?

The maximization of our internal capabilities have been the focus. So, the use of data analytics and software development in general has represented been as an opportunity to accelerate our digital transformation.

Interviews 2 (Transcript)

1- Which location are you based on?

Paris, France

2- How long have you been working in this company?

Approximately 5 years

3- What do you consider to be the greatest challenge faced by supply chain managers? And why?

Currently because of COVID-19 I would say logistics of a global supply chain are probably the major challenge we have ever faced. Long lead times have affected considerably our operations

4- How dependent is schlumberger of its suppliers?

Because we are a service provider the focus of our business is on service delivery. Therefore, the majority of our material and equipment is mainly supplied by 3rd-party vendor. This make us dependent but because of a wide range supplier I would say moderately.

5- Which tools/strategies are used to predict customer demand?

I am not entirely aware of all the techniques used but I am aware that it is responsibility of the sales and operation department to come up with the expected customer demand.

6- How are inventories effectively managed?

A general rule of thumb is to have for every equipment a safety stock 20-30 % losses breakdown. But because ours stock equipment is often capitalized based on the project it can depend on the client and project special requirements.

7- Are IT/ data driven solutions implemented along the supply chain and if so, how do they impact the overall performance?

Our company has always implemented technological solutions within the process to ensure maximum performance is achieved. We have the 1-click application for example that allowed us in the procurement and sourcing to save time. Because now every employee request its product directly from the desktop.

8- As a service company, knowledge provided by employees is one of the key products the company has to offer. Are employees seen as component of supply chain? if so, what are the biggest challenges associated with it and how are they managed.

For sure they are part of the supply chain. For example, now with COVID-19 limitation on employees has represented a great challenge in terms of supply chain. The criticality of our operations have increased because of this issue.

9- Which supply chain strategies have been used by schlumberger in order to remain resilient during Downturns?

Cost reduction and division segmentation are often the first course of action. Also, more cautious risk assessments and focus on performance.

10- Can you say schlumberger has an agile supply chain structure?

Most definitely, we are constantly changing and adapting our organization to deal with the adversities of market instability.

11- How has COVID-19 affected negatively the organization in terms of supply chain?

Extremely long lead times and orders cancelation have been represented the greatest challenge during this pandemic as I mentioned previously.

12- What are the supply chain innovations/opportunities that emerged during this pandemic?

Remote monitoring and digitalization have been the biggest trends in the industry. Companies in the sector are racing to provide the most innovative solution from the technological standpoint.

Interview 3 (Transcript)

1- Which location are you based on?

Cabinda, Angola

2- How long have you been working in this company?

I would say 8 years in total, but I was in furlough for a year in 2016

**3- What do you consider to be the greatest challenge faced by supply chain managers?
And why?**

At least in Angola lack of resources, procurement is the main issue almost nothing can be sourced in locally. First because of the price and availability of products and second because local equipment often does not have the required certification.

4- How dependent is schlumberger of its suppliers?

Extremely dependent. And because of the geography many SLB global suppliers do not deliver in Angola. As result the few suppliers that do are critical for our operations.

5- Which tools/strategies are used to predict customer demand?

Sales and operations forecast. Analysis on market, customer preferences and histories are made and with the use of analytics the demand is predicted.

6- How are inventories effectively managed?

On a monthly basis inventory is reviewed and lean methodologies applied. The 5s in our location is mainly used to minimize excess and promote optimization of resources.

7- Are IT/ data driven solutions implemented along the supply chain and if so, how do they impact the overall performance?

Yes, everything in our company is made through a system and the company provides access to its employee to data. This greatly impacts organization performance and efficiency. Recently there have been even incentives for employees to share their ideas on software development.

8- As a service company, knowledge provided by employees is one of the key products the company has to offer. Are employees seen as component of supply chain? if so, what are the biggest challenges associated with it and how are they managed.

Generally, employees are not considered as part of supply chain. Human resources deal with the issues with staff. But certainly, in supply and chain we do have a lot of issues because of global mobility. Many managers and technicians are based in other countries and the commute and international challenges do play a part.

9- Which supply chain strategies have been used by schlumberger in order to remain resilient during Downturns?

In general, schlumberger rely on its internal capabilities and ability to constantly innovate as the mean to remain resilient. For instance, nowadays we have been offering many of the systems that were developed in-house to our customers as a mean to help them improve their operations. The know-how is our greater asset

10- Can you say schlumberger has an agile supply chain structure?

Most definitely as mentioned before we are constantly innovating.

11- How has COVID-19 affected negatively the organization in terms of supply chain?

Orders cancelation and lead times are our main problems during this pandemic as I mentioned previously.

12- What are the supply chain innovations/opportunities that emerged during this pandemic?

Acceleration of the digital transformation and digital solutions services to customer.

Interviews 4 (Transcript)

1- Which location are you based on?

Luanda, Angola

2- How long have you been working in this company?

Approximately 5 years

3- What do you consider to be the greatest challenge faced by supply chain managers? And why?

I would say logistics and long lead time, high local costs and taxes costs. In Angola the government require international companies to use their transportation and designated base. It is very difficult to improve such issue as the company has to improve roads to ensure its operational continuity.

4- How dependent is schlumberger of its suppliers?

Highly an issue with a supplier can jeopardize an entire operation. As the number of suppliers that deliver products and services to Angola are very limited.

5- Which tools/strategies are used to predict customer demand?

The demand is predicted based on sales team information. Periodical meeting are held with the operations to align and make decisions based on sales input. Every product line has autonomy and it determines its own demand.

6- How are inventories effectively managed?

Depending on the product line periodic monitoring sessions are schedule to ensure low levels of inventories.

7- Are IT/ data driven solutions implemented along the supply chain and if so, how do they impact the overall performance?

IT systems and Big data are the backbone of the entire chain

8- As a service company, knowledge provided by employees is one of the key products the company has to offer. Are employees seen as component of supply chain? if so, what are the biggest challenges associated with it and how are they managed.

For sure they are part of the supply chain. For instance, now with COVID-19 limitation on employees has represented a great challenge in terms of supply chain. The criticality of our operations have increased because of this issue.

9- Which supply chain strategies have been used by schlumberger in order to remain resilient during Downturns?

Cost reduction and division segmentation are often the first course of action. Also, more cautious risk assessments and focus on performance.

10- Can you say schlumberger has an agile supply chain structure?

Most definitely, we are constantly changing and adapting our organization to deal with the adversities of market instability.

11- How has COVID-19 affected negatively the organization in terms of supply chain?

Extremely long lead times and orders cancelation have been represented the greatest challenge during this pandemic as I mentioned previously.

12- What are the supply chain innovations/opportunities that emerged during this pandemic?

Remote working as means to reduce traveling costs; Digitalization acceleration; Joint ventures with technological companies.

Interviews 5 (Transcript)

1- Which location are you based on?

Kuala Lumpur, Malaysia

2- How long have you been working in this company?

9 years

3- What do you consider to be the greatest challenge faced by supply chain managers? And why?

The relationship with suppliers because the business is constantly changing becomes very hostile. Negotiations of contract less flexible and risks associated with suppliers.

4- How dependent is schlumberger of its suppliers?

Although important because there are many. They are different categories based on supplier criticality.

5- Which tools/strategies are used to predict customer demand?

Sales and operations team responsibility

6- How are inventories effectively managed?

There is a whole department that ensures inventories are managed correctly. Part numbers and tracking and to minimize further just in time strategies are used to delay the assembly until the last stage of production.

7- Are IT/ data driven solutions implemented along the supply chain and if so, how do they impact the overall performance?

Every aspect from sourcing to delivery in our company requires an IT system behind and more now than ever data analytics is increasingly becoming more important on making decisions such which supplier to partner with.

8- As a service company, knowledge provided by employees is one of the key products the company has to offer. Are employees seen as component of supply chain? if so, what are the biggest challenges associated with it and how are they managed.

No, they are not seen. But do contribute

9- Which supply chain strategies have been used by schlumberger in order to remain resilient during Downturns?

Apart from well-known lean and agile methodology. The company continuous risk assessment and focus on performance maximization have been the key to SLB success. Also, focusing on the leverage of its core capabilities people knowledge and technology.

10- Can you say schlumberger has an agile supply chain structure?

For sure, it's part of the company culture just recently it has been announced that an organization re-structuration is coming.

11- How has COVID-19 affected negatively the organization in terms of supply chain?

Freight cancelation that contributes to interruptions on supply chain.

12- What are the supply chain innovations/opportunities that emerged during this pandemic?

Faster implementation of robots and automated system that minimize human interaction. Also, Data analytics to improve business performance.