

# Improving Supply Chain Strategies towards Mitigating the Effect of Crude Oil Theft and Pipeline Vandalism in the Nigerian Oil and Gas Industry: A Case Study of the Nigerian National Petroleum Corporation (NNPC)

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**How to cite this paper:** Panle, R.A. (2024) Improving Supply Chain Strategies towards Mitigating the Effect of Crude Oil Theft and Pipeline Vandalism in the Nigerian Oil and Gas Industry: A Case Study of the Nigerian National Petroleum Corporation (NNPC). *Open Journal of Yangtze Gas and Oil*, 9, 75-93.

<https://doi.org/10.4236/ojogas.2024.93005>

**Received:** June 9, 2024

**Accepted:** July 28, 2024

**Published:** July 31, 2024

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## Abstract

Generically, SCM may be said to include all activities carried out to ensure proper functioning of the supply chain. The activities included in proper management of a supply chain broadly include logistics activities, planning and control of the flow of information and materials in a firm, management of relationships with other organizations and government intervention. However, crude oil theft and pipeline vandalism are established products supply chain disruptors in Nigeria which are rendering the task of running an efficient petroleum supply chain onerous. This paper aims to establish the importance of effective supply chain strategies for companies in the oil and gas industry with special focus on the Nigerian oil and gas sector and the strategies by which the state oil and gas corporation in this sector may mitigate disruptions to its supply chain. This study investigates the enhancement of supply chain strategies towards meeting the challenge of crude oil theft and pipeline vandalism, using the Nigerian National Corporation (NNPC) as a case study. Based on this study, data were collected from two sources: A summary of incident reports obtained from NNPC and an interview with personnel in the PPMC Department. Incident report refers to a report produced when accidents such as equipment failure, injury, loss of life, or fire occur at the work site. Content analysis is utilized to evaluate data obtained from interview responses, CBN financial stability reports, NDIC annual reports, circulars, banking supervision reports and implementation guidelines. The study found out that NNPC should endeavor to sustain its value chain and ward of pipeline vandals and crude oil thieves by engaging in community

partnership, detailing security outfits to ensure its pipelines' right of way and bridging. Concluded that the oil supply chain of the Nigerian National Petroleum Corporation has been plagued by disruptions in the form of crude oil theft and pipeline vandalism which has had debilitating effects on its value.

### **Keywords**

Supply Chain Strategies, Management, Production, Crude Oil, Theft, Pipeline Vandalism, Information Technology, Operations

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## **1. Introduction**

The term "supply chain" emanated fortuitously by sheer preference of nomenclature by a consulting team that initially tagged their concept of improving the coordination of internal functions to reduce inventory "integrated inventory management" (I<sup>2</sup>M) [1] [2]. One of the team leaders and co-authors of the term was Keith Oliver who described the initial concept as perceiving a chain of supply as a single entity [3] [4]. The key words "supply chain" from Oliver's description was given preference to "integrated inventory" by the committee for the project and has then been used in literature dating back to 1982 till now [5].

Although SCM has expanded rapidly since its inception as a harmonizer of activities of the departments in a corporation to blending production activities across different companies in the global state, [5] stated that its core mission is still the same, viz:

- a. Propound supply chain policies that merge with the firm strategy;
- b. Make wholesome examination of trade-offs from all possible perspectives and not just the corporation's alone;
- c. Utilize support systems with far-reaching functionalities as basis for optimal decision-making.

Generically, SCM may be said to include all activities carried out to ensure proper functioning of the supply chain. The activities included in proper management of a supply chain broadly includes logistics activities [6], planning and control of the flow of information and materials in a firm, management of relationships with other organizations and government intervention [7].

This description of SCM activities to include "control of flow of information and materials of a firm" is central to the premise of this paper. The study aimed to examine the supply chain activities of the Nigerian oil corporation, the Nigerian National Petroleum Corporation with special reference to strategies employed in managing the well-known disruptors of oil and gas supply chain; pipeline vandalism and crude oil theft. Since the supply chain is topical to all discussions surrounding its management and strategies employed in so doing, seeking suitable contemporary definitions for the supply chain is sacrosanct. The world has increasingly become globalised in contemporary times. This notwithstanding, this global environment does not have global traits and local peculiarities

still present businesses with unique challenges from one geographical location to the other. The basis of any successful business is to consistently bundle value (goods and services) to end user. Hardly would one find a free-flowing chain of supply in any business sector that would be entirely devoid of any encumbrance. In order to adapt and stay competitive in its unique environment, a firm must employ tools and methods that will allow its supply chain to stay a step ahead of potential or existing disruptions to it [8]. Such tools and methods employed may be referred to as the supply chain strategy. Traditionally, the mode by which a firm is expected to come by its supply chain strategy involves analysis of the environment and fashioning out its niche in such environment; a strategic approach termed “unique positioning” [9]. [7] however stressed the importance of sedulous execution of a firm’s unique strategy in order to ensure unperturbed chain of supply. Citing the concept of “scenario planning” pioneered by Shell in which managers are encouraged to postulate possible future challenges and propound practical palliatives, [7] argued that the winning strategy will always be the one that employs plethora of creative tools to make various strategic options available to a firm’s supply chain management team. [11] referred to these creative tools as “enablers of supply chain performance” and itemised some of them as; formidable communication and information technology repertoire, use of capable third-party logistics providers, seamless inter-firm coordination capabilities. Whilst still describing strategy in the global sense, [9] opined that a company’s strategy must be designed after its market environment, unique strengths, people, technology, processes and culture. Strategic decisions fashioned with pedantic consideration of these factors are destined to be inimitable by the competition. The essential elements of the oil and gas supply chain include; production, short term storage, ports of call, pipelines, refineries, terminals, and final points of sale [11]. Production activities form the upstream sector, storage, ports of call, and pipelines form the midstream and the last three components form the downstream sector. During production, crude oil is made from both land and sea oil installations in a process that involves drilling, extraction and recovery of oil. Temporary storage provides a central point of crude oil distribution for an entire supply chain. The ports of calls are the main entry and exit locations of crude oil before refining. Pipelines are the main transportation mechanism for moving crude oil and refined products in the supply chain. Refineries are the transformation unit for making consumable petroleum products from crude oil. Terminals are the housing units for refined products before the final points of sale. Final points of sale are the ubiquitous sales outlets where the end consumer accesses the refined products. This simplicity of the outline given above largely belies the potential complication and obscurity (to the end user) of the oil and gas supply chain [6]. This is so because the oil and gas supply chain is high technology driven, characterised by high capital investment and prone to producing undesirable environmental consequences [12]. The upstream supply chain particularly is culpable as it produces various wastes into the atmosphere, water and sediments [12]. Successful supply chain management prac-

tice for the oil and gas industry therefore must entail careful and global consideration of trade-offs and risks [1]. The winning SCM for this industry, therefore, must be characterised by [1]:

- a. Savvy evaluation of trade-offs between cost of downtime and empty stocks
- b. Possession of the appropriate capacities and informed supply predictions
- c. Possession of appropriate facilities at required sites
- d. Vast experience with oil and petrochemicals

[13] itemised the role of supply chain management in the oil and gas industry to include the following:

- i. Optimization of supply chain operations
- ii. Identification of probable means of reducing costs
- iii. Reception of production and produced materials, warehousing, transportation on a global basis
- iv. Meeting end user demands

It is therefore incumbent on supply chain management to deploy appropriate strategies in order to successfully function. For example, in order to reduce cost being incurred on transportation; a supply chain management firm employed a scheduled shipment strategy hence reducing the number of shipments and consequently cost [13].

### **1.1. Problem Statement**

The Nigerian National Petroleum Corporation was created to add value to the nation's hydrocarbon resources for the benefit of all Nigerians and other stakeholders. The Pipeline and Products Marketing Company (PPMC) was later set up under the administration of the NNPC to make petroleum products accessible to end users in Nigeria at uniform prices [14] *i.e.* to optimise the efficiency of products supply chain. However, crude oil theft and pipeline vandalism are established products supply chain disruptors in Nigeria which are rendering the task of running an efficient petroleum supply chain onerous [14] [15]. About 7% of Nigeria's daily crude production is lost to these disruptors [16]. The central premise of this thesis hence derives from extant studies [17]-[23], that the current petroleum supply chain in Nigeria can be enhanced to significantly reduce the challenge of crude oil theft and pipeline vandalism. Such enhancement modalities are what the thesis seeks to establish with reference to perspective from various existing sources and novel data from the case study, NNPC.

### **1.2. Research Questions**

- i. What are the main supply chain strategies employed by NNPC in satisfying its consumer market?
- ii. Are crude oil theft and pipeline vandalism causing significant disruptions to the existing supply chain of NNPC?
- iii. How can the current supply chain of NNPC be improved to ameliorate the challenge of crude oil theft and pipeline vandalism?

### 1.3. Research Objectives

This paper aims to establish the importance of effective supply chain strategies for companies in the oil and gas industry with special focus on the Nigerian oil and gas sector and the strategies by which the state oil and gas corporation in this sector may mitigate disruptions to its supply chain.

#### Objectives

The objectives of carrying out this research are presented below:

1. To identify key SC strategies employed by the organization.
2. To understand the effect of crude oil theft and pipeline vandalism on corporate performance and revenue.
3. To examine the effect of crude oil theft and pipeline vandalism on existing and future investors.
4. To examine ways by which current supply chain strategies can be enhanced to mitigate disruptions.

## 2. Literature Review

A literature review is “an organized written presentation of what has been published on a topic by scholars. The purpose of the review is to convey to the reader what is currently known regarding the topic of interest” [24]. In qualitative studies, the literature review functions to aid the researcher in identification of information relevant to the study, establish a theoretical framework and write a research question [25]. Although adequate literature review is ideal, qualitative researchers believe too many details in the review of existing body of work on a topic sets up a bias in the research as to the direction in which the new work should assume and expected results [25].

### 2.1. Associations between Research Objectives and Literature Review Discourse

This section presents efforts taken at maintaining focus in review of literature with respect to satisfaction of research aims and objectives. **Table 1** shows the link between reviewed literature and objectives of research that were highlighted in Section 1.

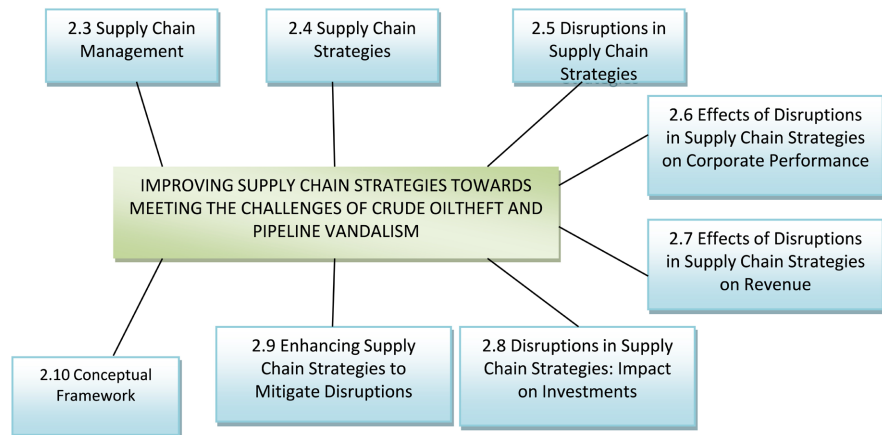
**Table 1.** Affiliations between research objectives and discourse of literature review.

Item Number	Objectives of Research	Discourse of Literature Review
1	To identify key SC strategies employed by the organization	Supply Chain Strategies
2	To understand the effect of crude oil theft and pipeline vandalism on corporate performance and revenue	a. Effects of Disruption in Supply Chain on Corporate Performance b. Effects of Disruption in Supply Chain on Revenue
3	To examine the effect of crude oil theft and pipeline vandalism on existing and future investors	Disruption of Supply Chain: Impact on Future Investments
4	To examine ways by which current supply chain strategies can be enhanced to mitigate disruptions	Enhancing Supply Chain Strategies to Mitigate Disruptions

(Source: Researcher).

After literature review on items 1 (**Table 1**), examination of disruptions in supply chain was done. Causes and consequences of disruptions in supply chain were reviewed. Crude oil theft and pipeline vandalism as disruptions in supply chain of corporations exploring and marketing oil products were examined. This was done to put the effect of these disruptions on corporate performance and revenue reviewed in ensuing Sections 2.6 and 2.7 in proper perspective.

A depiction of the discourse of literature review in this study is presented in **Figure 1**.



**Figure 1.** Overview of literature review.

## 2.2. Supply Chain Management

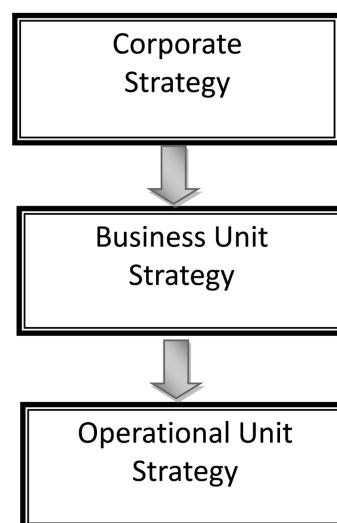
[26] quoting the APICS Dictionary described the supply chain to encompass activities from raw material to final consumption of finished goods spanning supplier companies. Supply chain management (SCM) evolved from traditional disparate activities of suppliers, companies and consumers to contemporary integration of materials management. This turning point came in the 1990s when firms started internalizing management of their production materials on the realization that pioneer companies in this regard were accruing larger turnovers than their contemporaries [26]. Supply chain management then came to be out of the need for more efficient and profitable production process. [27] defined supply chain management as “the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across business within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole”. This definition clearly emphasizes the integration of traditional business functions for an extended betterment of corporate performance. From structured review of literature in 100 articles, [28] concluded there was only minimal consensus on the definition of supply chain management. Fifty-eight percent of articles reviewed by [28] did not use any definition for supply chain management and pre-existing definitions were used by 21 percent of the articles. They also reported paucity of articles on SCM prior to 1985 and a fast

increase in the number of articles on it by late 1990s. Studies into supply chain management are therefore still at the rudimentary stage, according to the findings of [28].

### 2.3. Supply Chain Strategies

Corporations are financial entities that have as their primary aim wealth creation for shareholders [27]. A lot of details come into the activities that must be carried out daily for a firm to remain profitable. Strategy is therefore the means of achieving the objectives of a corporation [26] [28]. The day-to-day operations of a firm must be in tandem with its business strategies aimed at giving it competitive advantage. Business strategy of a firm also must align with its strategy [29]. Against this background, it is apparent that there is some kind of organization and linkage between the components of a firm's strategy, part of which is the supply chain strategy. [30] [31] gave this relation between components of a firm strategy as illustrated in **Figure 2**. He posited that the firm strategy deals with larger issues of portfolio, expansion and distribution of resources. The corporate strategy governs business unit strategies which in turn determine strategies of operational units aimed at competitive edge [32].

In the views of [29] [33], the supply chain of a corporation is a strategic asset which is well capable of imbuing competitive advantage on such corporation and must be treated as such. However, some firms do not realise this fact and have not laid out strategy that their supply chain follows. This is wrong supply chain practice and it invariably affects the economy of such companies. The supply chain strategy must be well articulated and aligned with operations and business strategy for maximum economy. In order to wield the supply chain as a strategic weapon for competitive advantage, it must be of high performance and responsive such that it foresees and corrects possible sources of disruptions [34] [35]. [7], illustrated their argument of a high-performance supply chain as requisite



**Figure 2.** Organizational hierarchy of firm strategy. Source: [38].

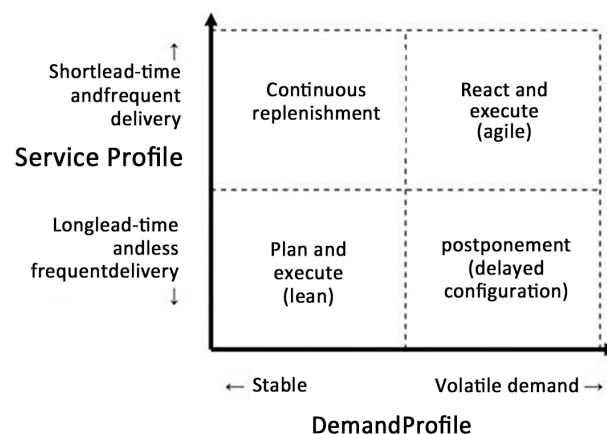
for strategic differentiation with the examples of two leading corporations in different industries; Wal-Mart (Retail) and Dell (Computer hardware & software, IT services & consulting). Both companies, although in different industries have a common strategy of adding value and increasing performance of their supply chains constantly hence staying a step ahead of competitions at all times. Supply chain strategy introduced by Dell that gave it competitive advantage in its industry include direct-to-consumer sales and build-to-order manufacturing [36]. Walmart imbibed one of the attributes of supply chain agility, rapid replenishment [37], and partnered with Procter & Gamble for automatic replenishment of inventory. The reward of Walmart's high-performance supply chain strategy is being the world's largest retailer [38].

## 2.4. Classifications of Supply Chain Strategies

Supply chain strategies are classified into four main types [39]:

- Continuous replenishment SC strategy
- Lean SC strategy
- Postponement SC strategy
- Agile SC strategy

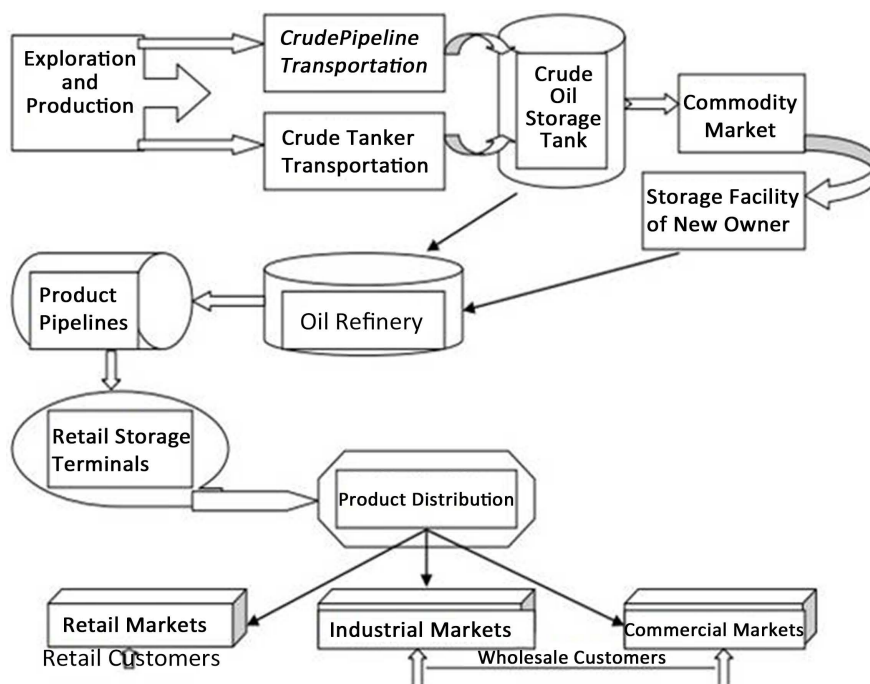
The aim of the continuous replenishment SC strategy is to replace bought merchandise through constant, timed supply [39]. This is the Walmart-type SC strategy [36]. Continuous replenishment strategy is best suited for consumer products with rapid demands. This is also referred to as the “plan and execute” strategy. In a bid to minimize waste in the supply chain, product demand is ascertained and manufactured to consumer order. Due to high variability in consumer specification for products in this category, manufacturers must delay coupling of product units until specific customer requirements are known [39]. This strategy is used when expected lead time is long enough. In cases of variable demand, short lead time products, the agile strategy is most adequately suited (see Figure 3). Investment is made in operational capacities (in-house or out-sourced) for rapid response to consumer orders with short lead time.



**Figure 3.** Service and demand profiles of the four categories of supply chain strategies [39].

## 2.5. Disruptions in Supply Chain

The supply chain of the petroleum industry is segmented into three sectors; the upstream, the middle stream and the downstream sectors. The upstream supply chain is made up of explorations and production operations and this part of the chain introduces crude oil to other nodes in the supply chain [40]. The middle stream consists of all transport facilities for movement of crude oil and petroleum products to refineries and storage facilities. The last segment of the petroleum industry SC is the downstream sector which is responsible for processing, transportation, marketing and distribution of petroleum products [41]. Potential and actual disruptions in supply chain are adversaries of all firms [42]. Disruptions of supply chains are unplanned and unexpected occurrences that interrupt the regular flow of materials and products within a supply chain [40]. [41] defined supply chain disruption as “anything that affects the flow and supply of raw materials, sub-components, components, and finished goods all the way from the origin to the final demand point”. [43] defined SC disruption as “a major breakdown in production or distribution nodes that impacts other nodes in the supply chain”. Disruption was described as one of the three types of SC risks; with the other two being deviation and disaster [44]. These three terms vary in intensity of potential impact with deviation being benign and disaster malignant. This thesis focuses on disruptions in flow of crude and affiliated products in the supply chain of the oil and gas industry in Nigeria (see **Figure 4**). Management of supply chain disruption is a relatively novel area of study [43] [45], hence more research efforts must be devoted to the topic.



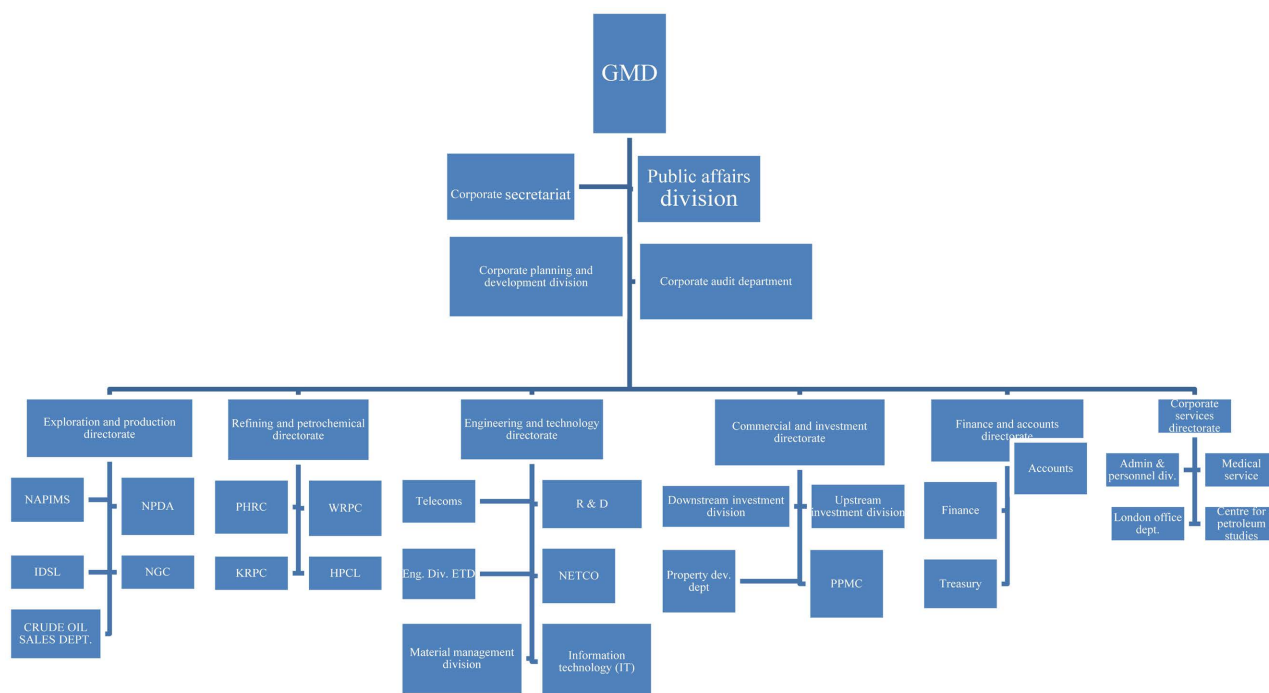
**Figure 4.** The petroleum industry supply chain. Source: [8].

### **The Nigerian National Petroleum Corporation (NNPC) and the Pipeline and Product Marketing Company (PPMC)**

This sub-section examines existing literature on two corporations in the Nigeria petroleum supply chain whose SC strategies in mitigating disruption this dissertation centres on. These are the Nigerian National Petroleum Corporation (NNPC) and the Pipeline and Product Marketing Company (PPMC). The NNPC is the state oil corporation in Nigeria established in 1977 [44] [46]. Its jurisdictions cover exploration, operational capabilities in refining, transportation of petroleum products and marketing. NNPC currently has twelve subsidiary companies namely [47] [48]:

- Nigerian Petroleum Development Company (NPDC) (Upstream)
- The Nigerian Gas Company (NGC) (Downstream)
- The Products and Pipelines Marketing Company (PPMC) (Downstream)
- Integrated Data Services Limited (IDSL) (Upstream)
- National Engineering and Technical Company Limited (NETCO) (Commercial)
- Hydrocarbon Services Nigeria Limited (HYSON)
- Warri Refinery and Petrochemical Co. Limited (WRPC) (Downstream)
- Kaduna Refinery and Petrochemical Co. Limited (KRPC) (Downstream)
- Port Harcourt Refining Co. Limited (PHRC) (Downstream)
- NNPC Retail
- Duke Oil (Commercial)

The mission of NNPC as an integrated Oil and Gas Company is “engaging in adding value to the nation’s hydrocarbon resources for the benefit of all Nigerians and other stakeholders”. **Figure 5** presents the organisational chart of the corporation. NNPC is structured such that the general managing director oversees six directorates; Exploration and Production, Refining and Petrochemical, Engineering and Technology, Commercial and Investment, Finance and Accounts and Corporate Service Directorate [48]. The Pipeline and Product Marketing Company was created in 1988 in the NNPC reorganization process that occurred that year (PPMC, 2014). The creation of PPMC was of purported significant importance in making petroleum products accessible to customers at uniform prices in Nigeria [49]. The PPMC is a key node in the supply chain of petroleum products in Nigeria as it is saddled with the responsibility of distributing these products to depots for end-user’s accessibility. [50], believed that mitigation of pipeline vandalism must commence from restriction of all-access to information regarding type of product being transported in pipelines within the ranks of PPMC. The corporate organisation at PPMC is such that a non-executive Chairman heads its Board of Directors. Daily operations is run by a Chief Executive Officer, the Managing Director assisted by two Executive Directors, one for Operations and one for Services. The Managing Director and Executive Directors are members of the Board whose Secretary is PPMC’s Company Secretary or Legal Adviser. Activities of the Information Technology



**Figure 5.** The Organogram of NNPC. Source: [48].

Department, Internal Audit, Materials Management and Company Secretary are all coordinated by the Managing Director [49].

### 3. Methodology

This study investigates the enhancement of supply chain strategies towards meeting the challenges of crude oil theft and pipeline vandalism, using the Nigerian National Corporation (NNPC) as case study. Based on this study, data were collected from two sources: A summary of incident reports obtained from NNPC and interview with personnel in the PPMC Department. Incident report refers to a report produced when accidents such as equipment failure, injury, loss of life, or fire occur at the work site. Based on previous studies on interdiscursivity [31] [51]-[53], similar approach was adopted for the present study in order to analyze the functions of the reports. In addition, the methods of content analysis were incorporated in the process of data analysis.

### 4. Result and Discussion

Content analysis is utilized to evaluate data obtained from interview responses, CBN financial stability reports, NDIC annual reports, circulars, banking supervision reports and implementation guidelines. In summary, content analysis is used for the analysis of qualitative data in this study. [42] view content analysis as an approach to the analysis of documents and texts that try to quantify content in terms of prearranged categories and in a systematic and replicable manner. In like manner, content analysis is viewed as a research methodology which analyses textual data for patterns and structures, drawing out key features to

which researchers base their attention, develop categories, and incorporate them into perceptible constructs in order to derive text meaning [54]-[56]. Furthermore, the strengths of content analysis [57], which justifies its utilization in this study, are presented below: Content analysis can be applied to examine written documents as well as pictures, videos, and situations, it is widely used and easily understood, It is convenient for analyzing archival material, establishing reliability is simple and straightforward.

**Research Objective one:** To identify key SC strategies employed by the organizations. Examination of the responses from NNPC staff interviewed shows the summaries of the following responses on the variables:

- i. Active corporate social responsibility.
- ii. Oil Movement and Quality Control Unit responsible for oil supply chain.
- iii. Oil supply chain disparate from procurement supply chain management.
- iv. Six oil supply chain management strategies.

**Research Objective two:** To understand the effect of crude oil theft and pipeline vandalism on corporate performance and revenue. Examination of the responses from NNPC staff interviewed shows the summaries of the following responses on the variables:

- i. Pipeline vandalism and crude oil theft awareness.
- ii. Pipeline vandalism and crude oil theft affect oil supply chain.
- iii. Pipeline vandalism and crude oil theft cause loss of revenue.
- iv. Numerous shutdowns experienced.
- v. Most, but not all shutdowns are theft-induced.

**Research Objective three:** To examine the effect of crude oil theft and pipeline vandalism on existing and future investors. Examination of the responses from NNPC staff interviewed shows the summaries of the following responses on the variables:

- i. Investments opportunities abound in the industry especially in the gas sector.
- ii. Few new local investors seen recently in marginal fields.
- iii. Royal Dutch Shell most-hit by pipeline vandalism induced divestments.
- iv. Good government policies and completion of current supply chain strategies enhancements will boost investor confidence.
- v. Main pipeline network owned by the federal government and loss from their vandalism is borne by the federal government in the long run.

**Research Objective four:** To examine ways by which current supply chain strategies can be enhanced to mitigate disruptions. Examination of the responses from NNPC staff interviewed shows the summaries of the following responses on the variables:

- i. Current medium term strategies more effective than current short term strategies.
- ii. Enhancements on supply chain strategies being deployed include In-line Technology, Horizontal Directional Drilling and Satellite Surveillance.

iii. Enhancement in supply chain strategies will significantly curb pipeline vandalism and crude oil theft.

## 5. Discussion and Conclusion

The first objective of this study was to identify key SC strategies employed by NNPC. Review of literature revealed some cogent points which shall be re-presented briefly before we delve into primary data from NNPC employees. Creation of financial value for shareholders is key to the establishment of any corporation [58]. The NNPC as the state oil corporation in Nigeria was established in 1977 with a mandate central to the premise of [59]; the addition of value to Nigeria's hydrocarbon resources for the benefit of all Nigerians and other stakeholders (see Section 2.9). The phrase *all Nigerians* in the mission statement of the corporation implies that the first set of people that hold a stake in NNPC are Nigerians as a whole, represented by a constituted federal government. [60] simply defined strategy as the means of achieving the objectives of a corporation. Applying this definition to the mandate of the NNPC, the strategies of the corporation must be geared towards one objective: creating and sustaining a value chain by activities on Nigeria's hydrocarbon resources for the benefits of all Nigerians and other stakeholders. It is also worthy to note the perspective of [61] on the position of the supply chain strategy in a corporations framework; it is part of the firm strategy (concerned generically with portfolio, expansion and resource distribution) and must be in tandem with the firm strategy for a corporation to successfully carry out business operations that will enable it achieve its objectives. [62] opined that a firm's supply chain strategy will determine how it will obtain its raw materials, transport them to and from the company, manufacture and distribute finished products to the consumer market. In examining the key supply chain strategies of NNPC, we shall make a quote from [63] which we believe surmises the essence of a firm's supply chain strategy.

Support for induction of this strategy was established mainly with respondent 1 who explained at length that in the Nigerian National Petroleum Corporation, the procurement supply chain and the oil supply chain were viewed as separate value chains and therefore assigned to different departments; the Supply Chain Management Unit (SCM) and the Oil Movement and Quality Control Unit (OMQC). He however hinted that these two units may be merged in the future. With recourse to [64] [65] and primary data from respondents, the most vital activities that NNPC endeavors to carry out well to sustain its value chain as induced from respondents' data are: a) community partnership, b) security manning of pipelines, c) in-line technology, d) open deep cut, e) bridging, f) Horizontal Directional Drilling (HDD). The second objective of this study was to understand the effect of crude oil theft and pipeline vandalism on corporate performance and revenue. This objective was also to be met by the deductive and inductive approach. While reviewing literature on this theme, it was noted that

disruption in oil value chain implies deleterious effect for operating income, sales, and assets of affected firm [60]. Secondary data focusing on pipeline vandalism and crude oil theft in Nigeria revealed that crude oil theft costs Nigeria 150,000 barrels of crude oil per day, about 7% of the total production [61]. Increased budgetary allocations and reduced performance of oil revenue-dependent government were also listed as effects of disruptions in NNPC oil value chain [62].

Existing literature gave some insights into the effects of supply chain disruptions on investors and some of the deductions include a) reduction of shareholder value b) reduction in profit margins of investors [48]. We however concentrate on the inductive approach (see Table 2) in examining this theme as it relates to the Nigerian context. Local investors have been taking advantage of this fact over the years as many of them have been seen entering marginal fields left by International Oil and Gas Companies that may have unbundled their business interests in such fields. Royal Dutch Shell was reported by interview participants as a major case of such divestment; in which the firm sold more than 50% of its business interests in the oil-rich Niger Delta due to overbearing supply chain risks. It is a laudable fact that the Federal Government of Nigeria is trying to encourage more local players in the Oil and Gas industry, as this will help minimize geopolitical risks such as unemployment that may have been arguably caused by over involvement of IOCs in the Oil and Gas Industry. Local companies may be regulated to employ indigenes in certain percentages of different cadres of their workforce, a strategy that will engender more inclusion and may reduce the feeling of disenfranchisement that spurs the geopolitical risk [18] of the oil and gas supply chain. However, there is a need for better government policies and legislations for more stringent punishments for pipeline vandals and crude oil thieves. This will project a more determined outlook for the Federal Government and will in turn boost investor confidence.

Presented respondents views on enhancement of current supply chain strategies to mitigate disruptions. This theme emanated from the fourth objective of this study and is the epicentre of the theoretical framework of the research. The proposed approach of examining this theme was inductive.

**Table 2.** Aim and objectives of research.

<i>Aim</i>	<i>Objectives of Research</i>	<i>Approach</i>	<i>Data Type</i>	<i>Related Chapters</i>
<b>To establish the significance of astute supply chain strategies for firms in the Nigerian oil and gas sector by looking at strategies by which the NNPC may mitigate disruptions to its supply chain.</b>	To identify key SC strategies employed by the organization	Deductive and inductive	Secondary and primary	2 & 4
	To analyse the effect of crude oil theft and pipeline vandalism on corporate performance and revenue	Deductive and inductive	Secondary and primary	2 & 4
	To analyse the effect of crude oil theft and pipeline vandalism on existing and future investors	Inductive	Primary	4 & 5
	To examine ways by which current supply chain strategies can be enhanced to mitigate disruptions	Inductive	Primary	4 & 5

Inductions made from primary data with regard to this research theme were:

- i. Current medium term strategies more effective than current short term strategies.
- ii. Enhancements on supply chain strategies being deployed include In-line Technology, Horizontal Directional Drilling and Satellite Surveillance.
- iii. Enhancement in supply chain strategies will significantly curb pipeline vandalism and crude oil theft.

Currently, the NNPC endeavors to sustain its value chain and ward of pipeline vandals and crude oil thieves by engaging in community partnership, detailing security outfits to ensure its pipelines' right of way and bridging. These strategies were described as "short-term strategies" by interview participants and were deemed not to have been very effective in curbing pipeline vandalism and crude oil theft. The reasons for their evident failure in doing so has been mainly attributed to the fact that human involvement in surveillance (security manning) is prone to fatigue and compromise and the pipelines as presently constructed were too shallow and easily accessible to anyone with a digger and shovel. This has spurred the corporation to embark on more lasting and effective measures which are In-line Technology, Horizontal Directional Drilling and Satellite Surveillance.

## 6. Conclusion

This study concludes that the oil supply chain of the Nigerian National Petroleum Corporation has been plagued by disruptions in the form of crude oil theft and pipeline vandalism which has had debilitating effects on its value. It is however possible to mitigate and eliminate these disruptions if suitable government regulations are enacted to serve more punitive measures to vandals. Most importantly, current oil supply chain strategy enhancements must be fully deployed over time to curb this menace.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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