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# Integrated supply chain management approach in petroleum industry: A case of British Petroleum Southern Africa


**By**

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## Declaration

I **Gumede, Zanele, Angel, Thobile** declare that

All of the research presented in this thesis is original from the researcher, unless otherwise noted. There is no other university to which this thesis has been submitted for evaluation toward a degree or test. Unless clearly cited as originating from another person, no data, or other information from other people are included in this thesis. The broad material attributed to other written sources has been referenced, however their words have been rewritten when they have been quoted. Furthermore, their writing has been referenced and enclosed in quote marks whenever their exact words have been used.

Signed: 

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## Dedication

This dissertation is dedicated to my late parents, Linda Posselt Gumede and Sibongile Maureen Gumede. They always supported me and believed that I could do more regardless of my age. My father passed away before I started my first year however my mother was there to give me courage and motivation to continue with this journey despite hardships that I had experienced during this journey. Unfortunately, they were not present to see my success, but I am confident that they are still supporting and rejoicing with me from wherever they are.

## Abstract

The broader literature shows that supply chain uncertainty in the petroleum industry remains the challenging issue as the world changing, where several studies focus on the Collaboration Planning, Forecasting and Replenishment (CPFR) model in the petroleum industry. Industries find it challenging to successfully match their processes for demand planning to the unpredictable environment in which they work. Lack of coordination would probably lead to unreliable and erroneous forecasts, which may ultimately jeopardise a company's long-term existence. One of the key components to enhancing supply chain performance is the ability to effectively predict demand in variable situations. This study aims to establish the level of the integrated supply chain of activities in British Petroleum and to enable real time information sharing, along with an integrated network through (CPFR) to enhance cooperation between supply chain activities. The research methodology for this study included a description of the precise methods used to gather and analyses the data, as well as the research approach, population, sampling strategy, data collecting, and data analysis. This study adopted quantitative method that entails the numerical value allowing the researcher to translate numeral data to the relevant statistics. The study further used questionnaires research tools to collect data. Furthermore, according to the research most of the respondents strongly agreed that the terminal collaborate with other internal operational department in order to ensure that information is shared across the organisation so as to enable value creation in the industry, minimising delays and maximising efficiency and product quality. As a result of this finding, the petroleum industries need to shift their focus more to collaborative supply chains, which can help to mitigate the challenges associated with uncertainty in the business. Collaboration is crucial and is expected of all parties involved in the supply chain.



**Keywords: integration, collaborative planning, scheduling, forecasting and replenishment**

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## GLOSSARY OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ANOVA | Analysis of variance |
| BP | British Petroleum |
| CPFR | Collaboration, Planning, Forecasting and Replenishment |
| CT | Cape Town |
| e SCM | Electronics Supply Chain Management Systems |
| EDI | Electronic Data Exchange |
| ISCM | Integrated Supply Chain Management |
| P&G | Procter and Gamble |
| SPSS | Statistical Package for Social Science |
| VICS | Voluntary Inter industry Commerce Standards |

# CHAPTER 1: INTRODUCTION

## 1.1 Introduction

The petroleum industry is the fast-growing sectors and world's largest commercial sectors that significantly contributes to global and national economic growth. However, there is a requirement for supply chain collaboration, due to high operating costs and supply chain uncertainties in the petroleum industry. Fuel shortages leave the industry's future under threat. As the result of these, organisations are required to become more specialised, and coordinate their activities and work electronical. This requires British Petroleum (BP) to partner with other department within the business in order to enhance profitability and customer satisfaction. Furthermore, the constantly changing business environment has influenced supply chain organisations to seek other ways to overcome these changes.

## 1.2 Background of the study

Supply chain uncertainty in the petroleum industry remains a challenging issue, as the world changing. The industry face issues with regards to uncertainties caused by the demand fluctuation, corona virus pandemic, natural disasters, and civil unrest. Azizian and Sepehri (2022) assert that the lack of integrated supply chain has resulted in the reduced certainty. In addition, the crisis brought about by the uncertainties such corona virus has forced the organisation to shift the focus of innovation and restructuring efforts to ensuring continuity, by concentrating more on resiliency and flexibility. Furthermore, the uncertainties among the petroleum supply chain contributed to lack of supply chain market development (Hyland, 2015). This is associated with the pandemic that affected the economy including global supply chain, which resulted in business disruptions. Consequently, supply chain collaboration is necessary for many organisations in the sector to enhance performance. In addition, before the pandemic, cost reduction and productivity were the source of driving the enhancement of supply chain processes. The drivers remain significant, the disarray brought about by the global pandemic leaves competitive advantage under threat and puts the survival of businesses in question. Furthermore, the pandemic resulted in most companies trying to decrease their costs by downsizing, retrenching, and closing the business (Hamdulay, 2017). British Petroleum Southern Africa ambition is to develop safe, sustainable, and competitive supply chain through integrated business. This requires the industry to ensure that their activities

are centralised to increasingly reinforce performance. The need for integrated supply chain has been the main driver for managing the unforeseeable future in the evolution of supply chain over the decade.

### 1.3 Research Problem

One of the major issues for the petroleum industry is the need to meet the increasing energy demand, reduce costs, and navigate uncertainties, which consequently requires supply chain collaboration. Industries find it challenging to successfully align their demand planning processes with the unpredictable environment in which they operate Kang and Moon (2016). Lack of coordination can lead to unreliable forecasts, potentially jeopardizing a company's long-term viability (Swierczek, 2019). A key component of enhancing supply chain performance is the ability to effectively predict demand in variable situations (Chowdhury and Quaddus, 2016). Inadequate planning can result in higher supply chain expenses (Whitten, Green, and Zelbst, 2012). Therefore, collaboration within the supply chain, inter-organizational relationships, and information sharing can improve customer service and create value by coordinating processes across various links in the chain (Gong, 2023). Research indicates that supply chain collaboration positively and significantly enhances company performance (Li, Lei, Ge and Wu, 2017).

Despite the critical role of supply chain management in ensuring the efficient and reliable distribution of petroleum products, the petroleum industry in Southern Africa, particularly within British Petroleum (BP) Southern Africa, faces persistent challenges related to supply chain fragmentation, inefficiencies in demand forecasting, inventory management, and distribution logistics (Freen, Kousar, Kausar, Pamučar, and Oros, 2023). These issues are exacerbated by the volatile nature of the petroleum market, regulatory constraints, and infrastructure limitations, leading to increased operational costs, stockouts, and sub-optimal customer service (Manuj and Sahin, 2011). There is a pressing need to explore and implement an integrated supply chain management approach that can address these challenges holistically (Ehrenthal and Stölzle, 2013). This research seeks to investigate the potential of such an approach to streamline operations, enhance coordination among supply chain partners, and improve the overall efficiency and responsiveness of BP Southern Africa's supply chain, thereby contributing to more sustainable and competitive operations in the region's petroleum industry (McLean, Ogbe, and Li, (2015).

### 1.4 Research Aim

The aim of this research is to evaluate the effectiveness of an integrated supply chain management approach in enhancing operational efficiency, reducing costs, and improving service delivery within the petroleum industry, with a specific focus on British Petroleum Southern Africa.

### 1.5 Research Questions

- To what extent supply chain collaboration can be improved by information sharing within supply chain partners?
- What are the advantages of scheduling and planning in ensuring smooth operation within the petroleum industry supply chain?
- How can collaborative forecasting assist in meeting demand and supply across the extended enterprise and functional areas?
- What is the role of effective stock replenishment in adding supply chain value across the supply chain in petroleum industry?

### 1.6 Research Objectives

- To examine the extent to which supply chain collaboration can be improved by information sharing within supply chain partners.
- To understand the advantages of scheduling and planning in ensuring smooth operation within petroleum industry supply chain.
- To examine how collaborative forecasting can assist in meeting demand and supply across the extended enterprise and functional areas.
- To assess the role of effective stock replenishment in adding supply chain value across the supply chain in petroleum industry.

### 1.7 Literature review

#### 1.7.1 Collaboration of operational activities

The any company's future depends on supply customer interactions, which can only be attained when businesses collaborate (Chilkapure and Pillai, 2019). Azizian and Sepehri (2022) mention that supply chain collaboration refers to a partnership, exact alignment, and teamwork within the supply chain. Adams, Richey Jr, Autry, Morgan and Gables (2014) affirm that it is a grouping of

suppliers and buyers who use similar management techniques and collaborate to improve their cooperative performance in manufacturing, delivering, and providing the final consignment. In addition, supply chain collaboration and integration are designed to achieve operational effectiveness and efficiency. In this study, supply chain collaboration will ensure that most effective connections to the best markets and customers are made both along and across the value chains for BP, as well as the structuring of customer solutions to provide value and create new revenue streams. This was done by collaborating with co-workers throughout the company to spot potential business possibilities and create synchronised approaches to new markets. In the last decade, the value of integration in supply chain has tripled, due to integration with midstream refining and marketing. This proves that supply chain integration is essential in any organisation to deal with uncertainties in the business.

### 1.7.2 Scheduling and planning of the activities

Scheduling is common in practically every industry, since it supports the success of production or service for businesses. According to Larco, Wiers, and Fransoo (2018), scheduling and planning in the supply chain enable real time visibility into all pertinent business aspects and significant optimisation capabilities that boost efficiency and support precise planning. The goal of scheduling is to distribute resources such that they can be used to finish a task in a timely manner, while also generating value. Planning refers to the process of making decisions and controlling all company processes by obtaining data without interruptions or delays in the context of supply chain management (Tanimizu and Amano, 2016). The allocation of resources and activities in line with truck scheduling can produce high yields in business performance within BP. According to this study, scheduling and planning involves the process whereby the company plans and ensures that there is enough product in the tanks to meet customer demand. The company must ensure that it leads to the smoothness flow of processes, which can improve the financial performance, whilst creating the reputation for the company. The purpose of scheduling is to ensure that value is created by assigning sufficient resources in a business.

### 1.7.3 Forecasting of the petroleum

Spiliotis, Petropoulos and Assimakopoulos (2023) defined forecasting as making projections or predictions about the future by considering the events in the present and past. Tony, Kumar, Rohith

(2021) mentioned that the technique of forecasting uses previous data as input to generate precise forecasts of the future behaviour of trends. Sohrabpour, Oghazi, Toorajipour and Nazarpour (2021) observe that forecasting is concerned with what the future will be like, as opposed to planning, which is focused on what the planner believes the future should be like. In this study, forecasting will assist BP to ensure that both their tanks as well as the petrol station do not run dry. Previous demand and supply are put together by the forecasting team to get a reliable view on how the inventory should look like. Demand forecasting is the foundation of replenishment buying across the supply chain structure. Good demand forecasting gives companies vital information about their prospects in both their current and future markets, enabling managers to make decisions regarding pricing, corporate expansion plans, and market potential. Furthermore, without demand forecasting, businesses run the risk of making bad decisions about their products, which could have a big influence on revenue, client satisfaction, supply chain management, and storage costs (Subramanian, 2021).

### 1.7.4 Replenishment of petroleum inventory

The practice of moving goods from reserve storage to primary storage prior to pick up at a site is known as replenishment (Achieng, Nyanga and Mbura, 2018). According to Nyabwanga and Otinga (2021), retailers can gain a competitive edge in replenishment to surpass the competition and satisfy customers. The demand prediction is essential to understanding the anticipated need, because replenishment is focused on purchasing stock to meet that need. Most of the petroleum industry outsources their distribution business to local private transporters, who are paid from a few tenths of a cent to slightly more than a cent for each litre delivered. However, BP use their own transport such as tank trucks, which consist of a tractor and one or more compartment separated trailers. Furthermore, whenever the product level falls below certain thresholds, petrol stations frequently inspect their underground tanks throughout the course of their regular business operations and send orders to the suppliers. However, the remaining fuel must therefore be delivered back to the terminals as a left on board if the underground tanks of a petrol station cannot hold a full compartmented cargo.

## 1.8 Theoretical framework

According to Panahifar, Azadnia, Ghadimi and Heavy (2013), collaboration, planning, forecasting and replenishment (CPFR) enable collaboration between supply chain partners using a range of

technological models and procedures. Providing information exchange that integrates supply and demand is the aim. This model was adopted in this study to integrate multiple supply chain management commercial parties' asset.

### 1.9 Significance of the Study

This study wants to assist companies to shift their focus more to collaborative supply chain, which can help to mitigate the challenges associated with unexpected situations in the business. Furthermore, with the increasing competition, this can lower the company cost, while maintaining a good relationship with the customer. The findings of this study can be utilised as the guideline for the implementation of appropriate strategies to ensure a proper's supply chain collaboration of activities within the company.

### 1.10 Justification of the study

This research articulates ways in which the positive experience for the customers can be improved by ensuring that operational activities have been integrated with customer's needs. It will also grasp the top management attention and increase the competitive advantage of the organisation. If the study is not conducted, petroleum industry concerns experienced due to poor supply chain collaboration will not be resolved, which might also affect productivity in the business.

### 1.11 Research Methodology

#### 1.11.1 Research Design

Research design entails three research designs that can be used when conducting the study, such as explanatory, exploratory, and descriptive design. The purpose of this study is to use explanatory methods to enhance, analyses, and clarify the researcher's theories and hypotheses. Explanatory studies isolate the impacts of a particular variable and comprehend the mechanism of action with the primary goal of explaining instead of merely describing a given situation (Winston, 2016:12).

#### 1.11.2 Research approach

Research approach uses combined or quantitative and qualitative methods. This study aims to adopts quantitative study in order to develop a clear interpretation of the problem and transmit data into numerical values. Okoli (2023) claims that quantitative research entails the modification of

facts and numerical values. Qualitative research methodologies involve to unique experiences and ideas. According to Cameron (2011), mixed method research involves a kind of analysis where a researcher incorporates parts of qualitative and quantitative methodologies to better understand the breadth and depth of a topic.

### 1.11.3 Study Site

The study site of this research is British Petroleum located in Cape Town in Western Cape under the city of Cape Town Municipality. The study site is located near to N7 towards Malmsbury via Bosmansdam to Montague Gardens Road.

### 1.11.4 Research population

Research population refers to the total number of people to be studied in the research (Kowalczyk, 2015). In other words, it refers to the people required to conduct the study. To a researcher, it may be described to as the complete population who share certain traits and interests. The population of this research are British Petroleum Southern Africa employees in Cape Town, Western Cape Province. Individuals from all the departments involved with supply chain was selected. Such departments involve storage and handling, transport, scheduling and planning, information, and technology, and forecasting with a total of 40 employees.

Table 1.1 Target Population

| Department | Storage and Handling | Transport | Scheduling and Planning | Information and Technology | Forecasting | Total |
|---|---|---|---|---|---|---|
| Employees | 10 | 19 | 5 | 3 | 3 | 40 |

***Source:*** Population determined by the department's personnel count.

### 1.11.5 Sample Size

In the study, the sample size consists of all the employees from the selected departments. There are 36 participants included in the overall sample. This implies that 36 self-administered surveys were given to all department employees, where the population of employees in these respective departments is not the same. Each department was sampled. For example, scheduling four, storage

seven, transport twenty-one, forecasting two, information and technology two employees (Sekaran and Bougie, 2016).

### 1.11.6 Sample design

The sample design comprises all the steps involved in dividing the units on the frame, ranking the sample size, allocating the sample to the unit frame's stratum, and selecting the sample (Daniels, 2012). According to Rahman, Tabash, Salamzadeh and Rahaman (2022), choosing the best sample techniques enables the researcher to conduct the research efficiently and successfully, with less expense and greater precision. The researchers can utilise either probability sample or non-probability sample when sampling their participants. A method known as non-probability sampling design does not calculate the probability that every element of the population was represented in the sample (Faems, 2020). It is hard to predict the chance that any sample was selected from the total population because a sampling technique called "nonprobability sampling" does not give each element in the population the same probability of selection. Stratified random sampling is a probability sampling approach in which the population is divided into subpopulations called strata and the ultimate topic is randomly chosen for each stratum separation (Weiss, 2012). This study will employ nonprobability sample, called purposive sampling technique, which depend on the researcher's own judgment when selecting group of the individual to participate in the research.

### 1.11.7 Data Collection Methods

The different information gathering techniques used in research can be divided into two categories: primary data and secondary data (Ajayi, 2017). According to Rott (2021), primary data refer to facts discovered through personal observation. Experimentation, surveys, questions, and interviewing constitute the key data sources. Secondary data is information gathered from a source that has previously been made available to the public in any way. Research always uses secondary data as the foundation for literature reviews. Books, newspapers, biographies, the internet, and research articles are used in this process. In this study, secondary and primary data was adopted. In addition, a five-point Likert scale was adopted to get true information from the respondents regarding the questions asked, whereas quantitative method will used to analyse data using statistics tools.

### 1.11.8 Data Analysis

According Love and Corr (2022), The process of providing the collected data with meaning, order, and relevance is referred to as data analysis. Theron (2015) states that data analysis is the process used to transform, redesign, and examine specific information with the intention of gathering pertinent data and providing a fix for a specific situation.

Univariate data analysis, which contains the descriptive statistics and the frequency distribution and bivariate, was utilised to explore data through Statistical Package for Social Science (SPSS) (Ho, 2014). Collected data was checked to ensure cleanness before analysis. Histograms, tables, or bar graphs was used for frequency distribution to interpret data more easily. Production of charts, graph and calculating a variety of descriptive measures, such as measures of variation, averages, and percentiles, are all part of descriptive statistics (Weiss, 2012). Furthermore, the study aims to use bivariate approach that includes analysis of variance, cross tabulation, Pearson correlation, chi square, testing of the hypothesis.

### 1.11.9 Data Quality Control

Quality control is defined as those methods and procedures employed by researchers in a study that provide assurance of the accuracy and quality of obtained data (Webster, 2010). Trustworthiness, conformability, and transferability of the qualitative method refer to all aspects of data quality control. Reliability and validity are equality important in the quantitative data quality control process to ensure that data collected is accurate. In a quantitative study, reliability and validity are referred to as trustworthiness. In a qualitative study, trustworthiness also encompasses credibility, conformability, dependability, and transferability.

**Trustworthiness**: According to Love and Corr (2022), the method or process that the researcher employed to show the study's truth value is recognised as reliable. Validity and reliability are referred to as trustworthiness in a quantitative investigation. Reliability and validity make ensuring that the information gathered is correct. According to the qualitative study, credibility, conformability, dependability, and transferability are all included in the concept of trustworthiness.

**Reliability:** The degree to which test measurements hold true over multiple runs of the same subject conducted under identical circumstances is known as reliability. It measures how well measuring processes produce consistent results across trials (Artilheiro et al., 2018).

**Validity:** According to Alkhadim (2020), validity refers to the extent to which theory and evidence support the intended uses' interpretations of test results. Therefore, it is crucial that the surveys given to employees achieve a certain level of validity. There was time set aside for questions, answers, and assistance from employee's aides.

### 1.12 Ethical consideration

The permit to conduct the study has been obtained and research office will issue ethical consideration clearance. The respondents' privacy is of the utmost importance and all information acquired was handled with complete confidentiality, be voluntary for the participants, no one was compelled to do it. Before the survey, the study was explained, and the anonymity of the information gathered for the study was protected. Participants was given false names to remain anonymous and not be victimised by the employer.

### 1.13 Limitation and delimitation of the study

The limitation of this research includes the restricted time of finishing questions by the responders due to other work activities. Furthermore, the vagueness of the responses from the questionnaires of the participants from employees constitutes a limitation of this research, as some individuals might not understand the questions, or may lack focus and motivation in replying. The delimiting factor is that this research focuses only on Western Cape Terminal, while the company have other sites or head offices in other provinces and international.

### 1.14 Outline of the Study

**Chapter One:** In this chapter, the study's preamble is explained. The study's opening chapter addresses the major goal, research aims, and related questions.

**Chapter Two:** Chapter Two contains the literature review. In this chapter, the collaboration planning, forecasting and replenishment (CPFR) model was explained.

**Chapter Three:** It describes the study's methodology, research techniques, and research design.

**Chapter Four:** It discusses the findings of the investigation and the data analytics.

**Chapter Five:** In Chapter Five, a summary of the full investigation is offered. Additionally, discussions and data analyses based on pertinent literature was offered to address the goals of the research.

**Chapter Six:** The findings, conclusions, and recommendations derived from the study, together with its limitations and delimitations, are summarised in this chapter.

### 1.15 Conclusion

This chapter provides an introduction to the research. The goal, purpose, and research questions are covered in this chapter. The objective is to comprehend and evaluate the importance of synchronisation in supply chain operations planning. The next chapter contain the literature review for the theoretical framework of the investigation. The foundation of the study was the CPFR model, which promotes collaboration in supply chain networks to ensure that information is shared across disciplines in the business.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1. Introduction to the study

The important elements of the study literature were introduced in the first chapter. In this chapter, the importance of the collaboration, planning, forecasting and replenishment (CPFR) model in the petroleum industry was explained. Bani, Hallaoui, Correa and Tahir (2023) mention that, despite the growing use of other alternative energy sources such as gas, electricity, and solar power, petroleum is still a significant source of energy in most contemporary cultures. The effectiveness of its intricate distribution system proves itself to be one of the primary success factors in the petroleum sector. However, it faces a persistent and significant issue in effectively managing its various activities, due to poor collaboration in supply chain. These activities include moving petroleum products between depots and sales locations and managing inventories at both depots and sales locations. Therefore, the alliance method, known as (CPFR), which enables departmental collaboration, can be used to assure activity synchronisation throughout the company (Kamalapur, Lyth and Houshyar, 2013). Therefore, this approach is applied in the study to coordinate activities and make sure that the company received the product in timely manner, with proper planning and adequate resources available to them to meet customer satisfaction. Mbhele (2017) is of the view that positive cues for a sensually based experience can be delivered by good, collaborated planning and a better synchronised event strategy, which can also remove bottlenecks. Businesses that want to preserve margins and remain competitive must be able to optimise the whole value chain. Effective supply chain collaborative planning, and execution are the essential elements to achieving overall organisation efficiency, as in any industry.

## 2.2 Background of the study

Yunus and Tadisina (2016) highlight that the British Petroleum was initially registered as the Anglo Persian Oil Company Ltd on April 14, 1909, by William Knox. In 1920, the company's name was changed to Anglo Iranian Oil Company Ltd. The industry entered to international marketing. In 1954, it became the British Petroleum Company Limited and in 1982, British Petroleum Company was adopted and became known. British Petroleum is the leading international oil and gas businesses in the world. Furthermore, while their main industry is oil, they have recently demonstrated a keen interest in plastics and chemicals, encompassing a range

of specialty products such as innovative ceramic designed materials, detergents, and sophisticated composite materials.

According to Xing, (2023), the British Petroleum has a terminal in Cape Town, which was constructed in 1976. The terminal has 21 tanks, which were built in 1979. It consists of four product grades, which involve diesel, petrol, kerosene and Jeta product. The company received these products through the pipeline. However, the pipeline from harbour to Gooseneck is owned by Astron Energy and from Gooseneck to Tie in pit is owned by Engen (Wieland and Wallenburg, 2012). Thus, the company only owns that which is inside the terminal. Millions of consumers around the world can attest to company's long-standing reputation for superior customer service and goods. This integrated oil and gas firm, ranked among the top petroleum corporations in the world, provides consumers with fuel for vehicles, electricity for lights and heaters, and lubricants to maintain the smooth operation of engines. It operates through two sections: upstream and downstream. The upstream division is in charge of midstream transportation, storage, and processing in addition to oil and natural gas exploration, production, and field development. In addition, it sells and exchanges power, natural gas liquids, and liquefied natural gas. The downstream business unit is responsible for managing the supply of crude oil, petroleum, petrochemicals, and associated products to wholesale and retail customers, as well as their refinement, production, marketing, distribution, and trading (BP, 2010).

Supply chain uncertainty in the petroleum industry remains the challenging issue as the world changes Wang, Jie, and Abareshi, (2018). The industry faces issues with regards to uncertainties caused by demand fluctuation, the coronavirus pandemic, natural disasters, and civil unrest (Freen, Kousar, Kausar, Pamucar, and Oros, (2023). The lack of integrated supply chains has resulted in reduced certainty (Perdana, 2021). In addition, pandemic-related uncertainties have forced organizations to shift the focus of innovation and restructuring efforts to ensure continuity of the business by concentrating more on resiliency and flexibility (Shah, Li, and Ierapetritou, 2010).). Furthermore, the uncertainties among the petroleum supply chain contributed to a lack of supply chain market development (Wang, 2018). This is associated with the pandemic that affected the economy, including the global supply chain, which resulted in business disruptions (Acquah, Naude, and Soni, 2021). Supply chain collaboration is therefore necessary for many organizations

in the sector in order to enhance performance (Hult, Craighead, and Ketchen, 2010). In addition, before the pandemic, cost reduction and productivity were the sources driving the enhancement of supply chain processes (Yunus and Tadisina, 2016). However, although the drivers remain significant, the disorder caused by the coronavirus leaves the competitive advantage under threat, where businesses are struggling to survive (Tong, Feng, and Rong, 2011). Furthermore, the pandemic resulted in most companies trying to decrease their costs by downsizing, retrenching, and closing their businesses (Hamdulay, 2017). BP Southern Africa's ambition is to develop safe, sustainable, and competitive supply chain through integrated business. This requires the industry to ensure that their activities are centralised to increasingly reinforce performance. The need for integrated supply chain has been the main driver for managing the unforeseeable future in the evolution of supply chain over the decade (Yunus and Tadisina, 2016).

### 2.3 Theoretical framework

Collaborative Planning, Forecasting and Replenishment (CPFR) was designed by Voluntary inter industry Commerce Standards (VICS) in 1998 as the model that incorporates vendor interactions and forecasts of product demand (Hemant, Rajesh and Daultani, 2022). According to Panahifar, Azadnia, Ghadimi and Heavy (2013), CPFR allows for cooperation across the supply chain using set of processes and technology models. The goal is to provide information sharing that is integrating supply and demand. In addition, it has been adopted by numerous firms with encouraging outcomes. The CPRF model is being used by Walmart and Procter and Gamble (P&G) to optimise the supply chain, information flow, and movement of goods. The CPFR concept has enabled the two businesses to profitably share information (Wang, 2018). Despite the CPFR's impressive advantages, there are still implementation issues that remain frequently overlooked. This tool reacts more quickly and is less expensive. The goal of introducing CPFR was to get rid of the barriers that were disrupting supply chains. These problems emerge from the unclear market demand, which is exacerbated by bad decisions brought on by incomplete information (Barratt and Oliveira, 2001). The purpose of CPFR is to integrate multiple supply chain management commercial parties' asset replenishment, forecasting, and procurement planning activities. In other words, its act as a model for a cooperative inventory management system and facilitates the sharing of forecast and planning data among numerous business partners.

According to Hemant et al. (2022), CPFR constitutes the ability for more than one parties in the supply chain to collaboratively perform a variety of activities and apply this in synchronised predictions, depending upon which the manufacturing and replenishment processes can be conducted. Panahifar et al. (2013) assert CPFR as a cooperative management model used within organisations to assists in enhancing supply chain participants capacities to raise profit and revenue. It involves sharing of information increase planning effectiveness and organisational performance. Lin (2014) mention that CPFR involves the combination of new business strategies that harness the internet and EDI (electronic data exchange) to significantly cut inventory and expenses, while increasing customer service. Fliedner (2003) shows that CPFR is a web-based system that integrates many tasks, including demand forecasting, planning, and supply chain partner replenishment. Its goal is to communicate information via a common web server in order to get an accurate long-term picture of supply chain needs.

Companies using CPFR usually have more accurate forecasts, improved manufacturing and flow planning, and higher product availability than companies not using it. According to Mohammaddust, Rezapour, Farahani, Mofidfa and Hill (2017), the use of CPFR has led to a decrease in inventory, an increase in sales, and superior financial performance, as assessed by the cost of goods purchased. Additionally, it has been found that CPFR promotes the development of solid relationships with your supplier or client. According to Kamalapur, Lyth and Houshyar (2013), CPFR involves an alliance approach that unites all the various business divisions and gives the buyer and supplier the chance to participate in activities such as demand forecasting and planning for inventory replenishment.

This study focuses on the significance of coordination of supply chin activities in BP. Furthermore, to enable real time information sharing and an integrated network, this model seeks to foster cooperation in the BP supply chain network. As a result, this collaboration necessitates knowledge of the linkages that arise in the network. The CPFR model was used to enhance cooperation between supply chain activities in BP. This model will ensure that the company received the product in timely manner with a proper planning and adequate resources available to them to meet customer satisfaction. In addition, by enabling visible information, synchronisation makes it possible to reap the rewards of an effective value chain. Thus, each department can work together

through CPFR when carrying out their crucial tasks (Liu and Sun, 2012). According to Kamalapur et al. (2013), CPFR is an alliance approach that unites all the various business divisions and gives the buyer and supplier the chance to participate in activities such as demand forecasting and planning for inventory replenishment. This review of the literature is a thorough investigation into the various elements of CPFR which are collaboration, planning, forecasting and replenishment.

In the petroleum industry, CPFR can be particularly valuable tool in supply chain due to the complexity of managing the supply and demand of petroleum products, which are subject to volatile market conditions, regulatory requirements, and logistical challenges (Hollmann, Scavarda, and Thomé, 2015). For BP Southern Africa, implementing CPFR can help address key supply chain challenges by fostering greater collaboration between the company and its suppliers, distributors, and retailers (Kim and Mahoney, 2010). Through shared forecasting and planning, BP Southern Africa can better anticipate market demand, reduce inventory costs, and optimize replenishment processes (Panahifar, Heavey, Byrne, and Fazlollahtabar, 2015). This collaborative approach enables all parties to respond more swiftly to changes in demand or supply disruptions, thereby reducing the risk of stockouts or excess inventory (Whipple and Russell, 2007). Additionally, CPFR can improve visibility and transparency across the supply chain, allowing BP Southern Africa to identify and mitigate potential bottlenecks or inefficiencies more effectively (Kazemi and Zhang, 2013). By aligning the supply chain processes through CPFR, BP Southern Africa can enhance its ability to meet customer demand reliably, maintain cost efficiency, and strengthen its competitive position in the dynamic petroleum market (Sari, 2008).

### 2.4 Understanding Integrated Supply Chain Management (ISCM)

Integrated Supply Chain Management (ISCM) is a comprehensive approach to managing the entire flow of goods, services, information, and finances involved in producing and delivering a product from the raw material stage to the final consumer. Unlike traditional supply chain management, which often operates in silos, ISCM emphasizes the integration of all elements within the supply chain to optimize performance, reduce costs, and enhance customer satisfaction (Xu, Xiong, Proverbs, and Zhong, 2022).

The concept of ISCM emerged as a response to the increasingly complex and global nature of supply chains. As businesses expanded their operations across borders, they encountered challenges such as longer lead times, greater variability in demand, and increased pressure to reduce costs while maintaining high levels of service. ISCM addresses these challenges by fostering collaboration and communication among all participants in the supply chain, from suppliers and manufacturers to distributors, retailers, and customers (Zhu, Krikke, and Caniëls, 2018).

At the core of ISCM is the idea that all components of the supply chain are interdependent. Decisions made in one part of the chain can have significant repercussions throughout the entire system. For example, a delay in receiving raw materials can disrupt production schedules, leading to delays in delivering finished products to customers. Similarly, inaccurate demand forecasting can result in either excess inventory or stockouts, both of which can be costly for the business (Bui, Tsai, Tseng, Tan, Yu, and Lim, 2021).

To effectively implement ISCM, companies must adopt a holistic view of their supply chain operations. This involves integrating key functions such as procurement, production, distribution, and logistics into a unified system. Advanced technology plays a crucial role in this integration, providing real-time visibility into all aspects of the supply chain. This visibility allows companies to make informed decisions quickly, respond to changes in demand, and manage risks more effectively (Danese and Romano, 2011).

One of the primary goals of ISCM is to create a seamless flow of information across the supply chain. This requires the use of sophisticated information systems that can capture, process, and share data in real-time. Enterprise Resource Planning (ERP) systems, for example, integrate various business processes, such as inventory management, order processing, and financial accounting, into a single platform. This enables different departments within a company to access the same information, reducing the likelihood of errors and ensuring that everyone is working towards the same goals (Núñez-Merino, Marín, Fuentes, and Martínez-Jurado, 2020).

Another critical aspect of ISCM is the alignment of objectives among all supply chain partners. In a traditional supply chain, each participant often operates with its own set of goals, which may not always align with those of others in the chain. For instance, a supplier might focus on maximizing production efficiency, while a retailer might prioritize reducing inventory levels to minimize carrying costs. ISCM seeks to harmonize these objectives by fostering collaboration and trust among all parties. By working together, supply chain partners can identify opportunities for cost savings, improve service levels, and enhance overall performance (Wieland and Wallenburg, 2012).

Risk management is another key component of ISCM. Supply chains are vulnerable to a wide range of risks, including natural disasters, political instability, and fluctuations in demand. ISCM helps companies to identify potential risks and develop strategies to mitigate them. This might involve diversifying suppliers, increasing inventory buffers, or developing contingency plans for critical operations. By proactively managing risks, companies can minimize disruptions to their supply chains and maintain a competitive edge in the market (Bui *et al*., 2021).

Moreover, ISCM places a strong emphasis on continuous improvement. The dynamic nature of global markets means that supply chains must constantly evolve to remain competitive. Companies that adopt ISCM are committed to regularly reviewing and optimizing their supply chain processes. This might involve implementing lean manufacturing techniques to reduce waste, adopting just-in-time inventory practices to minimize excess stock, or leveraging data analytics to improve demand forecasting accuracy (Zhu *et al*., 2018).

Sustainability is also increasingly becoming a focus in ISCM. As consumers and regulators place greater emphasis on environmental responsibility, companies are under pressure to reduce the environmental impact of their supply chains. ISCM enables businesses to take a more sustainable approach by optimizing transportation routes to reduce carbon emissions, sourcing materials from environmentally responsible suppliers, and minimizing waste throughout the production process (Bui *et al*., 2021). In addition to the operational benefits, ISCM can also lead to significant financial gains. By improving the efficiency and effectiveness of their supply chains, companies can reduce costs, increase revenue, and enhance profitability. For example, better demand forecasting can lead

to more accurate production planning, reducing the need for costly overtime or expedited shipping. Similarly, improved inventory management can free up working capital that would otherwise be tied up in excess stock (Xu *et al.*, 2022).

Customer satisfaction is another area where ISCM can have a profound impact. In today's competitive marketplace, customers have high expectations for product availability, delivery speed, and service quality. ISCM helps companies meet these expectations by ensuring that products are delivered on time, in the right quantity, and in the right condition. This, in turn, can lead to increased customer loyalty and repeat business (Xu et *al*., 2022).

In conclusion, Integrated Supply Chain Management is a strategic approach that enables companies to optimize their supply chain operations by integrating key functions, fostering collaboration among supply chain partners, and leveraging advanced technology. By adopting ISCM, businesses can improve their operational efficiency, reduce costs, enhance customer satisfaction, and achieve a sustainable competitive advantage in the global market. As supply chains continue to evolve, the importance of ISCM will only grow, making it a critical component of any successful business strategy (Zhu *et al*., 2018).

### 2.5 The Integrated Supply Chain Management Approach at BP Southern Africa

BP Southern Africa's Integrated Supply Chain Management (ISCM) approach involves the integration of various supply chain activities to achieve operational excellence Ahwazian et al. (2022). This approach can be divided into several key areas:

**2.5.1 Upstream Integration:** BP Southern Africa's upstream operations involve the exploration and extraction of crude oil, which is then transported to refineries (Tasleem et al., 2019). The company has integrated its upstream activities by using advanced technologies such as seismic imaging and data analytics to optimize exploration and production processes (Green et al., 2019). This integration allows BP to reduce exploration costs, improve resource utilization, and ensure a steady supply of crude oil for downstream operations (Xing, 2023).

**2.5.2 Downstream Integration:** In the downstream segment, BP Southern Africa focuses on refining crude oil into various petroleum products, including gasoline, diesel, and jet fuel ("A Hybrid Model for Supply Chain Risk Management Based on Five-dimensional Sustainability Approach in Telecommunication Industry", 2022). The company has integrated its refining operations with its distribution network to ensure that products are delivered efficiently to customers (Acquah et al., 2021). This integration involves real-time monitoring of refinery operations, inventory levels, and transportation routes, enabling BP to minimize production downtime and reduce distribution costs (Giannakis and Παπαδόπουλος, 2016).

**2.5.3 Collaboration and Partnerships:** BP Southern Africa has established strong partnerships with suppliers, distributors, and other stakeholders in the supply chain (Xu *et al*., 2020). These collaborations are essential for achieving the level of integration required in ISCM (Kazemi and Szmerekovsky, 2015). By working closely with its partners, BP can coordinate production schedules, share demand forecasts, and optimize inventory levels, leading to improved supply chain efficiency and reduced costs (Wang and Sarkis, 2013).

**2.5.4 Technology and Innovation:** The use of advanced technologies is a cornerstone of BP Southern Africa's ISCM approach (Appiah *et al*., 2022). The company has implemented digital supply chain solutions, such as Enterprise Resource Planning (ERP) systems, to integrate data from different parts of the supply chain (Ribas *et al*., 2010). These technologies enable BP to gain real-time visibility into its operations, make data-driven decisions, and respond quickly to changes in demand or supply chain disruptions (Ebinger and Omondi, 2020).

**2.5.5 Sustainability and Risk Management:** BP Southern Africa is also committed to sustainable practices in its supply chain (Haddach, 2020). The company has integrated environmental and social considerations into its supply chain management processes, such as reducing greenhouse gas emissions and ensuring the responsible sourcing of raw materials (Choudhary and Sangwan, 2019). Additionally, BP has implemented risk management strategies to mitigate the impact of supply chain disruptions, such as natural disasters, geopolitical instability, or market volatility (Qu and Ji, 2023).

## 2.6 Challenges in Implementing Integrated Supply Chain Management at BP Southern Africa

Implementing Integrated Supply Chain Management (ISCM) at BP Southern Africa, a subsidiary of the global energy giant BP, presents several complex challenges. These challenges are multifaceted, stemming from the intricacies of the energy sector, the unique dynamics of the African market, and the internal organizational structures and processes (Ogunlela, 2018). The energy industry, especially in Africa, faces unique obstacles that influence the implementation of ISCM, which aims to streamline operations, reduce costs, and enhance service delivery (Mehta, Alba, Bolding, Denby, Derman, Hove and Koppen, 2014).

One of the most significant challenges in implementing ISCM at BP Southern Africa is the infrastructural limitations within the region. The supply chain in the energy sector heavily relies on robust infrastructure, including transportation networks, storage facilities, and distribution channels (Frimpong, Gyamfi, Ishaq, Agyei, Agyapong, and Adam, 2021).). In Southern Africa, however, infrastructural inadequacies, such as underdeveloped road networks, insufficient storage capacities, and unreliable logistics systems, create bottlenecks that hinder the seamless integration of supply chain processes (Hlongwa and Sibiya, 2019). These infrastructural challenges are compounded by varying levels of economic development across the region, making it difficult to implement standardized ISCM practices (Mehta *et al*., 2014).

Another challenge is the regulatory and political environment in Southern Africa. The energy sector is highly regulated, and the policies governing the industry can vary significantly from one country to another within the region (Frimpong et al., 2021). BP Southern Africa must navigate a complex web of regulations, which often change with shifts in political leadership or economic priorities (Hlongwa and Sibiya, 2019). These regulatory uncertainties can delay the implementation of ISCM initiatives, as the company must continuously adapt its strategies to comply with new laws and policies (Ogunlela, 2018). Furthermore, political instability in some parts of Southern Africa can disrupt supply chains, making it challenging to maintain consistent operations across the region (Frimpong *et al*., 2021).

Cultural diversity and workforce management present additional hurdles. Southern Africa is a region characterized by a rich tapestry of cultures, languages, and business practices (Ogunlela, 2018). Implementing ISCM requires not only technological integration but also the alignment of diverse teams across multiple locations (Mehta *et al*., 2014). The cultural differences among the workforce can lead to communication barriers, resistance to change, and varying interpretations of ISCM practices (Frimpong *et al.,* 2021). BP Southern Africa must invest in extensive training and change management programs to ensure that all employees understand and embrace the principles of ISCM (Ogunlela, 2018). This process is time-consuming and requires significant resources, which can strain the company's ability to implement ISCM efficiently (Hlongwa and Sibiya, 2019).

The integration of technology within the supply chain is another critical challenge. ISCM relies heavily on advanced technologies such as Enterprise Resource Planning (ERP) systems, real-time data analytics, and automation tools (Tobie, Etoundi, and Zoa, 2016). However, the technological infrastructure in Southern Africa may not be uniformly developed, leading to disparities in the adoption and implementation of these technologies across BP Southern Africa's operations (Ogunlela, 2018). Additionally, the high costs associated with upgrading existing systems and training personnel to use new technologies can be a significant barrier (Tobie *et al.,* 2016). BP Southern Africa must also consider cybersecurity risks, as integrating various technological platforms increases the vulnerability to cyberattacks, which can disrupt supply chain operations (Frimpong *et al.,* 2021).

Moreover, the volatility of global oil prices adds another layer of complexity to implementing ISCM at BP Southern Africa. The energy sector is highly sensitive to fluctuations in oil prices, which can be influenced by global economic conditions, geopolitical tensions, and changes in demand and supply (Sek, 2017). These fluctuations can affect the cost structures and profitability of BP Southern Africa, making it difficult to plan and execute long-term ISCM strategies (Frimpong *et al.,* 2021). The company must remain agile and adaptable, constantly adjusting its supply chain practices to align with the changing economic landscape (Sek, 2017).

Sustainability and environmental concerns also pose significant challenges. As a major player in the energy sector, BP Southern Africa faces increasing pressure from governments, stakeholders,

and the public to reduce its carbon footprint and adopt sustainable practices (Frimpong et al., 2021). Implementing ISCM in a way that aligns with these sustainability goals requires a delicate balance between efficiency and environmental responsibility (Hlongwa and Sibiya, 2019). For example, optimizing transportation routes to reduce fuel consumption and emissions may conflict with the need to maintain reliable delivery schedules (Frimpong et al., 2021). Additionally, sourcing sustainable materials and investing in renewable energy technologies can increase operational costs, challenging the economic viability of ISCM initiatives (Hlongwa and Sibiya, 2019).

Finally, the complexity of BP Southern Africa's supply chain itself is a major challenge. The company's supply chain spans multiple countries, involving numerous suppliers, distributors, and customers (Ogunlela, 2018). Coordinating these diverse elements into a cohesive and integrated supply chain requires significant logistical expertise and coordination (Frimpong et al., 2021). The sheer scale of operations can lead to inefficiencies, as delays or disruptions in one part of the supply chain can have a cascading effect on the entire system (Hlongwa and Sibiya, 2019). Ensuring visibility and transparency across the supply chain is crucial but challenging, as it requires real-time data sharing and collaboration among all stakeholders (Ogunlela, 2018).

To sum up, implementing Integrated Supply Chain Management at BP Southern Africa is fraught with challenges that are deeply rooted in the region's infrastructural, regulatory, cultural, technological, economic, and environmental contexts (Frimpong *et al*., 2021). Overcoming these challenges requires a comprehensive approach that addresses the unique conditions of the Southern African market while leveraging BP's global resources and expertise (Ogunlela, 2018). The successful implementation of ISCM will depend on BP Southern Africa's ability to adapt to these challenges, invest in the necessary infrastructure and technology, and foster a culture of collaboration and innovation across its operations (Frimpong *et al*., 2021). Despite the difficulties, the potential benefits of ISCM, including enhanced efficiency, cost savings, and improved customer satisfaction, make it a critical initiative for BP Southern Africa's long-term success in the region (Ogunlela, 2018).

## 2.7 Collaboration of operational activities

Parsa, Shbool, Rossetti and Sattar (2020) argue that collaboration takes into consideration the full range of the system's many categories. This involves using a variety of techniques and tactics to synchronise the separate production, sourcing, storage, and logistical processes in a setting of information exchange. In addition, cooperation in the supply chain indicates that multiple unconnected departments or organisations work together rather than independently to design or decide on supply chain strategy (Yunus and Tadisina, 2016). In essence, given the emphasis on integration and synchronisation, businesses confront issues related to the dispersion of information and knowledge among people in one organisation from different departments. As a result, everyone must be available when making decisions (Hemant et al., 2022). Baig, Ahmed, and Najmi (2021) indicate that supply chain collaboration plays a vital role in gaining competitive advantage of the organisation and making the company's position in the global markets. Hasan, Alhanatleh, Aboalganam, and Awad (2021) note that supply chain collaboration positively and significantly enhances the company's performance.

Any company's future depends on its ability to communicate with its suppliers and customers, which can only happen when companies work together (Chilkapure and Pillai, 2019). Flynn, Huo and Zhao (2010) mention that supply chain collaboration refers to a partnership, exact alignment, and teamwork within the supply chain. Adams, Richey Jr., Autry, Morgan and Gables (2014) define this as a grouping of suppliers and buyers, who use similar management techniques and collaborate to improve their cooperative performance in manufacturing, delivering, and providing the final consignment. In addition, supply chain collaboration and integration seek to achieve operational effectiveness and efficiency.

In this study, supply chain collaboration serves to ensure that most effective connections to the best markets and customers are made both along and across the value chains for BP, as well as the structuring of customer solutions to provide value and create new revenue streams. This was done by collaborating with co-workers throughout the company to spot potential business possibilities, create synchronised approaches to new markets, optimise company's portfolio, design integrated solutions, and control any risk involved. In the last decade, the value of integration in supply chain has tripled due to integration with midstream refining and marketing (Yunus and Tadisina, 2016).

This proves that supply chain integration is essential in any organisation to deal with uncertainties in the business.

However, a lack of supply chain cooperation among petroleum stakeholders has contributed to limited market expansion and customer satisfaction. Uncertainties in the supply chain can significantly impact both demand and supply (Wang, Jie, and Abareshi, 2018). Furthermore, the threat posed by the coronavirus pandemic left businesses struggling with sales, particularly in the petroleum industry, as demand decreased during the economic shutdown (Freen, Kousar, Kausar, Pamučar, and Oros, 2023).). Supply chain collaboration is essential for organizations in this sector to respond effectively to supply chain shocks and enhance business performance (Ahwazian, Amindoust, Tavakkoli–Moghaddam, and Nikbakht, 2022). The integration of activities plays a crucial role in creating a centralized supply chain that meets customer expectations (Xu, Xiong, Proverbs and Zhong, 2021).). Effective supply chain management requires careful planning in selecting suppliers and scheduling orders according to consumer specifications (Green, Inman, Sower and Zelbst, 2019). BP can benefit from its supply chain by reducing costs and improving customer satisfaction through timely delivery of the right products in the right quantities (Huang, Yang, and Shi, 2021). This approach will help ensure that their gasoline supply remains consistent (Khan, Christopher and Creazza, 2012).

### 2.7.1 Synchronisation of operational activities

Synchronisation of operations is crucial when scheduling and planning for production in the supply chain and maximising competitive advantage, defined as the capability of substances with various properties to come into contact or be forced to operate together (Klug, 2013). Synchronisation requires a shared approach that coordinates actions for diverse organisations in order to achieve the continuous flow in the supply chain. A key objective of synchronisation is to guarantee uninterrupted material and information flow within individual supply chain nodes. Furthermore, its assist in getting all the supply chain participants to work together and flexibly (Erlach, 2013). Synchronisation considers the full scope of various system categories. This involves using a variety of techniques and tactics to synchronise the individual production, sourcing, storage, and logistical processes in a setting of information exchange. Hyland (2015) mentions that collaboration in supply chain implies that more than one unrelated department or organisations work together to plan or make decisions for supply chain strategies, rather than working

individually. Business experience issues associated with dispersed information and knowledge between employees in one organisation from different departments, where all of them need to be available when making decisions, due to the emphasis of integration and synchronisation (Bedwell, Wildman, Grandoz, Salazar, Kramer, and Salas, 2012). Shukor et al. (2022) agree that synchronised supply chains can prevent the bullwhip effect, which prevents a cascading rise and fall inventory dynamic from occurring.

Production processes flow smoothly when real time information is shared from upstream to downstream. In this study, this can be ensured by the availability of enough resources within the company, and the production of the good in accordance with the requirements of the customer. The product must be delivered without any disruptions. Thus, the *Just in Time* synchronisation principle can be utilised, which emphasises that all demands must be met on schedule without any delays, thereby strengthening demand frequency (Pearse, 2021). In addition, this promotes synchronisation of activities along value chains. For instance, the company can coordinate production with customer demand, utilising expertise in logistics and planning in order supply the output to satisfy the demands of the clients. This study aims to explain how synchronisation of activities is vital within BP, while ensuring that company utilise facilities with enough resources and to deliver on time. Synchronisation enables visible information, which constitutes the essential tool in gaining all the benefits of an efficient value chain.

BP collaborates with the company to establish strong bonds with preferred suppliers for each commodity to provide the best value for the company, while lowering risk and guaranteeing compliance with company's regulations (Yunus and Tadisina, 2016). Furthermore, procurement is the sole department with the ability to support the sourcing and commitment of products and services on behalf of the company. The company is always striving to gain suppliers that can achieve the mutual goal in enhancing innovation, service, and quality, lowering internal complexity to simplify purchasing, reducing costs, while increasing the value we deliver. In addition, the company is always looking to actively manage third party risk and encouraging a diverse range of suppliers and innovation. Relationship development and trust management were mentioned as being essential to CPFR performance in the petroleum industry (Wang and Sarkis,

2013). Despite competitive constraints, improving cost efficiency and relationships with key suppliers can help provide market experience and create customer satisfaction.

### 2.7.2 Joint Ventures

A sort of cooperative strategy called a joint venture is when companies band together to combine their resources and expertise. Stabilising a more competitive position is the aim (Wang and Sarkis, 2013). By building higher barriers to entry through the combination of financial resources, research and development, manufacturing, and distribution networks, organisations can diminish the negative effects of competing rivals. Through reduced rivalry in the markets where both companies are present, joint ventures increase the profitability of an industry. Mergers and joint ventures are the two most common entrance strategies utilised by multinational organisations to enter overseas markets (Derik and Tanya, 2017). Thompson and Strickland (2001) mention that strategic partnerships and joint ventures with foreign businesses increase a company's ability to compete globally.

In keeping with new aim of rethinking energy for people and the earth, BP ventures play a critical role in helping the firm reinvent itself as an integrated energy organisation (Wang and Sarkis, 2013). In order to do this, the business invests in a portfolio of rapidly expanding technology firms that will enhance and broaden its core business activities and open up new business prospects in associated digital sectors. The company also plans to contribute into companies that can assist in producing less carbon in its operations. BP in South Africa have independent joint venture, where its share ownership of strategically located depots, viz. the Waltloo Depot in Pretoria, which was previously owned exclusively by BP and Cape Town terminal, as well as the Alrode Fuel Depot in Alberton, Johannesburg, along with the adjacent Beryllium site. Furthermore, the corporations control the depots in fifty percent and share the same access to the same amount of storage space at the depots. The joint venture as a whole and the operation inside is governed by the joint venture agreement.

## 2.8 Scheduling and planning of the activities

Scheduling is common in practically every industry, since it supports the success of production or service in the businesses. Larco, Wiers, and Fransoo (2018) argue that scheduling and planning in

the supply chain enable real time visibility into all pertinent business aspects and significant optimisation capabilities that boost efficiency and support precise planning. Jagadish (2013) notes that scheduling is the crucial planning tool that deal with resource allocation, utilisation, and activity planning. The goal of scheduling is to distribute resources such that they can be used to finish a task in a timely manner while also generating value. Tanimizu and Amano (2016) state that planning involves the process of making decisions and controlling all company processes by obtaining data without interruptions or delays in the context of supply chain management.

Tiwari (2021) argue that, in a production system, scheduling refers to the order of tasks that must be carried out, whether manually or mechanically. Goals and current restrictions ought to inform scheduling and planning, which should balance the system and ensure that all tasks are assigned to the available resources. Gur and Eren (2018) define scheduling as the art of assigning the activities with the available resources in a way that maximises the pre-defined goal, as opposed to planning, which refers to the resources needed to execute the given work with the precise information. The management of planning and scheduling is done separately, with the scheduling process taking place after the creation of the process plans for each activity. As argued by Saragih et al. (2020) planning and scheduling work together to facilitate and manage production to achieve the maximum performance as measured by metrics like on time delivery and utilisation. While scheduling outlines when and who should complete certain tasks, planning considers what, how, where, and in what order tasks ought to be considered. Decisions about scheduling are not only impacted by those made during planning; interruptions that arise during the execution phase can also affect how well the plan and the schedule work together. The interplay between scheduling and planning is therefore inevitable.

Lian, Zhang and Gao (2012) argue that the following issues can arise while scheduling and planning the work in a production system. The adaptability of the production system will be limited when scheduling specific operations according to predetermined plans to accommodate dynamic changes. Planning without consideration for real processing times may use the time provided for the subsequent operation, leading to resource imbalance (Wang and Sarkis, 2013). There is a great likelihood that issues may arise when the goals of planning and scheduling are not properly coordinated. Tiwari (2021) further discuss that, in the scheduling process, there are two crucial

factors that must be considered to overcome those issues such involve the creation of the schedule and its revision. In other words, tracking the process and updating the schedule in accordance with the needs and parameters that emerge. The creation of the schedule, which is based on a predictive mechanism that provides a descriptive plan regarding the start and end times of all the operations that ought to be performed during the production process, is the first aspect in scheduling (Wang, 2018). The other aspect of scheduling involves modification of the plan by keeping track of and monitoring it, which addresses the issue of unforeseen events like breakdowns, order cancellations, and other occurrences that disrupt the production process.

Scheduling evaluates time and resource allocations to produce the desired quantity. Therefore, resources must be managed in a way that enables value creation in the industry to minimise delays and maximising efficiency and product quality (Manuj, and Sahin, 2011).  mentions that the key to maximising resource utilisation and improving performance is the scheduling of tasks in advance. The productive potential of resources is wasted if they are made accessible but remain unused, due for example to poor plant design. The allocation of resources and activities in line with truck scheduling can produce high yields in business performance within BP. According to this study, scheduling and planning involves the process where, through planning, the company ensure that there is enough product in the tanks to meet customer demand (Wang, 2018). The company ought to ensure that it leads to the smoothness flow of processes, which can improve the financial performance, whilst creating the reputation for the company. The purpose of scheduling is to ensure that value is created by assigning sufficient resources in a business.

### 2.9 Forecasting of the petroleum

A company's business process depends heavily on forecasting. This is regarded as the organisation and the supply chain management department's most basic input. An organisation must link its forecasting to all supply chain planning processes. Spiliotis et al. (2023) defined forecasting as the making of projections or predictions about the future by considering the events in the present and past. Tony, Kumar and Rohith (2021) mentioned that the technique of forecasting uses previous data as input in order to generate precise forecasts of the future behaviour of trends. Sohrabpour, Oghazi, Toorajipour and Nazarpour (2021) note that forecasting is concerned with what the future will be like, as opposed to planning, which is focused on what the planner believes the future ought to be like.

Borucka (2023) argues that demand forecasting is essential to a company's operations and ability to obtain a competitive edge in the marketplace. Reliable and accurate projections enable businesses to respond more effectively to changing market conditions and client requests. It further assists in cost reduction, process optimisation and minimistion of inventory issues. However, many businesses do not employ quantitative forecasting at all, instead relying only on subjective judgment or qualitative methods to determine orders or inventory levels. This is due to how challenging it is to create precise forecasts (Wang, 2018).

In Chandraul and Barode (2018) examine the following four forecasting techniques: simulation, time series, causal, and qualitative. The majority of qualitative forecasting methods depend on human judgment and are illogical. They are especially helpful when historical data is scarce or when experts in the field know information about the market that could affect the estimate. Based on previous demand, time series forecasting systems generate projections. They are based on the notion that demand data from the past may be used to accurately forecast demand in the future. When the basic demand pattern does not significantly alter from year to year, these strategies perform well. Causal forecasting methodologies suggest that the demand prediction is highly correlated with certain environmental variables, such interest rates and the state of the economy. In order to provide a prediction, simulation forecasting approaches replicate consumer decisions that lead to demand.

Zied, Boylan, and Tabar (2022) argue that most supply chain management choices are based on demand estimates. The level of complexity in these judgments leads to different forecasting needs. For instance, judgments about inventory replenishment require estimates at lower levels over shorter timescales, whereas decisions about supply chain strategy require projections at higher levels over longer timeframes. Ivanov and Dolgui (2021) argue that the identification of probable disruption scenarios is of importance to supply managers in attempting to address demand shortages to improve decision making and identify the steps necessary for recovery. The failure of supply chains and the widespread effects of the pandemic have made it abundantly clear that it is necessary to build resilient supply chains that can use effective ways to deal with outside disruptions. Furthermore, in order to deal with interruptions brought on by extreme disasters and

extraordinary demand, it was found that strengthening supply chain resilience was a crucial concern.

Zhang, Srivastava and Eachempati (2021) claim that, aside from the theoretical advantages of using a cooperative approach through information sharing, one of the most common challenges in supply chain management is the lack of analytical tools that may make it feasible to foresee future demand and potential disruptions. Ivanon et al. (2021) note that decision makers can use forecasting as a crucial tool to make supply chain more resilient to future demand shocks. Aljanabi and Ghafour (2022) meanwhile highlight that the capacity to identify disruptions and increase the flexibility of supply chains to deal with demand fluctuation is enabled by sharing information on real demand. Critical information sharing as part of knowledge management can also serve as a helpful analytical tool for dealing with scenario planning and mitigating the effects of unexpected interruptions.

In this study, forecasting will assist BP to ensure their tanks do not run dry as well as the petrol station. Previous demand and supply are put together by the forecasting team to get a reliable view on how the inventory should look like. Demand forecasting constitutes the foundation of replenishment buying across the supply chain structure (Świerczek, 2019). Good demand forecasting gives companies vital information about their prospects in both their current and future markets, enabling managers to make decisions regarding pricing, corporate expansion plans, and market potential. Without demand forecasting, businesses run the risk of making bad decisions about their products, which could have a big influence on revenue, client satisfaction, supply chain management, and storage costs (Subramanian, 2021).

### 2.10 Replenishment of petroleum inventory

The process of moving goods from reserve storage to primary storage prior to pick up at a site is known as replenishment (Achieng, Nyanga and Mbura, 2018). Almost every sector of the economy finds it difficult to manage and keep inventory. Since most organisations handle inventory on a regular basis, inventory replenishment is quite important. Additionally, any company that undervalues its inventory faces the possibility of losing customers (Świerczek, 2019). This is particularly true if the manufacturing elements are not adequately managed to meet client requests and desires. Nyabwanga and Otinga (2021) agree that retailers can gain a competitive edge in

replenishment to surpass the competition and satisfy customers. Having enough product available when customers need them is the difficulty with inventory. A well-planned inventory of commodities is required to ensure that there is neither a surplus nor a deficit. The company needs to be able to give customers what they need in terms of both quantity and quality.

Mohamud and Mwangi (2021) claim that maintaining products in non-domestic markets is now essentially necessary to maintain customer service standards, making inventory management a special issue when selling overseas. Furthermore, all businesses need to match their inventory levels with demand, since excess inventory depletes cash flow and results in carrying expenses (Świerczek, 2019). Regardless of the industry, businesses must keep a close eye on their inventory in order to save money and make sure they have enough on hand to match both actual orders and production schedules. Ali et al. (2023) mentioned that effective product replenishment rules are crucial to the petroleum inventory distribution system for boosting sales income, reducing inventory costs, and improving cash flows. In order to ensure business continuity, this is a crucial concern that needs to be considered, both carefully and constantly. Despite the shifting demand patterns for petroleum products, it is crucial to have the best replenishment procedures in place; otherwise, excessive inventory costs for maintaining stock levels may have a negative impact on business performance (Świerczek, 2019).

The demand prediction is essential in order to understand the anticipated need because replenishment is focused on purchasing stock to meet that need. Supply chain decision makers are working to increase operational efficacy and cut costs by using a collaborative replenishment method in the increasingly competitive industry. Di Maria, De Marchi and Galeazzo (2022) highlight that industries wishing to preserve margins and remain competitive must be able to optimise the whole value chain influenced by the inventory strategy. The distribution of the products to final retail and commercial clients along the downstream oil and gas value chain is a complicated process that begins in the oil field and continues through refineries (Shah, Li and Ierapetritou, 2010). Digital technology adoption can facilitate the supply chain's efficient operation. However, due to the compartmentalised nature of the businesses, inventory management is a significant difficulty in the downstream supply chain. Multiple organisations managing inventories with different key performance indicators frequently leads to suboptimal

decision making that reduces company value (Sek, 2017). Inventory planning at the refineries throughout the supply chain is different from inventory planning at the depots. This is because refineries have push pull boundaries, where they are asset intensive, and need to run as efficiently as possible to cut down on unit costs and downtime expenses. Products are continuously created because of refinery activities, and to prevent top tank problems, products must be periodically removed from the refinery (Qu and Ji, 2023). The rate at which products are removed from the refinery depends on the demand that pulls up the supply chain, together with the mode of bulk transportation being used to deliver the products to depots or to export customers, such as a vessel, pipeline, rail, or road.

Most of the petroleum industry outsource their distribution business to local private transporters, who are paid from a few tenths of a cent to slightly more than a cent for each liter delivered (Sek, 2017). However, BP use their own transport, such as tank trucks, which consist of a tractor and one or more compartment separated trailers. Each truck has three to six compartments, each with a different capacity between and liters (Shah, Li and Ierapetritou, 2010). Furthermore, in order to prevent internal contamination, two different grades of petroleum must be loaded into two separate compartments. The replenishment of gasoline is carried out from the depot/terminal to the petrol stations. The logistics deliver petroleum products to a group of customers in petrol stations in a way that meets their needs within the transporter's operational capabilities while maximising the total distribution profits produced by the distribution operation (Sek, 2017). Furthermore, whenever the product level falls below certain thresholds, petrol stations frequently inspect their underground tanks throughout the course of their regular business operations and send orders to the suppliers. However, the remaining fuel must be delivered back to the terminals as a ‘left on board’ if the underground tanks of a petrol station cannot hold a full compartmented cargo. This causes the business to incur a send back fee that is typically high (Shah, Li and Ierapetritou, 2010). However, cost can be minimised through proper collaborative planning and forecasting in the business.

### 2.11 Information sharing and technology

Information sharing is vital to ensure cooperation between supply chain partners and supply chain integration, where information sharing is crucial. According to Sodero, Rabinovich and Sinha

(2013) the best way to increase collaboration in the supply chain network is to share information. In other words, it entails the sharing of data for decision making from several departments or organisations. Through the exchange of concepts, information, and initiatives, operational effectiveness and corporate efficiency may be achieved. The bullwhip effect or demand variability could emerge from a lack of information exchange, which would lower customer satisfaction and damage the company's reputation (Qu and Ji, 2023). Consequently, the business's issues caused by client order and demand unpredictability may be lessened by information sharing (Lin, 2014). The information sharing in this study can be enhanced by the use electronic supply chain management systems. Systems for managing supply networks and enhancing supply chain operations via the use of technology are known as electronics supply chain management systems (e SCM) (Lin and Huang, 2012). The usage of e SCM enables the organisation to be agile and efficient in its supply chain operations, as well as to react swiftly to changing customer order demand. In this study, information exchange was shown to maximise activity synchronisation while guaranteeing consistent customer satisfaction. The foundation for businesses to electronically communicate real time information with other supply chain partners has been established by internet-based IT (Sodero et al, 2013).

According to this study, the accuracy and quality of information communicated along the supply chain are proven to be key factors in efficient information sharing, Poor business decisions and financial outcomes are the result of communication that uses incorrect data or transmits slowly. As a result, the literature suggests that technology is a major factor in the effective or optimal exchange of information.

## 2.12 Conclusion

Background of the study was covered in this chapter and the adoption of the CPFR model and its importance to the study. It further discussed the fundamental variables in this model to enhance cooperation between supply chain activities at BP Southern Africa. It ensures that the company received the product in timely manner with a proper planning and adequate resources available to them to meet customer satisfaction. In addition, by enabling visible information, synchronisation makes it possible to reap the rewards of an effective value chain. The following chapter describes the study's methodology, research techniques, and research design as well as data collection

process. Additionally, it describes the study population as well as the sample size and sample frame. The reliability and validity issues with the study was also be covered in this chapter. Furthermore, the study was included information on the data analysis, data gathering method, and questionnaire design.

# CHAPTER 3: RESEARCH METHODOLOGY

## 3.1 Introduction

In the previous chapter, the review of the literature on the use of CPFR was presented. The research methodology consists of the strategies, tactics, and metrics utilised to create a research design and strategy (Streubert and Carpenter, 2011). In other words, it refers to the processes and guidelines that the research team used to carry out the study. Botma, Greeff, Maluadzi and Wringt (2010) acknowledge that the broad strategy a researcher uses to carry out a research study is referred to as research methodology. According to Sekaran and Bougie (2016), the study methodology is also described as the justification or reasoning of the actual utilisation of the design.

The particular procedures utilised to collect and analyse the data, as well as the research approach, population, sampling plan, data collection, and data analysis, are all described in the study's research methodology. Ensuring that exact data procedures are employed to fulfill the study objectives and research questions is the primary objective of this methodology. Therefore, the researcher must select the appropriate tools in order to analyse data and assess the study's findings or conclusions. The study's presented findings should always be in line with its predetermined objectives.

## 3.2 Research Design

According to Harish (2021), research design is known as the overall approach the researcher select to combine the various elements of the study in a logical and cogent manner, while ensuring research problem is solved successful. It acts as a manual for the procedures involved in measuring, collecting, and analysing data. Mbhele (2014) mentions that the research design outlines the conceptual framework and plan for how the researcher intends to conduct the investigation to address the issue at hand. A study's overall plan or rationale, known as the research design, outlines how the investigation was carried out. Research design entails three research designs that can be used when conducting the study, such as explanatory, exploratory, and descriptive.

Explanatory studies isolate the impact of a particular variable and comprehend the mechanism of action with the primary goal of explaining instead of merely describing a situation (Kowalczyk, 2015). De Vaus (2013) states that the main objective of explanatory research is to identify any

causal relationships between the components or variables linked to the studied problem. Exploratory research refers to the investigation into a topic to learn more. User research and general ideas is used as a starting point for study and as a means of identifying potential future research topics (Winston, 2016). Either original research, secondary research, or both may be used in research. These studies typically exhibit a great degree of flexibility and lack a systematic structure. As argued by Cooper and Shindler (2010), defining the dimensions of the environment in which the issues, opportunities, or situations of interest are likely to occur and identifying the important variables or factors that may be present and be relevant to the study are the goals of exploratory research.

According to Wyse (2011), a descriptive study is one that tries to characterise a particular subject type without establishing a particular connection between the variables under consideration. The goal of a descriptive study is to gather information that describes the subject of interest. It frequently aims to gather information about the traits of the goals, such as those of a person, organisation, product, or circumstance (Sekeran and Bougie, 2016). This study aims to adopt explanatory to further develop, examine, and explain the researcher's theories and hypotheses. This kind of research design is employed to elaborate on the unresearched facets of a specific subject and attempt to explain the missing. The phenomenon in this research serves to explore how BP coordinate its activities to ensure a smooth flow in supply chain and customer satisfaction.

### 3.3 Research approach

According to Bhattacherjee (2012), a broad set of assumptions is used in the research approach method to describe how to gather, analyse, and evaluate data. It uses combined or quantitative or qualitative research methods. Qualitative research methodologies involve unique experiences and ideas. This strategy enables academics to offer analysis, and justifications based on texts or words (Harwell, 2011). This is research using words instead of data, and qualitative writing often contains a wealth of expressions, quotes, and meaning (DeVos, Strydom, Fouche and Delport, 2011).

Sukamolson, (2010) claims that quantitative research entails the modification of facts and numerical values. Qualitative research methodologies involve to unique experiences and ideas. Using effect statistics such as correlation, relative frequencies, and differences between means,

quantitative researchers aim to test ideas by measuring variables on a sample of participants and showing relationships between variables (Cokley and Awad, 2013). According to Cameron, (2011) a mixed method research is a kind of analysis where a researcher incorporates parts of qualitative and quantitative methodologies to better understand the breadth and depth of a topic. Mixed method study entails developing a study plan and using several research techniques. Fiorini, Griffiths and Houdmont (2018) argue that the researcher use both research methodologies to obtain correct data and analyse it utilising a variety of tools, including various data sources, research techniques, and researchers. This study aims to adopts quantitative research to have a clear understanding of the problem and transmit data into numerical values. Controlling the relationship between an independent variable and a population dependent variable, often known as an outcome variable, is the main objective of quantitative study design (Mehrad and Tahrini, 2019).

### 3.4 Study Site

Williams, (2016) states the study site refers to the site the researcher aims to use when conducting the entire research. The study site of this research is the BP located in Cape Town in Western Cape under the city of Cape Town Municipality. The study site is located near to N7 towards Malmsbury via Bosmansdam to Montague Gardens Road.

### 3.5 Research population

Research population refers to the total number of people to be studied in the research (Kowalczyk, 2015). In other words, it refers to the people required to conduct the study. To a researcher, it may be described as the complete population, who share certain traits and interests. The population of this research are BP Southern Africa employees in Cape Town, Western Cape Province. Individuals from all the departments involved with supply chain was selected. Such departments involve storage and handling, transport, scheduling and planning, information, and technology, and forecasting with a total of 40 employees.

**Table 1.1 Target Population**

| Department | Storage and Handling | Transport | Scheduling and Planning | Information and Technology | Forecasting | Total |
|---|---|---|---|---|---|---|
| Employees | 10 | 19 | 5 | 3 | 3 | 40 |

***Source:*** Population calculated based on the number of employees in the department.

### 3.6 Sample Size

A sample size is a group of people, or a selection of individuals, objects, or events drawn from a huge population that you gather and analyse from which to draw conclusions (Evans, Hastings and Peacock, 2010). The total number of people participated in the inquiry is what is meant by the term "sample size." In order to provide reliable, valid, and trustworthy information on the general population in the conclusion, the sample size must be sufficient (Suresh and Chandrashekara, 2012).

According to Sekaran and Bougie (2016), if the population is 40, then 36 people was sampled. This implies that 36 self-administered questionnaires were given to all department employees. Thus, since the population of employees in these department is not identical, each department was sampled. For example, scheduling four, storage seven, transport twenty-one, forecasting two, information and technology two employees (Sekaran and Bougie, 2016:295).

### 3.7 Sample design

The sample design comprises all the steps involved in dividing the units on the frame, ranking the sample size, allocating the sample to the unit frame's stratum, and selecting the sample (Daniels, 2012). Collins (2011) explains that using the best sample techniques enables the researcher to complete the study efficiently and effectively, to lower the expenditures involved when doing the study, and to increase accuracy, distinguishing between probability and non-probability sampling techniques. The non-probability sampling design is a method that does not calculate the probability that every member of the population was represented in the sample (Kothari, 2011). A sampling

method known as "non-probability sampling" does not give every element in the population the same probability of selection, where it is impossible to determine the likelihood that any sample was chosen from the entire population (Mugura, 2013). According to Haque and Salam (2010), there are various kinds of non-probability, including convenience, quota, purposeful or judgement, snowball, and double sampling. Gravetter and Forzano (2012) mention that convenience sampling refers to when individuals are chosen for a study based on their willingness and ambition to participate in the study. Using the quota sampling strategy, which divides the population according to its characteristics, a representative sample must be obtained with a great deal of work (Black, 2011). Snowball sampling occurs when a researcher gathers data on some members of the desired population that he can locate, then requests those who were selected to supply information needed to locate more members of that community (Babbie, 2010). Purposive sampling is predicated on the assumption that a researcher's knowledge of the population can be utilised to select sampled individuals (Polit and Beck, 2010). Purposive sampling technique depends on the researcher's own judgment when selecting group of the individual to participate in the research.

The probability sampling design or the non-probability sampling design are both options for the researchers when sampling their population. According to Rahman, Tabash, Salamzadeh, and Rahaman (2022). choosing the best sample techniques enables the researcher to carry out the study efficiently and successfully, with less expense, and greater precision. The researchers can utilise either a probability sample or non-probability sample when sampling their participants. The probability sampling design is one that ensures every component has an equal likelihood of being included in the sample (Kothari, 2011). The population elements that have a chance of being chosen as sample objects are also included in the design (Sekaran, 2016). Probability sampling also includes simple random, stratified, systematic, and cluster sampling. Furthermore, when a study divides the population into subpopulations known as strata and then randomly chooses the overarching topic for each stratum division, it is using a probability sampling approach called stratified random sampling (Weiss, 2012). Supply chain management and relevant departments are closely coordinated, with the population separated into these divisions. Thus, stratified random sampling, a probability sampling design, was used in this investigation. Workers from the relevant departments who are part of the population was chosen at random.

### 3.8 Data Collection Methods

Data collection happens where the writer gathers the information from a variety of sources in order devise solutions to the problem and examine the results (Polit and Beck, 2012). Bryman and Bell (2011) define a research method as a system for gathering data, which includes instruments like questionnaires, interviews, and observational methods, where the researcher simply listens or watches. The goal of qualitative research interviews is to identify and explain key themes that are present in individuals' daily lives. Furthermore, there are structured and unstructured interviews. The procedure for gathering data has a significant impact on the statistical analysis. Primary data and secondary data are two categories into which the numerous information gathering procedures used in research can be separated (Ajayi, 2017).

According to Kabir, (2016) firsthand experience-based knowledge is referred to as primary data. Primary data is not yet released but is more trustworthy, real, and objective. Primary data has a higher level of validity than secondary data because it has not been changed or tampered with by humans. Furthermore, primary data sources are hard to come by and can provide difficulties in data collection because of low involvement or poor teamwork (Perdana, 2021). Surveys, questionnaires, interviews, and experiments are the sources of primary data.

Information obtained from a source that has previously been made available in any format is referred to as secondary data. Secondary data is the foundation of any research that makes use of literature reviews (Qu and Ji, 2023). It is collected by someone else for an alternative purpose. Books, newspapers, biographies, the internet, and research articles are all used in this process. Sometimes it can be difficult to obtain primary data; in these cases, gathering information from secondary sources is easier and feasible. When original data is unavailable, one must confine their research to secondary sources. In addition, when primary data is available, but respondents are unwilling to share it, secondary data can be used (Ajayi, 2017). In this study, secondary and primary data was adopted.

Furthermore, questionnaires were used in this study to collect data from the participants. According to Dong, Wang, Zhou, Cao and Li (2019), the basic objective of the questionnaire,

which has been a tried and true technique for gathering participant data, is to operationalise the user's information demand into a structure that allows for statistical assessment. A popular tool for obtaining participant data is the questionnaire, whose main objective is to apply the user's information demand in a way that makes statistical analysis easier (Milner and Furnham, 2017). Furthermore, questionnaires were distributed to BP selected employees to acquire information. The researcher's questionnaire is divided into two portions. The first component of the questionnaire contains the respondent's biographical information, the length of time they have in the industry, and their work background. Interval scale questions employing the five-point Likert scaling system was included in the questionnaire's second section. Boone and Boone (2012) state that the Likert scale consists of a sequence of questions with five possible answers: 1 for strongly agreeing; 2 for agreeing; 3 for neutrality; 4 for disagreeing; and 5 for strongly disagreeing. On the questionnaire, respondents were presented with the choice of revealing or not revealing their names. The researcher described the goal of the study to the participants to elucidate why they should be answering the questionnaire.

### 3.9 Data Analysis

According to Vosloo (2014) data analysis is the process of giving the gathered data meaning, order, and significance. Theron (2015) states that data analysis is the process used to transform, redesign, and examine specific information, with the goal of discovering useful information and offering a solution for a particular scenario. Johnston (2014) argues that data analysis is a deliberate search, or a strategy used to analyse qualitative data so that what has been learnt may be communicated to others. Furthermore, data analysis is required for every research to define various kinds of principles, ideologies, frameworks, and procedures used. The analysis also aims to address the research problem; the better the analysis is executed, the more powerful the conclusion (Polit and Beck, 2012). In essence, before beginning data analysis, the accuracy of the data collected must be checked.

Deductive and inductive research methodologies are also used in data analysis. The deductive approach involves the researcher developing a hypothesis from an existing theory (Soiferman, 2010). The quantitative data presents the focus of the deductive approach. It enables researchers to assess the validity of a theory or hypothesis (Saunders, Lewis and Thornhill, 2012). The researchers use the inductive approach to collect data relevant to their concern. When a researcher

wishes to construct a new hypothesis based on facts, the inductive approach is appropriate. Inductive approaches are also concerned with qualitative data. This enables researchers to start with a research question, objective, and purpose for the study (Bryman and Bell, 2011). Data collected is analysed using quantitative and qualitative methodologies. Non numerical data such as words or texts are analysed in qualitative research. In quantitative research, statistics tools are used to analysed numerical data to produce conclusions and outcomes (Biber, 2010).

The quantitative technique employs several data analysis tools, including univariate, bivariate, and multivariate analyses. Univariate data analysis, which contains the descriptive statistics and the frequency distribution and bivariate, was used to analyse data through Statistical Package for Social Science (SPSS) (Ho, 2014). The descriptive statistics and frequency distribution are included in the univariate data analysis method.

The frequency distribution pattern looks at one variable at a time and offers various findings, conclusions, and relative frequencies, such as percentages inside the given range. Both tabular and graphical representations are possible for it. To show frequency distribution, researchers typically use histograms, tables, or bar graphs, which allows them to quickly comprehend their data (Wang and Fang, 2015). A frequency distribution, by definition, is a table that indicates the frequency at which a given value of a variable occurs within a particular group. For any variable, it can be used to arrange or rank data points from highest to lowest (Aguocha, Olekanma and Uzowuihe, 2023). It also assists the researcher in presenting the information acquired from the sample. The cumulative or relative frequencies are included in the frequency distribution. Cumulative frequency describes the number of observations in a particular data set that are lower or higher than a certain value. Additionally, it can analyse data using proportions or percentages. Furthermore, when researchers want to know how frequently a given event occurs in comparison to the total number of events, they utilise relative frequency (Sahu, 2013).

The researcher can identify the most important components of the study by using frequency to understand and rank the employees' responses from highest to lowest score. Frequency will also be used in the study to communicate demographic and category information from the questionnaire respondents. In this study, SPSS v 29.0 software was utilised to confirm the accuracy and reliability

of participants ratings. SPSS is a critical application for presenting graphs, based on complex raw data. It additionally serves an important role in analysing and interpreting data obtained through various methods. Furthermore, in order to make the research more logical and dependable, statistical methods such as Anova, cross tabulation with Chi square, and Pearson's correlation was employed in the study with the support of SPSS software. Collected data was checked to ensure cleanness before analysis. Histograms, tables, or bar graphs was used for frequency distribution to interpret data more easily. Production of charts, graph and calculating a variety of descriptive measures, such as measures of variation, averages, and percentiles, are all part of descriptive statistics (Weiss, 2012). Furthermore, the study aims to use bivariate approach that includes analysis of variance, cross tabulation, Pearson correlation, Chi square testing of the hypothesis.

Techniques for organising and analysing data include descriptive statistics. In descriptive statistics, graphs and charts are made and various descriptive measures including averages, measurements of variation, and percentages are computed (Weiss, 2012). The study utilises descriptive statistical techniques to examine the central tendency, dispersion, skew, and kurtosis. A measure of statistical significance known as central tendency identifies a single value that accurately reflects the whole distribution of scores. Finding a single number that most accurately captures the entire data set is the aim of the measure. (Adams, Khan and Raeside, 2014). The researcher can synthesise and condense the content to make it easier to understand by using the central tendency measures. Metrics like as the mean, median, and mode are used to determine the central tendency.

In order to assist comparison, such metrics allow the researcher to make comparisons between multiple sets of data. The mean measurement is the average of a distribution of scores; academics use it because it provides a single number that summarises the distribution (Urban, 2010). In addition, when analysing the questionnaire findings, the variable with the highest mean is thought to be the most pertinent of the important aspects. Furthermore, the value near the middle of the data set is known as the median when the measurements are arranged in order of magnitude. Half of the integers in the data set above it and half of the digits in the data set below it make up this number (McKeague, 2010). In essence, when examining the skewness of a distribution, researchers utilise the median for dividing the distribution scoring into two distinct categories. The mode is the most frequent value in the data; it tells which score has the most frequency (Urban,

2010). It is among the least common measurement of central tendency, because it contains less information, although it is useful for characterising a data set.

- A positive linear relationship and a skewed distribution to the right are indicated when the mode is smaller than the median and the median is smaller than the mean (mode less than median less than mode). Also, this suggests that the long tail is tilted to the right.
- It is implied that the long tail of the distribution is skewed to the left if the mode is greater than the median and greater than the mean, which suggests a negative linear connection and skewed distribution (Longnecker, 2010).

Dispersion is a measure of dispersion in the fluctuation of a variable around its mean value. This is employed to express the fact that there is a lack of homogeneity in the dimensions of elements within a specific group (Algar, 2009). The skewness of a distribution is a measure of its symmetry. Skewness is a measure of the difference in size between the two tails of a distribution (Longnecker, 2010). Kurtosis is an indicator of the combined sizes of two tails; it additionally explains the distribution and skewness of data about the mean via chart descriptions. Kurtosis helps the researcher by providing information about the distribution's peak, and skewness provides information about the distribution's symmetry. Pallant (2010) mentions that:

- The distribution is normal if both the kurtosis and the skewness are zero.
- The distribution is skewed to the left and the scores are low when the skewness is positive.
- If the skewness is negative, the distribution is skewed to the right and the scores are high.
- The peak will be centred and have lengthy tails when the kurtosis is positive.
- The distribution is flatter when the kurtosis is negative.

### 3.9.1 Inferential statistics

Most researchers use inferential statistics to derive interpretations or assumptions about a group of people depending on the sample size chosen. It makes use of bivariate and multiple regression. Inferential statistics are processes that enable researchers to extrapolate, or generalisation findings made with samples to the broader population from which they were drawn. Inferential statistics additionally enable researchers to use data collected from a sample to generate conclusions based on a broader group of people (Privitera, 2013). Multivariate data and bivariate is used in inferential statistics.

### 3.9.2 Bivariate data analysis

According to Denis (2016), in analysing bivariate data, the researcher examines two separate variables. In simple terms, the researcher is looking for two distinct pieces of data that might represent the collection of elements that are reliant on each other. Bivariate, on the other hand, can be defined as the numbers from two variables that are typically displayed using a scatter plot for quickly determining the connection between both variables. Furthermore, Fesel (2012) indicates that in bivariate data analysis, data are unaffected by one another, but two measures inside an observation are dependent on one another. The goal of data analysis is to fully explain the study of two variables at the same time, as well as to provide a quick explanation of the connection, contrast, relationship, and reasons. Furthermore, data analysis explains tables in which one variable has an impact on the outcomes of another variable.

Statistical analysis is critical for simpler interpreting and analysing data. Furthermore, it helps researchers to summarise and address the population through determining the sample size (Olaewe and Kareem, 2010). Statistics analysis is classified into two distinct categories: nonparametric and parametric. In understanding population data, parametric statistical measures rely on the shape of the distribution. Indicates that when analysing or interpreting data, nonparametric statistical techniques do not rely on the shape of the distributions (Hoskin, 2014).

The parametric statistical procedures include a single way analysis of variance, also known as ANOVA, and the t test. Olaewe and Kareem (2010) mentioned that ANOVA is used by academics to determine when there is an important distinction among several variables. The Anova test enables the researcher to examine the degrees of importance and level of freedom. The 0.05 level of significance was used in this investigation, which means that:

- The variation among variables is considered significant whenever the degree of importance is less than or equal to 0.05.
- There is no statistically significant distinction among variables whenever the threshold of importance exceeds 0.05.

This research will use bivariate analysis, which includes hypothesis testing, cross tabulation, Chi square, Pearson correlation and analysis of variance.

Pearson correlation is a statistical method for determining the degree as well as the direction of a linear connection among two independent variables (Jonhson, Beyl, Burton, Johnson, Romer and Zhang, 2015). The range of values for the correlation coefficient (r) is 1 to 1. The coefficient's absolute magnitude increases with the strength of the relationship between the variables. Moreover, a Pearson correlation with an absolute value of 1 indicates a perfect, linear relationship. The absence of a linear relationship between the variables is shown by a correlation near 0. Furthermore, the relationship line slopes downward, and the coefficient is negative if one of the variables typically rises while the other normally decreases (Cooper and Schindler, 2010).

Jonhson et al. (2015) state that the Chi square test evaluates the actual number in every cell in the table to what should be predicted if there is no relationship between the raw and column categorisation. The Chi square test can also be used to test the hypothesis that there is no connection among multiple groups, populations, or criteria. In other words, actual counts undergo comparison with anticipated counts. Cross tabulation is a quantitative research approach employed to examine the connection among variables (Micheal. 2010). Furthermore, cross tabulation is defined as the combined distribution of frequencies calculated using several variables.

### 3.10 Data Quality Control

Quality control is defined as methods and procedures employed by researchers in the study for assurance of the accuracy and quality of obtained data (Webster, 2010). Trustworthiness, conformability, and transferability of the qualitative method are all aspects of data quality control. Reliability and validity are equality important in the quantitative data quality control process to ensure that data collected is accurate. In a quantitative study, reliability and validity are referred to as trustworthiness. In the qualitative study, trustworthiness also encompasses credibility, conformability, dependability, and transferability.

Trustworthiness: According to Morake (2020), the approach or procedure utilised by the researcher to demonstrate the truth value in the study is regarded as trustworthiness. In a quantitative study, reliability and validity are referred to as trustworthiness. Validity and reliability ensure that the data collected is accurate. In the qualitative study, trustworthiness also encompasses credibility,

conformability, dependability, and transferability. Positivism and interpretivism are the two paradigms available to the researcher to utilise.

Positive paradigms place a strong emphasis on empirical information derived from theories. They also depend on the computational observations that result in statical analysis. In essence, the positivist study restricts the researcher's use of data interpretation and collecting (Thomas, 2010). The goal of interpretivist paradigms is to understand people's subjective experiences. In favour of more individualised research structures, interpretivists refrain from rigid structural frameworks. Thus, instead of oversimplifying and predicting causes and effects, understanding and interpreting the meanings in human behavior is the main objective of interpretivist study (Thanh, 2015). Trustworthiness is concerned with the interpretivist paradigm in qualitative and it is primarily focused on the positivist paradigm in the quantitative study. Therefore, this study will focus on positivist paradigm.

Reliability: The degree to which test measurements hold true over multiple runs of the same subject conducted under identical circumstances is known as reliability. It measures how well measuring processes produce consistent results across trials (Braz, 2018). Several types of reliability exist, including parallel form, test retest, internal consistency and observing the observer's reliability. Most often, researchers use Cronbrach’s alpha coefficient, defined as scale reliability, to assess the consistency of the items, which translates to how closely linked a group of items are (Alkhadim, 2022). The Cronbach’s alpha coefficient was adopted in the study to evaluate the reliability and consistency of the questionnaire responses.

Validity: According to Alkhadim (2022), validity refers to the extent to which theory and evidence support the intended uses' interpretations of test results. Therefore, it is crucial that the surveys given to employees achieve a certain level of validity. There was time set aside for questions, answers, and assistance from employee’s aides. Internal validity, construct validity, external validity, and content validity are the several types of validity. The degree to which outcomes may be attributed to the independent variable identified as internal validity (White and McBurney, 2012). The external validity is the degree to which a study's findings can be applied generally; the validity assesses this degree of generalisability (White and McBurney, 2012). Testing a scale's

construct validity entails comparing it to theoretically derived hypotheses about the characteristics of the underlying variable rather than a single criterion. The appropriateness of a measure or scale's sample from the intended topic domain is known as content validity (Pallant, 2010).

In this research, validity was ensured though several key measured. First, the study employed a research design called quantitative approaches, which allowed for an analysis of the data through numerical values and manipulation of observations. It allowed the researcher to transmit numerical data to the important statistics to quantify behaviors, opinions, attitudes and generalize results from a larger sample population. This approach helped in validating the findings. Additionally, data quality control measures were implemented to ensure the accuracy and reliability of the data collected. This included cleaning the data before analysis and utilizing appropriate statistical tools, such as the Statistical Package for Social Sciences (SPSS), to analyze the data effectively.

The research also relied on established theoretical frameworks, such as the Collaborative Planning, Forecasting, and Replenishment (CPFR) model, to guide the study, ensuring that the findings were grounded in existing literature and best practices. Moreover, the study included a clear and systematic process for data collection, involving the use of questionnaires that were carefully designed to capture relevant information from participants. The use of a Likert scale in the questionnaires helped in quantifying responses, thus enhancing the validity of the data. The Cronbach's alpha coefficient was adopted in the study to evaluate the reliability and consistency of the questionnaire responses. Based on the results, it indicated a high or good level of internal consistency and dependability for both the research instrument (questionnaire) and the continuous study variables.

Furthermore, the study maintained a focus on ethical considerations, ensuring that the data collection process was conducted with respect for participant confidentiality and voluntary participation. By adhering to these rigorous methodological standards and ethical guidelines, the research ensured the validity and reliability of its findings, thereby contributing meaningful insights into the supply chain management practices at BP Southern Africa.

### 3.11 Measurement Scale

The process of measuring involves determining and recording which of the possible attributes of a variable each particular case exhibits or possesses. A scale of measurement offers the range of scores that can be assigned to instances throughout the measurement process (Argyrous, 2011).

Nominal data was utilised when collecting the information into different groups, such as biographical data (race, gender, and age). In addition, a Likert scale was adopted to get true information from the respondents regarding the questions asked. Quantitative method will used to analyse data using statistics tools (Biber, 2010:10).

### 3.12 Ethical consideration

Researchers must ensure that there are no delays when conducting the study by considering the ethical clearance early. Kahari (2010:10) asserts that ethics is the moral principles that governs or influence the individual's behaviour when performing an exercise or any activity. The researcher has obtained the permit to conduct the study at the British Petroleum situated in Western Cape Province. Therefore, the ethical approval was acquired from the research committee at the University for the distribution of questionnaires to employees. The respondents' privacy is of the utmost importance and all information acquired was handled with complete confidentiality. All participants were handled with respect and the surveys will completely be voluntary for the participants, no one was compelled to do it. Before the survey, the study was explained, and the anonymity of the information gathered for the study was protected. Participants was given false names in order to remain anonymous, and not be victimised by the employer.

### 3.13 Limitation and delimitation of the study

Limitations are affecting that researcher cannot change (Wiesrma, 2012:24). The limitation of this research is restricted time of finishing questions on the part of responders, due to other work activities. Furthermore, the vagueness of the responses from the questionnaires of the participants from employees is one of the research's weaknesses, as some individuals might not understand the questions or lack focus and motivation in replying. According to Simon and Goes (2013:3), delimitations encompass those aspects that disturb the scope of the research. The delimiting factor is that this research focuses only on Western Cape Terminal, while the company has other sites or head offices in other provinces, or internationally.

### 3.14 Conclusion

This chapter concludes with a discussion and an overview of the used study design. The objective of this study is to apply quantitative research in order to translate facts into numerical values and

gain a comprehensive grasp of the issue. Controlling the relationship between an independent variable and a population dependent variable, often known as an outcome variable, is the main objective of quantitative study design (Mehrad and Tahrini, 2019). Therefore, stratified random sampling, a probability sampling design, was used in this study. Workers from the relevant departments who are part of the population was chosen at random. Self-administered questionnaires form part of this research as well as secondary and primary data. It further provided discussion regarding all the methods employed to ensure reliability and validity of the research. The population of this research are the BP Southern Africa employees. The chapter highlighted the study's limitations, ethical considerations, and limits. Approaches for analysing statistical data such as univariate, bivariate, and multivariate statistics have been addressed. The following chapter analysis and interprets information obtained from the participants.

# CHAPTER 4: DATA ANALYSIS AND RESENTATION

## 4.1 Introduction

The purpose of this chapter is to present an overall perception of the BPSA employees regarding the importance of integrated supply chain management approach in the petroleum industry. The chapter analyses the data collected from thirty nine respondents participated in the study. Univariate and bivariate were analysed with graphs, tables and diagrams, using SPSS v 29.0. Multiple regression analysis was utilised in conjunction with central tendency measures to investigate the correlation between the independent variables in the study and the dependent variable, collaboration of activities. The research produced compelling data on every research goal and self-administered questionnaires were given to all department employees. Such departments involve storage and handling, transport, scheduling and planning, information, and technology, and forecasting.

## 4.2 Data Preparation and Coding

Every questionnaire was reviewed to make sure it was filled out completely and error free to verify that all the data obtained could be analysed. The respondents were given the opportunity to complete returned incomplete forms since the data was gathered through door to door canvassing and emails. This allowed all the questionnaires to be returned error free, with zero denoting any missing values. Every question and potential response in the questionnaire had a code in terms of coding since data coding was required for both data transmission and SPSS editing.

## 4.3 Univariate statistical analysis

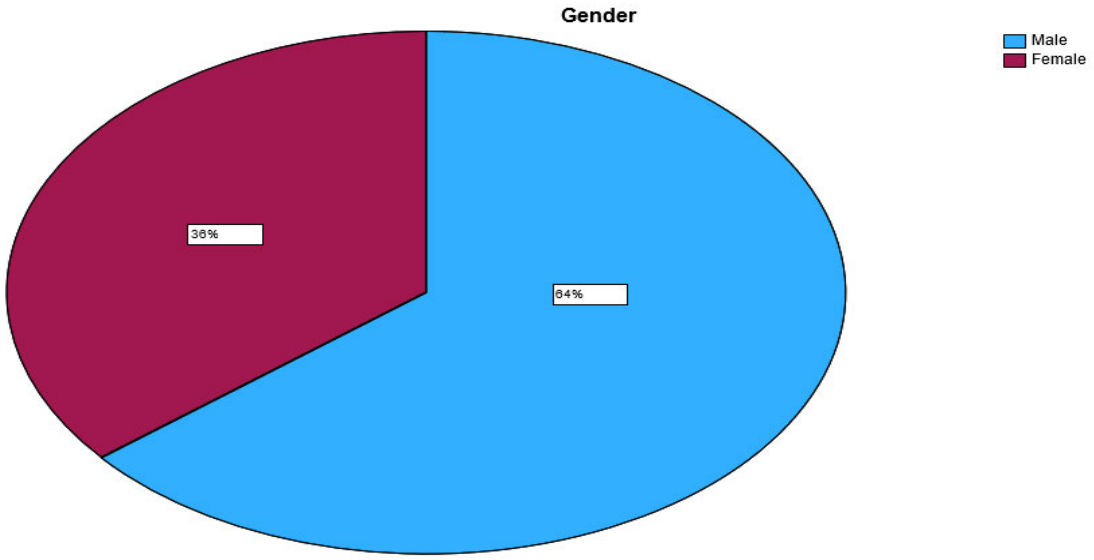
Analysis that looks at cases based on a single variable at a time is called univariate data analysis. According to Ho (2014), the study looks at how the independent variable affects the dependent variable. The frequency distribution and descriptive statistics are components of the univariate data analysis.

### 4.3.1. Frequency distribution

Manikandan (2011) claims that a frequency distribution looks at a single variable at one point in time and offers a variety of findings, observations, and related frequencies, such as percentages inside the specified interval. This can be represented graphically, or by tabular means. To make

material easier to understand, the researcher represented frequency distribution using histograms, tables, or bar graphs. Below frequency distribution is used to analyses gathered data from demographic data such as age, gender and respondents experience data.

**Figure 4.1 Gender**




A statistical comparison of respondents' genders between female and male. Figure 4.1 illustrates that the gender distribution of the respondents involves 64% males and 36% female employees from the total of all employees who participated in the study. Therefore, this indicates that there are more males than female who responded the questionnaires. However, this was influenced by the depot environment, since its male dominant.

**Figure 4.2 Age group**

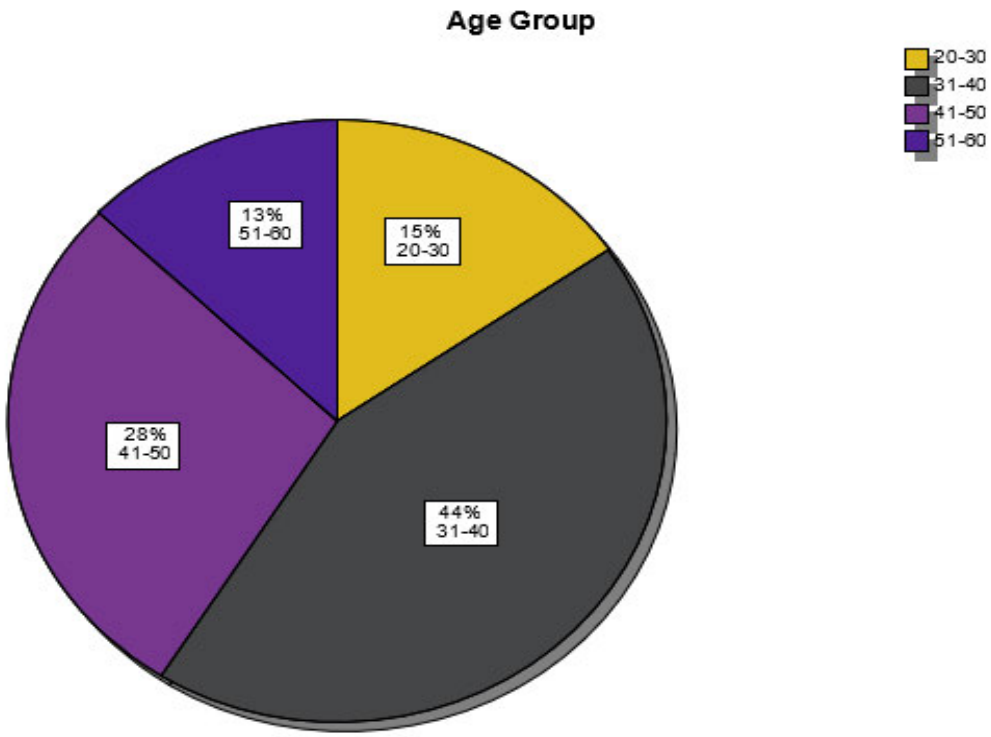



Figure 4.2 indicates the age group of the respondents, 15% respondents belong to 20 30 age group, 44% respondents belong to the age group between 31 40, 28% respondents belong to the age group between 41 50 and 13% respondents belong to the age group between 51 60. This demonstrates that most of the employees who participated in this research belong to the age group of 31 40.

**Figure 4.3 Level of management**

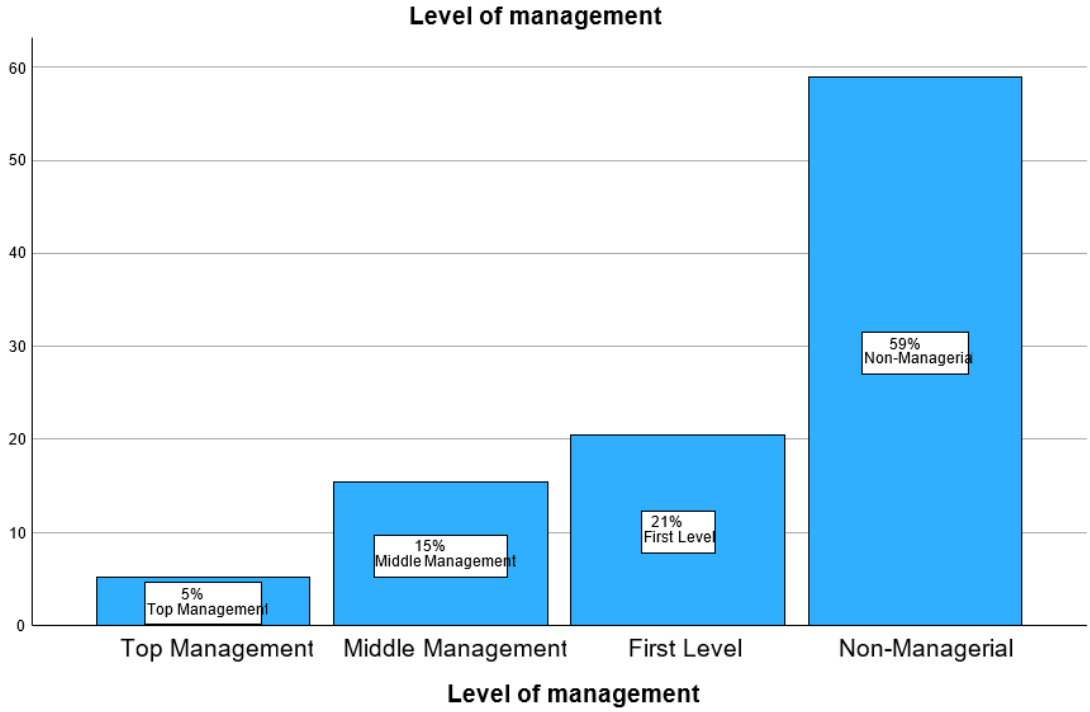



Figure 4.3 depicts the level of management for the employees who participated in the study, where: 5% respondents belong to top management; 15% respondents belong to the middle management; 21% respondents belong to the first level; 59% respondents belong to the non-managerial. Respondents were chosen using the stratified random sample, a probability sampling technique. Most employees at the depot environment fall under the non-managerial level. This therefore contributed to a high percentage of the non-managerial 59% compared to other levels of management.

**Figure 4.4 Number of years working for petroleum industry**

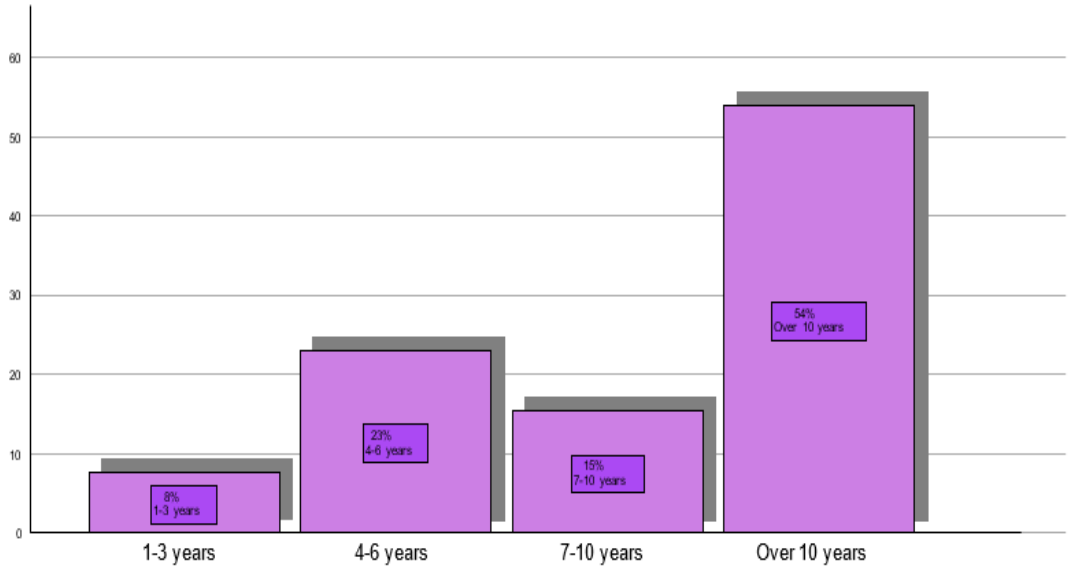



Figure 4.4 shows how long the employees have been working for the petroleum industry, where: 8% of the respondents have worked for 1 3 years; 23% of the respondents have worked for 4 6 years; 15% of the respondents have worked for 7 10 years; and 54% of the respondents have worked for over 10 years. This figure indicates that the company has more people who have worked for over 10 years, which further elaborates that many employees have extensive experience.

**Figure 4.5 The right quantity delivered at the right time**

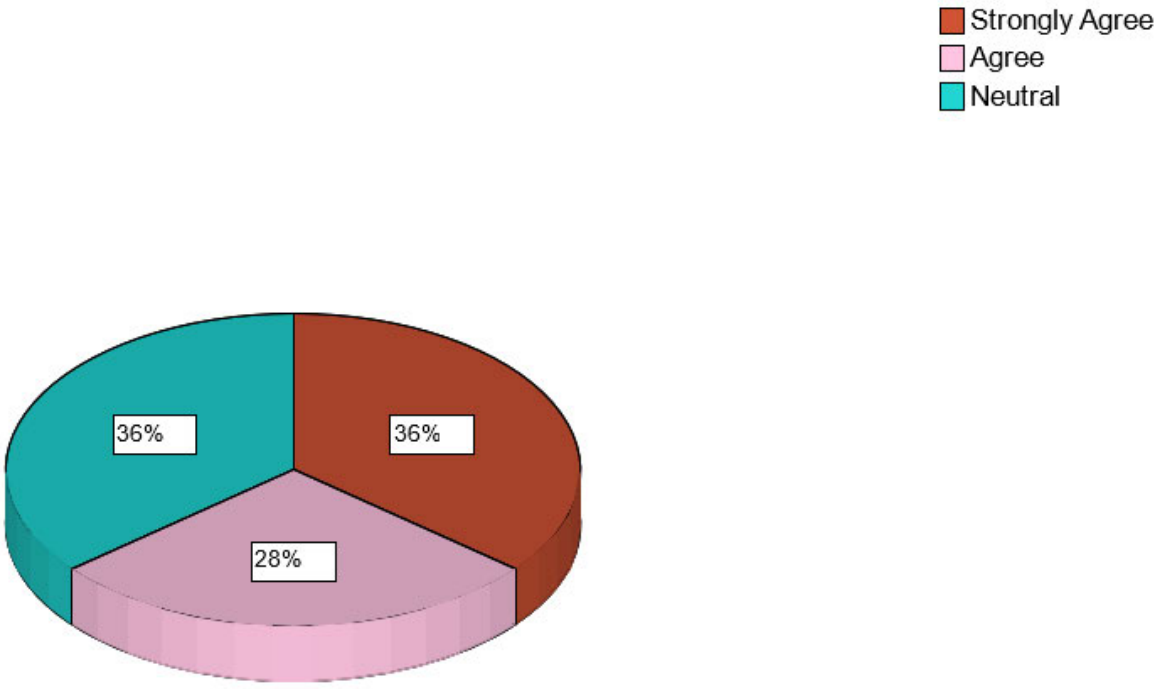



Figure 4.5 provides the insight on the respondents' responses to the question of the replenishment system in place, which allows customers to access product of their choice the right quantity, at the right time and delivered at the place. According to the above figure, (36%) strongly agree; (36%) are neutral; and (28%) agree that product is always delivered at the right time. This captures the fulfilment of demand as accurately and promptly as possible. However, it is likely possible that product is in a different place than anticipated due to unforeseen circumstances. Therefore, to ensure that the customer orders are fulfilled, shorten shipment lead times, and eliminate stockouts and markdowns, businesses require an accurate view of the inventory.

**Figure 4.6 Collaboration with other internal operational departments**

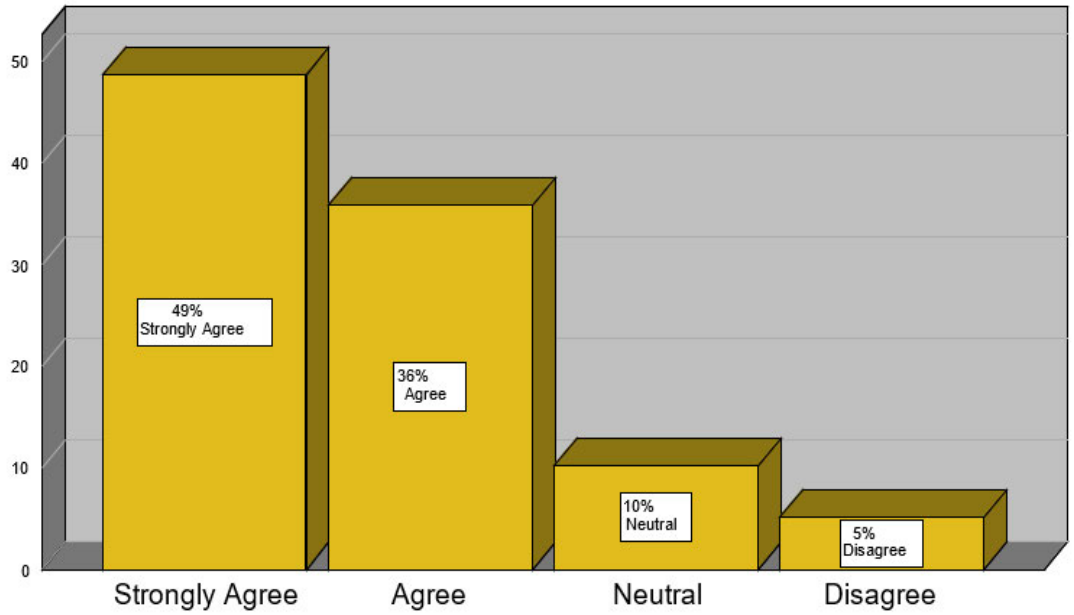



Figure 4.6 illustrates that only 5% of the respondents disagree that the terminal collaborate with other internal operational departments, while 10% of the respondents were neutral about the collaboration within departments. Notably, 36% of the respondents agreed, while 49% strongly agreed that the terminal collobarate with other internal operational departments. Establishing a cohesive framework for data and integrating the many components of a supply chain results in improved chainwide knowledge that enables the terminal to minimuse low stcok levels and increased inventory turnover. With more respondents agreeing to the collaboration in the business, it shows that the terminal collaborate with stakholders in ensuring increased supply chain transparency to avoid suffering reputational harm as a result of suppliers' vulnerabilities.

**Figure 4.7 Reliability of previous data**

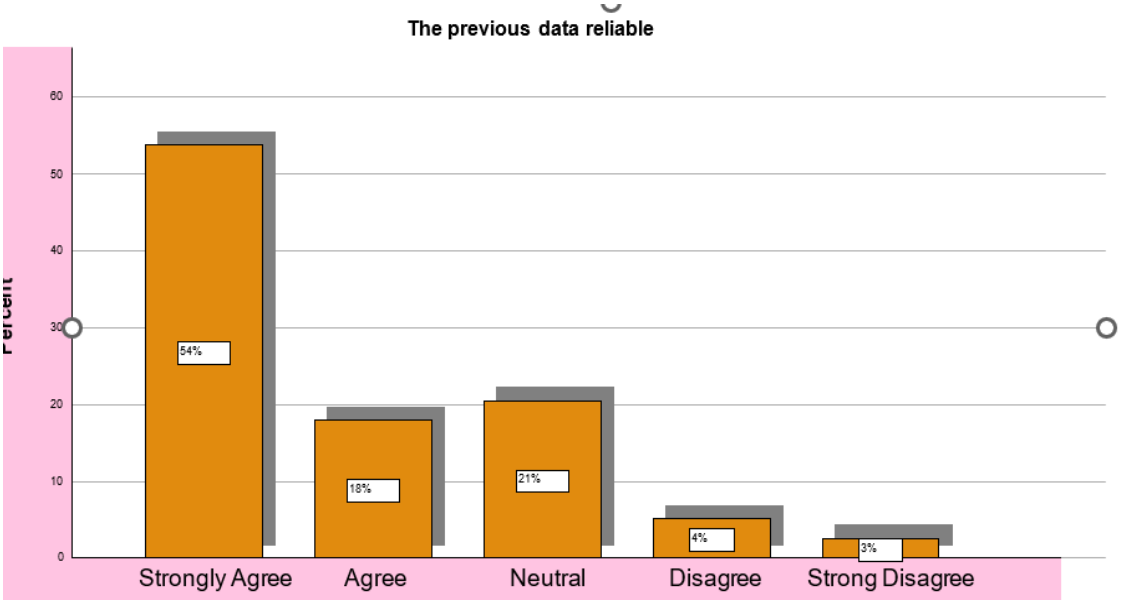



Figure 4.7 demonstrate that 54% respondents strongly agree that previous data is reliable in such a way that it predicts future demand; 21% respondents were netrual; 18% respondents agree that previous data reliable; 4% disagreed; and 3% strongly disagreed that previous data always predit future demand. This shows that collected data from previous years helps to ensure that future demand is predicted.

**Figure 4.8 Forecasting result communication**

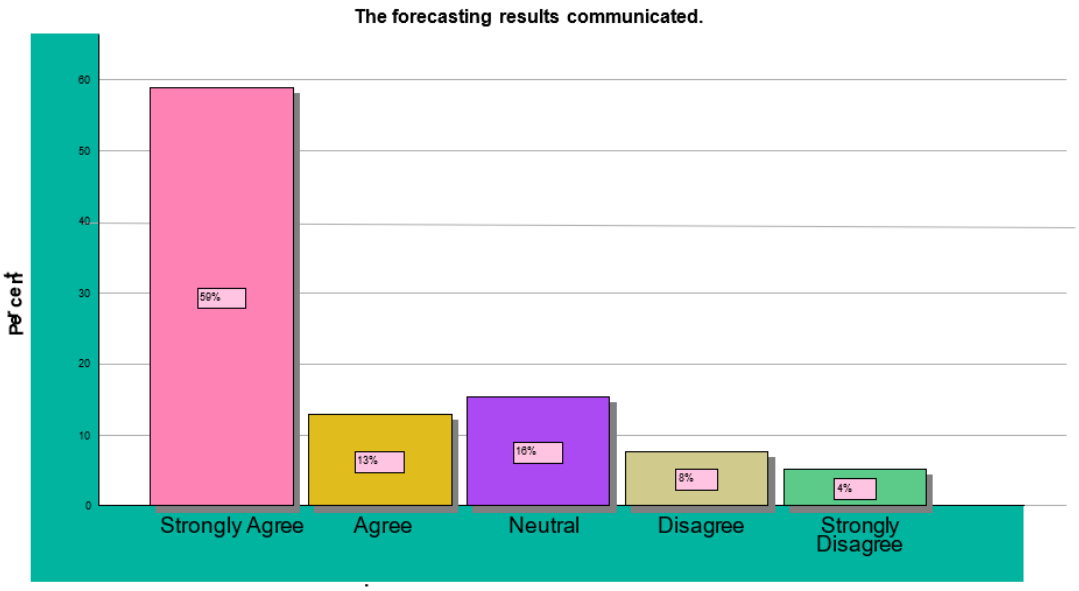
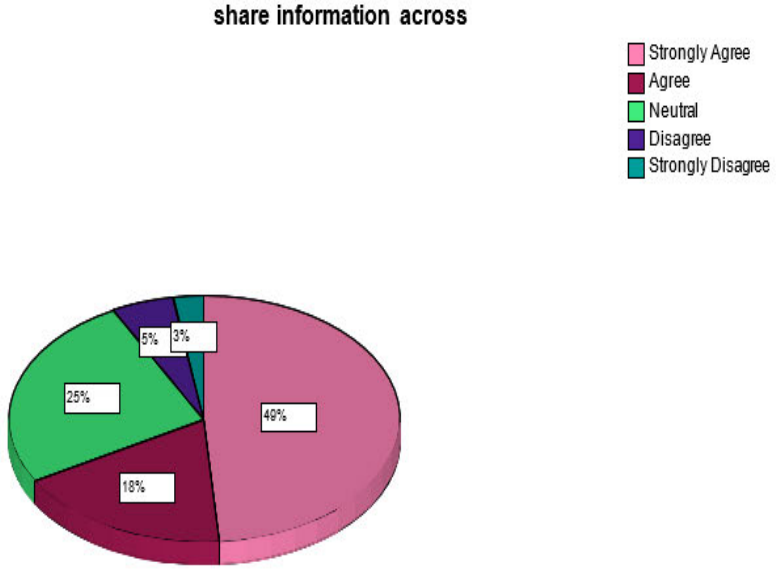



Figure 4.8 shows that 59% respondents strongly agree that forecasting results are always communicated to all stakeholders; 16% respondents were neutral; 13% respondents agree that focaresting are always communicated; 8% disagree; and 4% strongly disagree. This graph shows that forecast results are always communicated to all relevent stakeholders.

**Figure 4.9 Information sharing across operational departments**




Fugure 4.9 provide an insight into the information sharing across business, where 49% of respondents strongly agreed that operational departments such as storage and handling, transport, scheduling always share information across to ensure that theres enough petroliem products in the tanks. A quarter or 25% were netrual about information sharing; 18% agreed that information is shared across; 5% disagreed; and 3%strongly disagreed that information is shared.

**Figure 4.10 Replenishment system**

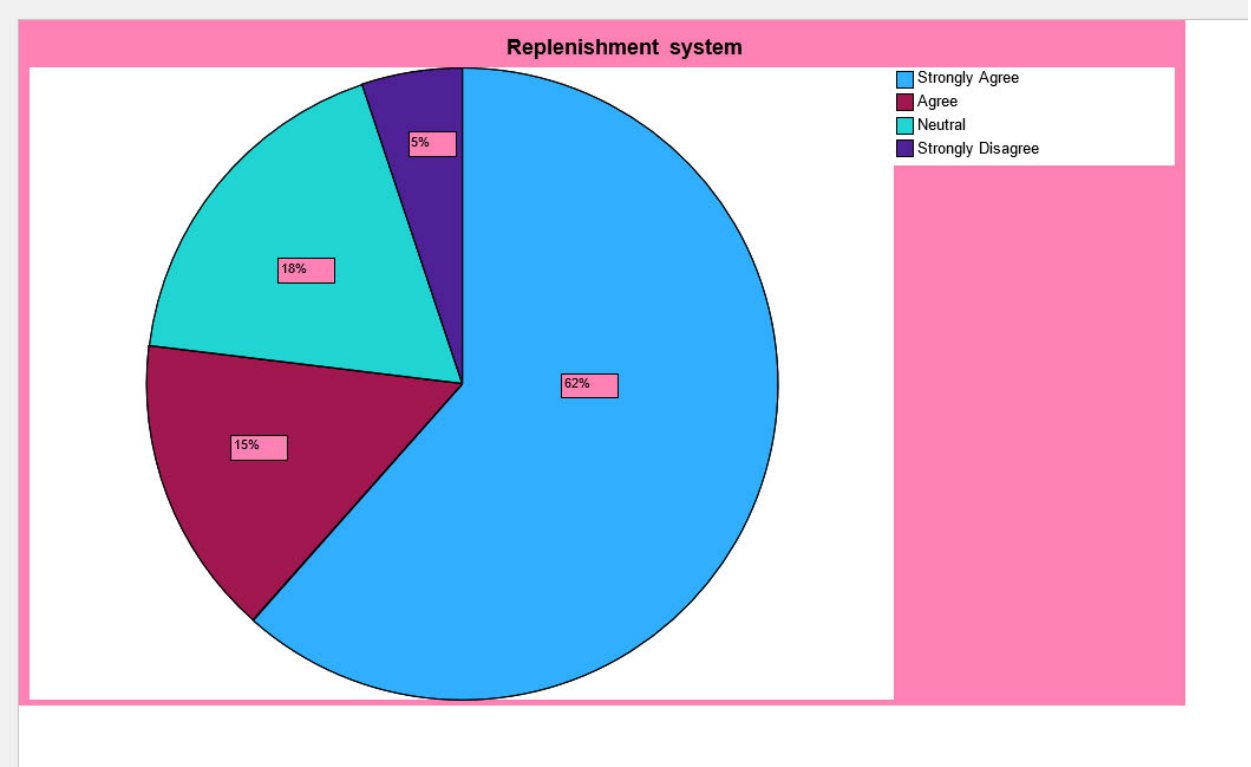
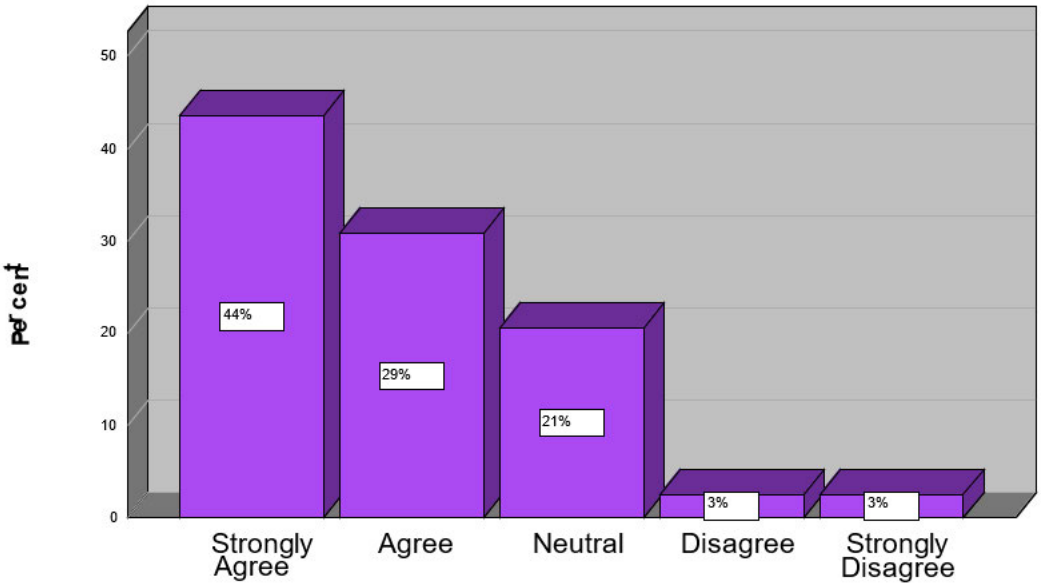



Figure 4.10 provides insight into whether the replenishment system in place allows customers to access product of their choice at the right time, the right quantity and delivered at the right place, where 62% of respondents strongly agreed; 18% were neutral; 15% respondents agreed; and 5% strongly disagreed. This shows that replenishment systems were in place to ensure that the customers receive their product on time.

**Figure 4.11 Sufficient petroleum in tanks**




Fugure 4.11 shows respondents perceptions about having suffient product in tanks, where 44% of respondents strongly agree; 29% of respondents agree; 21% were netrual; 3% disagree and another 3% strongly disagree. This demonstrates that most respondents strongly agreed that planning and scheduling could assist in ensuring that all tanks have enough petroleum product.

### 4.3.2 Descriptive statistics

One type of statistic known as descriptive statistics is a methodical approach to arranging and summarising data. The interval scaling questions, as well as the central tendency, dispersion, skew, and kurtosis, are illustrated by the descriptive statistics below. Five-point Likert scale data, with 1 denoting least satisfaction, 2 slightly satisfaction, 3 neutral, 4 considerably satisfaction, and 5 extremely satisfaction, was used to create the table.

**Table 4.1 Collaboration**

| | Matching demand and supply liquid petroleum product | Internal operational departments | Supply chain collaboration managed effectively | Adequate systems and processes |
|---|---|---|---|---|
| N | 39 | 39 | 39 | 39 |
| Mean | 1.77 | 1.72 | 2.13 | 2.15 |
| Median | 1.00 | 2.00 | 2.00 | 2.00 |
| Mode | 2 | 1 | 1 | 1 |
| Std. Deviation | .986 | .857 | 1.014 | .894 |
| Skewness | 1.189 | 1.124 | .793 | .437 |
| Kurtosis | 1.219 | .761 | .364 | .440 |

Table 4.1 demonstrates that the factor, adequate systems and processes has the highest mean (2.15) with a standard deviation of (0.894), the responders' deviations from the mean were minimal, as indicated by having the second lowest standard deviation. Supply chain automated activities minimise human mistake and lost time if you want to be sure it is operating at peak efficiency. To maximise production, it is important to constantly maintain the appropriate tools on hand and minimise the number of idle tools. The skewness of the factor of (0.437) shows a leftward skew in the distribution and a greater number of low scores. The mode factor is (1 Likert scale 1= strongly agree), which means that most respondents agreed that there is adequate systems and processes to ensure that tasks are well coordinated between functional departments. Furthermore, the kurtosis (0.440) means that the distribution is flatter since the kurtosis is negative.

The second factor is supply chain collaboration managed effectively indicates the highest mean (2.13) with the mode (1), such specifies that supply chain collaboration that is managed effectively is the most crucial variable in the organisation. The standard deviation represents the degree to which a collection of data deviates from its mean, the standard deviation of the factor managed collaboration effectively is high (1.014), which signifies that the respondents deviated that much from the mean.

The distributional symmetry measure is called skewness. The skewness of the factor, which is (0.793), means that the distribution is skewed to the left, and that the scores are low when the skewness is positive. In the case of the factor of which the mode is (1 Likert scale 1= strongly agree), the majority of respondents stated that they strongly agree with the factor of managing collaboration in the petroleum industry. The term "mode" indicates to the value that appears most frequently in the data set. The kurtosis factor is (0.364) therefore the peak was centred and have lengthy tails when the kurtosis is positive.

Another factor that affects the collaboration in the table above is the collaboration with other functional operations to add value in matching demand and supply of liquid petroleum product. This factor has the third largest mean (1.77), which shows that respondents view matching demand and supply as a very critical element in supply chain collaboration. The last factor with the lowest mean (1.72) and mode (1) is the internal operational department, which influences collaboration. However, according to the respondents, it is not as significant as other factors as it listed as the last one compared to others. With regards to the factors that influences collaboration, employees indicated that having adequate systems and processes plays a crucial role in the business to ensure that tasks are well coordinated between functional departments. Coordination of actions among organisational members is necessary for the efficient fulfillment of organisational objectives.

**Table 4.2 Planning and scheduling of operational activities**

| | Operational activity always customer driven | Enough petroleum product | Fair distribution amongst all the stakeholders | Planning and scheduling systems | Allocation of operation resources | Smooth operation |
|---|---|---|---|---|---|---|
| N | 39 | 39 | 39 | 39 | 39 | 39 |
| Mean | 2.03 | 2.10 | 1.97 | 2.23 | 2.08 | 2.21 |
| Median | 2.00 | 2.00 | 2.00 | 3.00 | 2.00 | 2.00 |
| Mode | 2 | 2 | 2 | 1 | 2 | 1 |
| Std. Deviation | .986 | .912 | .873 | 1.038 | .900 | 1.005 |
| Skewness | 1.160 | .887 | .551 | .700 | .528 | .549 |
| Kurtosis | 1.329 | 1.388 | .377 | .037 | .355 | .068 |

Table 4.2 above illustrates planning and scheduling of operational activities. Planning and scheduling systems allows tracking of stock in transit between receiver and dispatch is found to be the factor with the highest mean (2.23) and the standard deviation (1.038) with the median (1) and mode (1). The mode refers to the most frequent value in the data, referring to which score has the most frequency. The modes indicate that respondents strongly agree (1), demonstrating that they deemed planning and scheduling systems to be the most critical factor in allowing the tracking of stock in transit between receiver and dispatch.

This factor has the kurtosis of (0.037), which means that the peak was centred and have lengthy tails since the kurtosis is positive. Kurtosis is an indicator of the combined sizes of two tails; it additionally explains the distribution and skewness of data about the mean via chart descriptions. Kurtosis helps by providing information about the distribution's peak, and skewness provides information about the distribution's symmetry. The skewness of the factor is (0.700), which is positive, showing that the distribution is skewed to the left, and that scores are low. Skewness is a measure of the difference in size between the two tails of a distribution.

The second factor that influences collaboration is smooth operation, with mean (2.21), and standard deviation of (1.005). The skewness of the factor is (0.549), which shows that there are more low scores, and the distribution is skewed to the left. The mode of the factor is 1, which means that respondents strongly agree (1 Likert scale) that planning and scheduling of operational activities allows smooth operation. The kurtosis is (0.068), which means that the distribution is skewed to the left, and scores are low.

The third highest factor is enough petroleum product in the tanks with the mean (2.10), the standard deviation (9.12), and the mode 2 = agree according to Likert scale. Kurtosis (0.741) and skewness (0.378) are positive. The distribution is skewed to the left, and the scores are low when the skewness is positive, where the peak was centred and have lengthy tails for the kurtosis. The fourth factor refers to the allocation of operation resources such as transport and labour. The factor's mean is (2.08) with the standard deviation of (0.900), and mode of 2, indicating that the respondent agreed (2 Likert scale) that this factor influences planning and scheduling. Kurtosis is (0.355) and skewness (0.378), where in terms of negative kurtosis, the distribution is more horizontal and shows positive skewness, with the distribution skewed to the left and low scores.

The last factor is customer driven operational activities, with a mean of (2.03), standard deviation of (0.986), and a mode of (2). The kurtosis (0.741) and skewness (1.160) are both positive. The last factor is the fair distribution amongst all the stakeholders with the mean (1.97), standard deviation of (0.873), and mode of (2). This shows that respondent agree (2 Likert scale) with this factor, but there is still room needed for improvement. The kurtosis (0.377), which is negative, meaning that the distribution is flatter, and skewness is (0.551), where distribution is skewed to the left, since skewness is positive.

**Table 4.3 Forecasting of the liquid petroleum product**

| | Future demand predicted | The right quantity at the right time | Communication to all stakeholders |
|---|---|---|---|
| N | 39 | 39 | 39 |
| Mean | 2.28 | 2.49 | 2.38 |
| Median | 2.00 | 2.00 | 2.00 |
| Mode | 1 | 1 | 2 |
| Std. Deviation | .999 | 1.211 | 1.161 |
| Skewness | .559 | .359 | .561 |
| Kurtosis | .095 | .867 | .438 |

Table 4.3 illustrates the forecasting of the liquid petroleum product and the right quantity at the right time has been identified as the most important factor in forecasting with the highest mean (2.49) with the standard deviation (1.211). The standard deviation is less than the mean, which means that there is small variance in the data. As a result, the sample mean accurately represents the population mean. " Strongly Agree" is the most commonly occurring value among these three variables, as demonstrated by the sample's critical point, which is further supported by the median and mode figures. The mode is 1 = Strongly Agree shows that respondent strongly agreed that forecasting influences the right product, with the right quantity delivered at the right time. The skewness of the factor is (0.359) positive shows that the distribution is skewed to the left. Furthermore, the kurtosis is (0.867), which is negative, suggests that the distribution is more horizontal and has a smaller peak with most of the values extreme towards the end.

According to the table above, the second factor is the forecasting results always communicated to all stakeholders with the mean (2.38), mode (2) and standard deviation of (1.161). This is the second crucial factor in forecasting to ensure that results are communicated all the time. Most issues with emotions and expectations are avoided with a consistent rhythm and straightforward communication. In the situation that the forecast takes a different turn, clearly conveying the forecast, while outlining the uncertainties and underlying assumptions of each model will help to

control the situation. A flat distribution curve is revealed by negative kurtosis (0.438), which indicates that the distribution curve lacks a top or peak and lastly the skewness factor is (0.561). The last factor is the predicted future demand with the mean (2.28), standard deviation (0.999), and mode (1) = strongly agree. This factor does not need too much attention from management as most of the respondent strongly agreed that forecasting predict future demand. The skewness and kurtosis are both positive which means the distribution is skewed to the left and the scores are low, and the peak was centred and have lengthy tails.

**Table 4.4 Replenishment**

| | Operational departments | Orders tracked and delivered in right quantity | The replenishment systems |
|---|---|---|---|
| N | 39 | 39 | 39 |
| Mean | 2.28 | 2.18 | 2.00 |
| Median | 2.00 | 2.00 | 2.00 |
| Mode | 2 | 2 | 1 |
| Std. Deviation | 1.025 | .997 | .858 |
| Skewness | .474 | .965 | .000 |
| Kurtosis | .149 | 1.463 | 1.663 |

Table 4.4 indicates that operational department e.g. warehouse, transport, scheduling always share information across is the most important factor with the highest mean (2.28), with the standard deviation of (1.025), which is less than the mean meaning the respondent deviated from the mean. The mode is 2, as most respondents agreed that this factor is thought to be one of the best strategies for enhancing supply chain effectiveness and reducing stock out of the petroleum product. Furthermore, the exchange the appropriate information at the appropriate time is essential for effective information exchange between companies with disparate goals and viewpoints. Nevertheless, putting information sharing into reality is difficult and this factor still requires a room of improvement in ensuring that the terminal operates smoothly. In the joint venture

business, participating enterprises typically lack the information about each other's plans and intentions needed to appropriately synchronise their services and operations, which gives rise to the problem of asymmetric information. Due to the economic worth of that information, chain members frequently do not want to fully and honestly disclose all their private information to other chain members. The skewness is (0.474), indicating that the distribution is skewed to the left and there are low scores as many of the respondents agreed. In addition, the kurtosis is (0.149), showing a more horizontal distribution.

The second factor with the next highest mean (2.18) is the orders tracked and delivered in right quantity with the mode (2) and standard deviation (0.997). Most respondents agreed that this factor is influenced by replenishment. The skewness is (0.965) and kurtosis is (1.463). The last factor is the replenishment system in place, which allows customers to access product of their choice at the right time, at the right quantity and delivered at the right place. The mean (2) standard deviation (0.858) and mode (1). The mode is 1 = strongly agree meaning that factor does not need too much attention from top management, because the replenishment system in place allows customers to access product of their choice at the right time, at the right quantity and delivered at the right place. The skewness and kurtosis are (0.000) and (1.663).

### 4.4 Inferential statistics

Most researchers use inferential statistics to derive interpretations or assumptions about a group of people depending on the sample size chosen. It applies multiple regression as well as bivariate analysis. The procedures known as inferential statistics allow researchers to extrapolate, or generalize, findings from samples to the entire population. Additionally, inferential statistics allow researchers to draw conclusions about a larger population from data gathered from a sample (Privitera, 2013). Multivariate data and bivariate is used in inferential statistics.

## Table 4.5 Pearson correlation coefficient analysis

| | | Internal operational departments | Demand and supply | Collaboration managed | Systems and processes | Customer driven | Enough product | Distribution | Operation resources |
|---|---|---|---|---|---|---|---|---|---|
| Internal operational departments | Pearson Correlation | 1 | .606** | .627** | .564** | .632** | .611** | .377* | .575** |
| | Sig. (2 tailed) | | <.001 | <.001 | <.001 | <.001 | <.001 | .018 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Demand and supply | Pearson Correlation | .606** | 1 | .326* | .333* | .575** | .437** | .176 | .466** |
| | Sig. (2 tailed) | <.001 | | .043 | .038 | <.001 | .005 | .283 | .003 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Collaboration managed | Pearson Correlation | .627** | .326* | 1 | .791** | .469** | .552** | .510** | .362* |
| | Sig. (2 tailed) | <.001 | .043 | | <.001 | .003 | <.001 | <.001 | .024 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Adequate systems and processes | Pearson Correlation | .564** | .333* | .791** | 1 | .533** | .403* | .308 | .478** |
| | Sig. (2 tailed) | <.001 | .038 | <.001 | | <.001 | .011 | .057 | .002 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Operational activity customer driven | Pearson Correlation | .632** | .575** | .469** | .533** | 1 | .699** | .459** | .620** |
| | Sig. (2 tailed) | <.001 | <.001 | .003 | <.001 | | <.001 | .003 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Enough petroleum product | Pearson Correlation | .611** | .437** | .552** | .403* | .699** | 1 | .764** | .600** |
| | Sig. (2 tailed) | <.001 | .005 | <.001 | .011 | <.001 | | <.001 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Distribution amongst all the stakeholders | Pearson Correlation | .377* | .176 | .510** | .308 | .459** | .764** | 1 | .721** |
| | Sig. (2 tailed) | .018 | .283 | <.001 | .057 | .003 | <.001 | | .002 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Planning and scheduling systems | Pearson Correlation | .282 | .259 | .566** | .421** | .303 | .558** | .588** | .403* |
| | Sig. (2 tailed) | .082 | .111 | <.001 | .008 | .061 | <.001 | <.001 | .011 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Allocation of operation resources | Pearson Correlation | .575** | .466** | .362* | .478** | .620** | .600** | .471** | 1 |
| | Sig. (2 tailed) | <.001 | .003 | .024 | .002 | <.001 | <.001 | .002 | |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Smooth operation | Pearson Correlation | .589** | .315 | .485** | .410** | .605** | .752** | .576** | .652** |
| | Sig. (2 tailed) | <.001 | .051 | .002 | .010 | <.001 | <.001 | <.001 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| The previous data reliable | Pearson Correlation | .341* | .148 | .632** | .371* | .340* | .661** | .763** | .444** |
| | Sig. (2 tailed) | .033 | .368 | <.001 | .020 | .034 | <.001 | <.001 | .005 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| The right quantity always delivered at the right time | Pearson Correlation | .187 | .295 | .623** | .378* | .342* | .549** | .535** | .327* |
| | Sig. (2 tailed) | .255 | .068 | <.001 | .018 | .033 | <.001 | <.001 | .042 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| The forecasting results communicated | Pearson Correlation | .429** | .310 | .731** | .585** | .589** | .707** | .633** | .575** |
| | Sig. (2 tailed) | .006 | .055 | <.001 | <.001 | <.001 | <.001 | <.001 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Share information across | Pearson Correlation | .483** | .301 | .590** | .477** | .591** | .701** | .567** | .518** |
| | Sig. (2 tailed) | .002 | .063 | <.001 | .002 | <.001 | <.001 | <.001 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| Orders are tracked | Pearson Correlation | .482 | .124 | .519** | .358* | .397* | .674** | .671** | .424** |
| | Sig. (2 tailed) | .088 | .453 | <.001 | .025 | .012 | <.001 | <.001 | .007 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |
| The replenishment system | Pearson Correlation | .465** | .404* | .574** | .480** | .497** | .572** | .492** | .545** |
| | Sig. (2 tailed) | .003 | .011 | <.001 | .002 | .001 | <.001 | .001 | <.001 |
| | N | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 |

Table 4.5 demonstrates the connection between the dependent variable and the factors listed in the questionnaire's CPFR section. With a correlation coefficient of 0.60, the collaboration with internal operational department and matching demand and supply of liquid of petroleum product show a strong association. Additionally, the relationship is positive. The table further demonstrates, the substantial positive association between supply chain collaboration that is managed and internal operational departments with the correlation coefficient of 0.62. This indicates that managed supply chain collaboration is achieved through integration with necessary departments internally. Collaborating with co-workers throughout the company assist to spot potential business possibilities, create synchronised approaches to new markets, optimise company's portfolio, design integrated solutions, and control any risk involved. Furthermore, adequate systems and processes and well-coordinated tanks between functional departments have a strong correlation coefficient of 0.53. This is supported by the literature which states that, with enough systems and processes, it proves easy to respond quickly to supply chain shocks in order boost business performance.

Distribution of information amongst all stakeholder and allocation of operational resources shows a very strong correlation of (0.72). Thus, shared information influences the availability of enough resources within the company, and the production of the good in accordance with the requirements of the customer. There is no strong Pearson correlation between orders tracked and internal operational department (0.48). This shows that these variables are dependent on each other and that there remains room for improvement in these variables in ensuring that orders are managed properly.

In essence, there's a strong correlation (0.76) between enough product and distribution. This illustrate that the driver distributes petroleum products to a group of customers in petrol stations in a way that meets their needs within the transporter's operational capabilities, while maximising the total distribution profits produced by the distribution operation. Furthermore, whenever the product level fall below certain thresholds, petrol stations frequently inspect their underground tanks throughout the course of their regular business operations and send orders to the suppliers. This ensures that there's enough product in the tank.

The correlation coefficient of 0.65 depicts a positive and strong correlation between smooth operation and allocation of resources. This explains that enough allocated resources can improve the smooth operations.

### 4.4.1 Cross Tabulation

Contingency tables are tables made especially for statistical testing. By cross tabulating the variables, the data can be shown in a two dimensional frequency distribution once a relationship between the two variables has been established. This is the cross tabulation's objective. Cross tabulation is therefore used to investigate the relationship between the selected variables. In addition, by cross tabulating the data, the tables below ascertain whether there is a relationship between the two variables. Table 1.6 illustrates whether there is a relationship between product availability and gender.

**Table 4.6 Liquid petroleum product availability Cross tabulation**

| | | Liquid Petroleum Product availability | | | | | |
|---|---|---|---|---|---|---|---|
| | | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree | Total |
| Gender | Male | 11 | 9 | 2 | 2 | 1 | 25 |
| | Female | 8 | 3 | 3 | 0 | 0 | 14 |
| Total | | 19 | 12 | 5 | 2 | 1 | 39 |

**Table 4.7 Chi Square Tests**

| | Value | Df | Asymptotic Significance (2 sided) |
|---|---|---|---|
| Pearson Chi Square | 3.880[a] | 4 | .423 |
| Likelihood Ratio | 4.830 | 4 | .305 |
| Linear by Linear Association | .659 | 1 | .417 |
| N of Valid Cases | 39 | | |

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .36.

Tables above indicates that 25 (64%) and 14 (35%) of female of male indicated that product is always available in the terminal, while more males strongly agreed. Whether or not this value suggests a significant association can be ascertained by examining the value. If the probability is greater than 0.05, there is no discernible association between the variables. In a similar vein, if the probability is less than or equal to 0.05, the variables are significantly related. The Chi square value is 3.880, with a level of significance of 0.423 and a degree of freedom of 4, as seen in the Chi square table above. With a high degree of confidence, the null hypothesis is rejected since the level of significance is greater than the significance threshold of 0.05. Therefore, the alternative hypothesis is accepted, where there is no discernible relationship between the variables.

### 4.5 Multiple regression

It is noteworthy that multiple regression analysis is said to be performed in order to determine the degree to which the independent variable or variables affect the dependent variable (Downing and Clark, 2003). The impact of the independent factors was examined in the study, which include collaboration, planning and scheduling, forecasting and replenishment of the liquid petroleum product.

**Table 4.8 Model Summary**

| Variables Entered/Removed | | | |
|---|---|---|---|
| Model | Variables Entered | Variables Removed | Method |
| 1 | Collaboration of activities | . | In stages the criteria are as follows: probability of F to enter <=.050 and probability of F to remove >=.100. |
| 2 | Replenishment | . | In stages the criteria are as follows: probability of F to enter <=.050 and probability of F to remove >=.100. |
| a. Dependent Variable: Liquid Petroleum Product availability | | | |

| Model Summary | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Change Statistics | |
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change |
| 1 | .702[a] | .563 | .546 | .827 | .563 | 21.069 |
| 2 | .759[b] | .535 | .503 | .790 | .572 | 4.563 |

| Model Summary | | | |
|---|---|---|---|
| | Change Statistics | | |
| Model | df2 | Sig. F Change | Durbin Watson |
| 1 | 37 | <.001 | |
| 2 | 36 | .040 | 1.660 |
| a. Predictors: (Constant), replenishment | | | |
| b. Predictors: (Constant), collaboration of activities | | | |
| c. Dependent Variable: Liquid Petroleum Product availability | | | |

The multiple correlation coefficient, or R, is represented by the value in the "R" column. R is the dependent variable's quality metric R=0.702. This figure consequently indicates a high degree of prediction proficiency. The R square column, also known as the coefficient of determination, indicates how much of the variance in the dependent variable can be explained by the independent variables. The fact that our dependent variable's value of 0.563 explains 56.3% of its variability serves as evidence of this. The R square number, also known as the coefficient of determination and located in the "R square" column, indicates the amount of the dependent variable's variance that the independent variables can explain.

Adjusted R Square is 0.546 in Model 1

Adjusted R Square is 0.503 in Model 2

Once the number of variables is considered, model one has the greatest adjusted R Square value and, thus, a higher degree of explanatory power. Therefore, Model One defines a lot of collaboration of activities compared to Model Two. Testing for correlation between successive error terms is what the Durbin Watson test does. The possible values are one through four. Positive autocorrelation is most likely present if it is near zero. When it approaches four, negative autocorrelation is present. (Webster, 2013). A respectable 1.660 is shown in the model above. "In a standard regression setting, the degree to which the normal linear model's assumptions are satisfied is determined by analyzing [sic] the distributional characteristics of the residual terms, e(i) = (yi – y^i)" (Heeringa, West and Berglund, 2010).

**Table 4.9 Analysis of Variance (ANOVA)**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
| 1 | Regression | 14.420 | 1 | 14.420 | 21.069 | .000[b] |
| | Residual | 25.323 | 37 | .684 | | |
| | Total | 39.744 | 38 | | | |
| 2 | Regression | 17.269 | 2 | 8.635 | 13.831 | .000[c] |
| | Residual | 22.474 | 36 | .624 | | |
| | Total | 39.744 | 38 | | | |
| a. Dependent Variable: Liquid Petroleum Product availability | | | | | | |
| b. Predictors: (Constant), Collaboration | | | | | | |
| c. Predictors: (Constant), Replenishment, Smooth operation | | | | | | |

Table 1.10 presents the results, which indicate that all two models have a 95% confidence level significance value of 0. This means that only models 1 to 2 achieve statistical significance. As a result, the researcher may agree with the alternative theory and determine that the variables in Models 1 and 2 have a relationship.

**Test for multicollinearity.**

According to Chase Jr. (2013), When analysing regressions, the researcher must make sure to test for multicollinearity. When two or more independent variables exhibit a substantial association with one another, this is known as severe multicollinearity. The table below shows that there is no multicollinearity in the data, which is an important finding. Given that the VIF for every model is bigger than 1, this has been deduced. These two models have a tolerance value that is bigger than one which means that multicollinearity is not violated.

**Table 4.10 Collinearity**

| Model | | Unstandardised Coefficients | | Standardized Coefficients | T | Sig. | 95.0% Confidence Interval for B | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Tolerance | VIF |
| 1 | (Constant) | .645 | .288 | | 2.238 | .031 | .061 | 1.229 | | 2.789 |
| | Collaboration of activities | .619 | .135 | .302 | 4.590 | <.001 | .346 | .893 | .602 | 2.546 |
| 2 | (Constant) | .477 | .286 | | 1.667 | .104 | .103 | 1.058 | | 2.432 |
| | Collaboration of activities | .418 | .160 | .207 | 2.623 | .013 | .095 | .742 | .602 | 1.245 |
| | Replenishment | .335 | .157 | .531 | 2.136 | .040 | .017 | .652 | .571 | 2.463 |

When analysing the independent variables, a beta value assessment is crucial. The beta weight serves as a measure of a predictor's relative significance in predicting the dependent variable. The more power this factor must predict the dependent variable (liquid petroleum product availability), the higher its beta weight value. Replenishment of the petroleum product has the highest beta value of 0.531 compared to other models. After every other variable in the model is controlled, the strongest unique contribution to explaining the dependent variable is the replenishment. At 95% confidence, the significance value (p) is 0.000.

### 4.6 Reliability and Validity

According to (Alkhadim, 2022) a statistical measure of how closely a scale's items correlate with one another is called the Cronbach's alpha. More than 0.07 alpha values typically indicate that the scale being utilised is trustworthy. The Cronbach's alpha coefficient was adopted in the study to evaluate the reliability and consistency of the questionnaire responses. In essence, the scale used in the study has an actual Cronbach's alpha score of 0.871, indicating its reliability.

| Reliability Statistics | | |
|---|---|---|
| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
| .871 | .872 | 20 |

To determine whether the research instrument measures the elements in line with the study's aims, construct validity was employed. The multivariate analysis and findings interpretation support the validity of the measurements used in this study. Based on a reliability analysis of the users' questionnaire and comments from continuous research, the Cronbach alpha for standardised items (questionnaires from the Likert scale) was found to be = 0.872. This indicates a high or good level of internal consistency and dependability for both the research instrument (questionnaire) and the continuous study variables.

### 4.7 Conclusion

In conclusion, the data analysis used in the chapter leads to conclusions. It also thoroughly looks at whether the analysis has provided an answer to the research questions. Numerous concerns came to light because of the data analysis. The outcomes of this previous chapter display were covered in the next chapter. The research's quantitative findings are included in the results. As techniques for outcomes analysis and exposure, this also covers theme analysis and content analysis.

# CHAPTER FIVE: DISCUSSION OF FINDINGS

## 5.1. Introduction

The fourth chapter of the study included an analysis and presentation of the data in tabular, diagrammatic, and statistical formats. The study's problem statement concentrated on concerns facing the petroleum sector, such as the need to reduce uncertainty, control costs, and satisfy the world's growing energy demand all of which call for cooperation across the supply chain. The purpose of this study was to evaluate the importance of an integrated supply chain for BP. Moreover, an integrated network via CPFR is made possible in order to facilitate real time information sharing and improve collaboration amongst supply chain operations. Consequently, chapter six discussed the interpretations of the data that were looked at in the previous chapter and compare these interpretations to the main objective of the study. This chapter provided an additional summary of the study's findings and discuss how they may affect future investigations.

### 5.1.1 Research Objectives Restated

- To examine the extent to which supply chain collaboration can be improved by information sharing within supply chain partners.
- To understand the advantages of scheduling and planning in ensuring smooth operation.
- To examine how collaborative forecasting can assist in meeting demand and supply across the extended enterprise and functional areas.
- To assess the role of effective stock replenishment in adding supply chain value across the supply chain.

## 5.2 Research Objective One

**To examine the extent to which supply chain collaboration can be improved by information sharing within supply chain partners**

The first objective was to examine the extent to which information sharing can be improved by supply chain collaboration planning within supply chain partners. It was noted in the literature reviewed that information sharing is crucial to ensure cooperation between supply chain partners and supply chain integration, where information sharing is crucial. According to Sodero, Rabinovich and Sinha (2013), the best way to increase collaboration in the supply chain network is to share information. Through the exchange of concepts, information, and initiatives, operational effectiveness and corporate efficiency may be achieved. Baba, Wang, Adzani and Abdul (2021) argue that providing up to date and accurate business data available at each stage in the supply chain is the key to an effective supply chain system. However, assuring data availability and making it available to supply chain participants can help improve business performance. Lin (2014) asserts that the bullwhip effect or demand variability could emerge from a lack of information exchange, which would lower customer satisfaction and damage the company's reputation. Consequently, the business's issues caused by client order and demand unpredictability may be lessened by information sharing.

The integration of activities plays an essential role in supply chain in creating a centralised supply chain in meeting customers' expectations (Chizogie, Ian and William, 2020). The questionnaires distributed gathered data from respondents regarding collaboration with other internal department in the terminal. A minority of the respondents disagreed that the terminal collaborate with other internal operational departments, while other few respondents were neutral about the collaboration within departments. Notably, less than half of the respondents agreed, while more strongly agreeing that the terminal collobarate with other internal operational departments. Establishing a cohesive framework for data and integrating the many components of a supply chain results in improved chainwide knowledge, which enables the terminal to minimuse low stock levels and increased inventory turnover. With a majority of respondents agreeing to the collaboration in the business ,it shows that the terminal collaborate with stakholders in ensuring increased supply chain transparency, so as to avoid suffering reputational harm as a result of supplier vulnerabilities.

Supply chain collaboration ensures that most effective connections to the best markets and customers are made, both along and across the value chains for BP, as well as in the structuring of customer solutions to provide value and create new revenue streams. This is done by collaborating with coworkers throughout the company to spot potential business possibilities, create synchronised approaches to new markets, optimising company portfolios, designing integrated solutions, and controlling for risk. In the last decade, the value of integration in supply chain has tripled due to integration with third party industries. Through the combination of research and development, financial resources, manufacturing, and distribution networks, the sector lowers the negative effects of competing rivals by creating higher barriers to entry. Thompson and Strickland (2001) mention that strategic partnerships and joint ventures with foreign businesses increase a company's ability to compete globally. In keeping with new aim of rethinking energy for mankind, incumbent as it is in maintaining the natural balances of the earth, BP ventures play a critical role in helping the firm reinvent itself as an integrated energy organisation. The integration of activities plays an essential role in supply chain in creating a centralised supply chain in meeting customers' expectations. Therefore, this proves that supply chain integration is essential in any organisation to deal with uncertainties in the business. Supply chain collaboration is necessary for many organisations in the sector to respond quickly to supply chain shocks and boost business performance (Chizogie, Ian and William, 2020).

The research conducted clearly demonstrates that the deployment of innovation in technology and enhancement throughout the supply chain allows for optimal information sharing. Thus, it can be said that optimised information exchange greatly improves integrated supply chain operations across businesses. According to the data analysis, respondents overwhelmingly agreed that improved information sharing technologies improve integrated supply chain operations across extended companies. A majority of the respondents strongly agreed that operational departments such as storage and handling, transport, scheduling always share information across to ensure that theres enough petrolieum products in the tanks. Less than half of the respondents were netrual about information sharing, while others agreed that information is shared across, few disagreed and strongly disagreed that information is shared. Sodero, Rabinovich and Sinha (2013) confirm that with enough systems and processes, optimised information exchange greatly improves integrated supply chain operations across businesses. It was further confirmed that the best way to increase collaboration in the supply chain network is to share information. In other words, it entails

the sharing of data for decision making from several departments or organisations. Through the exchange of concepts, information, and initiatives, operational effectiveness and corporate efficiency may be achieved. The bullwhip effect, or demand variability, could emerge from a lack of information exchange, which would lower customer satisfaction and damage the company's reputation. Consequently, the business's issues caused by client order and demand unpredictability may be lessened by information sharing (Lin, 2014).

The sufficient systems and procedures category had the largest mean and standard deviation, indicating that respondents did not stray significantly from the norm, as indicated by having the second lowest standard deviation. Supply chain automated activities minimise human mistake and lost time to ensure it is operating at peak efficiency. In order to maximise production, it is important to constantly maintain the appropriate tools on hand and minimise the number of idle tools. Electronics supply chain management systems are used to manage supply networks and enhancing supply chain operations via the use of technology (Lin and Huang, 2012). The usage of electronics supply chain management system enables the organisation to be agile and efficient in its supply chain operations, as well as to react swiftly to changing customer order demand. Furthermore, the literature strongly confirms that production processes flow smoothly, when real time information is shared from upstream to downstream. Efficient information exchange is dependent on both the electronic tools used by the organisation and integrated information sharing systems. In this study, information exchange was shown to maximise activity synchronisation, while guaranteeing consistent customer satisfaction. The foundation for businesses to electronically communicate real time information with other supply chain partners has been established by internet-based IT (Sodero et al. 2013).

Most respondents strongly agreed that there is adequate systems and processes to ensure that tasks are well coordinated between functional departments. This shows that BP uses enough technology to optimise and manage supply chain forecasting and replenishment processes. This method is employed as a tool for empowerment and information sharing throughout divisions, and is thought to be the organisation's driving force behind CPFR. Additionally, it was discovered that businesses that employ CPFR typically have better production and flow planning, fewer forecasting errors, and greater product availability than businesses that do not. Mohammaddust, Rezapour, Farahani, Mofidfa and Hill (2017) point out that the use of CPFR led to a decrease in inventory, an increase

in sales, and superior financial performance, as assessed by the cost of goods purchased. Supply chain operations across extended organisations can be integrated in part through the application of CPFR. In this study, this was ensured by the availability of enough resources within the company and the production of the good in accordance with the requirements of the customer. The product must be delivered without any disruptions. Thus, the just in time synchronisation principle can be utilised, which emphasises that all demands must be met on schedule without any delays, strengthening the demand frequency (Kung, 2013).

### 5.3 Research Objective Two

**To understand the advantages of scheduling and planning in ensuring smooth operation**

This research objective served to establish the advantages of scheduling and planning in ensuring smooth operation. Scheduling is common in practically every industry, since it supports the success of production or service in the businesses. According to the examined literature, efficient scheduling and planning facilitates efficient resource use, which improves the management process and raises the standard of the finished goods or services. As claimed by Rezaei, Eivazy, Rezazadeh, and Nazari Shirkouhi (2011), planning and scheduling work together to facilitate and manage production to achieve the maximum performance as measured by metrics such as on time delivery and utilisation. While scheduling outlines when and who should complete certain tasks, planning considers what, how, where, and in what order they take place. The efficiency of the plan and the schedule may be impacted by interruptions that arise during the execution stage, in addition to the influence of planning decisions on scheduling decisions. Therefore, it is inevitable that planning and scheduling will interact.

It was determined whether there are any concerns with scheduling and planning behind the availability of the product in the terminal. Operationally, graphs were used to evaluate this objective, since they were seen to be the fundamental approach to categorical data analysis. A majority of respondents strongly agree with retaining sufficient product in tanks, some were netrual, few respondents disagreed and others strongly disagreed. This demonstrates that most respondents strongly agreed that planning and scheduling assist in ensuring that all tanks have enough petroleum product. Larco, Wiers, and Fransoo (2018) argued that scheduling and planning

in the supply chain enable real time visibility into all pertinent business aspects and significant optimisation capabilities that boost efficiency and support precise planning.

The planning and scheduling of the liquid petroleum product appeared to be a critical task to save the company from running dry by ensuring that there's enough product in the tanks. British petroleum uses planning and scheduling in order to determine the unloading schedule for the vessel/pipeline movement. In essence, this involves rates, timing, and determining the correct tank to transfer the product to, depending on the available ullage. As mentioned by Rezaei, Eivazy, Rezazadeh, and Nazari Shirkouhi (2011), planning and scheduling work together to facilitate and manage production in order to achieve the maximum performance as measured by metrics like on time delivery and utilisation. Additionally, it has been acknowledged that incorporating new technology into process operations is crucial for profitability, where doing so requires careful planning. The main aim with proper planning and scheduling in order to minimise demurrage, unloading, and inventory cost.

It was discovered that planning and scheduling evaluates time and resource allocations to produce the desired quantity. Consequently, resources must be managed in a way that enables value creation in the industry to minimise delays and maximising efficiency and product quality. Almansouri (2014) mentioned that the key to maximising resource utilisation and improving performance is to schedule tasks in advance. In addition, if resources are made available but remain inactive because of inactivity, poorly designed plants, or any of the many other reasons for planned or unplanned idleness, their productive potential is squandered. Additionally, the final result would not bring about the satisfaction that it should. BP can achieve significant improvements in business performance by allocating resources and completing tasks in accordance with truck scheduling. When it comes to Gur and Eren (2018), whereas planning refers to the resources required to carry out the assigned job with exact knowledge, scheduling is the art of allocating the activities with the resources that are accessible in a way that maximises the predefined aim.

The most significant element was shown to be planning and scheduling systems, which have the largest mean and standard deviation and enable the tracking of stock throughout transit between dispatch and receiver. Shivaprasad and Paul (2021) have argued that in a production system, scheduling refers to the order of tasks that must be carried out, whether manually or mechanically.

Planning and scheduling should be based on goals and existing constraints to maintain system balance and guarantee that all tasks are allocated to the resources that are available. The score with the highest frequency is shown by the mode, which is the most frequent value in the data. The modes show that respondents strongly agreed, indicating that the most important aspect enabling the tracking of stock in transit between the dispatcher and the receiver was the planning and scheduling systems. Jagadish (2013) argues that scheduling is that crucial planning tool that assists in dealing with resource allocation, utilisation, and activity planning. The goal of scheduling is to distribute resources such that they can be used to finish a task in a timely manner while also generating value. This finding therefore shows that with enough systems in place, where confidence in decision making is enabled and responsiveness improved.

### 5.4 Research Objective Three

**To examine how collaborative forecasting can assist in meeting demand and supply across the extended enterprise and functional areas**

This research objective sought to establish how collaborative forecasting can assist in meeting demand and supply across the extended enterprise and functional areas. The literature confirms that optimal inventory levels are the outcome of cooperative forecasting and planning that synchronises supply and demand. Businesses may better optimise their supply chains, cut down on waste, and prevent overstock or stockout scenarios. In essence, previous demand and supply are put together by the forecasting team in order to obtain a reliable view on how the inventory should look like at British Petroleum. Petropoulos, Apiletti, and Assimakopoulos (2022) defined forecasting as making projections or predictions about the future, by considering the events in both the present and past. The majority of the respondents strongly agreed that previous data is reliable in such a way that it predicts the future demand, where less than half of the respondents were neutral, while few disagreed, and some strongly disagreed that previous data always predicts future demand. This shows that data collected from previous years helps to ensure that future demand is predictable.

The basis for replenishment purchase throughout the supply chain is demand forecasting. Good demand forecasting gives companies vital information about their prospects in both their current and future markets, enabling managers to make decisions regarding pricing, corporate expansion plans, and market potential. Without demand forecasting, businesses run the risk of making bad decisions about their products, which could have a big influence on revenue, client satisfaction, supply chain management, and storage costs (Subramanian, 2021).

Forecasting of the liquid petroleum product, including determinations on the right quantity at the right time, has been found as the vital factor in forecasting with the highest mean with the standard deviation. Zied, Boylan and Tabar (2022) argue that most supply chain management choices are based on demand estimates. Different forecasting requirements emerged from the level of detail for these decisions. For example, forecasts at lower levels over shorter periods are required for inventory replenishment decisions, but predictions at higher levels over longer timeframes are required for supply chain strategy decisions. The mean is greater than the standard deviation, which means that there is small variance in the data. As a result, the sample mean accurately represents the population mean. "Strongly Agree" is the most commonly occurring value among these three variables, as demonstrated by the sample's critical point, which is further supported by the median and mode figures. The mode shows that respondent strongly agreed that forecasting influences the right product, with the right quantity delivered at the right time.

Ivanon et al. (2021) note that decision makers can use forecasting as a crucial tool to make supply chain more resilient to future demand shocks. Aljanabi and Ghafour (2022) highlight that the capacity to identify disruptions and increase the flexibility of supply chains to deal with demand fluctuation is enabled by sharing information on real demand. Critical information sharing as part of knowledge management can also serve as a helpful analytical tool for dealing with scenario planning and mitigating the effects of unexpected interruptions. In collaborative forecasting, buyers and suppliers share important information and insights. Both parties can produce demand projections that are more accurate by exchanging information about market trends, consumer behaviour, and other pertinent elements. Better production planning, fewer stockouts, and higher customer satisfaction are thereby made possible.

In keeping with new aim of rethinking energy for people and the earth, BP ventures play a critical role in helping the firm reinvent itself as an integrated energy organisation. In order to do this, the business invests in a portfolio of rapidly expanding technology firms that will enhance and broaden its core business and open up new prospects in associated digital sectors. The company also contribute into companies that can assist in producing less carbon in its operations. BP in South Africa have independent joint venture, where it shares ownership of strategically located depots. Furthermore, the Waltloo Depot in Pretoria, which was previously owned exclusively by BP and Cape Town terminal, as well as the Alrode Fuel Depot in Alberton, Johannesburg, along with the adjacent Beryllium site. Furthermore, the corporations control depots in equal shares and share the same access to the same amount of storage space at the depots hence forecasting results are also shared amongst the stakeholders to predict future demand.

Collaborative forecasting assists BP to ensure that neither their tanks nor the petrol stations run dry. Previous demand and supply are combined by the forecasting team to obtain a reliable view on how the inventory ought to look. The basis for replenishment buying throughout the supply chain structure is demand forecasting. Accurate demand forecasting gives companies vital information about their prospects in both their current and new markets, enabling managers to make decisions about pricing, business expansion plans, and market potential. Without demand forecasting, businesses run the risk of making bad decisions about their products, which could have a big influence on revenue, client satisfaction, supply chain management, and storage costs (Subramanian, 2021).

It was discovered that a majority of the respondents strongly agree that forecasting results are always communicated to all stakeholders, while other respondents were neutral and yet other respondents agree that focaresting are always communicated, few disagree, and strongly disagree. This shows that forecast is communicated are always communicated to all relevent stakeholders. Borucka (2023) argued that demand forecasting is essential to a company's operations and ability to obtain a competitive edge in the marketplace. Reliable and accurate projections enable businesses to respond more effectively to changing market conditions and client requests. It further assists in cost reduction, process optimisation, and minimising inventory issues.

Sohrabpour, Oghazi, Toorajipour and Nazarpour (2021) argue that forecasting is concerned with what the future will be like, as opposed to planning, which is focused on what the planner believes the future should be like. Tony, Kumar, Rohith (2021) point to the fact that the technique of forecasting uses previous data as a form of input to generate precise forecasts of the future behaviour of trends. Suppliers effectively manage resources and modify their production schedules when they possess precise demand estimates. This flexibility results in shorter lead times, quicker order fulfillment, and a better capacity to adapt to the changing demands of the client. A sense of shared accountability for supply chain results is fostered via collaboration. A sense of collaboration and trust is fostered when customers and suppliers collaborate to achieve a common objective. As a result, communication may be easier, problems may be resolved more quickly, and collaborative improvement projects may be more profitable. Diverse viewpoints and specialties are brought together through collaborative forecasting and planning. Businesses may make better decisions that lead to long term profitability and strategic growth by combining their resources and data.

### 5.5 Research Objective Four

**To assess the role of effective stock replenishment in adding supply chain value across the supply chain**

The last objective was to assess the role of effective stock replenishment in adding supply chain value across the supply chain. The practice of moving goods from reserve storage to primary storage prior to pick up at a site is referred to as replenishment (Achieng, Nyanga and Mbura, 2018). Almost every sector of the economy has trouble keeping and managing its inventory. Since most organisations deal with daily inventories, inventory replenishment is essential. Additionally, any company that undervalues its inventory faces the possibility of losing customers. This is particularly true if the manufacturing elements are not adequately managed to meet client requests and desires. Nyabwanga and Otinga (2021) agree that retailers can gain a competitive edge in replenishment in order to surpass the competition, and satisfy customers. Having enough product available when customers need it proves to be difficulty when it comes to inventory. The number of items in stock must be acceptable; there should never be an excess or a shortage. The company needs to be able to give customers what they need in terms of both quantity and quality.

An insight was provided from data collected regarding whether the replenishment system in place allows customers to access product of their choice at the right time, in the right quantity, and delivered to the right place. A majority of the respondents strongly agreed while other were neutral and most respondents agreed and few strongly disagreed. This shows that there are replenishment systems in place to ensure that the customers receive their product on time. Nyabwanga and Otinga (2021) agreed that retailers can gain a competitive edge in replenishment. Having enough product available when customers need it proves difficult with inventory. It is necessary that the inventory of goods be reasonable, where neither too little nor too much is present. A business must be able to supply consumers with both the quantity and quality they require.

Sempijja, Senfuka and Mubiru (2020) further mentioned that effective product replenishment rules are crucial in the petroleum inventory distribution system for boosting sales income, reducing inventory costs, and improving cash flows. In order to ensure business continuity, this is a crucial issue that needs to be watched carefully and constantly. Despite the shifting demand patterns for petroleum products, it is crucial to have the best replenishment procedures in place; otherwise, excessive inventory costs for maintaining stock levels may have a negative impact on business performance. The replenishment of gasoline is carried out from the depot/terminal to the petrol stations. The logistics deliver petroleum products to a group of customers in petrol stations in a way that meets their needs within the transporter's operational capabilities, while maximising the total distribution profits produced by the distribution operation. Furthermore, whenever the product level fell below certain thresholds, petrol stations frequently inspect their underground tanks throughout the course of their regular business operations, and send orders to the suppliers. However, the remaining fuel must therefore be delivered back to the terminals as a left on board if the underground tanks of a petrol station cannot hold a full compartmented cargo. This causes the business to incur a send back fee that is typically high. However, cost can be minimised through proper collaborative planning and sharing of information across business.

Sodero, Rabinovich and Sinha (2013) state that it proves vital to share information to boost collaboration in the supply chain network. Bullwhip effect or demand variability could emerge from a lack of information exchange, which would lower customer satisfaction and damage the company's reputation. Furthermore, information was collected from the respondents pertaining to

information sharing across oprerarional departments. A majority of the respondents strongly agreed that operational departments such as storage and handling, transport, scheduling always share information across to ensure that theres enough petroleum products in the tanks. Others were netrual about information sharing, most agreeing that information is shared, with few disagreeing and strongly disagreeing that information is shared. The research clearly demonstrates that the deployment of technical advancements and enhancement throughout the supply chain allows for optimal information sharing. Consequently, it can be said that optimised information exchange greatly improves. Madduri (2020) further highlighted that industries that want to preserve margins and remain competitive ought to be able to optimise the whole value chain influenced by the inventory strategy. The distribution of the products to final retail and commercial clients along the downstream oil and gas value chain is a complicated process that begins in the oil field and continues through refineries. Digital technology adoption can facilitate the supply chain's efficient operation.

### 5.5.1 Summary of the specific findings

1. **Supply Chain Collaboration and Information Sharing:** According to the data analysis, respondents overwhelmingly agreed that improved information sharing technologies improve integrated supply chain operations across extended companies. In addition, the study found that enhancing information sharing among supply chain partners significantly improves collaboration. By exchanging accurate and up-to-date information, companies can reduce uncertainties such as the bullwhip effect, which negatively impacts customer satisfaction and company reputation. The findings strongly support the idea that an integrated supply chain, supported by effective information sharing, is critical for operational efficiency in BP Southern Africa.

2. **Advantages of Scheduling and Planning:** Based on the question about any concerns with scheduling and planning behind the availability of the product in the terminal. Most respondents strongly agreed that planning and scheduling assist in ensuring that all tanks have enough petroleum product. The research highlighted that well-coordinated scheduling and planning within the supply chain are vital for ensuring smooth operations. Effective scheduling not only aligns production with customer demand but also optimizes logistics

and resource allocation, leading to timely deliveries and reduced operational disruptions. This alignment is crucial for meeting the dynamic needs of the petroleum industry.

3. **Collaborative Forecasting for Demand and Supply Alignment:** The study provided the insight on the respondents' responses to the question of the replenishment system in place, which allows customers to access product of their choice the right quantity, at the right time and delivered at the place. This captured the fulfilment of demand as accurately and promptly as possible. However, it is likely possible that product is in a different place than anticipated due to unforeseen circumstances. Therefore, to ensure that the customer orders are fulfilled, shorten shipment lead times, and eliminate stockouts and markdowns, businesses require an accurate view of the inventory. The study emphasized the importance of collaborative forecasting across the extended enterprise. It was found that when supply chain partners engage in joint forecasting efforts, it leads to better alignment between supply and demand. This collaboration helps in mitigating risks associated with demand variability and ensures that resources are appropriately allocated across different functional areas of the company.

4. **Role of Effective Stock Replenishment:** The study showed that replenishment systems were in place to ensure that the customers receive their product on time, as most respondents strongly agreed. The findings underscored that efficient stock replenishment is a key driver of value in the supply chain. By maintaining optimal inventory levels and ensuring that products are available when needed, BP Southern Africa can enhance its service levels and reduce the costs associated with stockouts or excess inventory. The study confirmed that an effective replenishment system is crucial for sustaining competitive advantage in the petroleum industry.

## 5.6 Conclusion

The chapter began with restating the goals of the investigation in order to wrap up. To ascertain any parallels or divergences with the research objectives, the empirical findings were scrutinised. It was found throughout the debate that BP's integrated supply chain activities are essential to enable real time information sharing and an integrated network via CPFR. The research findings corroborated this, indicating that a sizable portion of the workforce strongly agreed that the terminal work with other internal operational departments to guarantee that the product is

consistently available in tanks. The limits and ethical considerations are also covered in the chapter that follows, which also presents the study's conclusions and recommendations for more research.

# CHAPTER SIX: RECOMMENDATIONS AND CONCLUSIONS

## 6.1 Introduction

The research's empirical findings were covered in the previous chapter. These results are summed up based on the literature reviewed about the significance of an integrated supply chain of activities in British Petroleum. This chapter will drive the debates based on the empirical findings, give arguments based on the study's findings and recommendations for further research. The chapter will provide a more thorough explanation of the study's implications, limits, and delimitations.

## 6.2 The Main Purpose of the Study

This main purpose of this study is to analyse and understand the significance of an integrated supply chain of activities in British Petroleum Southern Africa. Furthermore, this study investigated how to enable real time information sharing and an integrated network through CPFR to enhance cooperation between supply chain activities.

### 6.2.1 Overview of the research study

**Chapter one**: The preface to the study is detailed in this chapter. The major goal, research aims, and associated questions are covered in the first chapter of the study. Furthermore, it provides a more comprehensive explanation of the research problem and incorporates the research question together with the reasons for conducting the study. The investigational techniques to be used, together with the limitations and contribution of the study, are discussed.

**Chapter two:** In this chapter, the CPFR model is explained and explored through extant literature. The review of the literature intended to undertake a thorough investigation into all the various elements of CPFR on how it can enhance cooperation between supply chain activities in BP. In addition, this section discussed data and findings from other studies on crucial considerations for supply chain collaboration.

**Chapter Three**: describes the study's methodology, research techniques, and research design. This chapter discussed the study's data collection process, and the stages involved in a literature review. Additionally, it describes the study population as well as the sample size and sample frame. The reliability and validity issues with the study are covered in this chapter. Additionally, the study included information on the data analysis, data gathering method, and questionnaire design.

**Chapter Four**: Chapter Four discussed the findings of the investigation and the data analytics. To show the data gathered from respondents and the study's findings, graphs, tables, and reports were be used. Furthermore, quantitative data analysis was used to fulfill the study's aims.

**Chapter Five***:* In Five, a summary of the full investigation is provided. Additionally, discussions and data analyses based on pertinent literature is provided to address the goals of the research. This involved analysing every research objective and using the data that was available to support the conclusions.

**Chapter Six:** This chapter provides a summary of the study's findings, conclusions, and recommendations based on those findings and the study's limits as well as delimitations.

### 6.2.2 Ethical Issues

Researchers must ensure that there are no delays when conducting the study by considering the ethical clearance early. Kahari (2010) asserts that ethics is the moral principles that governs or influence the individual's behaviour when performing an exercise or any activity. The gatekeepers' letter was released without issue, but Research Office issued ethical consideration clearance was obtained with excessive delay. From the researcher's perspective, this means that for the ethical clearance form to be easily approved, it needs to be checked and verified. As a result, taking part in the approval process required a lot of time because it took more than a month, which was closer to the deadline for data collecting and analysis.

## 6.3 Conclusion Based on the Reviewed Literature

The literature research revealed that supply chain uncertainty in the petroleum business continues to be a difficult problem as the globe changes. Furthermore, the lack of supply chain cooperation among the petroleum stakeholders also contributed to a lack of supply chain market expansion and customer satisfaction. The uncertainties also have an impact on the demand and supply. Furthermore, the threat caused by corona virus left business struggling with their sales especially the petroleum industry since the demand decreased because of economic shut down. Supply chain collaboration is necessary for many organisations in the sector to respond quickly to supply chain shocks and boost business performance (Chizogie, Ian and William, 2020). Integration of activities plays an essential role in supply chain in creating a centralised supply chain in meeting customers' expectations. Proper supply chain management requires good planning when selecting suppliers

and scheduling the orders in accordance with consumer specification. Petroleum industries can benefit from their supply chain in lowering cost and improve customer satisfaction by delivering at the right time with the right product and quantity. This ensures that the company does not run dry with gasoline.

Production processes flow smoothly when real time information is shared from upstream to downstream. In this study, this was ensured by the availability of enough resources within the company and the production of the good in accordance with the requirements of the customer. The product must be delivered without any disruptions. The Just in Time synchronisation principle can be utilised, which emphasises that all demands must be met on schedule without any delays, strengthens the demand frequency (Kung, 2013). In addition, synchronisation of activities along value chains. For instance, the company can coordinate production with customer demand utilising expertise in logistics and planning in order supply the output to satisfy the demands of the clients. This study aimed to explain how synchronisation of activities is vital within BP, while ensuring that company utilise facilities with enough resources and to deliver on time. Synchronisation enables visible information which is the essential tool in gaining all the benefits of an efficient value chain.

## 6.4 Recommendations

### 6.4.1 Recommendations on the Study Conducted

Based on the study conclusions, the following recommendations are suggested:

- **Enhance Supply Chain Coordination**

To improve supply chain efficiency, BP Southern Africa should establish a dedicated team responsible for integrating supply chain activities across the organization. This team will focus on aligning production schedules with customer demand, optimizing logistics, and ensuring synchronization across all departments. By coordinating these critical functions, the company can achieve better alignment between production outputs and market needs, resulting in enhanced operational efficiency and reduced costs.

- **Optimize Inventory Management**

Implementing advanced inventory management software is essential for BP Southern Africa to monitor stock levels in real-time effectively. This software should be integrated with suppliers and logistics providers to enable just-in-time inventory management, which will help reduce the costs associated with holding excess inventory and minimize the risk of stockouts. This approach will also enhance the company's ability to respond swiftly to market changes, ensuring that the supply chain remains agile and efficient.

- **Foster Collaboration Through Technology**

Adopting a unified communication platform is crucial for improving collaboration within BP Southern Africa's supply chain. This platform should facilitate seamless information sharing among all stakeholders, enabling real-time data exchange, collaborative planning, and accurate forecasting. Increased transparency and improved communication across the supply chain will lead to better decision-making, reducing the risk of disruptions and enhancing overall supply chain performance.

- **Regular Supplier Engagement**

BP Southern Africa should engage in regular meetings with key suppliers to discuss demand forecasts, address supply chain challenges, and identify potential areas for improvement. These meetings will foster stronger relationships with suppliers, ensuring that both parties are aligned on strategic objectives and can collaboratively address any issues. This proactive approach will lead to more reliable supply chains and better alignment with the company's business goals.

- **Continuous Improvement in Planning and Scheduling**

Periodic reviews of planning and scheduling processes are necessary for identifying inefficiencies and areas where improvements can be made. BP Southern Africa should also implement training programs to enhance staff skills in planning and scheduling, ensuring that the workforce is equipped to manage these critical functions effectively. By continuously refining these processes, the company can achieve more accurate production schedules, reduce lead times, and improve on-time delivery performance.

- **Invest in Training and Development**

Investing in a comprehensive training program focused on supply chain best practices is essential for BP Southern Africa. This program should cover new technologies, collaboration techniques, and effective inventory management strategies. By developing a more skilled workforce, the company can drive continuous improvements in the supply chain, leading to better performance, increased efficiency, and a stronger competitive position in the market.

### 6.5 Contribution of the Study to Knowledge

The conducted study must contribute and add value to the businesses, society and institution. (Cooper and Schindler, 2014). A majority of the research on supply chain integration is centered on various businesses and industries. Therefore, it is essential to add more knowledge about integrated supply chain with emphasis in the petroleum industry. This would arguably assist petroleum industries to shift their focus more to electronic and collaboration supply chain which can help to mitigate the challenges associated with unexpected situations in the business.

### 6.6 Suggestions for Further Research

In this section, research suggestions are discussed. This pertains to both the gaps in the literature and the study's conclusions. The study's empirical results are limited to BP Cape Town terminal. It is recommended that a bigger sample be used in a replication of this study. Furthermore, more qualitative methods like focus groups and interviews, where participants are free to completely express their opinions on the issues with supply chain collaboration in the petroleum can be used to further explore the research issue of this study. This could provide the industry with more useful information. As a result, this study shown the substantial positive association between supply chain collaboration that is managed and internal operational departments. This therefore implies that managed supply chain collaboration is achieved through integration with necessary departments internally. These results are consistent with the conclusions drawn from the evaluated literature. However, other aspects that influences collaboration in the petroleum industry can be further investigated. It is recommended that the study include all employees from different terminals to understand issues faced relating to supply chain collaboration.

### 6.7 Limitations and Delimitations of the study

Limitations refer to aspects that researcher cannot change (Wiesrma, 2012). The limitations of this research included the ambiguity of the replies from the questionnaires of participants as some lack

the concentration and interest in responding the questionnaires. Thus, respondents had restricted time for finishing questions due to other work activities. This type of study required respondents to be creative and reflect on their past experiences since it was conducted for the first time. Furthermore, since the major data used for this study came from questionnaires, the conclusions can only be relied upon to be accurate given the quality of the data that was gathered.

According to Simon and Goes, (2013) delimitations encompass things that disturb the scope of the research. Delimitations involve elements that the researcher cannot control in the study. The delimiting factor is that this research focuses only on Western Cape Town Terminal, while the company have other sites/depots or head offices in other provinces and international. In addition, before responding to the questions, each participant received a copy of the quantitative questionnaire. This allowed everyone to sufficiently prepare and avoid any unpleasant surprises. In accordance with the principle of confidentiality, the respondents' anonymity was maintained for the duration of the quantitative study by withholding information that would have revealed their identities.

### 6.8 Conclusion

In conclusion, the primary goal of the study, its contribution, and chapter summaries were described. Following that, the study's delimitations and limits as well as recommendation for further research were examined. The main purpose of this study was to analyse and understand the significance of an integrated supply chain of activities in BP Southern Africa. The alliance approach method known as CPFR, which enables departmental collaboration was applied in the study to coordinate activities and ensure that the company received the product in timely manner with proper planning and adequate resources available to them to meet customer satisfaction. Furthermore, this study has validated that information systems and technology are necessary for optimal information sharing throughout the extended enterprise.

Furthermore, the study provided the insight on how significant is supply chain integration in the petroleum industry. Supply chain collaboration plays a vital role in gaining competitive advantage of the organisation and making the company’s position in the global markets. It can positively and significantly enhance the company’s performance. It was also discovered that with more respondents agreeing to the collaboration in the busisness it shows that the terminal collaborate with stakholders in ensuring increased supply chain transparency to avoid suffering reputational

harm as a result of suppliers' vulnerabilities. Supply chain decision makers are working to increase operational efficacy and cut costs by using a collaborative replenishment method in the increasingly competitive industry. Despite the shifting demand patterns for petroleum products, it is crucial to have the best replenishment procedures in place; otherwise, excessive inventory costs for maintaining stock levels may have a negative impact on business performance.

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# 8 Appendices

## Appendix A Questionnaire


**School of Management, Information Technology and Governance**

**Master Research Project**

**Researcher: Zanele Angel Thobile Gumede (212526574)**

**Supervisor: Dr Eric Dumisani Ncube**

**Title: Integrated supply chain management approach in petroleum industry: A case of British Petroleum Southern Africa**

The aim of this questionnaire is to generate information from employees of the company about the importance supply chain integration at British Petroleum Southern Africa. The respondents' privacy is of the utmost importance and all information acquired was handled with complete confidentiality. The questionnaire will take approximately 10 15 minutes to complete.

**CONSENT**

I hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

_____ _____

Signature of Participant Date

**Section A: Demographic information**

The following questions relate to personal details. Please complete this section by ticking in the corresponding box.

1. Gender

| Male | Female |
|---|---|
| | |

2. Age group

| 20 30 | 31 40 | 41 50 | 51 60 | Above 60 |
|---|---|---|---|---|
| | | | | |

3. Indicate the number of years working for petroleum industry

| Less than 1 | 1 3 | 4 6 | 7 10 | Over 10 |
|---|---|---|---|---|
| | | | | |

4. Level of management

| Top management | Middle management | First Level | Non-Managerial |
|---|---|---|---|
| | | | |

**Section B**

**The following questions use a Likert scale with responses ranging from 1 5. Based on your experience and perception, please encircle (○) or tick (✓) on the appropriate number.**

1- **SA (Strongly Agree)**
2- **A (Agree)**
3- **N (Neutral)**
4- **D (Disagree)**
5- **SD (Strongly Disagree)**

| **Collaboration** | | | | | |
|---|---|---|---|---|---|
| | **SA** | **A** | **N** | **D** | **SD** |
| Does the terminal collaborate with other internal operational departments? | **1** | **2** | **3** | **4** | **5** |
| Does collaboration with other functional operation department add value in matching demand and supply liquid petroleum product? | **1** | **2** | **3** | **4** | **5** |
| Does the organisation manage supply chain collaboration effectively? | **1** | **2** | **3** | **4** | **5** |
| Does the organisation have adequate systems and processes to ensure that tasks are well coordinated between functional departments? | **1** | **2** | **3** | **4** | **5** |
| **Planning and scheduling of operational activities** | | | | | |
| | **SA** | **A** | **N** | **D** | **SD** |
| Does the planning and scheduling of operational activity always customer driven? | **1** | **2** | **3** | **4** | **5** |
| Does planning and scheduling assist in ensuring that all tanks have enough petroleum product? | **1** | **2** | **3** | **4** | **5** |
| Does planning and scheduling allows fair distribution amongst all the stakeholders? | **1** | **2** | **3** | **4** | **5** |
| Does planning and scheduling systems allows tracking of stock in transit between receiver and dispatch? | **1** | **2** | **3** | **4** | **5** |
| Does allocation of operation resources e.g. transport and labour matches with planning and scheduling? | **1** | **2** | **3** | **4** | **5** |

| | | | | | |
|---|---|---|---|---|---|
| Does planning and scheduling enhance smooth operation? | **1** | **2** | **3** | **4** | **5** |
| **Forecasting of the liquid petroleum product** | | | | | |
| | **SA** | **A** | **N** | **D** | **SD** |
| Does the previous data reliable in such a way that it predicts the future demand? | **1** | **2** | **3** | **4** | **5** |
| Is the right quantity always delivered at the right time? | **1** | **2** | **3** | **4** | **5** |
| Are the forecasting results always communicated to all stakeholders? | **1** | **2** | **3** | **4** | **5** |
| **Replenishment** | | | | | |
| | **SA** | **A** | **N** | **D** | **SD** |
| Does operational department e.g. warehouse, transport, scheduling always share information across? | **1** | **2** | **3** | **4** | **5** |
| Does information sharing internal and external ensures that orders are tracked and delivered in right quantity? | **1** | **2** | **3** | **4** | **5** |
| Does the replenishment system in place allows customers to access product of their choice at the right time, at the right quantity and delivered at the right place? | **1** | **2** | **3** | **4** | **5** |

**Thank you for participating!!!**

## Appendix B: Informed Consent Form

**UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)**

**APPLICATION FOR ETHICS APPROVAL**
**For research with human participants**
**INFORMED CONSENT LETTER**
**Information Sheet and Consent to Participate in Research**

Researcher: Zanele Angel Thobile Gumede ([redacted])
Supervisor: Dr E Ncube (0312608805)
Research Office: Marlette Snyman (0312608350)

**Date: 31/07/2023**

Good day Sir/Madam

My name is Zanele Angel Thobile Gumede a MCOM (Supply Chain Management) student at the University of KwaZulu Natal the School of Management, Information Technology and Governance. College of Law and Management Studies invite you to participate in research project "Integrated Supply Chain Management Approach in petroleum industry. A case of British Petroleum Southern Africa (BPSA)."

You are being invited to consider participating in a study that involves research that is study designed and quantitative in nature. The aim and purpose of this research is to discuss the importance of adopting Collaborative Planning, Forecasting and Replenishment (CPFR) model to ensure coordination of supply chain activities in the British Petroleum Southern Africa. The study is expected to enroll forty employees however since the population of employees in these department is not the same. Each department was sampled to 36 people. The population of this research are the BPSA employees in Cape Town, Western Cape Province. It will involve the following procedures a five Likert scale to get true information from the respondents regarding the questions asked. Quantitative method will used to analyse data using statistics tools. Furthermore, the study aims to use bivariate approach that includes analysis of variance, cross tabulation, Pearson correlation, chi square, testing of the hypothesis. The duration of your participation if you choose to enroll and remain in the study is expected to be to assist companies to shift their focus more to collaborative supply chain which can help to mitigate the challenges associated with unexpected situations in the business.

The study may involve the following risks and/or discomforts which is the restricted time of finishing questions by the responders because of other work activities. We hope that the study will establish how the positive experience for the customers can be improved by ensuring that operational activities have been integrated with customer's needs.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number_____).

In the event of any problems or concerns/questions you may contact the researcher at [redacted] or 212526574@stu.ukzn.ac.za the UKZN Humanities and Social Sciences Research Ethics Committee, contact details as follows:

**HUMANITIES and SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION**
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu Natal, SOUTH AFRICA

Tel: 27 31 2604557 Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

The respondents' privacy is of the utmost importance and all information acquired was handled with complete confidentiality. All participants were handled with respect and the surveys will completely be voluntary for the participants, no one was compelled to do it. participants may withdraw participation at any point. In addition, in the event of refusal/withdrawal of participation the participants will not incur penalty or loss of treatment or other benefit to which they are normally entitled.

Before the survey, the study was explained, and the anonymity of the information gathered for the study was protected. Participants was given names to remain anonymous.

**CONSENT (Edit as required)**

I……have been informed about the study entitled **Integrated Supply Chain Management Approach in petroleum industry. A case of British Petroleum Southern Africa (BPSA)** by Zanele Angel Thobile Gumede.

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study related procedures.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher at (provide details).

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

**HUMANITIES and SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION**
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu Natal, SOUTH AFRICA
Tel: 27 31 2604557 Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Additional consent, where applicable

I hereby provide consent to:

| | |
|---|---|
| Audio record my interview / focus group discussion | YES / NO |
| Video record my interview / focus group discussion | YES / NO |
| Use of my photographs for research purposes | YES / NO |

_____ _____

**Signature of Participant** **Date**

_____ _____

**Signature of Witness (Where applicable)** **Date**

_____ _____

**Signature of Translator (Where applicable)** **Date**

## Appendix C: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

02 December 2023

**Zanele Angel Thobile Gumede (212526574)**
**School Of Man Info Tech & Gov**
**Westville Campus**

**Dear ZAT Gumede,**

**Protocol reference number:** HSSREC/00006084/2023
**Project title:** Integrated supply chain management approach in petroleum industry: A case of British Petroleum Southern Africa
**Degree:** Masters

### Approval Notification – Expedited Application

This letter serves to notify you that your application received on 31 August 2023 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

**Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.**

This approval is valid until 02 December 2024.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

---

**Professor Dipane Hlalele (Chair)**

**/dd**

**Humanities and Social Sciences Research Ethics Committee**
**Postal Address:** Private Bag X54001, Durban, 4000, South Africa
**Telephone:** +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

## Appendix D Editing Certificate

PRO EDIT PTY LTD

**EDITING CERTIFICATE**

PO BOX 23081, CLAREMONT CAPE TOWN 7735 | +[redacted]

Date: 2024/07/08

This serves to confirm that the document entitled:

**Integrated supply chain management approach in petroleum industry: A case of British Petroleum Southern Africa**

**By**

**Zanele Angel Thobile Gumede**

has been language edited on behalf of its author.

[redacted]
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