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LOGISTICS INFRASTRUCTURE AND SUPPLY EFFICIENCY OF PETROLEUM PRODUCTS IN KENYA: A SURVEY OF OIL MARKETING COMPANIES IN KENYA

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ABSTRACT

In Kenya, petroleum products are a major source of commercial energy accounting for about 80% of the country's commercial energy requirements. The country has been faced with frequent fuel shortages leading to unstable fuel prices which result to high cost of production incurred by manufacturers. The general objective of the study was to establish the effects of Logistics Infrastructure on Supply Efficiency of Petroleum Products in Kenya. The specific objectives were to establish effect of oil Storage Infrastructure, effect of Transport Infrastructure, effect of Handling Infrastructure, and effect of Clearing Infrastructure on Supply Efficiency of Petroleum Products in Kenya. Correlation results showed that storage infrastructure, handling infrastructure, transport infrastructure and clearing infrastructure are all positively and significantly related with supply chain efficiency. Regression results indicated that storage infrastructure, transport infrastructure, handling infrastructure and clearing infrastructure were all positively and significantly affect supply efficiency.

Key Words: *Clearing, Efficiency, Handling, Infrastructure, Storage, Supply, Transport*

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BACKGROUND

Because it provides products and services like energy, chemicals, heating, petroleum products, lubricants, and transportation, the gas and oil business continues to be one of the biggest in the world. Every nation on the planet uses petroleum products in its economy, and the oil and gas sector is worth billions of dollars (Bacon & Kojima, 2016). Despite their widespread need, petroleum products are only produced in a few, restricted areas of the world. The petroleum industry's management has become increasingly complex and difficult due to the rise in worldwide demand, the ease of conducting business internationally, and the rigidity of the industry's supply chain (Cohen, 2016). World Bank (2018) concurs that growing demand for petroleum products has resulted from market liberalization and easier access to international trade, to the point where the sector's complicated supply chain faces numerous difficulties. The petroleum industry can be broadly classified into three segments: upstream, which involves the discovery, development, and production of natural gas or crude oil; midstream, which involves refining; and downstream, which includes oil tankers, pipelines, retailers, and consumers. When considering the entire petroleum industry, including production, distribution, refining, and retailing, the total dollar worth of this sector is the highest in the world. When completed petroleum products are efficiently transported from the point of refinery to the final users in gas stations or whole sales, supply chains in the oil business are deemed complete. One of the biggest challenges facing the worldwide industry is getting the product from its point of origin to the end user. Certain forms of transportation are needed for commodities like oil, gas, and petrochemicals, including pipelines, tankers, and trains. In this industry, lead times of a few weeks between the shipping port and the end customer's location are rather typical. An effectively run downstream petroleum sector can help all of the economy's producing sectors. According to Gboney (2009), strengthening supply conditions is necessary since the high costs of petroleum products in the majority of countries are a result of poorly managed supply chains.

Saudi Arabia, Russia, the United States, Iran, Mexico, China, Canada, United Arab Emirates, Venezuela, Norway, Kuwait, Nigeria, Brazil, Kazakhstan, and Iraq are the major producers of oil in the world. Major crude oil is controlled by the Organization of the Petroleum Exporting Countries (OPEC), which establishes output limitations. Because the oil sector involves a wide range of activities, including material handling, technical application, international transportation, and exploration, among others, it has one of the most complicated supply chains in the world. When it comes to applying supply chain management techniques, the oil business offers a highly developed framework. Supply chains must therefore provide the appropriate product at the right location at the right time for the right price in order to satisfy customers of the goods they supply. Despite the significance of supply chain management and its increasing complexity, the petroleum sector globally is still in the early stages of developing effective supply chain management strategies. The oil and petrochemical industries' understanding of the global supply chain is still in its infancy, according to Briggs et al. (2012). The majority of businesses in North America, Europe, and Asia have realized that increased supply chain efficiency offers significant potential for cost savings, particularly in the logistics sector, which accounts for an estimated 10–20% of total revenue. As a result, they are focusing more on their logistics infrastructure (Cigolini and Rossi, 2017). Although they agree that there is still much space for improvement and cost reduction, particularly in the logistics sector, they have made significant progress in lowering the rigidity and complexity of the petroleum industry's supply chain (British Petroleum, 2015).

Due to the production capacities of crude oil suppliers, lengthy lead times for transit, and the constraints of available modes of transportation,

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the petroleum industry's logistics network in Africa is incredibly rigid. Thus, each node in the network poses a significant challenge (World Bank, 2015). Long distances between supply chain partners and sluggish modes of transportation result in high carrying costs for inventory in terms of safety stocks at the ultimate customer location in addition to high transportation costs and in-transit inventory. Due to the large distances between supply chain participants, there is a tremendous deal of uncertainty in the transit timeframes, which can be detrimental to suppliers' service standards and ultimately to final customers' safety stock prices. Few sectors deal with the intricacy of shipping that requires a package to utilize many means of transportation in order to reach the final customer's location, however it happens frequently. Compared to other industries, this form of business has longer lead times from the shipping point to the ultimate clients' location due to restrictions on transportation modalities (Deloitte, 2018). The World Bank (2015) states that a significant problem facing the African petroleum industry is the degree of rigidity required to satisfy the expanding potential for oil demand and its derivatives while upholding good service standards and efficiency.

Petroleum product markets in Eastern and Southern Africa are seen as modest and fraught with difficulties (PIEA, 2019). In the entire region, only South Africa and Kenya have product pipelines. Power outages have often interrupted pipeline operations in Kenya, and limited pipeline capacity in South Africa is currently driving up petroleum delivery costs (BP, 2018). Although the market-based tariff for road movements is more than 50% greater than that of rail, rail transport is often underutilized; in 2018, just 28% of petroleum products were moved by rail and more than 70% by road (Jones & Murphy, 2012). Poor road conditions, traffic, and perhaps sluggish border clearance when there is cross-border trade all hinder road transportation (PIEA, 2021).

Statement of the Problem

Most economies in the world have a high need for petroleum products. About 80% of Kenya's needs for commercial energy are met by petroleum products, making them a significant source of energy for the nation. Following the collapse of KPRL, which processed crude oil, all petroleum products used in Kenya are imported as refined petroleum products from the Gulf region (PIEA, 2019). This necessitates effective downstream petroleum industry management. But the nation has had regular fuel shortages, which have led to volatile fuel prices. According to PIEA (2021), the current oil terminals, which are built to process one billion liters annually, processed more than 2.5 billion liters in 2017. This increase in oil receipts has put stress on the infrastructure already in place and made the delayed discharge issue worse. Customers and local C&F companies are complaining about Mombasa Port's overworked and overburdened oil handling capabilities (Omolo & Mwabu, 2014; Kenya Shippers report, 2017). Significant losses are also incurred by other private sector participants in the chain, including manufacturers, carriers, and Oil Marketing Companies (OMCs). Due to artificial shortages of petroleum products brought on by this deficient Logistics Infrastructure, the price of oil and other products has increased on the market.

According to a 2018 World Bank study on Kenya's strategy to make liquefied petroleum gas the country's primary cooking fuel, there is not enough bulk storage for imported volumes, and the port of Mombasa is experiencing equipment strain, which leads to the importation of shipments that are not economically viable. This explains why landed supply costs are high and drive up prices for Kenyan consumers (World Bank, 2018). In 2019, UNCTAD carried up a study titled "Kenya's Oil Sector: Situation, Developments, and Prospects," which came to the conclusion that the country's inadequate transportation and Storage Infrastructure was the primary cause of unexpected price increases. Thus, the purpose of this study was to close the aforementioned gaps by determining

how Kenya's current Logistics Infrastructure affects the country's ability to supply petroleum products efficiently and by formulating recommendations for the enhancements that would be required to raise that efficiency.

Research Objectives

The main objective of this study was to establish effects of Logistics Infrastructure on Supply Efficiency of Petroleum Products in Kenya.

The specific objectives of the study were:

- To establish effects of oil Storage Infrastructure on Supply Efficiency of Petroleum Products in Kenya.
- To determine effects of Transport Infrastructure on Supply Efficiency of Petroleum Products in Kenya.
- To find out effects of Handling Infrastructure on Supply Efficiency of Petroleum Products in Kenya.
- To investigate effects of Clearing Infrastructure on Supply Efficiency of Petroleum Products in Kenya.

The study sought to test the following null hypotheses:

- HO_1: Storage Infrastructure has no significant effect on Supply Efficiency of Petroleum Products in Kenya.
- HO_2: Transport Infrastructure has no significant effect on Supply Efficiency of Petroleum Products in Kenya.
- HO_3: Handling Infrastructure have no significant effect on Supply Efficiency of Petroleum Products in Kenya.
- HO_4: Clearing Infrastructure has no significant effect on Supply Efficiency of Petroleum Products in Kenya.

LITERATURE REVIEW

Theoretical Framework

The supply chain Operations Reference (SCOR), Queuing Theory and a theoretical approach to Resource-Based View and the network theory supported this study.

Supply Chain Operations Reference Theory

Supply Chain Operations Reference Theory is by definition a tool that helps users discuss, approve, and share information on all the parties engaged in a supply chain as well as its activities. According to Hwang et al. (2018), the theory explains the business procedures necessary to meet consumer needs, aids in the explanation of the procedures throughout the whole supply chain and offers a foundation for process improvement. Simchi-Levi et al (2015) asserts that SCOR extends from vendors to clients. According to Lysons & Farringtone (2012), this framework concentrates on the following five aspects of the supply chain: plan, source, make, deliver, and return. Hwang et al. (2018) agree and note that certain regions recur often throughout the supply chain. According to the supply chain council, this procedure involves "the supplier's supplier to the customer's customer." Planning entails creating plans to accomplish the goals of the supply chain strategy and communicating them. It covers tasks including developing sourcing strategies, organizing inventories, and anticipating demand. It entails deciding on communication throughout the chain and striking a balance between resources and requirements. Along with connecting the supply chain strategy with the company's financial plan, additional aspects of the plan include establishing business rules to measure and enhance supply chain efficiency in respect to assets, transportation, inventory, and regulatory compliance, among other things (Supply Chain Council, 2014). The source outlines how to handle supplier payments and specifies when to receive, verify, and transfer product. It also covers sourcing infrastructure and material acquisition, as well as how to manage inventory, the supplier network, supplier agreements, and supplier performance (Lysons & Farringtone, 2012).

The Queuing Theory

In accordance with Sundarapandian (2019), the mathematical study of waiting lines, often known as queues, is referred to as queuing theory. The outputs of a queuing model, which is constructed to

estimate wait times and queue lengths, are typically used as the basis for business decisions regarding the resources that are necessary to provide a service. Queuing is a tool that can be used to improve overall customer service and is one of the operations management tools that may be used. Assessing and streamlining the requirements for staff, scheduling, and inventory can be accomplished with its help. When there are not enough resources available, queues arise, which makes economic sense. It is possible to create well-balanced systems with the assistance of queuing theory. These systems should be able to deliver timely and effective customer service while also remaining economical enough to be long-lasting. Since this is the case, queuing theory contributes to the development of well-balanced systems that provide users with prompt and efficient service while keeping costs at a level that is low enough to be sustainable over time. All queuing systems are comprised of the entities that are waiting in line for an activity. According to the queuing theory, the first step in determining the service requirements of a facility is to examine the arrivals that it receives. With the use of queuing theory, a business can develop more efficient pricing strategies, personnel arrangements, arrival management plans, and queuing systems in order to reduce the amount of time that customers have to wait in line and to accommodate a greater number of customers. According to Adan and Resing (2015), a queuing system will ensure that customers will receive input service and that they will be required to wait for it in the event that it is unavailable. The optimization of transit and waiting times, which in turn leads to a reduction in fuel consumption, can be achieved by setting priorities for tasks that belong to any aspect of supply chain management.

Resource-Based Theory

Intimately connected to the concept of the Resource-Based View is the competitive power and advantage that the organization possesses. According to Simchi-Levi et al. (2015), the development, manufacturing, and delivery of goods and services to customers are all activities that make use of the organizational, financial, physical, and human resources that a company brings to the table. These strategic resources are valuable, unusual, somewhat imitable, and difficult to replace, as stated by Rothaermel (2019). These are the four characteristics that come together to make them a strategic resource. Having resources that are able to fulfill these requirements might be of assistance to the company in maintaining and protecting its competitive edge. On the other hand, this is not a practical option unless the resource in question is useful in the sense that it assists the company in capitalizing on opportunities and mitigating risks. It is argued by Derrouiche et al. (2020) that if a resource is not rare, then numerous competitors will be able to access it, and the advantages that are achieved through the utilization of the resource will not be able to be maintained. This is due to the fact that having a resource is more of a prerequisite for being in the market than it is a competitive advantage. When it comes to replicating critical resources, it is an exceedingly difficult task. This holds especially true in the event that the resources consist of both tangible and intangible assets. In conclusion, it must be difficult to bring strategic resources back into operation. In the event that a substitute is available, it is impossible to keep a competitive advantage. In order for a company to achieve and sustain a competitive advantage, it is necessary for the company to recognize and cultivate these strategic resources (Lettice et al., 2020; Kelley et al., 2017; Simchi-Levi et al., 2015).

Network Theory

According to Simchi-Levi et al. (2015), in order for a business to be concerned about the supply chain as a whole, it is necessary for the business to establish a network with each and every other company in the chain. According to Gadde et al. (2020), Network Theory postulates that the ties that a firm has with other companies are frequently the most significant assets that the company possesses. This is because these partnerships provide access to

resources that are complementary to those of the other companies concerned. Because of this, it will be necessary to investigate the company from an external perspective in order to ascertain whether or not the information is applicable to other relationships. In the context of a collaboration, this might be considered a significant benefit for both of the companies involved. According to Oh et al. (2016) and Yu et al. (2019), an industrial network is comprised of actors, resources, and activities. Other components include activities. When evaluating the capabilities of the actors, the resources that they manage and the actions that they carry out are taken into consideration. The term "resources" refers to anything and everything that helps to making the final result more valuable. This includes both external and internal resources. For the purpose of achieving the best possible outcome for the network, it is a fundamental assumption that all of the players would behave in a manner that is honest and trustworthy toward one another. There is the formation of a relationship between two or more companies when they interact with one another. It is possible to achieve this goal through the utilization of either an exchange process or an adaptation process. The first scenario involves two companies moving one resource to the other by utilizing another resource. The second scenario, on the other hand, involves the modification of operations in a more cooperative manner in order to make better use of the resources. The interactions are responsible for establishing connections, and each interaction is fundamentally connected to other interactions as a constituent of the overall system (Håkansson, 2018). According to Simchi-Levi et al. (2015), this often leads to a stronger link between the two parties involved, which can be viewed as an indication of mutual trust between the two parties. There are many different firms within the network, and each of these firms has a unique capacity to influence the movements of other enterprises within the network. The evolution of the network is significantly influenced by the power structure of the network, which can be defined as this ranking that is based on similar interests and different resources as well. When it comes to the establishment of new interactions and contracts, the power structure plays a significant role.

Empirical Review

Storage Infrastructure and Supply Efficiency

According to Hu and Cao (2016), space is defined as the adequate area required for the berthing of ships and the storage of cargo space. Both the seamless movement of products and the prevention of delays require a sufficient amount of space. In spite of this, inventory management is absolutely necessary because of the limited space available in each store. This necessitates precise replenishment at each and every retail location, as well as a rapid response to demand by means of sales. The adoption of a responsive dimension is something that companies need to undertake in order to align themselves with uncertain demand and product life, as mentioned by Chopra and Meindl (2016). That being the case, space must be allotted inside the company in order to fit all of the products that have been bought. This is something that can only be accomplished by implementing storage layouts and procedures that are acceptable and effective, as well as by frequently reviewing the requirements. It is a typical objective in procurement to ensure that things are delivered on time; but, if there is no space to secure the items, this could result in traffic congestion and delays in delivering the items to the spot where they are supposed to be. According to Brettel et al. (2011) and Mayrson (2016), there is an increasing body of research suggesting that the delivery of goods and services that are late or incomplete can lead to a decline in sales, production halts, and the activation of penalty clauses, which eventually results in dissatisfaction among customers. Immediately berthing ships is necessary in order to reduce the amount of time that is wasted during loading and unloading. The lengthy wait apparently begins as soon as a ship docks in Mombasa, as stated in the study that was published by the Kenya Shippers Council in 2014. Because there is a shortage of space at the port, it

takes anywhere from ten to fourteen days for a ship to be granted a berth. Shipping companies are required to pay demurrage costs that range from ten thousand to twelve thousand dollars each day.

Transport Infrastructure and Supply Efficiency

"The conveyance of goods and people over land, across water, and through the air" is the definition of transportation that is provided by Aderamo (2012). According to him, transportation is beneficial to both industry and commerce since it enables the delivery of finished goods for consumption as well as the delivery of raw materials to the location where they are produced. Adding value or utility to a region is the function of transportation. It has an effect on the speed and dependability with which items are transported from one location to another, which is a factor that contributes to the formation of temporal utility. According to Hessler (2010), value chains begin when products, resources, or vessels are brought into an organization. Therefore, transport services must be ongoing in order to ensure an effective flow of goods throughout the supply chain along the supply chain.

In order to transport petroleum products from the Mombasa port, there are a number of challenges that need to be taken into consideration and solved. These challenges include an inadequate pipeline, stringent safety standards for transporters, and a poor road network. The KPA has been strengthening its capacity to manage larger cargo volumes, as stated in the management report for 2011–2012; nonetheless, they are falling short due to the lack of suitable infrastructure. Delivery delays are the result of inadequate transportation since it takes longer for the vehicles to convey cargo from one location to the necessary places. This causes the delivery delays to occur.

Handling Infrastructure and Supply Efficiency

Materials handling refers to the process of moving objects all the way through the processes of an organization. In addition to transporting goods from one process to the next, it also transports items that have been selected from retailers to the site that is necessary. The purpose of material handling is to be able to deliver effective movements with short journeys, as well as quick movements that are free of harm by utilizing the appropriate equipment, specific handling and packaging when it is required, and quick movements. Because of this, it is possible that the layout of the factory will need to be reorganized in order to improve the conditions under which materials are handled (Djassemili, 2014). According to Lysons and Farringtone (2012), efficient handling systems are essential for the correct handling of materials. This is because these systems are the method by which objects can be transferred from one location to another with the least amount of human labor. It is common for a corporation to incur significant costs while making investments in infrastructure and systems necessary for material handling. According to Leuschner and Lambert (2017), decisions about the amount, size, and placement of warehouses can have an effect on a variety of aspects of logistics operations. Materials handling decisions can also have an impact on these aspects.

The fact that firms usually deal with a diverse range of commodities necessitates the utilization of a variety of different kinds of equipment (Kumar & Suresh, 2009). Despite this, the implementation of fully automated handling systems will result in an increase in pressure throughout the offloading process. To ensure that there is a consistent flow of trucks and to avoid congestion, which may necessitate an organization to make additional investments in loading and unloading facilities in order to get rid of congestion, the objective will be to finish the unloading process as rapidly as is practically possible.

Cargo Clearing Infrastructure and Supply Efficiency

Cargo clearance refers to the amount of time that is necessary for the processing of goods that have been received, the unloading of goods, the storage of goods, the verification of goods, the movement of cargo within the company, and the transfer of ownership to clearing and forwarding agents, the owner of the cargo, or transshipping in the event

that the cargo is in transit. However, if the requisite length of time for document processing, unloading, verification, storage, and cargo issuance is not fulfilled, then there will be a delay in the clearance of the cargo. Infrastructure that is insufficiently constructed, low traffic volume within the constraints of physical and environmental constraints, and inadequate technology are the three primary factors that contribute to delays in the delivery of cargo (Cuadrado et al. 2013). The process of clearing cargo is carried out with the assistance of these add-ons, which can be found in a variety of government departments, divisions, or sectors inside the port. According to the Clearing Infrastructure ranking, information technology (IT) stands at the very top of the list. In order to successfully execute supply efficiency, information technology is essential since it connects people and information. Alink and Kommer (2011) state that information technology not only improves the quality of service that is provided to customers, but it also considerably boosts productivity, saves money, and saves time.

Conceptual Framework

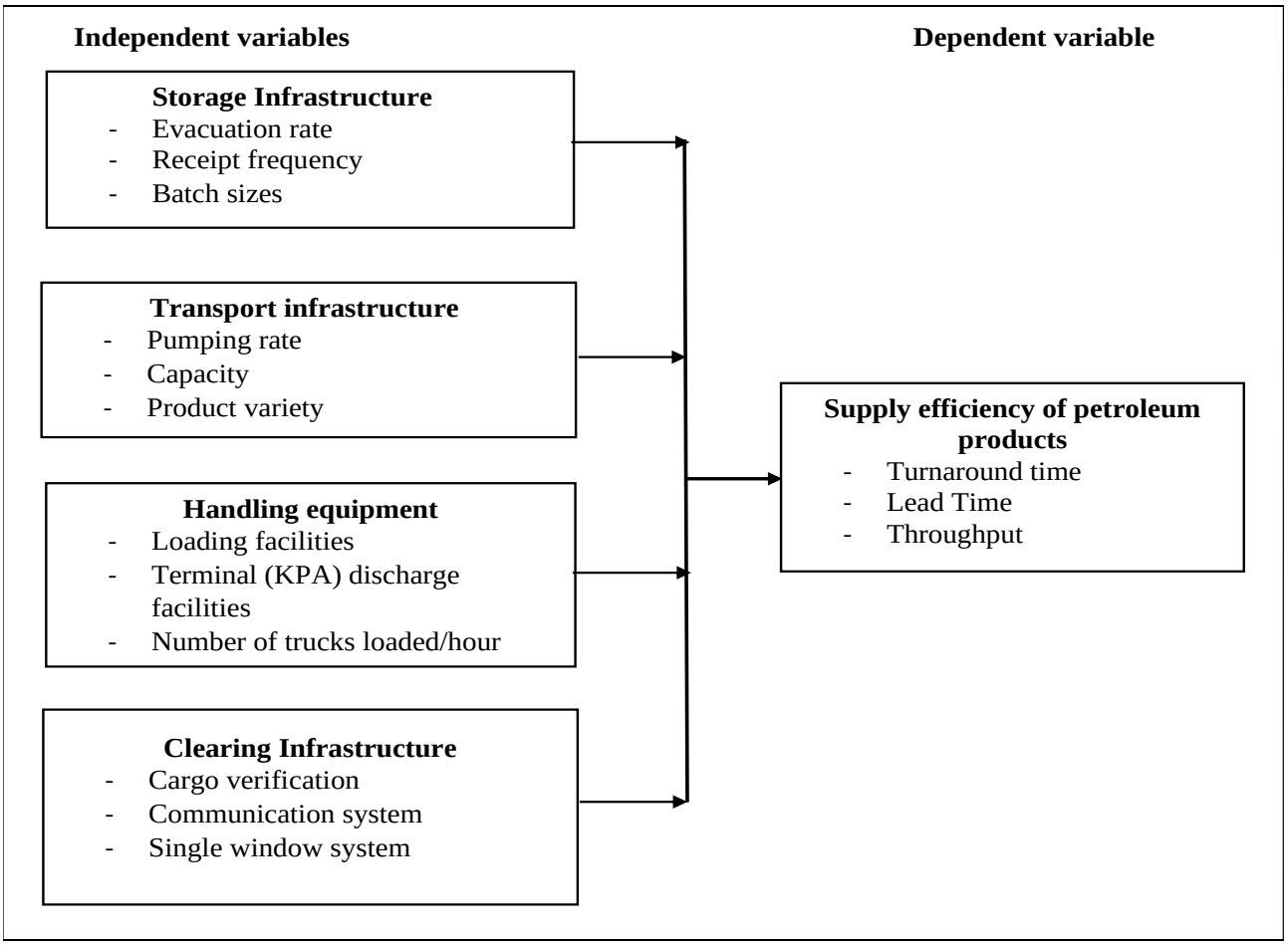

Figure 1: Conceptual Framework

Source: Research data (2022)

METHODOLOGY

The study employed an explanatory research approach and the target population consisted of 120 respondents, 60 of whom were supply managers and 60 of whom were operations managers from Kenya's 60 operating oil marketing companies. Due to the small size of the target population, census method was used. Data was collected by use of a structured questionnaire and

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the multiple linear regression analysis method was used as follows:

$Y=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\varepsilon$

Where:

- Y = Supply Efficiency
- α = Constant
- β_1, β_2, β_3, β_4 = Régression Coefficient
- X_1 = Storage Infrastructure
- X_2 = Transport Infrastructure
- X_3 = Handling Infrastructure
- X4 = Clearing Infrastructure
- ε = Stochastic term or error term

Descriptive results indicated that majority of the respondents agreed that storage, transport, handling and clearing strongly affected efficiency.

Table 1: Descriptive Results

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
STORAGE	2.49	1.018	.999	.233	.265	.461
TRANSPORT	2.36	1.027	.804	.233	.114	.461
HANDLING	2.23	.838	.896	.233	.859	.461
CLEARING	2.31	.932	.762	.233	-.007	.461
EFFICIENCY	3.06	.687	-.788	.233	1.551	.461

Correlation Analysis

Table 2: Correlation Results

		Storage	Transport	Handling	Clearing	Efficiency
Storage	Pearson Correlation	1				
	Sig. (2-tailed)					
Transport	Pearson Correlation	.194*	1			
	Sig. (2-tailed)	.044				
Handling	Pearson Correlation	.386**	.406**	1		
	Sig. (2-tailed)	.000	.000			
Clearing	Pearson Correlation	.206*	.453**	.318**	1	
	Sig. (2-tailed)	.032	.000	.001		
Efficiency	Pearson Correlation	.239*	.419**	.436**	.562**	1
	Sig. (2-tailed)	.013	.000	.000	.000	

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
c. Listwise N=108

The findings demonstrated a positive and substantial relationship between all infrastructure factors and supply chain efficiency, i.e., an improvement in Logistics Infrastructure led to an improvement in supply chain efficiency. The main takeaway from these results is that oil marketing companies with highly efficient logistical systems will typically be able to achieve higher levels of efficiency than those with less efficient systems. In other words, increased Storage, Transport, Handling, and Clearing Infrastructure all contribute to increased petroleum product Supply Efficiency in Kenya.

Model Summary

Table 3: Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.634[a]	.402	.379	.582

Predictors: (Constant), horizon_1, perfrom_1, vertical_1, congrom_1

Source: Research Data (2022)

The R square was 0.402, meaning that Logistics Infrastructure variables—Storage, Transport, Handling, and Clearing Infrastructure—accounted for 40.2% of the variance in supply chain efficiency in oil marketing firms. Other factors in Kenya's oil and gas sector, which were not examined in this research, explained the remaining 59.8% of the variance.

Table 4: ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.404	4	5.851	17.294	.000[b]
	Residual	34.846	103	.338		
	Total	58.250	107			

a. Dependent Variable: Efficiency

b. Predictors: (Constant), Storage, Transport, Handling, Clearing

Source: Research Data (2022)

Results from a significant ANOVA show that the model fits. A good linear model with Supply Efficiency as the dependent variable and Logistics Infrastructure variables as independent variables was shown by the results, which had a significant p value ($F_{(4,107)} = 17.294$, $p<.001$).

Table 5: Regression Coefficients

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Hypothesis Test
		B	Std. Error	Beta β			
1	(Constant)	.529	.411		1.289	.200	
	Storage	-.027	.060	.037	.446	.657	Fail to reject H_O1
	Transport	.134	.037	.124	3.616	.000	Reject H_O2
	Handling	.183	.069	.236	2.640	.010	Reject H_O3
	Clearing	.504	.104	.423	4.863	.000	Reject H_O4

a. Dependent Variable efficiency

Source: Research Data (2022)

The results indicated that storage infrastructure, transport, handling and clearing infrastructure positively and significantly affect supply efficiency and was significantly impacted by logistical infrastructure. This implies that increased Storage, Transport, Handling, and Clearing Infrastructure all contribute to increased petroleum product Supply

Efficiency in Kenya. The derived model was as follows;

$$\text{Supply Efficiency} = .037\text{STORAGE} + .124\text{TRANSPORT} + .236\text{HANDLING} + .423\text{CLEARING}$$

CONCLUSIONS

- Storage infrastructure positively and significantly affects Supply Efficiency of Petroleum Products in Kenya.
- Transport Infrastructure positively and significantly affects Supply Efficiency of Petroleum Products in Kenya.
- Handling Infrastructure positively and significantly affects Supply Efficiency of Petroleum Products in Kenya.
- Clearing Infrastructure positively and significantly affects Supply Efficiency of Petroleum Products in Kenya.

RECOMMENDATIONS

- Oil marketing companies should invest in storage infrastructure so as to improve on supply efficiency of Petroleum Products in Kenya.
- Oil marketing companies should invest in transport infrastructure so as to improve on supply efficiency of Petroleum Products in Kenya.
- Oil marketing companies should invest in handling infrastructure so as to improve on supply efficiency of Petroleum Products in Kenya.
- Oil marketing companies should invest in clearing infrastructure so as to improve on supply efficiency of Petroleum Products in Kenya.
- Oil marketing companies should formulate the criteria for ullage allocation in KPC and inform Ministry of Petroleum and Mining accordingly.

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