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Optimizing supply chain management for competitive advantage in the marketing of petroleum products in Nigeria

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Abstract
This study was designed to determine the relevance of logistic models in achieving optimal supply chain management for competitive advantage in the marketing of petroleum products in Nigeria. Survey research design was adopted for this study. Employees of Northwest Petroleum/Gas, Nigerian Customs, Nigerian Navy and Nigerian Ports Authority, as well as Tanker drivers and Jetty owners (ECM Terminal), constituted the population for the study, from which a sample of 200 was randomly drawn. Three research questions and three hypotheses were formulated to guide and direct the study. A four point likert-type questionnaire was used to collect data. Data was analyzed and hypothesis tested with Pearson product-moment correlation analysis. Analysis revealed that the bottlenecks experienced by organizations involved in petroleum product marketing and supply chain management was majorly caused by the abject lack of appropriate logistics models that would have made the process easier and faster. It was also discovered that quantitative and empirical approaches were deficient in the decision making and problem solving procedures of the organization's supply chain management. It was recommended that organizations involved in this line of business, as well as, government regulatory agencies' should employ the use of appropriate logistics models to facilitate service delivery.

Keywords: chain, supply, management, optimizing competitive, marketing and petroleum products

1. Introduction

1.1 Background of the study

A model is an abstraction of reality. It is a simplified version of a real phenomenon, (Stevenson 2011) [9]. Models are conceptual frame works that provide supply chain managers with a set of values and standard on how logistics processes ought to be. Logistics and supply chain experts use models to abstract real life situations. For instance through the use of graphs, they can forecast demand for services and charts on the other hand, can be used to show variations in demand according to seasons. These models shows real life situation of what an ideal phenomenon should be. Ideally there should be a model for procurement of spares, and criteria for award of contracts and so on. From these abstractions, managers build up ideas and take decisions. For example, decision models facilitates loading of fuel tankers and firefighting, (Brawo, 2020) [2].

As aptly observed by Hosseini & Nezhand, (2017) [4], in logistics and supply chain operations, models are decision making aids and simplifications of real life processes. They are classified according to whether they are physical, schematic or mathematical. Physical models look like real life counterparts, for instance cars, trucks, airplanes and model buildings. Schematic models are more abstract. They have fewer semblances with real life situations. For instance, graphs, scales, charts, drawing and Blueprints. They have some degree of visual correspondence. Mathematical models are most abstract. They are easy to manipulate and form essential inputs for computers. They help to eliminate unimportant details that characterize real life situations. For instance, mathematical models can be represented by formulae like this: ($\Sigma \geq x^0$), symbols or ($X^2=\Sigma$) and so on, these are selected representations of real life situations (Kobler, 2019) [6]. The goals of modeling are to adequately portray some real life phenomenon. Once a model is developed, much is learnt about it by manipulating its variables and observing the results. If the models are good, the knowledge gained is applied in a real life situation. Here, managers understand the problem and its real solutions better. In real life, experts use model according to their need e.g. the political scientist will talk of a model of social systems, a models of state instrument and governance and so on.

2. Review of Literature

2.1 Conceptual Review

2.1.1 Importance of models in logistics and supply chain management

As observed by Asadi & Sadeghian (2019) [1], Logistics and supply chain experts use optimal models in a variety of ways and reasons among such are:

1. Models are easy to use and less expensive than dealing with actual situation, hence they save time and cost.
2. Models provides supply chain managers a systematic approach to problems solving
3. Optimal, models provides reinforcement for intuition for the logistics manager in decision taking, provides a quantitative support for the managers preconceived notion, bolsters his confidence in his own intuition.
4. Help to increase the managers understanding of the problem and its solutions
5. Models as tools for decision making also serves as tools for evaluation. They force managers to identify and record decision variables that influence objectives.
6. Models compel Logistics managers to record constraints (limitations) on the values the variables may take.
7. Optimal models compel logistics managers to identify and record pertinent interactions and tradeoffs between decision variables.
8. Models provide additional data, data are for decision making in the real world while decision in the context of models are numbers.
9. They enables users bring to bear the power of mathematics and quantitative analysis on problem solving. Here, quantitative approaches to problem solving provide the most accurate approach for instance there is optimum allocation of resources as in linear programming and related mathematical technique and queuing technique used in waiting line (telephone operators).
10. Models provide standardized format for analyzing logistic problems for example for the British to handle their logistics problems, they assembled a mix of interdisciplinary teams (Psychologist, Mathematicians, Economist and Strategists) to combine efforts for a workable solution to their logistics problems. Also, mathematical and quantitative approaches are used in various fields of logistics for instance the project model PERT (Program Evaluation and review technique) the CPM - (Critical path method) are used for project planning, coordination and controlling large scale projects.
11. Forecasting techniques are used as basis for planning and scheduling. Mathematical and statistical models are used in all areas of logistics and supply chain decision making activities where elements of risks are present.

In all, optimal supply chain models are used by logistics and supply chain organization to gain or ensure optimal results and competitive advantage. However, what is optimal in a model may not be optimal in a real life situation (Omale et al, 2017) [7].

2.1.2 Building optimal logistics and supply chain models

In logistics and supply chain, decisions are numbers and are based on data. Models provide these data on which decisions are based. For a logistics manager to build an optimal logistics and supply chain models, they must carry out a study of the problem environment (environmental scanning to know the variables at work and the possible constrain factors). This helps the organization assemble information about the problem. (Kelly, 1992) [5] Take for example, supply of spares to the factory, the manager will know the possible lead time and lead time variables. This will help him know his buffer stock and recorder point. It also entails going further to formulate decision variables, objective and the interaction between the variables, making pertinent assumptions and simplifications about the real life environment, as well as construct a symbolic expression of the formulation usually in mathematical terms, (Robinson, 1994) [8].

2.1.3 The SCOR model (supply chain operations reference model)

According to the council of logistics, supply chain management, is the process of planning, implementing and coordinating the efficient flow of raw materials, in process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conformity to customers' requirements. (Cavale & Rajani, 2002) [3]. It is the flow of goods information and finance from point sourcing to the hand of the final consumer. It involves activities like Transportation, Warehousing, Inventory Management and Distribution. It also involves after sales services like customer education, installation, repairs and Maintenance. Supply chain flow can be divided into;

1. Product flow
2. Information flow
3. Finance flow

The SCOR model is a process reference model intended to be an industrial standard. It contains a standard description of management processes, a frame work that like process elements, metrics, best practice and feature a associated with the execution of supply chain in a unique format. The SCOR model is designed to be configurable and aggregates a series of hierarchical process models. It use allows firms communicate using common terminology abs standard descriptions of the process elements that help through understanding of the overall performance. It identifies the performance measurements and supporting tools suitable for each activity. The SCOR model as a reference model enables all departments of an organization involved in developing and managing integrated supply chain to collaborate effective. It integrates the processes of re-engineering, bench making and process measurement into a cross functional framework.

2.1.4 SCOR model-structure framework

The model is made up of these structures, as noted by Kobler, (2019) [6] Standard description of the individual elements that make up the chain processes. Standard definition of key performance measures

Description of best practices associated with each of the process elements

Identification of software functionality that enables best practices.

The model has however under gone series of revision since 1996 (Stevenson, 2011) [9].

2.1.5 SCOR model and management processes and levels

This has five management processes called levels. They include plan, source, make, deliver & return. These are further decomposed to categories (level 2) depending on the environment the mode of application.

The plan process is made up of processes that balance

aggregate demand and supply to develop a course of action that optimizes the business goal plan process here deals with demand/supply planning, which include all activities to assess supply resources, aggregate and priorities demand requirements, plan inventory, distribution, production, materials for all products and channels. This deals with procurement of good and services to meet planned and actual demand. Sourcing/materials acquisition includes obtaining, receiving, inspecting, holding, and issuing materials. Management of sourcing infrastructures includes vendor certification and feedback, sourcing quality, inbound freight, component engineering, vendor contracts and payments. On the other hand, make process includes functions that transform materials to finished goods to meet planned and actual demand. Make is the core process of the system in which actual production execution takes place. It includes, requesting and receiving materials, manufacturing and testing products, packaging, holding and release of products (marketing), (Robbinson, 1994) [8].

2.1.6 The six sigma model

Six sigma is a methodology, a measure and a model that measures the capability of a process to perform a defect-free work, where a defect is defined as anything hat will result to a customers' dissatisfaction. In logistics and supply chain, six sigma is taken to be a model or yard-stick for measuring quality of a process, service or product. Six sigma is derived from quality schemes in which a process is considered to be producing quality results, for example, if + - 38 or 99.74% of the product or its attributes were within specification, the six sigma methodology requires that + -38 to be within specification, (Kelly 1992, Stewart 1986, Robinson, 1994) [8, 5]. The goal of six sigma is to have 99.99966% of the product or its attribute to be within specification or not more than .00034%/0000034 out of specification. This implies that no more than 3.4 of the product or its attributes per million can be defective. It calls for all logistics processes to be defect-free (Brawo, 2020) [2].

2.1.7 Six Sigma as Optimal Model in Logistics & Supply Chain

For all logistics and supply chain firm, adoption of the six sigma model must be a philosophy. The model improves service quality, assures customer satisfaction and gives organizations edge over others. In the Airline industry, a three sigma approach may allow a 2.6 defect on a service or its attributes. This implies that there are about 2,600 errors in the service of the airline out of every one million. In a hospital, it implies that 2,600 of one million prescriptions are wrong. This is deadly and the hospital may not be competitive. The adoption of this quality model helps to keep logistics managers on their toes to ensure quality service delivery at all times (Asadi & Sadeghian 2019 & World Bank, 2019) [1].

Adoption of this approach forces companies to put in extra resources, work harder, quickly to discover and reduce sources of variation in processes and services. It "raises the bar" of quality goals of a firm causing the firm to emphasize more on continuous quality improvement. Here, the firm attains a world-class status and becomes a top competitor in international logistics market.

3. Statement of the Problem

A number of logistics bottlenecks are encountered by organizations whose business is concerned with loading, transportation, storage and supply of petroleum products to customers or outlets which in most cases are located several hundreds of kilometers away. The bottlenecks consist of issues such as; challenges in the confirmation of bank tellers before loading, inadequate data to facilitate prompt systematic problem solving and fast logistics decision making process and so on. As noted by Omale & Chima, (2017) [7], these bottlenecks adversely affects delivery time and cost, thereby naturally taking their roll on the logistics and supply process. Some of the bottlenecks emanate internally from organizations ineffectiveness of the supply chain, whereas others originate externally, from other stakeholders in the petroleum marketing, process, such as government regulatory agencies and so on.

An important or striking point worthy of note is not only really about whether the said bottlenecks are emanating internally or externally, but rather also about the fact that the said bottlenecks are only incidental to or occasioned by the lack of the application or utilization of appropriate logistics models in the supply chain management. It has been noted that most logistics companies in the developing economies, especially in the third world, where Nigeria belongs do not utilize logistic/supply chain models which would have enhanced prompt and cost effective service delivery. The few companies that attempt it, employ obsolete methods, (World Bank/ADB, 2019) [10].

3.1 Objectives of the Study

The major purpose of the study is to determine the relevance of logistics models as a tool for enhancing logistics and supply chain management for competitive advantage in marketing petroleum products. However there are other objectives of this study. They include the following:

1. To determine the role of logistics models as a cost and time effective measure or tool, in enhancing marketing of petroleum product.
2. To determine the role of logistic models in enhancing the decision making process, through quantitative analysis in petroleum product marketing.
3. To determine the role of logistic models in facilitating a systematic approach to problem solving in petroleum product marketing.

3.2 Research Questions

The following research questions were formulated for this study:

1. Do logistic models enhance quantitative analysis and the decision making process?
2. 2. Do logistic models save time and cost in the supply chain management?
3. Do logistic models inject objectivity and systematic approach to solving logistics problems?

3.3 Research Hypothesis

The following null hypothesis were formulated for the study:

Ho_1: There is no significant relationship between time/cost effectiveness, empowered by the utilization, of models and optimal supply chain management.

Ho_2: There is no significant relationship between enhanced decision making process empowered by the utilization of models and optimal supply chain management.

H03: There is no significant relationship between the systematic approach to problem solving, empowered by the utilization of models and optimal supply chain management.

4. Methodology

4.1 Research Design

The research design adopted for the study was survey

design. This was chosen to allow inferences to be made from sample and generalizations drawn from the population that would have been too expensive to study wholly.

4.2 Population/Sample of the Study

Although this study was meant to cover all companies that are into petroleum products marketing in Nigeria, but however, for time and financial constraints, this study was restricted to staff of Northwest Petroleum Co. Ltd located in the export free zone of the city of Calabar - Nigeria. In addition to staff of Northwest Petroleum, other stakeholders involved in petroleum product marketing such as, Tanker Drivers, Jetty owners, and staff of government regulatory agencies (such as Nigeria Ports Authority, Nigerian Navy and Nigerian Customs Service) are also included in the study, constituting an aggregate study population of 400. A sample of 200 which is representative of all the various categories of stakeholders is randomly drawn from the population.

4.3 Instrumentation

A four point likert-type questionnaire was utilized in gathering relevant data from respondents. Section A Sought information relating to respondents demographic details, while section B contained items that were to actually determine the role of logistics models in supply chain management. The well-structured questionnaire was validated by experts and through the recommendation of colleagues. The questionnaire required the following relative responses; strongly agree (SA), Agree (A), strongly Disagree (SD) and Disagree (D).

4.4 Data Collection/Analysis

A total of 200 copies of the questionnaire were administered to respondents, out of which 120 (60) were returned while 80 (40%) were not returned. Data was analysed and hypothesis tested and validated with the aid of Pearson product-moment correlation analysis.

Given by:

$$r = \frac{N\Sigma xy - \Sigma x\Sigma y}{\sqrt{N\Sigma x^2 - (\Sigma x^2)}\ \sqrt{N\Sigma Y^2 - (\Sigma y^2)}}$$

Decision Rule

The obtained r must be greater than the critical r to be significant. In other words, if the calculated value is less than the critical table value, we do not reject the null hypothesis and if however, otherwise we reject the null and accept the alternative. The level of significance is 0.05 and degree of freedom of ll8 (N-2).

5. Presentation of Results

Hypothesis 1: States that; there is no significant relationship between time/cost effectiveness empowered by the utilization of models and optimal supply chain management. Pearson product moment correlation analysis was used to test the hypothesis. The summary of the analysis is presented on table 1 below.

Table 1: Computation of Responses on Time/cost effectiveness of the supply chain

Variable	ΣX	ΣX	ΣXY	R
Time/cost effectiveness empowered by models	ΣY 5920	ΣY^2 20008970	4322402	0.81
Supply chain management	3008	607728		

***Source*:** Field Survey (Questionnaire, 2019)
P<0.05, df=118,t=1.98

The table above reveals a calculated r value of 0.81. This is less than the critical value of 1.98 at 0.05 level of significance with 118 degree of freedom.
The null hypothesis in accordance with the decision rule is therefore not rejected.

Hypothesis 2: States that, there is no significant relationship between optional supply chain management. Pearson products-moment correlation analysis was employed to test the hypothesis. The summary of analysis is presented in Table 2 below.

Table 2: Computation of Responses on enhanced decision making process and supply chain management

Variable	ΣX	ΣX	ΣXY	R
Enhanced decision making empowered by models	ΣY 66714	ΣY^2 2108208	4722313	0.66
Supply chain management	3508	607728		

***Source*:** Field Survey (Questionnaire, 2019)
P<0.05, DP=118, T=1.98

The table shows a calculated r-value of 0.66 which is less than the critical value of 1.98 at 0.05 level of significance with 118 degree of freedom. In accordance with tension rule therefore the null hypothesis is not rejected.

Hypothesis 3: States that, there is no significant relationship between systematic approach to problem solving, empowered by models and optional supply chain management. The hypothesis was tested suing Pearson products moment correlation analysis. The summary of analysis is shown in the table below.

Table 3: Computation of Responses on systematic problem solving approach and supply chain management

Variable	ΣX	ΣX	ΣXY	R
Systematic problem solving empowered by models	ΣY 5288	ΣY^2 1628400	3498290	099
Supply chain management	1890	490180		

***Source*:** Field Survey (Questionnaire, 2019)
P<0.05, DP=118, T=1.98

The table shows a calculated r-value of 1.98 at a 0.05 level of significance with 118 degree of freedom. In accordance with decision rule the null hypothesis is therefore not rejected.

5.1 Discussion of Findings

On the basis of the results of this study, it has been revealed that the present or prevailing delay in loading, transportation and supply experienced by Northwest Petroleum and NCS and indeed by other similar organization is caused by the lack of appropriate logistic models. Findings reveal that if logistics models are employed additional data would be made available which would facilitate quantitative and empirical approach to decision making. The development of appropriate logistic models would certainly be a time and cost effective measure.
Findings further indicates that there is an abject deficiency of systematic approach to problem solving occasioned by the lack of appropriate models. It was observed that the activities of government regulatory agencies such as the Nigerian Customs and Nigerian Port Authority constitute a major hindrance to service delivery, but could be facilitated it appropriate logistic model are developed to save cost and time.

5.2 Conclusion/Summary

The sum of empirical findings has led to the conclusion that lack of appropriate and functional model in logistic and supply chain management accounts for a bulk of the bottlenecks hindering adequate service delivery. The lack of a model to facilitate easy and fast confirmation of bank tellers delays the process of loading and supply of Petroleum products. Scare resources such as time .finance and materials as shown by analysis are wasted due to these bottlenecks. It can also clearly concluded that decision making and problem solving approaches could be made more empirical and objective due to the availability of data if significant models are employed in the logistic and supply chain management.

5.3 Recommendations

Based on the finding of the study and the conclusion drawn, the following recommendations are made:

1. Organizations, whose business concerned with petroleum products marketing and supply chain management such as Northwest Petroleum and Gas should employed appropriate logistics models and such as the SCOR model to enhance its service delivery.
2. The government should equally employ models that will enhance the effectively of its regulatory agencies.
3. Qualitative and empirical approached should be employed in the logistic decision making process by companies involved in supply chain management.

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