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# THE APPLICATION OF LINEAR PROGRAMMING IN PROFIT PLANNING OF LOGISTIC FIRMS IN PORT HARCOURT

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## ABSTRACT

*This study examines the influence of the application of linear programming in profit planning of logistic firms in Port Harcourt. Descriptive survey research design was adopted for the study. The population of the study was 20 logistic firms in Rivers states. The study adopted a census study. 3 managerial staff (marketing manager, operational manager, logistic manager) were selected from each firm multiplied by 20 firms gives us a total of 60 respondents. The study adopted a Structured questionnaire instrument title" linear programming in profit planning questionnaire was developed on five-point likert scale. The result of the Cronbach's Alpha reliability test indicates .766 which is above .70 which implies that the items are reliable. Regression analysis was used to test the hypotheses using SPSS (statistical package social science) version 22. The study revealed that profit maximization has a significant influence on Activity-Based Costing of logistic firms in Port Harcourt. Profit Maximization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt. Cost Minimization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt. Cost Minimization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt. The study concluded that Linear programming is a powerful mathematical tool that can be effectively utilized in profit planning for logistic firms in Port Harcourt. By optimizing resources and maximizing profits, linear programming can assist these firms in making informed decisions to enhance their operational efficiency and financial performance. Through the formulation of mathematical models that consider various constraints and objectives, logistic firms can identify the most cost-effective strategies to achieve their profit goals. The study recommended that Logistic firms in Port Harcourt should invest in specialized linear programming software to facilitate the implementation of optimization models for profit planning. These tools can streamline the decision-making process and provide accurate solutions to complex logistical challenges.*

## Background of the Study

Linear programming is a mathematical method used to determine the best possible outcome in a given mathematical model for a set of linear relationships. It is widely applied in various fields, including business and logistics, to optimize resource allocation and decision-making processes. In the context of profit planning for logistic firms in Port Harcourt, linear programming can be utilized to maximize profits or minimize costs by efficiently allocating resources and optimizing operational processes (Horngren, et al.,2012).

Hansen, and Mowen, (2006) Profit maximization and cost minimization are two primary objectives of profit planning in logistics firms. By using linear programming techniques, companies can identify the most profitable mix of products or services to offer, determine the optimal pricing strategy, allocate resources effectively, and streamline operations to reduce costs. Activity-Based Costing (ABC) is a costing methodology that assigns costs to

activities based on their consumption of resources, providing a more accurate way to allocate overhead costs and analyze profitability at a granular level. Incremental budgeting involves making incremental changes to the previous budget based on changes in business conditions or goals.

The application of linear programming in profit planning for logistic firms in Port Harcourt can help these companies make informed decisions regarding pricing strategies, product mix, resource allocation, and cost management. By utilizing mathematical optimization techniques, businesses can enhance their competitiveness, improve financial performance, and achieve sustainable growth in a dynamic market environment.

## Statement of the Problem

Linear programming is a mathematical technique used to optimize resource allocation in various industries, including logistics firms in Port Harcourt. However, several problems can affect the application of linear programming in profit planning, specifically in the context of profit maximization and cost minimization within logistic firms. One of the primary issues affecting the application of linear programming in profit planning for logistic firms in Port Harcourt is the complexity of real-world logistics operations. Logistic firms deal with numerous variables, constraints, and uncertainties that may not be easily captured or accurately represented in a linear programming model. This complexity can lead to inaccuracies in the optimization process and result in suboptimal solutions (Hansen & Mowen, 2006).

Another challenge is related to data availability and quality. Effective linear programming requires accurate and up-to-date data on various aspects of the logistics operations, such as costs, capacities, demands, and constraints. Inadequate or unreliable data can significantly impact the validity and effectiveness of the linear programming model, leading to flawed decision-making processes. Furthermore, the dynamic nature of logistics operations poses a significant challenge to the application of linear programming in profit planning. Logistic firms often face changing market conditions, customer demands, regulations, and other external factors that can quickly render a static linear programming model obsolete. Continuous updates and adjustments are necessary to ensure that the model remains relevant and effective in optimizing profit planning strategies (Hansen & Mowen, 2006).

Additionally, organizational resistance and lack of expertise can hinder the successful implementation of linear programming in profit planning for logistic firms. Resistance from employees or management who may not fully understand or trust the results generated by the model can impede its adoption and utilization within the organization. Moreover, a lack of skilled personnel with expertise in both logistics operations and mathematical modeling can limit the effective application of linear programming techniques.

Lastly, limitations in software capabilities and computational resources can also pose challenges to implementing linear programming for profit planning in logistic firms. Complex optimization problems may require advanced algorithms and substantial computational power to solve efficiently. Inadequate software tools or hardware infrastructure may constrain the ability to handle large-scale optimization problems effectively. Overall, while linear programming offers powerful optimization capabilities for profit planning in logistic firms, addressing these challenges is crucial to realizing its full potential in improving decision-making processes and maximizing profitability.

**Conceptual Framework**

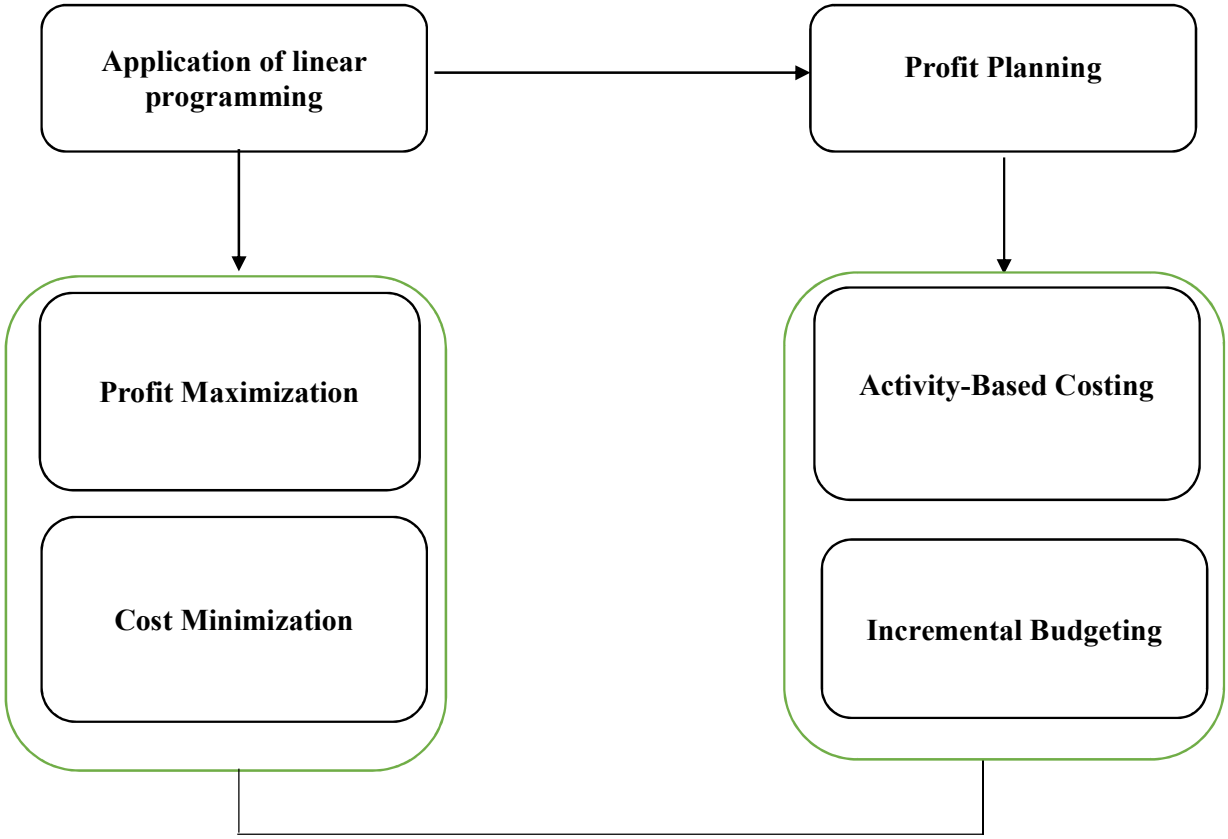


**Figure 1:** conceptual framework on The Application of linear programming in Profit Planning of logistic firms in Port Harcourt
**Source:** Adapted from Bodie, et al., (2014); Elton et al., (2014).

## Aims & Objectives

The aim of this study is to determine the influence of the application of linear programming in profit planning of logistic firms in Port Harcourt. The specific objectives are to:

i. To determine the influence of Profit Maximization on Activity-Based Costing of logistic firms in Port Harcourt.
ii. To determine the influence of Profit Maximization on Incremental Budgeting of logistic firms in Port Harcourt.
iii. To determine the influence of Cost Minimization on Activity-Based Costing of logistic firms in Port Harcourt.
iv. To determine the influence of Cost Minimization on Incremental Budgeting of logistic firms in Port Harcourt.

## Research Questions

The following research questions were raised to guide the study

i. What is the influence of Profit Maximization on Activity-Based Costing of logistic firms in Port Harcourt?

ii. What is the influence of Profit Maximization on Incremental Budgeting of logistic firms in Port Harcourt?
iii. What is the influence of Cost Minimization on Activity-Based Costing of logistic firms in Port Harcourt?
iv. What is the influence of Cost Minimization on Incremental Budgeting of logistic firms in Port Harcourt?

## Hypotheses

The following null hypothesis were formulated and tested at a significant level of 0.01

**$HO_1$**: Profit Maximization does not have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt.
**$HO_2$**: Profit Maximization does not have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.
**$HO_3$**: Cost Minimization does not have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt.
**$HO_4$**: Cost Minimization does not have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

## Review Of Related Literature

### Conceptual Review

### Concept of Linear Programming

Linear programming is a mathematical method used to optimize complex systems by finding the best possible solution to a problem with linear constraints. In the context of logistic firms in Port Harcourt, Nigeria, linear programming can be applied to various aspects of their operations, such as cost minimization and profit maximization. Overall, the application of linear programming in logistic firms in Port Harcourt enables them to make data-driven decisions that enhance efficiency, reduce costs, and increase profitability. By leveraging mathematical optimization techniques, these firms can gain a competitive edge in the dynamic logistics industry while meeting customer expectations and achieving sustainable growth (Drury, 2007).

### Dimensions of application of Linear Programming

### Cost Minimization

Cost minimization is a crucial aspect of logistics firms' operations as it directly impacts their profitability and competitiveness in the market. By utilizing linear programming techniques, logistic firms in Port Harcourt can optimize their resources, such as transportation routes, warehouse locations, and inventory levels, to minimize costs while meeting customer demand. For example, linear programming can help these firms determine the most cost-effective distribution network that minimizes transportation costs and reduces overall operational expenses (Drury, 2007).

### Profit Maximization

On the other hand, profit maximization is another key objective for logistic firms in Port Harcourt. By using linear programming models, these firms can identify the optimal pricing strategies, production levels, and resource allocations that maximize their profits while considering various constraints such as capacity limitations and market demand. For

instance, logistic firms can use linear programming to determine the optimal mix of products to offer based on customer preferences and profitability margins (Garrison, et al.,2010).

## Concept of Profit Planning

Profit planning is a crucial aspect of financial management for logistic firms in Port Harcourt, Nigeria. Two key methods that are commonly used in profit planning are Activity-Based Costing (ABC) and Incremental Budgeting. In the context of logistic firms in Port Harcourt, effective profit planning through ABC and incremental budgeting can lead to improved cost control, better decision-making processes, and ultimately higher profitability. By understanding the costs associated with different activities and using historical data to predict future financial performance, companies can optimize their operations and achieve their financial goals. Overall, profit planning through Activity-Based Costing and Incremental Budgeting plays a vital role in the financial management of logistic firms in Port Harcourt by providing valuable insights into cost structures and facilitating informed decision-making processes (Garrison, et al.,2010).

## Measures of Profit Planning

### Activity-Based Costing (ABC)

Activity-Based Costing (ABC) is a costing method that identifies activities within an organization and assigns costs to those activities based on their usage of resources. In the context of logistic firms in Port Harcourt, ABC can help in accurately determining the costs associated with various activities such as transportation, warehousing, inventory management, and order processing. By allocating costs more precisely to these activities, companies can make informed decisions about pricing strategies, resource allocation, and process improvements (Hansen & Mowen, 2006).

### Incremental Budgeting

Incremental Budgeting is a budgeting approach where the current budget is adjusted by considering incremental changes from the previous period. In logistic firms in Port Harcourt, incremental budgeting can be useful for predicting future revenues and expenses based on historical data and adjusting them incrementally to account for changes in the business environment. This method allows companies to plan for growth or contraction in operations while maintaining a level of consistency with past performance (Hansen & Mowen, 2006).

## Empirical Review

Okoro (2017) undertook a study on "Application of Linear Programming in Profit Planning of Logistic Firms in Port Harcourt." Population of the study was Logistic firms in Port Harcourt. Instrument for data collection was Surveys and interviews. Method of data analysis was Linear programming models and statistical analysis. The study found that the application of linear programming in profit planning significantly improved the efficiency and profitability of logistic firms in Port Harcourt. The study concluded that Linear programming is a valuable tool for optimizing profit planning in logistic firms, leading to improved decision-making processes and resource allocation. Further research should explore additional applications of linear programming in logistics to enhance operational efficiency and profitability.

Okeke, (2015) undertook a study on Application of Linear Programming Techniques in Profit Planning of Logistic Firms in Port Harcourt. Population of the study was Logistic firms in Port

Harcourt. Instrument for data collection was Surveys and interviews. Method of data analysis was Linear programming models and statistical analysis. The study found that the application of linear programming techniques in profit planning helped logistic firms in Port Harcourt improve their operational efficiency and increase profitability. The study concluded that linear programming can be a valuable tool for logistic firms to optimize their operations and achieve better financial performance. Recommendation: The author recommended that logistic firms in Port Harcourt should consider implementing linear programming techniques in their profit planning processes to enhance decision-making and improve overall performance.

## Theoretical Review

### Linear Programming Theory

Linear programming theory was propounded by George B. Dantzig in 1947. The theory of linear programming is a mathematical method for determining a way to achieve the best outcome in a given mathematical model for a given set of constraints. The main assumption of linear programming is that the relationships between variables are linear, meaning that the impact of changing one variable is proportional to the change in another variable. The relevance of linear programming to the study on "The Application of Linear Programming in Profit Planning of Logistic Firms in Port Harcourt" lies in its ability to optimize resources and maximize profits for logistic firms. By using linear programming techniques, logistic firms can determine the most efficient way to allocate resources such as transportation, inventory, and manpower to maximize profits while considering various constraints such as budget limitations, capacity constraints, and demand fluctuations.

## METHODOLOGY

Descriptive survey research design was adopted for the study. The population of the study was 20 logistic firms in Rivers states. The study adopted a census study. 3 managerial staff (marketing manager, operational manager, logistic manager) were selected from each firm multiplied by 20 firms gives us a total of 60 respondents.

**Table 3: Population of the Study**

| s/n | Firm |
|---|---|
| 1 | DHL Nigeria |
| 2 | FedEx Express |
| 3 | UPS Nigeria |
| 4 | Maersk Line |
| 5 | Bollore Transport & Logistics |
| 6 | Sifax Group |
| 7 | BHN Logistics Limited |
| 8 | Red Star Express Plc |
| 9 | ABC Transport Plc |
| 10 | Chisco Transport Nigeria Limited |
| 11 | GIG Logistics |
| 12 | CourierPlus Services Limited |
| 13 | Kobo360 |
| 14 | Tranex Courier Limited |
| 15 | Cargozeal Technologies |
| 16 | DHL Nigeria |

| | |
|---|---|
| 17 | FedEx Express |
| 18 | UPS Nigeria |
| 19 | Maersk Line |
| 20 | Bollore Transport & Logistics |

**Source: Nigerian Business Directory (2024)**

The study adopted a Structured questionnaire instrument title" linear programming in profit planning questionnaire "was developed on five point likert scale. The questionnaire was independently subjected to content and construct validity by three Lecturers in the Department of Management, Faculty of Management Sciences, Ignatius Ajuru University of Education, Port Harcourt. The corrections and suggestions of the validators were affected on the finale copy of the instrument. The reliability of empirical measurement is indicated by the internal consistency, one of the most commonly used indicators of internal consistency is Cronbach's alpha coefficient. Questionnaire item statements with Cronbach's alpha reliability coefficient below the 0.70 threshold were eliminated. the test-re-test method was used. 10 copies of the questionnaire instrument were issue and some later same copies were issue through electronic media. the results were used in computation using Cronbach's alpha test of reliability.

**Table 2: Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .766 | 4 |

**Source: Researcher Computation via SPSS Version 25**

The result of the Cronbach's Alpha reliability test indicates .766 which is above .70 which implies that the items are reliable. Regression analysis was used to test the hypotheses using SPSS (statistical package social science) version 22.

**Data Analysis**

**$HO_1$**: Profit Maximization does not have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt.

**Table 3: Regression analysis on Profit Maximization on Activity-Based Costing**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .788[a] | .620 | .614 | .700 |

a. Predictors: (Constant), Activity-Based Costing

Table 3: Regression analysis on Profit Maximization on Activity-Based Costing revealed Profit Maximization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt where R. 788 = 78% thus leading to acceptance of the alternate hypothesis: Profit Maximization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt.

**$HO_2$**: Profit Maximization does not have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

**Table 3: Regression analysis on Profit Maximization on Incremental Budgeting**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .699[a] | .488 | .479 | .813 |

a. Predictors: (Constant), Incremental Budgeting

Table 3: Regression analysis on Profit Maximization on Incremental Budgeting revealed that Profit Maximization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt where R. .699 = 69% thus leading to acceptance of the alternate hypothesis: Profit Maximization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

**$HO_3$**: Cost Minimization does not have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt.

**Table 4: Regression analysis on Cost Minimization on Activity-Based Costing**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .817[a] | .668 | .662 | .695 |

a. Predictors: (Constant), Activity-Based Costing

Table 4: Regression analysis on Cost Minimization on Activity-Based Costing revealed that Cost Minimization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt where R. .817 = 81% thus leading to acceptance of the alternate hypothesis: Cost Minimization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt.

**$HO_4$**: Cost Minimization does not have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

**Table 5: Regression analysis on Cost Minimization on Incremental Budgeting**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .822[a] | .676 | .670 | .593 |

a. Predictors: (Constant), Incremental Budgeting

Table 4: Regression analysis on Cost Minimization on Incremental Budgeting revealed that Cost Minimization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt where R. .82 = 82% thus leading to acceptance of the alternate hypothesis: Cost Minimization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

## Discussion of Findings

Table 3: Regression analysis on Profit Maximization on Activity-Based Costing revealed Profit Maximization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt where R. 788 = 78% thus leading to acceptance of the alternate hypothesis: Profit Maximization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt. Table 3: Regression analysis on Profit Maximization on Incremental Budgeting revealed that Profit Maximization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt where R. .699 = 69% thus leading to acceptance of the alternate hypothesis: Profit Maximization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

Table 4: Regression analysis on Cost Minimization on Activity-Based Costing revealed that Cost Minimization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt where R. .817 = 81% thus leading to acceptance of the alternate hypothesis: Cost Minimization have a significant influence on Activity-Based Costing of logistic firms in Port Harcourt. Table 4: Regression analysis on Cost Minimization on Incremental Budgeting revealed that Cost Minimization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt where R. .82 = 82% thus leading to acceptance of the alternate hypothesis: Cost Minimization have a significant influence on Incremental Budgeting of logistic firms in Port Harcourt.

Similarly, Okoro (2017) undertook a study on "Application of Linear Programming in Profit Planning of Logistic Firms in Port Harcourt. The study found that the application of linear programming in profit planning significantly improved the efficiency and profitability of logistic firms in Port Harcourt. The study concluded that Linear programming is a valuable tool for optimizing profit planning in logistic firms, leading to improved decision-making processes and resource allocation. Further research should explore additional applications of linear programming in logistics to enhance operational efficiency and profitability.

Also, Okeke, (2015) undertook a study on Application of Linear Programming Techniques in Profit Planning of Logistic Firms in Port Harcourt. The study found that the application of linear programming techniques in profit planning helped logistic firms in Port Harcourt improve their operational efficiency and increase profitability. The study concluded that linear programming can be a valuable tool for logistic firms to optimize their operations and achieve better financial performance. Recommendation: The author recommended that logistic firms in Port Harcourt should consider implementing linear programming techniques in their profit planning processes to enhance decision-making and improve overall performance.

## CONCLUSION

Linear programming is a powerful mathematical tool that can be effectively utilized in profit planning for logistic firms in Port Harcourt. By optimizing resources and maximizing profits, linear programming can assist these firms in making informed decisions to enhance their operational efficiency and financial performance. Through the formulation of mathematical models that consider various constraints and objectives, logistic firms can identify the most cost-effective strategies to achieve their profit goals.

## RECOMMENDATIONS

i. Logistic firms in Port Harcourt should invest in specialized linear programming software to facilitate the implementation of optimization models for profit

planning. These tools can streamline the decision-making process and provide accurate solutions to complex logistical challenges.

ii. It is essential for logistic firms to continuously monitor and evaluate the performance of their linear programming models. Regular reviews can help identify any deviations from the planned objectives and enable timely adjustments to ensure profitability targets are met.

iii. Collaborating with experts in operations research and mathematical modeling can provide valuable insights and guidance in applying linear programming techniques effectively in profit planning. External expertise can help optimize model parameters and improve decision outcomes.

iv. Training employees on the principles of linear programming and its application in profit planning is crucial for successful implementation. Building internal capacity and expertise will empower staff to utilize mathematical models efficiently and drive profitability within the organization.

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