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# Harnessing Information Communication Technology in The Development of Oil and Gas Business in Nigeria

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**Abstract**

The purpose of this study is to investigate the impact of Information Communication Technology in effectively managing the logistics and supply chain business of a 4th party logistics oil and gas service firm with a focus on TECON Oil Services Limited. This is predicated on the fact that Logistics is the process of 'strategically managing the acquisition, movement and storage of materials, parts, and unfinished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability is maximised through the cost effect fulfilment of orders'. A structured questionnaire was duly administered to selected management staff of the company with 60.7% retrieval rate. The collated responses were analysed, and the hypotheses were tested using the Eview software. At 5% level of significance, test of all five hypotheses showed p-values less than 0.005 ($P < 0.05$), indicating positive relationship between the tested ICT parameters and effective business performance. With overall significant regression, the coefficient of determination ranged between 87.9% and 99.7% of variation in the model. In conclusion therefore, the study ascertains a positive relationship between effective ICT and the Logistics and Supply Chain management of the firm's business operations. It further recommended, among others, the need for the development of policies in ICT to support the performance of various logistics networks for effective overall performance of the sector. Additional or further studies are required on the impact of effective supply chain management in the Oil and Gas Sector of the Nigeria Economy.

**Keywords:** ICT; Logistics; Supply Chan; Globalization; Oil and Gas

**Abbreviations:** ITS: Intelligent Transportation System; LNG: Liquefied Natural Gas; EDI: Electronic Data Interchange; LSP: Logistics Service Providers; ITS: Intelligent Transport System; RBV: Resource Based View

## Introduction

Globally, Logistics has emerged as a significant growth factor in most nation's economy, as well as an internal tool in the management and development of firms. Nigeria, being largest oil producer in Africa and one of Africa's fastest growing economies, as well as holding the largest natural gas reserves on the continent and ranking fifth world's-largest exporter of liquefied natural gas (LNG) as at 2018, is witnessing increasing demand for ICT deployment in the logistics and supply chain services of oil and gas service companies. The increasing pressures from the rapid change that are occurring in the business environment have led to variety of responses among industrial organizations.

Globalisation of logistics and supply chain functions, the rate of technological innovations, and fluctuations in consumers' demands are among the factors that have increased the dynamism of the competitive environment which organisations must respond to. Unarguably, there is distinct shortage of logistics experts, including information system support capabilities which have become hurdles to logistics development [1]. The inadequate logistics infrastructure coupled with lack of experts is blamed for the high level of loss through distribution [2] Kerr 2020. The challenges, however, also generate opportunities for companies with advance information and communication system and experts to grow and improve their distribution channels.

This study arises from the need to efficiently and effectively manage logistics operation of oil and gas service firms, deploying modern information and communication technologies. The rapid

growth of oil and gas companies, increase in technological changes, environmental variability and degree of competition, acute shortage of skilled labour and operational damage, have forced firms to strategize and incorporate ICT component into their operations, in this case, logistics and supply chain management. These industry issues and problems demand that these companies should continually adopt and access the various ICT components if they are to remain competitive. However, proving research is quite limited in investigating the impact of ICT on logistics management in terms of cost effectiveness. This study will examine the impact of information communication technology on effective logistics operation of the oil and gas company, highlighting the relationship between logistics and the various ICT components.

## Literature Review

### The concept of information communication technology in logistics

ICT is increasingly regarded as a vital resource that supports many business processes [3]. In the logistics industry, ICT such as internet, extranet, electronic data interchange (EDI), facilitates the integration of logistics activities (Angeles, 2000). The importance of ICT in logistics and supply chain operation in ICT'S contribution to the provision of timely and accurate information sharing both within the firm and between logistics partners and enhancing organisational decision making (Aldin and Stasher, 2003). Bower six, etal. (2002) outline four major reasons for the increasing importance of ICT as a valuable logistics resource. First, customers appreciate timely information about order status, product availability, delivery schedules and invoice settlement, which are increasingly enhanced by rapid advances in ICT [4]. Second, timely information is essential for inventing planning and resource scheduling. Third, timely information increases logistics flexibility with regard to how, when, and where resources may be utilized to gain strategic advantage.

Forth, enhanced information transfer and capability exchange utilising the internet is changing relationships between suppliers and buyers and redefining channel relationships. Therefore, the ability to utilize ICT skills and knowledge to enhance Logistics operation is fast becoming an indispensable resource for Logistics Service Providers (LSPs). The application of ICT to transportation has led to the emergence of Intelligent Transport System (ITS) [5]. ITS links individual transportation elements and combines them into a single system through the use of advanced information technologies. It also integrates various technologies and institutional functions to realise efficient, safe, and environmentally friendly transport system. It offers the potential to improve the efficiency of use of transportation systems by generating additional capacity from existing physical infrastructure [5].

### Impact of intelligent transportation system (ITS)

Dispatch centres can access road traffic information as they direct deliveries and ratings. This increases their accuracy in predicting vehicle arrival times, which improves their ability to respond quickly and accurately to customer inquiries. Recently, compilation of GPS (Global Positioning System) data have enabled route selection and coordination of departure time by day and time that improve the accuracy of arrival times real-time road traffic information is available not only at dispatch centres but also driver through mobile phone. Drivers are now able to contact customers directly. Automatic Vehicle Identification/Automatic Equipment Identification (AVI/AEL) is also expected to contribute to improved transport efficiency and security [4]. For example, a trailer could be automatically identified, given permission to enter a container yard and instructed where to drop its load. The ISO is standardizing data dictionary and message sets in anticipation of an international, inter-modal freight tracking system. That many trucking companies are small mid-sized has prevented the spread of ICT. Usage has finally increased, however, with the recent availability of inexpensive, high-speed, always-on internet access in offices and the development of vehicle side applications incorporating GPS and packet communication [6].

### The Resource Based View (RBV)

RBV identifies the (valuable, rare, imitable, and non-substitutable) resources owned by the firm as the source of the firm's sustainable competitive advantage. Extensions of the theory have produced several theoretical refinements including the knowledge-based view of the firm (Grant, 1996), core competency (Prahalad & Hamel, 1990) capabilities theory (Helfat & Peteraf, 2003) and the dynamic capabilities view (Teece, Pisano, & Sheun, 1997). The principal contribution of the resource-based view of the firm to date has been as a theory of competitive advantage. Its basic logic is a relatively simple one. It starts with the assumption that the desired outcome of managerial effort within the firm is a sustainable competitive advantage (SCA). Achieving an SCA allows the firm to earn economic rents or above -average returns. In turn, this focuses attention on how firms achieve and sustain advantages. The resource-based view contends that the answer to this question lies in the possession of certain key resources, that is, resources having the characteristics of value, barriers to duplication and appropriability. An SCA can be obtained if the firm effectively deploys these resources in its product-markets.

The effectiveness of the information communication technology capabilities hinges significantly on the security of the ICT facilities in use, such as internet, intranet, extranet, electronic data interchange, intelligent transportation systems and logistics management information systems [7] Angeles 2000. In a highly competitive market, like that of Nigeria, information leakage is


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a primary concern of logistics service providers [3] Aldine and Stasher, 2003. Information communication technology security, or the ability to protect proprietary information can give LSPs an edge over their competitors thus, enhancing their logistics capabilities. Therefore, the ability of any logistics service provider to secure its ICT base will guarantee secured information sharing and information flow between partners, control systems of operation at the various logistics ends, thereby making e=fleet management, e-commerce, and e-data interchange flexible.

Internet is rapidly becoming a powerful business tool because of its online commercial services and e-commerce capabilities. The net is ready to become a medium by which companies trade, make contracts, exchange data and information, discuss designs and locate components [5]. The application of ICT to transportation has also led to the emergence of intelligent transport systems (ITS) which links individual transportation elements and combines them into a single system using advanced information technologies [8]. ITS integrate various technologies and institutional functions to realise efficient, safe, and environmentally friendly transport systems. It offers the potential to improve the efficiency of use of transportation systems by generating additional capacity from existing physical infrastructure [8]. Strategic applications off innovative information such as Global Positioning System (GPS), ITS, Electronic Data Interchange (EDI), and electronic commerce integrated through the internet will become inevitable for supporting logistics. The existence of high-performance information infrastructure will dictate the logistics competence of any logistics service provider (LSPs) in Nigeria or around the globe. These complex and sophisticated information infrastructures will induce interactive processes in logistics functions.

The use of ICT has improved the exchange of logistics function information, leading to the development of integrated logistics management systems, and improving performance in many ways. Commercial transaction flow and physical distribution have both witnessed dramatic change in the way they are managed due to Electronic Data Interchange (EDI) [9]. The effectiveness of the information communication technology capabilities hinges significantly on the security of the ICT facilities in use, such as internet, intranet, extranet, electronic data interchange, intelligent transportation systems and logistics management information systems [7] Angeles 2000. In a highly competitive market, like that of Nigeria, information leakage is a primary concern of logistics service providers [3] Aldine, and Stasher, 2003. Information communication technology security or the ability to protect proprietary information can give LSPs an edge over their competitors thus, enhancing their logistics capabilities. Therefore, the ability of any logistics service provider to secure its ICT base will guarantee secured information sharing and information flow between partners, control systems of operation at the various logistics ends, thereby making e=fleet management, e-commerce, and e-data interchange flexible [10-15].

## Methodology

### The research design used was the descriptive survey.

The population which is the universal set consisting of all the staff of TECON Oil Services Limited which is made up of one hundred and fifty-five senior and management staff plus two hundred and seventy-four junior staff. The sample size which is a subset of the population was made up of all the senior staff of the organisation. Due to the small size of the target population, no sampling was conducted. Therefore, the researcher sampled all the senior and management staff of the organisation which comprises one hundred and fifty-five staff. This is because they are in position to provide information about logistics practices in the company having worked for a good number of years. Questionnaire was the instrument for data collection. To collect the data, a full-scale questionnaire survey was conducted during the months of April through August 2023. The survey data reported in this project draw on data collected from administering the structured questionnaire on the selected population of the company. The survey questionnaire used, therefore, contains many questions which were utilized in the analysis reported in this project and consist of three sections [16-20].

The survey engaged 110 respondent staff from the total of 155 in the organisation. After checking, 16 of the 110 returned questionnaires were found to be invalid and were excluded from the data file, reducing the usable sample to 94 giving a response rate of 60.65%. Basically, there exists numerous methods of analysing data, but in order to test the hypotheses formulated, the data was analysed by finding and grouping the proportion of each respondent that chose whatever response in the tables. The Regression Analysis model, (Eview software) was used as data analysis technique. The resulting regression could be used to predict LSP's performance and effective operation for any combination of the independent variables.

## Results and Discussions

Answers to the research Questions

**Research Question One**

[Table 1]

**Research Question two**

[Table 2]

These responses were inputted into the Eview software to test the hypotheses as follows:

**Test of hypothesis one**

**$H0_1$**: Control System in LSPs negatively impacts on LSPs' effective operation with a standardized coefficient.

[Table 3]



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**Table 1:** Source: Survey, 2023

| | To what extent does control System impact on LSPs' effective operation with a standardized coefficient? | SA | A | U | D | SD |
|---|---|---|---|---|---|---|
| 1 | It supports the use of GPS in monitoring of service delivery and other Logistics operations. | 61 | 30 | 3 | 0 | 0 |
| 2 | We hire people with specialized ICT skills. | 55 | 36 | 3 | 0 | 0 |
| 3 | It aids the contracting of Logistic services directly by Shippers or 3PLs. | 37 | 55 | 1 | 1 | 0 |
| 4 | We can provide integrated logistics services to all our customers using our ICT facilities | 49 | 42 | 3 | 0 | 0 |
| 5 | ICT Control system provide efficiency to LSP | 55 | 36 | 3 | 0 | 0 |
| | **Total** | **257** | **199** | **13** | **1** | **0** |

**Table 2:** Source: Survey, 2023

| | What is the extent of relationship between effective computerized transaction and effective Business operation in the firm? | SA | A | U | D | SD |
|---|---|---|---|---|---|---|
| 1 | My company uses ICT tracking-and-tracing system to check logistics operation. | 49 | 42 | 3 | 0 | 0 |
| 2 | We offer clients just-in-time delivery using internet facilities to enhance operation. | 61 | 33 | 0 | 0 | 0 |
| 3 | My organization's logistics operations are computerised to ensure less paperwork. | 64 | 30 | 0 | 0 | 0 |
| 4 | My organization provides continues ICT training programme | 55 | 36 | 3 | 0 | 0 |
| 5 | ICT Control systems use in my company reduce theft risk associated with logistics operations. | 55 | 30 | 6 | 3 | 0 |
| | **Total** | **284** | **171** | **12** | **3** | **0** |

**Table 3:** Source: Author's computation

| **Dependent Variable: EFF**<br>**Method: Least Squares**<br>**Date: 06/14/23 Time: 13:12**<br>**Sample (adjusted): 14.**<br>**Included observations: 4 after adjustments.** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 266.1962 | 88.50695 | 3.007631 | 0.0083 |
| CONTSYS | -1.392147 | 0.358388 | -3.88448 | 0.0028 |
| R-squared | 0.879343 | Mean dependent var | | 234.7956 |
| Adjusted R-squared | -0.052573 | S.D. dependent var | | 149.044 |
| S.E. of regression | 152.9117 | Akaike info criterion | | 13.00204 |
| Sum squared resid | 374111.8 | Schwarz criterion | | 13.10097 |
| Log likelihood | -115.0183 | Hannan-Quinn criter. | | 13.01568 |
| F-statistic | 0.150892 | Durbin-Watson stat | | 1.990589 |
| Prob(F-statistic) | 0.001805 | | | |



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**Table 4:** Source: Author's computation

| Test for Equality of Medians Between Series<br>Date: 05/06/23 Time: 15:57<br>Sample: 1 5<br>Included observations: 5. | | | |
|---|---|---|---|
| **Method** | **df** | **Value** | **Probability** |
| Med. Chi-square | 4 | 21.3333 | 0.0003 |
| Adj. Med. Chi-square | 4 | 14.1667 | 0.0068 |
| Kruskal-Wallis | 4 | 23.057 | 0.0001 |
| Kruskal-Wallis (tie-adj.) | 4 | 23.16 | 0.0001 |
| van der Waerden | 4 | 22.0401 | 0.0002 |

The output above shows that there is a positive relationship between control system and effective operation. This implies that as control system in LSPs activities increase, effective operation of LSPs is positively affected. The coefficient of determination is high and shows that the model explains about 87.9% of the total variation in the model. The overall regression is significant as the p-value is less the 5% level of significance. The researcher concludes that control system in LSPs positively impacts on LSPs' effective operation with a standardized coefficient [21-25].

**Test of hypothesis two**

**$H0_2$**: Effective computerized (ICT) transaction is negatively related with effective business operation.

(Table 4)

The model shows that computerised ICT transaction positively relates with effective business operation. The model is rightly signed and significant. The overall regression is significant, and the coefficient of determination explains about 98.8% of the variation in the model. Also, since the P-value is less than 0.005, the researcher concludes that effective computerized (ICT) transaction is positively related with effective business operation. It was found out in this study that in Hypothesis one ($\mathbf{H_1}$) Control System in LSPs had a positive impact on LSPs' effective operation with a standardized coefficient ($P < 0.050$) [26-30].

**The second hypothesis** ($H_2$)

Posited that effective computerised transaction is positively related with effective operation. The study results substantiate the hypothesis showing that computerised transaction is positively associated with LSPs' effective performance with a coefficient ($P < 0.05$). Thus, LSPs are putting more emphasis on skills and qualified employees, and computerised operations.

**Discussion on findings**

The demographic data of this study indicates that male employees are dominating at the higher positions in the LSPs surveyed. The field study result reveals that employees receive formal on-the-job training on ICT. Moreover, the majority of the respondents are degree holders followed by M.Sc. holders, other degrees and finally MBA holders. Most of the ICT Components have the high value of Means, approaching the highest possible score of five, suggesting that all variables are perceived by sample respondent employees and managers to have strong influence on effective Logistics Operation. The test results also supported these findings, and all the variables are found to have consistent high level of significance. This study's empirical results obviously suggest that the ICT Components are to be further improved, and it is particularly noted that the priority should be given to the control system they use, and computerised transaction and lastly using the Internet for effective contracting which received highest significant loading. The regression analysis results demonstrate that ICT components have a strong impact to overall effective LSPs' operations. The hypotheses focus on 'control system', 'computerised transaction', 'internet', 'IT consultancy services' and 'LSP capabilities. They all have positive impact on the firm's effective operation as was hypothesized [31-37].

## Conclusion and Recommendations

This study investigated the impact/relationship between ICT components and effective logistics and supply chain operation of oil and gas service firms with focus on TECON Oil Services Limited. Based on the empirical findings, most of the ICT components, namely ICT control systems, computerised transaction, Internet transaction, ITS, were all found to have a significant and positive impact on Logistics performance of the firm. This observation implies that firms should be encouraged to invest more in ICT systems improvement to enhance their operations and competitiveness.

The data collected and statistical results suggest that the firm would benefit by establishing some ICT related orientation programmes for new employees. These introduced programmes would provide continuous training for updating employee skills and knowledge on ICT usage in logistics operation. If the firm increases its ICT components investment both by off-the-job and on-the-job training, it should be able to improve its operation. Since attention in the global economy is on firm performance


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improvement, it is important that firms manage their ICT components well to enhance their overall performance for their competitiveness in the global market.

- Policy makers need to keep up with the rapid development of ICT and develop a stable communication framework that is conducive to logistics planning and operation in the country.

- There is need for the development of policies in ICT to support the performance of various logistics networks. There is need to understand that advanced logistics system, embracing intermodal transport, can be realised through the strategic use of ICT. This will bring just-in-time delivery of global consignments within a very tight timeframe, considering the pattern of distribution.

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