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ANALYSIS OF AIRPORT PRODUCTIVITY AND EFFICIENCY PERFORMANCE IN NIGERIA

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ABSTRACT

Nigeria as a developing country continues to grow in tandem with its air transport network following the construction of airports and planning of air routes, which have positive impact on passenger and cargo traffic, consequently, airports needs to expand and improve their operational capacity towards accommodating increasing workload, which invariably leads to increased operating and capital costs as well as economies of scale efficiencies for airport operators. On the other hand, it has been argued that increased in size will lead to increased operational and administrative complexities that will result in a loss of efficiencies (Oyesiku and Oduwole, 2004; Bubalo, 2009; 2011). It is in the light of this that the paper examined airport productivity and efficiency performance. The paper adopted a case study approach, utilising detailed and sectionalized questionnaires as data collection instrument from ten airports located in six geo-political zones of Nigeria based on multistage techniques. The questionnaire elicited primary data on components of airport productivity and efficiency performance for the period of 2004-2008 and were analysed using both descriptive and inferential analytical techniques. The paper revealed through adoption of production function of Cobb-Douglas that incorporates ordinary least-square and weighted least square methods, identified potential effects of various factors on gross Variable Factor Productivity (VFP), as well as computed a residual VFP index after removing the effects of these varieties on gross VFP. The pooled VFP Regression further revealed negative in Beta results of capital productivity, airport size, soft cost input productivity and share of international traffic, which are all attributed to the fact that sampled airports' inability to achieve their relative objectives due to poor management , infrastructural base and other factors. The paper however concluded that streamlining efficiencies in operational integrity, new business and paradigms, coupled with the use of new technology will continue to see the industry and airports work towards a competitive advantage and achieve outcomes which are appropriate for airport shareholders and acceptable for stakeholders.

Key words: Analysis, Airports, Productivity, Efficiency and Performance

Introduction

Nigeria as a developing country continues to grow in tandem with its air transport network following the construction of airports and planning of air routes. Most state capitals, big towns and cities are connected with aviation operations and services. Air transport in Nigeria has been growing in relation to the Gross National Product (GNP) as it accounts for a large part of transport expenditure in the economy (Oyesiku et al. 2013). It should be noted that the share of freight movement on a tonne kilometre is small compared to other modes; airlines carry high value, perishable, and provide emergency goods that make them an important part of the total transport system (Oyesiku and Oduwole, 2004). With the increasing passenger and cargo traffic, airports needs to expand and improve their operational capacity towards accommodating increasing workload, which invariably leads to increased operating and capital costs for airport operators. Some have suggested that with expansion, airports will benefit from economies of scale (less expenditure per unit of output) by enhancing efficiencies in operations and spreading out of the overhead costs; others, however, have suggested the opposite, arguing that increased in size will lead to increased operational and administrative complexities that will result in a loss of efficiencies (Oyesiku and Oduwole, 2004; Bubalo, 2009; 2011).

An outcome of the deregulation of the aviation industry is privatization which brought in the application of private capital thus intensifying the need for performance monitoring and measurement, in addition to basic benchmarking exercises. While private capital may not be forthcoming to an airport authority if the level of uncertainty is too great, effective performance indicators help to reduce several of these uncertainties. While the Federal Airports Authority of Nigeria (FAAN) and its airports may provide good profit opportunities, it possesses considerable monopoly power. The upward trend of air traffic growth further complicates the problem as the airports exploit the situation by charging high prices. This in turn renders profitability as an inaccurate measure of economic efficiency and creates the need for airports to be deregulated. Given that airports require large initial investments that require long gestation periods before profitable returns can be generated, cumbersome regulations discourage private capital. When airports are effectively regulated and subjected to good performance, more efficient terminals would justifiably earn higher profits or be able to attract further investments towards an efficient airport system.

Increase capacity come in discrete lumps, such as when a new runway is constructed or the erection of an additional terminal building. It was emphasized that, it may be impossible to expand the capacity of a specific airport, thus, increase in capacity can only be achieved through investment in a different airport. Several studies have analyzed airports efficiency with different approaches (Data Envelopment Analysis, Stochastic Frontier analysis, Total Factor Production Analysis), focusing on different performance measures and on different efficiency drivers Barros and Dieke (2008) and Fung et al. (2008). An airport is rarely being used exactly to the extent it is designed for (OEF, 1999). For much of the time it will be underused, as when a new airport is built and traffic gradually builds up. Measured productivity, in terms of output per unit of inputs, will increase even though there is no improvement in efficiency. Design and operational factors can have considerable impact on productivity of an airport. Usually, the configuration of runways reflects historical, land availability, environmental factors and also affect effective throughput. How an airport as a component of the air transport system impacts on the traffic pattern it faces, will in turn impact on its measured performance. Thus an airport that is a major hub within a busy air transport system will have a different traffic pattern than an airport that is at the end of the line. The peakness of traffic pattern affects the amount of traffic can be handled by an airport of a given capacity (Gourdin, 1991).It is posited that

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airports do not provide the same mix of services and that the mix provided can differ sharply among airports. Some airports provide services directly, such as baggage handling or terminal services directly, while others subcontract services. Sometimes services are produced beyond the boundaries of the airport itself, by separate firms (e.g. flight catering).

This poses the question of whether these services should be included or excluded in performance measurement. Some airports incorporate extensive retail activities; the question arises of whether these should be included when comparisons are made with airports that do not. There is a degree of substitutability between the production process of the airline and those of the airport. Increases in inputs at the airport level can lead to reductions in those needed by the airline. For instance, if an airport invests and expands a runway, airlines, on the other hand then schedule larger or more heavily laden aircrafts, with a consequent saving in per passenger costs. Such an investment may well be worthwhile in cost-benefit terms, but will lead to an increase in measured inputs of the airports, with no increase in measured output, and hence a decrease in productivity. Few studies have investigated the role of outsourcing strategy on airport performance (Oum *et al*.,2003; Oum and Yu, 2004). In the light of all these, the paper aims at examing airport productivity and efficiency performance in Nigerian airports with a view to holistically analyse the components of productivity in other to enhance revenue generation and service delivery.

2.0: Literature and Conceptual Understanding

2.1. Functions of Airport and Terminals

Transport analysts and policy makers particularly in developed countries are increasingly interested in efficiency and performance of airports. However, studies on capacity utilization of airport can be traced to the last decades, when air transport experts as well as decision or policy-makers globally observed significant differences in operational efficiency and activity patterns of most airports (Oum et al. 2003). Relatively few studies in developing countries, including Nigeria have addressed the issue of operational efficiency and capacity utilization of airports. The literature on this issue was reviewed under the following sub-headings: Airport traffic, efficiency and regulation; Economic of scale of airport industry and Cost Function, output and input of airport industry.

Air services are provided by flights that are maintained over permanent air routes established by the civil aviation authority subject to navigational regulations. Airports constitute the main component of an air-route network. It is a terminal in the air transport system which performs various functions to facilitate movement of either passengers or freight. It is a civil aviation establishment that serves air line and other categories of operators and incorporating a wide variety of facilities for handling passengers, baggage, freight and mail (Thor and Ellen, 2000). A typical airport consists of quite a number of buildings and structures. The key features include the runways, taxiways, aircraft parking areas, terminal buildings, hangars among others. There are facilities for airport buildings and aircraft maintenance. The size and arrangement of these facilities are determined so as to ensure safe, efficient, and low-cost functioning of an airport. Primary function of an airport is to serve as a terminal in an airline's network where the movement of passenger or freight is halted so that some "value-adding" activity (transfer, storage, retrieval, repackaging, documentation etc) can be performed (Airport Council International, 2012). Applying appropriate facilities and services in its logistics, an airport keeps traffic of passengers and freight moving at a constant speed through the transport system. These value adding activities are classified into five major functions:

(i) **Consolidating Function**

Airports provide the points at which passengers are combined to form plane-load to match the passenger-seat capacity of an aircraft. The terminal serves as the ideal point where the passenger manifest is compiled for a specific flight. Likewise, small shipments are combined at the transit sheds to form larger units that can constitute a full load for a cargo plane. This consolidating function is important for aircraft operations as it ensures carrier's capacity utilization.

(ii) **Dispersion Function**

It encompasses a broad range of services offered to passengers who disembark from an aircraft and depart from an airport. It involves separating larger number of passengers into small units for delivery to final destinations. An average passenger is self-discharging and freight may be held temporarily until the consignees or agents come for clearance and collection.

(iii) **Passenger and Freight Services**

These services involve the accommodation of passengers at the terminal from the elements. Ticketing, catering, information, shopping facilities are provided. Freight services include receiver, sorting, storage, documentation and delivery.

(iv) **Vehicle Services**

Airports provide facilities such as hangars, workshops, maintenance and repair services for airlines and private operation. Provision of fuels, charging services and which includes cleaning, food and water supplies are obtainable at airports.

(v) **Interchange Function**

Airports serve as interchanges between air and land transport system of the road and rail modes. Facilities such as car parks, road traffic control systems are also provided to ease the flow of vehicular traffic. Aprons and loading ramps are important features of the interchange function.

2.2 The Productivity cycle

Productivity cycle has four stages: productivity measurement, productivity evolution, productivity planning, and productivity improvement as shown in figure.2.4

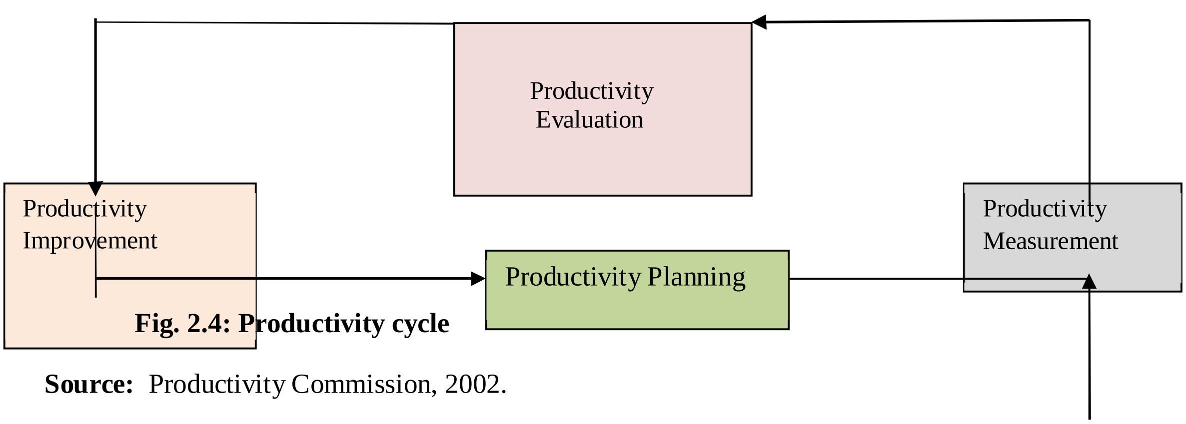

Fig. 2.4: Productivity cycle

Source: Productivity Commission, 2002.

An organization that begins a formal productivity program for the first time can begin with productivity measurement. When productivity levels are measured, they have to be evaluated or compared against planned values. The levels of productivity are planned on short and long terms bases. To achieve the planned targets, productivity improvement will take place next period; productivity level must be measured again. This cycle thus continues for as long as the productivity program operates in the organization (Oyesiku and Oduwole, 2004). The productivity cycle concept shows us that productivity improvement must be preceded by measurement, evolution, and planning. All four phases are important not just productivity measurement or just productivity improvement. Also this cycle emphasizes the process nature of the productivity issue. A productivity program is not one time project but rather a continuous ongoing process.

2.2.1. Productivity

Zografos et. al. (2013) see productivity as one of the most important issues in both developed and developing countries. Also in 1950 the Organization for European Economic Cooperation (OEEC) developed the following definition of productivity: “Productivity is the quotient obtained by dividing production output by one of the factor of production” (OEEC, 1950). Productivity is one of the key measures of utilization of human and financial resources because it is a strong indicator of efficient use of available resources and converts it to noticeable results.

Similarly, Nyshadham and Rao (2002) see productivity as an overall measure of the ability to produce a good or service. More specifically, productivity is the measure of how specified resources are managed to accomplish timely objectives as stated in terms of quantity and quality. Productivity may also be defined as an index that measures output (goods and services) relative to the input (labour, materials, energy, etc., used to produce the output).Two major ways to increase productivity: increase the numerator (output) or decrease the denominator (input). A similar effect would be seen if both input and output increased, but output increased faster than input; or if input and output decreased, but input decreased faster than output. Organizations have many options for use of this formula, labour productivity, machine productivity, capital productivity, energy productivity, and so on. A productivity ratio may be computed for a single operation, a department, a facility, an organization, or even an entire country. Productivity is an objective concept. It can also be used for tactical reasons such as project control or controlling performance to budget. Productivity is also a scientific concept, and hence can be logically defined and empirically observed. It can also be measured in quantitative terms, which qualifies it as a variable. Therefore, it can be defined and measured in absolute or relative terms. However, an absolute definition of productivity is not very useful; it is much more useful as a concept dealing with relative productivity or as a productivity factor.

Productivity is useful as a relative measure of actual output of production compared to the actual input of resources, measured across time or against common entities. As output increases for a level of input, or as the amount of input decreases for a constant level of output, an increase in productivity occurs. Therefore, a "productivity measure" describes how well the resources of an organization are being used to produce input. Also, Steering Committee for the Review of Commonwealth / State Service Provision (1997) indicates productivity as a measure of the physical output produced from the use of a given quantity of inputs. However, it is more common that production has multiple outputs and inputs, in which case productivity refers to total factor productivity; a productivity measure involving all factors of production.

It should be noted that productivity is often confused with efficiency. Efficiency is generally seen as the ratio of the time needed to perform a task to some predetermined standard time. However, doing unnecessary work efficiently is not exactly being productive. It would be more correct to interpret productivity as a measure of effectiveness (doing the right thing efficiently), which is outcome-oriented rather than output-oriented. It should be noted that there are different views/definitions of the term productivity and types of Productivity. Table 2.1 gives a description of notable views/definitions of productivity as it relates to airport productivity and performance.

Table 2.1: Chronology Definitions of Productivity

Century Author	Year	Definition
19th	1883	Faculty to produce.
	Early 1900s	Relationship between output and means employed to produce this output.
Davis	1955	Change in product obtained for the resources used.
Fabricant	1962	Always a ratio of output to input.
Kendrick et al	1965	Functional definition of partial, total factor and total productivity.
Siegel	1976	A family of ratios of output to input
Sumanth	1979	Total productivity - the ratio of tangible output to tangible input.
Alfeld	1988	The ratio that relates measurements of outputs to measurements of inputs.
Lema	1995	The ratio of outputs to inputs in a production process
Pilcher	1997	The rate of producing i.e. output divided by input.
Gupta et al	2002	The output in any productive work in relation to inputs.
Oglesby et al	2002	The ability to produce an abundance or richness of output.

Source: Mostafa (2003)

Productivity Commission (2002) described productivity as follows "Productivity is a comparison between how much you have put into the projects in terms of manpower, material, machinery or tools and the result you get out of the project. Productivity has to do with the efficiency of production. Making an airport more productive means getting more output for less cost in less time. Productivity is generally defined as the ratio of outputs to inputs.

$$\text{Productivity} = \frac{\text{Outputs}}{\text{Inputs}} \qquad \text{eq (2.1)}$$

It is important to specify the inputs and outputs to be measured when calculating productivity because there are many inputs, such as labour, materials, equipment, tools, capital, and design. The conversion process from inputs to outputs associated with any operation is also complex, influenced by the technology used, by many externalities such as government regulations, weather, unions, economic conditions, management, and various internal environmental components.

2.2.2 Total factor productivity

Mostafa (2003) exemplified that to overcome the limitations of the single factor approaches considered above, the total factors productivity measurement was developed. Total factor productivity is the ratio of net output to the sum of associated labour and capital input.

$$TFPt = \frac{Output}{(Ht + Ct)} \quad \text{eq. (2.2)}$$

Where:
TFPt = total factor productivity over period t
Ht = human input over period t
Ct = capital input over period t

It is worth mentioning that, from the point of view of productive efficiency under conditions of scarcity, a firm will have to combine the various inputs in the correct combination for optimal results to either minimize costs for a given level of production or to maximize production from available resources. From the point view of locative efficiency, the owners of the various factors of production may be assumed to seek to maximize their return from those factors (Mostafa 2003).

2.2.3. Total productivity

Mostafa (2003) also believes that total productivity is the ratio of total outputs to the sum of all input factors. Thus a total productivity measure reflects the joint impact of all the inputs in producing the outputs.

$$TPt = \frac{Total\ Output}{Total\ Input} \quad \text{eq. (2.3)}$$

Where: TPt is total productivity over period t

Thus: $TPt = \frac{Vt}{(Ht\ Ct\ Mt\ Et\ Ot)}$ ……eq. (2.4)

Where:
Vt = output value over period t
Ht = human input over period t
Ct = capital input over period t
Mt = material input over period t
Et = energy input over period t
Ot = other expenses over period t.

2.3. Airport Traffic, Efficiency and Regulation

With deregulation and liberalization of airlines and commercialization and privatization of airports, airport operators have been pressured to provide the best possible services in the most efficient way. Studies on efficiency and productivity of airports are therefore very germane to the present airport industry (ATRS, 2004). Furthermore, pricing and regulatory issues related to social welfare and increasing airport congestion are other problems plaguing the airport industry. Despite the trend toward commercialization and privatization of the airport industry, policy makers have placed more stringent regulatory governance to prevent airports from abusing market power and to increase the quality of service that is being provided. Additionally, with increasing demand and with the advent of the hub-and-spoke system, major hub airports have experienced increasing congestions since the end of 1990's (Brueckner, 2002). Salazar de la Cruz (1999) studied airport efficiency by using panel data from 16 Spanish airports between 1993 and 1995. He employed the Data Envelopment Analysis (DEA) method with the assumption of Variable Returns to Scale (VRS). He used total returns (total revenue), returns from infrastructure services (infra related aviation revenue), operative returns (non-infra related aviation revenue), final returns (non-aviation revenue) and number of passengers as outputs and total economic cost (total cost) as the input. He found that airports with 3.5 to 12.5 million passengers had constant returns to scale, whereas airports with over 12.5 million passengers exhibited decreasing returns to scale. However, as he indicated in the paper, his conclusions should be interpreted cautiously due to the small size of data at the end of the frontier; the overall degree of scale economies and its turning point may vary according to samples.

Martin and Roman (2001) explore the efficiencies of Spanish airports in 1997 with three inputs: labour, capital and material expenses and three outputs: air movements, passenger and cargo volume. On the basis of (Constant Returns to Scale) CRS and VRS DEA models, they concluded that the operations of twenty airports exhibited increasing returns to scale, while those of nine airports demonstrated decreasing returns to scale. Oum et al (2003) used a different approach, gross total factor productivity (TFP), and measured efficiencies for 50 major airports in the world. They found that larger airports had achieved higher gross TFP because of economies of scale and with a larger share of international passenger the gross TFP levels tended to decrease. Airports with a larger share of non-aviation revenue and capacity constraints were also more likely to have higher productivity. Interestingly, they found that ownership and service quality did not significantly influence efficiencies. On the other hand, Gillen and Lall (1997) classified airport operations into airside (aircraft movements) and landside (passenger movements) and estimated the efficiency and productivity for each side by using DEA models. Additionally, a second-stage analysis was carried out in order to examine the performance changes over time and across airports. Data from 21 US airports for the periods of 1989-1993 were used as the performance measures. They did not address the issue of whether economies of scale existed at airports. Their main objective was to separate airport operations into various in order to identify the source of efficiencies. Sarkis (2000), using a panel data from 44 major US airports over the period of 1990-1994, explored operational efficiencies at airports.

Sarkis, (2000) constructed various DEA methods with four inputs including operating costs, number of employees, gates and runways; five outputs including operating revenue, number of passengers, commercial and general aviation movements and cargo volume; and explanatory variables such as hubbing, multi or single airport system and snowfalls. He found that, on average, efficiency have increased over the years and that hubbing and snowfalls strongly affected efficiencies at U.S. airports in contrast, airport system was not a significant determinant of efficiencies. Although he did not specifically examine the issue of economies of scale, he took into account many operating characteristics in the efficiency models.

Pels et al (2003) similar to Gillen and Lall (1997) examined the economic efficiencies and economies of scale in airside and landside operations. By using DEA and SFA models and data from 34 European airports between 1995 and 1997, they found that European airports, on average, were relatively inefficient and most airports displayed constant returns to scale in terms of air transport movement but exhibited increasing returns to scale in terms of passenger movements. They also reported that a low load factor may be contributing to inefficiencies of operations at these airports. Although interestingly, the study had a major shortcoming: it did not consider labour inputs. Another study area relevant to economies of scale is the regulation field including pricing. Morrison (1983) examined optimal landing charges and investment levels by using data from 10 U.S. airports. Firstly, the author estimated various cost functions including maintenance, operation and administration, runway construction, land acquisition, capacity rental and delay expenditures, and then he optimized capacity variables and computed optimal long-run tool costs. Comparing optimal charges with actual fees, he concluded that airports were inefficient in terms of pricing and investment.

A study on airport regulation and competition was conducted by Starkie (2002). He pointed out that in a spatial context the airport industry was no longer under a natural monopoly, but rather under an imperfect or monopolistic competition. This transformation occurred because with privatization, airports became involved in a fierce competition with other airports for the connecting service of airlines. Based on the change in the market structure, he suggested that ex-post regulation for natural competition is likely the most appropriate model for the industry. Oum et al (2004) examined the relationship between different type of price regulation and airport efficiency as well as non-aviation activities at airports. Their empirical analysis found that airports under the dual-till price cap regulations tended to have higher levels of gross TFP than those with a single-till price cap or those that operate under the single-till Rate-of-Return (ROR) regulation. Those airports that operated under a dual-till regulation had better economic efficiencies than those under a single-till regulation, particularly for large, congested airports. This finding supported the arguments of Starkie and Yarrow (2000), Starkie (2001) and Forsyth (2002).

Vaze (2009) reiterated that each airport has its own characteristics in terms of technical, operational, environmental and financial variables and comparisons might lead to misleading results, airports have intensively and continuously been subject to benchmarking analyses which aim at airport rankings according to their efficiency scores. It was further elaborated that airports can be regarded as firms, which use multiple inputs to produce multiple outputs in a complex production system (Vaze, 2009). Airports were challenged by a more competitive environment as a result of liberalization and deregulation process in air transport markets. Following this, changes in the ownership structures due to different privatization processes, have raised questions whether privatization leads to a better performance –due to better management– of airports. Different ownership structures have been mentioned almost in every analysis, which aimed to compare the efficiency of airports (Morrison, 2001; Vasigh and Hamzace, 1998; Graham, 2008; Vogel, 2005). Meanwhile, regulation of airport charges is considered to be one of the main determinants of efficiency of an airport, especially in case of larger airports with capacity constraints and high congestion levels. In European airport industry, there are mainly three types of charges regulation which have been used (Starkie, 2002). One of them is traditional rate-of-return regulation, which is considered to lose its relevance in airport regulation (Menally, 2000). With this type of regulation, the regulator allows airports a pre-determined rate of return on capital by setting the price to be charged accordingly. It takes into consideration, in what quantity the marginal cost of capital changes. Hence, in case of uncertainty it leads to the well-known Averch-Johnson effect which implies that the airports adopt a higher level of capital than its efficient level.
Relationship between regulation and the efficient use of airport resources has been subject to economic research, because this is one of the two mechanisms to allocate the resources together with slot allocation according to IATA procedure guide (ICA), 2004; 2006; AITA, 2003). This phenomenon has not been as popular as privatization, regarding the determinants of efficiency in benchmarking analyses, but it has been

investigated separately. Airport competition is determined by the number of airports in an overlapping catchment area. Moreover, several definitions of airport competition and the existence of different players in the picture as airports, airlines and service providers make the analysis of airport competition even harder. For example, there is no consensus on which airport services are competitive and on which are monopolistic. Ceolli, et al. (2005) point out that low degree of airline competition in the past was the main determinant of low degree of airport competition in Europe. However, this situation has changed first with the deregulation of airline industry, forcing airports to use more attractive strategies for incumbent airlines as well as new entrants, and second with the development in low-cost-carrier market. Airports with excess capacity used low cost- carriers for extra passengers, which can create extra revenue sources. Hence, increasing level of competition and battle for the market power gave rise to the desire for the determination of “best practices” among airports which are competing with each other, in order to get support in developing new strategies to survive or to gain more power (Vaze, 2009).
The airport business has gone beyond plain field for landing and departure of an airplane to a diversified multi-business, including ramp and traffic handing, management of events and other commercial activities not directly related to the aviation business. There have been several studies concerning the examination of economies of scale in the airport industry. Findings from these studies range from no economies of scale exist at all, up to the existence of economies of scale until a traffic volume of 3, 20 or even 90 been passengers or that they do not exhaust at any number of passengers or work load unit (WLU).

3.0: Materials and Methods

3.1 Study Area

Nigeria Civil Aviation Authority (NCAA) was established by Act 49 of 1999, with among others, the statutory responsibility of ensuring economic and safety oversight for the Nigeria civil aviation sub-sector in line with the international Civil Aviation Organization (ICAO) Standard and Recommendation Practices (SARPs). The Authority effectively commenced operations on 1st January 2000. The immediate challenge is to ensure the implementation of action plan in compliance with ICAO SARPs in order to excel in the ICAO Safety Oversight Audit and meet requirements for the Category 1 Status of the International Aviation Safety Assessment (IASA) programme. Prior to the enactment of decree 45 of 1976 establishing Nigeria Airports Authority (NAA), the administration and maintenance of Nigerian airports were carried out by the Civil Aviation Department (CAD) of the Federal Ministry of Aviation. Sequel to the adoption of the National Policy on Civil Aviation of 1989 by the Federal Government, the Federal Civil Aviation Authority (FCAA) was established under decree 8 of 1990 as an aviation regulatory body. Towards the end of 1995, the government in its wisdom undertook a re-organization of some government parastatals in the Aviation Industry and as a consequence, the FCAA was scrapped. The Directorates of Safety Regulations and Monitoring (DSRAM) and Economic Regulation and Monitoring (DERAM) in the defunct FCAA were taken to the Federal Ministry of Aviation, while Air Transport Services (ATS) and AEROTEL were merged with the former NAA to form Federal Airport Authority of Nigeria (FAAN).

The Federal Airport Authority of Nigeria (FAAN) controls all airports which are fairly distributed in the country to service commercial, administrative centres and areas of natural resources. The airports in the country constitute the main component of the air-route networks. There are domestic and international airports in the country. The domestic airports fall into two basic groups, namely the trunk airports and local airports. The former provide air travel services mostly to cross-country routes (e.g. Ikeja, Domestic Terminal). International airports include Lagos, Port-Harcourt, Kano, Calabar and Abuja which handle international traffic and include passport, customs and quarantine controls.Most of the airports in the country are civil aviation establishments that serve scheduled airlines incorporate a wide variety of facilities for handling passengers, baggage, freight and airmail. Figure 3.1 depicts Nigerian Airports. There are eighteen air terminals. The Runway dimensions range between 2400 x 45m to 3600 x 65m. The international airports viz Abuja, Calabar, Kano, Lagos and Port-Harcourt have modern navigational facilities, lighting, terminals buildings, aprons and uninterrupted power supply.

3.1 Data Sources and Collection

Data used for this study were obtained from both primary and secondary sources. An integrative approach, employing a diversity of methods was used in collecting data. The primary data were collected through interviews and questionnaire from officers in charge of respective positions or sections in selected airports. This is predicated on the fact that the officer-in-charge of each section is considered to be proficient, consistent and reliable to provide adequate and accurate information about the related subject matter. The information sought includes socio-economic characteristics of the airports- name, location, year of establishment, staff strength, scope of the airport (local or international). The questionnaire also contains information on operational efficiency and capacity utilization of the airports- airside capacity, terminal-side capacity, number of gates and terminal, work load unit, aircraft movement, airport productivity and efficiency performance, factors affecting productivity.

The questionnaire were administered using multi-stage sampling technique which includes Selection of studied airports, the following factors were considered: (a) the airport must be either international or local and (b) it must be an approved airport by FAAN.

(i) Grouping of selected airports into different geo-political zones (sampling frame or primary sampling unit (PSU).
(ii) A simple random sampling was employed in the selection of airports in each zones.
(iii) 10 airports were chosen to make up the sampling size (Table 3.1)
(iv) A purposive sampling technique was used in the administration of the questionnaire to airport officials managing different activities in the airports.

Table 3.1: Geo-Political Zones and Airports

Geo – political zone	Airports
South-West	(1) Akure Airport (2) Ilorin Airport * (3) Ibadan Airport (4) MMA (Lagos) International *
South-East	(1) Enugu Airport * (2) Imo Airport
North-East	(1) Bauchi Airport * (2) Maiduguri Airport (3) Yola Airport
North-West	(1) Katsina Airport (2) Sokoto Airport * (3) Aminu Kano International Airport *
North-Central	(1) Kaduna Airport (2) Jos Airport * (3) Minna Airport (4) Nnamdi Azikwe International Airport *
South-South	(1) Benin Airport (2) Osubi Airport (3) Port Harcourt Airport * (4) Margaret Ekpo International Airport *

* Sampled Airport

Source; Field Survey, 2004-2008

4.0: Analysis and Discussion

4.1 Measurement of Productivity

The most commonly used output measures for airports are the number of passengers, volume of air cargo, and number of aircraft movements. Airports typically impose direct (separate) charges for their services, related to aircraft movements and handling of passengers. However, air cargo services are often handled directly by airlines, third cargo handling companies and others that lease space and facilities from airports. Revenue from direct services related to air cargo usually accounts for a very small percentage of an airport's total income. In addition to passenger traffic, cargo traffic and aircraft movements, airports also derive revenues from concessions, car parking, and numerous other services. These services are not directly related to aeronautical activities, but they are becoming increasingly more important for airports around the world. Thus, a "non-aeronautical output" that consists of revenues from all of those non-aeronautical services. A non-aeronautical output index is constructed by deflating the total non-aeronautical revenues by Purchasing Power Parity (PPP).

On the input side, four general input categories are considered, labour, which is measured by the number of employees who work directly for an airport operator (employee of FAANs for each sampled airports) purchased goods and materials; purchase services, including those contracted out to external parties and capital which consist of various infrastructure and facilities. A consistent measurement of capital input is rather complicated as airports have very different ownership and governance structures (Federal and State) with respect to the funding (and accounting) of infrastructure and facilities). This involves use of some direct physical measure as capital inputs. In particular, three physical input measures was considered; the number of runways, total terminal size (area), and the number of gates. It is interesting to note that there are no direct quantitative measures for the input factors of last two, thus related airport expenses as input measure, for these two inputs were considered. In practice, few airports provide separate expense accounts for these two input categories, so they were considered as a single input in this thesis, referred to as the soft cost input. This soft cost input consists of all operating experience not directly related to capital and personnel expenditure. As they are measured in monetary forms, and airports operate in countries with very different price levels, are use the PPP as a deflator in order to drive a constant quantity measure for soft cost inputs which is comparable across sampled airports as depicted in Figures 4.1.

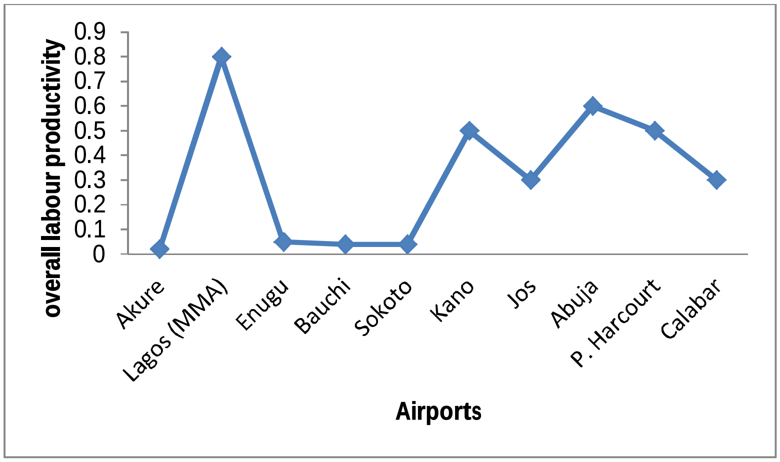

Fig. 4.1: Overall Labour Productivity of Sampled Airports
Source: Field Survey 2004-2008

Similarly, in the case of Partial Productivity Measure, airports produce multiple outputs using multiple inputs. This in turn causes difficulty in defining a consistent overall performance measure. Thus, partial measures of productivity are commonly used by the industry, academics researches and policy formulators to assess differences in performance. Partial productivity measures for airports generally relate a particular output passenger per employee is a labour-based partial productivity measure. A large variety of partial "performance ratios" are used to assess the performance of airports. These measures are very easy to compute require only limited data, and are intuitively easy to understand. However, the productivity of one particular input factor depends on the level of many inputs being used. Accordingly, high productivity performance of one input may come at expense of low productivity of other inputs. Therefore caution must be exercised in interpreting any partial measure, of productivity. This is shown in Figure 4.2.

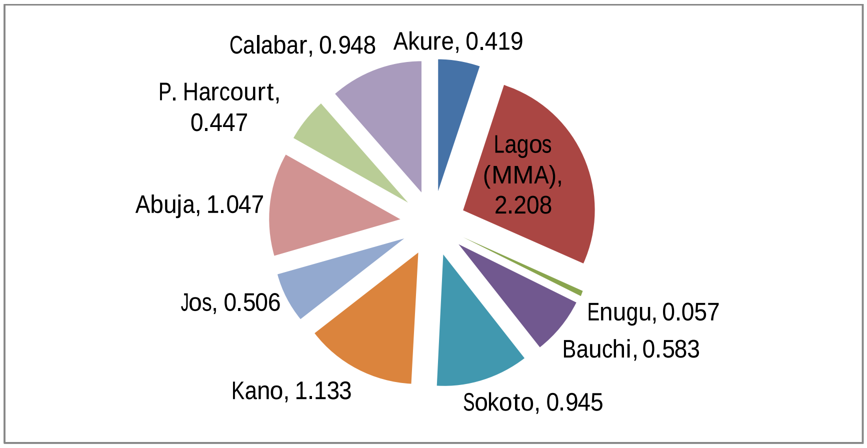

Fig. 4.2: Soft Cost/Passenger Output
Source: Field Survey 2004-2008

On the other hand, Labour productivity is a popular measure for assessing the performance of a production unit for airports; however, labour productivity may not always be directly comparable. This is because airports operate under various differing governing structure, and the responsibilities of airport operators vary accordingly. For example, services such as fire-fighting, rescue, security and meteorological services are provided directly by some airport operators, whilst covered by governments and third parties at other airports. Moreover some airport operators also engage in some non-aviation activities such as hotel operation and offshore land investments. Thus the number of employees for an airport operator depends not only on the true labour productivity but also on the range of services provided. In addition in some cases, government employees are involved in airport operation and management, but are not recognized on the airport operator's payroll as an alternate form of government subsidy. Therefore, it is important to understand that the relative performance indicated by the partial labour productivity measures presented in this section may not reflect the true efficiency of airports personnel. For example Figure 4.3 shows aircraft movement/employee and WLU/employee respectively.

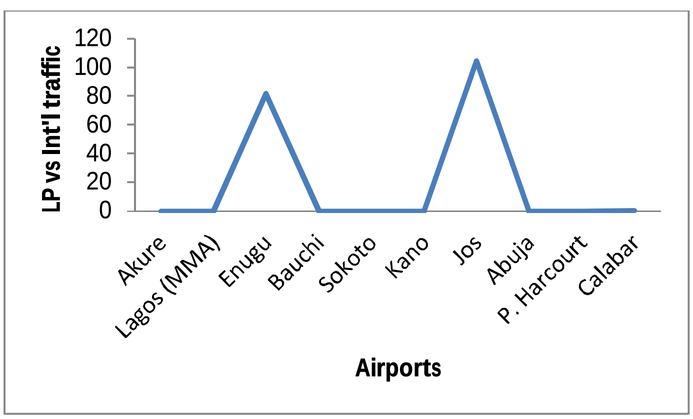

Fig 4.3: Labour Productivity vs Airport Size
Source: Field Survey 2004-2008

Based on figure 4.4, Work Load Unit (WLU) is only pronounced at some few airports, because of their relative involvement in cargo activities. These include MMA, Port-Harcourt, Kano, Abuja and others. Indeed, other sampled airports, apart from these mentioned only accounted for 1,095, which is far below what was observed at MMA

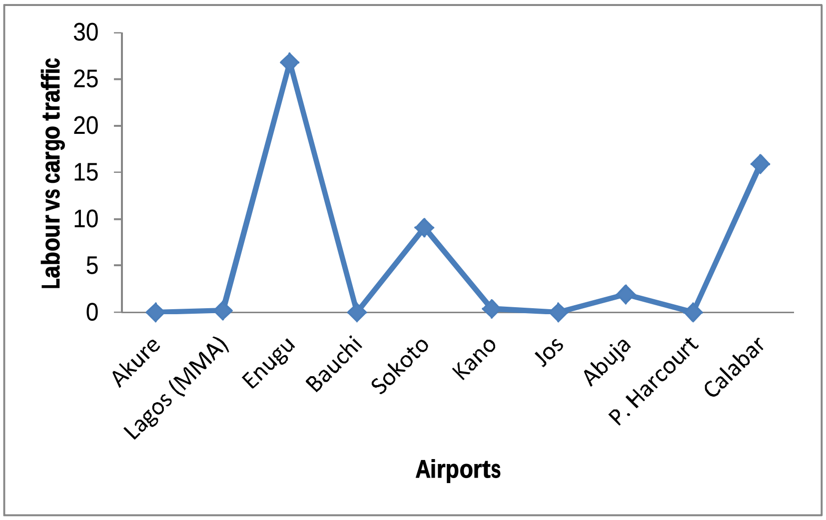

Fig. 4.4: Labour Productivity vs Cargo Traffic
Source: Field Survey 2004-2008

In the same clime, partial factor productivity, measures are influenced by the levels of other inputs being used concurrently, for example, an airport's labour productively depends on how much of its services (such as ground handling, baggage handling services, fire and police services, security screening etc) are outsourced to other firms or suppliers, because the number of employee they require is dependent upon on the extent of outsourcing (contractual services). Therefore, labour productivity or other partial factor productivity measures are not suitable in and of themselves, for comparing the efficiency of airport operations among airports consequently, there is a need to construct an aggregate measure of productivity for all of the input's that airports use. In the short to medium term, airports make management and operational decisions within the given state or their capital infrastructure and facilities; given the long lead time inherent in infrastructure development; this is assumed to be fixed in the short term. In general airport manager have nearly total control of their operation costs that is labour and soft costs, but may not have complete control of capital costs. Therefore, an aggregate productivity measure in the short to medium term would include all non-capital or variable inputs. Variable factor productivity (VFP) is computed essentially by aggregating labour productivity and soft cost input productivity using variable cost shares as the weights for measures how efficiently can airport utilizes variable inputs for a given, level of capital infrastructure and facilities,

In computing VFP, three output variables were considered; aircraft movement, number of airport passenger and a quantity index for non-aeronautical revenue, such as labour productivity, airport size and others. Two inputs were equally considered; labour and soft cost input, cargo traffic is not included for two (related) reasons (a) cargo services are generally handed by airlines, or cargo operations at most airports, and airports essentially play the role of landlord in providing spaces and facilities (b) it is very difficult, if not impossible, to collect consistent and comparable data on airports cargo revenue. Airports vary greatly in terms of how various services are provided. Some airport operators provide most of the facilities and services themselves, while other relies on airlines specialist agents, or third parties to provide many of his services.

One particular aspect that has attracted some debate is how airline operated terminals or terminals operated by other independent companies (owned or on long-term lease) should be treated in evaluation airport performance. One side of the argument posts that the omission of the resources employed by airlines or the independent terminal operators in operating such terminals may lead to possible underestimation of input factors for airports with such terminals operators or airlines as part of their business strategy in order to improve efficiency and reduce costs for the airport authorities, they do no income the full cost of operating such terminals, nor do they are receive the perspectives of airport performance measurement as long as the "net revenue" and "net cost" related to such contracts are considered in evaluating the airports performance, there is no danger of adhere to the latter view, and thus do not attempt to directly incorporate any input factors employed by the airlines or independent terminal operators in operating such terminal. In furtherance to this, analysis carried out on the variable factors as presented.

Table 4.2: Variable Label Definition

LBPD	Labour Productivity
AIRPS	Airport Size
INTTR	International Traffic
CARTR	Cargo Traffic
CAPPD	Capital Productivity
SCIPD	Soft Cost Input Productivity
SINTTR	Share of International Traffic

Source: Field survey, (2014)

Table 4.3: Correlation values of variable factor productivity

	LBPD	AIRPS	INTTR	CARTR	CAPPD	SCIPD	SINTTR
LBPD	_	-.091	.216	-.969**	-.005	-.047*	-.167
AIRPS		_	.820**	-.238	.587**	-.752	.955**
INTTR			_	-.257	.829*	-.748	.822*
CARTR				_	-.141	.053	-.265
CAPPD					_	-.502	.806*
SCIPD						_	-.655**
SINTTR							_

**correlation is significant at 0.01 level (2-tailed)
*correlation is significant at 0.01 level (2-tailed)
Source: Result output based on field survey (2014)

The use of common VFP estimates for all the sampled airports. There is a weak negative relationship between variable factor productivity and international traffic. International traffic requires more services and resources than domestic traffic, however, international passengers land to generate much more concession revenues than the domestic passengers on a per capital basis. Therefore, the effects of the international traffic on airports" variable factor productivity depend on the counter-balancing of the two sided, and are more of an empirical question as theory does not provide a clear direction. There is a positive relationship between variable factor productivity and share non-aeronautical revenue. Non-aeronautical revenue share is used as an indicator of an airport's business composition or business strategy. Many airports attempt to increase revenues from non-aviation sources so that they can reduce landing and /or terminal charges to airlines. This indicates business diversification that may help to improve an airport's productive performance. Similarly, Figure 4.6 shows descriptive analysis of some of the variables.

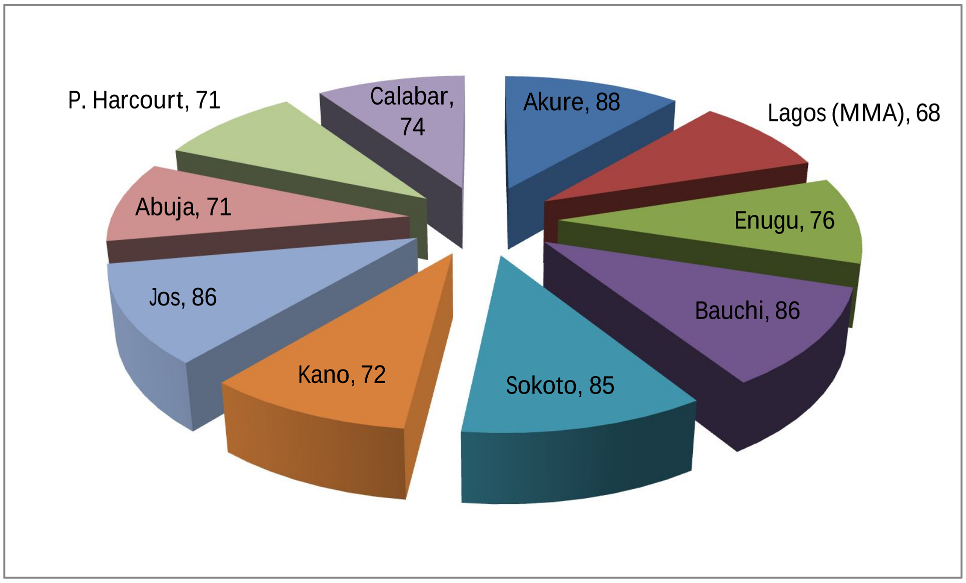

Fig. 4.6: Aeronautical Revenue Share of Sampled Airports
Source: Field survey 2004-2008

However, in line with variable factor Productivity Decomposition and Productivity, gross VFP levels are affected by a number of factors, some of which cannot be controlled by airport operators, and thus the gross VFP (computed from observed data) may not reflect an airport's true managerial efficiency level. In the input of true, regression analysis that adapted production function of Cobb-Douglas which incorporates ordinary least-square and weighted least square methods was adapted to decompose VFP differentials into various sources. Such regression analysis has two objectives, to identify the potential effects of various factors on gross VFP and to compute a residual VFP index after removing the effects of these varieties on gross VFP. Hence the following factors are likely to influence gross VFP. Airport size (output). Airports are often believed to have economies of scale. However, past studies, have found empirical evidence that economies of scale appears to be limited to airports with relatively low passenger number (Doganis 1998). Most of size of the airports sampled are less exhausted therefore we include airport size variable and regression.

Average aircraft size: large aircraft carries more passengers at one time thus the airport needs to have a large number of employees for the shift and larger facilities to provide land side services for the aircraft. That is airports need to provide sufficient landside capacity (employees and facilities) for the "peak"(when a large aircraft arrives/departs), but it may lean to low employee and facility utilization during "off-peak" period. On the other hand airports that mostly hand large aircraft are expected to have higher unitization of airside facilities. Percentage of international traffic: international traffic requires more services and resources than domestic traffic, however, international passengers tend to generate considerably higher concession revenues than domestic passenger on a per capital basis. Therefore the effect of the international traffic on airports variable factor productivity depend on the counter-balancing of these two factors and are more of an empirical question as theory does not provide a clear direction.

Since average aircraft size using an airport, percentage of international traffic, proportion of air cargo in total traffic handled, capacity constraints, and the connecting passenger ratio are in large part beyond the control of the airport management in the short to medium term, it is fair to remove the effects of these factors on gross VFP measures, in order to derive a true indicator of efficiency performance. This calls for the computation of the so-called "Residual VFP"

Pooled VFP Regression model: There are significant difference in airport governance structure, general operating environments and many other factors among the sample airports. However we do attempt to "chain line" the residual VFP measured across the entire sample via a pooled regression. For reference purpose, the results of the pooled regression are represented as follows:

Table 4.4: Model Summary

Model	R	R.Square	Adjusted R,Square	Std Error estimate
1	.854	.729	.661	.226073

Source: Result output based on field survey (2014)

Table 4.5: VFP Regression results

Variables	Beta	T	Sig	Partial	Collinearity Stat. Tolerance
LBPDvsAIRPS	.303	1.236	.304	.581	.785
LBPDvsINTTR	.416	2.982	.058	.865	.563
LBPDvsCARTR	.307	1.263	.296	.589	.833
CAPPDvsAIRPS	-.241	-.888	.440	-.456	.589
CAPPDvsINTTR	,303	1.237	.304	.581	.633
SCIPDvsAIRPS	.344	1.211	,321	.532	.568
SCIPDvsSINTTR	-234	-.562	,042	.455	.642

Source: Result output based on field survey (2014)

Based on Table 4.4, the multiple R shows .85 while the adjusted R-Square is .729. This indicates that all the variables accounted for 73% in the equation. This implies that the model actually fits. Similarly, in Table 4.5, there is negative value in Beta column of capital productivity and airport size. The same negative values are recorded against soft cost input productivity and share of international traffic. This is a result of inability of the sampled airport to achieve their relative objectives due to poor management and infrastructural base, and other factors. This will be further discussed in the other subsection of the thesis.

5.0: Conclusion and Recommendations

5.1: Examination of Airport Productivity and Efficiency Performance

Airport productivity and efficiency performance were examined using the output and input measures bearing in mind that airport produce multiple output using multiple inputs. Airport performance has been conducted using partial productivity measures which relate a particular output passenger per employee which is labour based partial productivity measure. In addition a large variety of partial "Performance ratios" was also used to assess the performance of airports. It is important to note that the differences in airport governance structure affect the outcome of the variable factor productivity (VFP) among the sampled airports. The result of the pooled regression shows a negative value in Beta column of capital productivity and airport size. The same negative values are recorded against soft cost input productivity and share of international traffic. This outcome is a reflection of the inability of the sampled airports to achieve their relative objectives as a result of poor management and infrastructure coupled with other factors.

Studies of airport costs will continue to be important as new technologies and third party outsourcing firms are becoming more significant and as regulatory reform and privatization of airports are taking place around the world. Different stakeholders, such as airport managers, policymakers and regional planners, must understand costs as they evaluate substantive issues such as the potential savings from multiple airport systems and dedicated terminal operations, the economic costs and benefits of new capacity investments, the sources and measurement of productivity growth and technical of new capacity investments, the sources and measurement of productivity growth and technical change and the effects of pricing regulations (price caps vs. rate of return). A proper understanding of cost is central to the making of sound airport strategies and the design of sustainable public policy.

The short term issues of financial instability at hand are complex and diverse and include the slowing economic conditions, consumer confidence and the flow on effect of weaker passenger demand, airline capacity reductions, loss of revenue from lower aeronautical charges and reduced access to capital. However, the industry has overcome many challenges in this past decade alone, from SARS to 9.11, to airline collapses, lack of aircraft and high fuel prices. Yet the industry continues to shine as robust and viable. The world needs air transport and airports, and airport's stakeholders can continue through the long term with common goals in place.

Streamlining efficiencies in operational integrity, new business processes and paradigms and the use of new technology will continue to see the industry and airports work towards a competitive advantage and achieve outcomes which are appropriate for airport shareholders and acceptable for stakeholders. Value creation for airports will continue to have a dominant effect on decision making by airport managers. Working with key airlines by closely understanding their business model and customizing the relationship will provide the benchmark for future airport/airline relationships. Excellence in operations, flexibility working with partners, efficiencies in lowering operation costs as well as reducing noise and emissions are all possible and timely for the aviation industry.

It is recommended that Airports and airlines should share business strategies as the partnership is the key to the growth of both the airport and airline.   The role government as the principal facilitator of infrastructure is to regulate the provision of air transport infrastructure with a view to ensuring the efficient operation of the aviation industry at the lowest social cost. Oni (2014) aptly noted that government as enabler and facilitator must creates the right environment and incentives for stakeholders to contribute to development and ensures that resources needed for construction and maintenance of transport infrastructures are available at the lowest possible cost or price through a more pluralistic and inclusive approach to transportation planning, in which all stakeholders functions as partner

Aeronautical revenue can be maximized by marketing on behalf of or in conjunction with an airline to grow passenger numbers through the airport. Joint marketing plans and co-operative marketing can add value to the partnership with the airline by helping them sell seats and provide airlines with the confidence of working more closely with the airport. Giving the airport a more strategic role in the airline's development for the airport and leading to more effective future passenger forecasting.

Innovative strategies in communication and marketing approaches will help share the future recognition of airports as market leaders of creative thinking. Embracing change yet solidifying approaches to marketing that will be effective for the target market. Airports can learn from other industries and be prepared with aggressive strategies for the longer term growth, post the short term instability of the economic environment.

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