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Route Architecture and Cost Model Impact on Route Profitability of Indigenous Airlines in Nigeria.

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Abstract
The airline industry is one of the most important service industries in the world. Aviation industry offers benefits in social, economic and political integration of countries, regions and indeed the whole continent. However, the aviation industry in developing and less-developed countries has suffered undue and cumulative neglect from the governments, owners and managers, hence creating an institutional decay in the sector and undermining the performance of the industry. The airline industry in Nigeria faces challenges in safety oversight, route architecture and cost model, as well as having many small non-viable privately-owned carriers. The choice of route architecture and cost model affects performance of airlines in varying proportions. This study therefore investigated the effect of route architecture and cost model on route profitability of selected indigenous airlines in Nigeria. This study adopted a cross-sectional survey research design. The population of this study was 170 senior management staff of the 6 selected local airlines operating in Nigeria. The sample size was 170 determined using total enumeration method. A structured and validated questionnaire was used for data collection. The reliability test yielded Cronbach's alpha for the constructs ranges from 0.75 to 0.93. The response rate was 94.04%. Data were analyzed using descriptive and inferential statistics. Findings revealed that route architecture and cost model had significant effect on route profitability of selected indigenous airlines in Nigeria (Adj. R^2 = 0.499, F(5, 152) = 32.259, p<0.05). It is recommended that industry practitioners and aviation entrepreneurs pay greater attention to route architecture and cost model in determining their route profitability especially with the new challenges posed by the COVID-19 pandemic to the aviation industry.

Keywords: *Hub and spoke architecture, Point to point architecture, Low cost model, Hybrid cost model, Full cost model, Route profitability*

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I. Introduction

Globally, air transportation is a progressively developing sector and one of the most important service industries. According to the Industry High Level Group (IHLG) 2019 report, Europe has one of the most liberalized and integrated markets in the world. The single aviation market created by the European Union (EU) was subsequently expanded to the European Common Aviation Area (ECAA). The report further shows that the single market revolutionized mobility, not only providing cheaper and safer air travel but also more jobs and economic growth. Also, the report of the Industry High Level Group (2019) indicates that air transport supports 12.2 million jobs and USD 823 billion in GDP in Europe. Likewise, it supports 7.2 million jobs and USD 156 billion in GDP in Latin America and the Caribbean. This reveals that Latin America and the Caribbean aviation sector have been growing in recent years, despite economic and political difficulties in certain markets. Although, expansion is expected to continue over the next two decades in the aviation sector, however, infrastructure deficiencies and higher taxes on the sale or use of air transport are constraints to creating jobs and generating economic benefits (Aguiar, Torres, & Antonio, 2013).

In United Kingdom, the airline industry has witnessed a tremendous growth in the past 25 years (Anderson, 2016). Anderson (2016), reiterated further that, the demand for passenger air travel in particular, is expected to increase from the current level of 281 million passengers to 465 million in 2030. Anderson (2016) submitted that London Heathrow Airport was amongst the top ten busiest airports in the world and more than half of all passengers travelling by air in the UK travelled via the six London area airports, namely, London city, London Gatwick, London Heathrow, London Luton, London Stansted and London Southend

The Middle East region has also been at the forefront of aviation growth and restructuring of the global long haul markets, by elevating its hub position for connecting Europe and Asia Pacific, in line with the West to East shift of the geographical center of gravity of air transport operations (ATAG, 2019). Equally, the aviation industry in the Asia and Pacific region has, in recent decades, become a success story with an impressive level of growth with air transport supporting 2.4 million jobs and USD 130 billion in GDP in the Middle East, as well as 30.2 million jobs and USD 684 billion in GDP in Asia and Pacific region.

North America is, along with Europe, a consolidated and liberalized market in need of new technology implementation to improve efficiency in aircraft operations. Much of the growth of the region can be attributed to the status of North America as a manufacturing powerhouse. Air transport supports 7.3 million jobs and USD 844 billion in GDP in North America. According to the United States Federal Aviation Authority (2018) report, the United States has an extensive air transportation network of 5,300,000 square miles of domestic airspace. In 2018, there were 19,622 airports in the U.S. that annually handled 16,100,000 flights, one billion passengersand 44,300,000,000 pounds of freight per year, contributing 10,600,000 jobs and 5.1% of GDP. Due to the geography of the United States and the generally large distances between major cities, air transportation is the preferred method of travel for trips over 300 miles (480 km), such as for business travelers and long distance vacation travelers (Wahl, 2015).

In Africa, more than 6 million jobs and $67.8 billion in GDP are supported by aviation and the aviation sector directly employs over 250,000 people (ATAG, 2019). When included, indirect employment at suppliers to the industry, induced employment from spending by aviation industry employees and the jobs in tourism that air transport makes possible, this increases the regional figure to 6.7 million jobs (ATAG, 2019). In addition, African economies derive substantial benefits from the spending of tourists travelling by air. Aviation's economic benefits spread far beyond monetary aspects. The Africa's air transport, though has experienced significant growth in the last decade, both in international and domestic traffic faces the challenges of high concentration in services and lack of competition, with only a few dominant airlines providing international services within the continent. In addition, African airlines face challenges in safety oversight, route architecture and cost model, as well as having many small non-viable state-owned carriers (Bofinger & Mathias, 2017).

In line with the global trend in airline industry, the Nigeria airline industry has recorded tremendous change over the last three decades. In particular, between the year 2000 and 2011, airline operations in Nigeria expanded considerably and air traffic is projected to grow at an annual rate of 9–10% reaching the level of 15 to 20 million passengers by 2020 (Oghojafor, Ladipo & Raheem, 2016). Whilst there has been significant improvement in regulation and safety of airline industry in Nigeria, the same cannot be said of airline operators that continue to record operational losses and liquidation in Nigeria. For instance, Arik Airline and Aero contractors were the largest and second largest airlines, respectively, as at 2014. However, in recent time they are being managed by receiver managers appointed by the Asset Management Corporation of Nigeria, (AMCON) set up by the federal government to buy toxic assets of commercial banks, in readiness for outright sales to willing investors or eventual liquidation. Airlines in Nigeria have progressively adopted the full-service model introduced by the front runner, Nigeria Airways, in 1959. The successive failure of airlines suggests that this model may not be sustainable on the long run. In the light of this, this paper aims at investigating the effect of route architecture and cost model on route profitability of selected indigenous airlines in Nigeria.

Statement of the Problem

Scholars such as Borenstein (2011), Gordon (2013); Holloway (2003); Mason and Alamdari, (2007); O'Connell and Williams (2011); and Sedar and Hearle (2014) have investigated the performance of the airline industry globally, but in the context of Nigeria Aviation industry, there is no known study that has critically examined the effect of route architecture and cost model on organizational performance of indigenous airlines in Nigeria. Hence, this study seeks to fill this gap in literature. Airline industry in Nigeria has been losing value consistently over the last 20 to 30 years and this is attributed to various factors, such as decline in route profitability, passenger load factor, market share, firm competitiveness, firm profitability among other factors (Becker, Bouwer, John & Toutaoui, 2018; Bland, 2014; Bowcott, 2017; De Wit & Zuldberg, 2012; Gillen & Lalle, 2004). According to Stephen and Ukpere (2014), the choice of route architecture and cost model affects performance of airlines in varying proportions from country to country. For instance, in USA and South Africa the rate is 72%, 69% in Egypt, 77% in UK, 97% in Japan, 91% in China, 82% in Australia, 72% in UAE, 81% in Ethiopia, 47% in Ghana and 8.2% in Nigeria (Stephen & Ukpere, 2014). Hence, since Nigeria has one of the lowest rates in the world, there is a need to find out whether route architecture and cost model has significant effect on organizational performance of selected indigenous airlines in Nigeria. This paper focuses on determining effect of route architecture and cost model on route profitability of selected indigenous airlines in Nigeria and therefore seeks to answer the following question: how do airline route architecture (hub & spoke route architecture and Point-to-point route architecture) and cost model(Low cost model, hybrid cost model, and full service model) affect route profitability of selected indigenous airlines in Nigeria?

This study will provide strategic information to policy makers in the aviation industry in Nigeria on the key information that will help to stimulate and strategically react towards business information in order to achieve firm performance. The study will also help airline organisations identify what is expected of them by the stakeholders regarding their market share, profitability, competitiveness and creativity respectively. It would also assist top-level managers in airline companies identify steps to take in ensuring that their employees are aware of their business initiatives, strategic policies and also carry them along. On the part of the employees, this study shows what they should demand and expect from their top-level management and how they can help the top-level management in their respective companies to meet up organizational objectives and goal.

II. Literature Review

Route architecture and Cost Model

Ludwig (2015) defined routing as the process of selecting a path for traffic in a network or between or across multiple networks. Swan (2010) defined route architecture as the foundation of an airline's product, with point-to-point and hub & spoke architectures lying at the poles of a continuum with most large airlines operating some combination of the two. Button, (2000) in defining route architecture further broke the concept down into two components, point to point and hub & spoke. He defined a hub as an airport where a large percentage of flights operated by an airline as part of a radio network, and a spoke as other airports where flights originate to feed passengers to the hub for further flights to different destinations. According to Button (2000), all passengers in a pure point-to-point system board at flight origin and deplane at the destination. In the hub and spoke system, by contrast, all passengers except those whose origin or destination is the bub, transfer at the hub for a second flight to their destination.

Route architecture and cost model are some of the complexities airlines contend with in making a choice of their business model. Other major factors are route/destination choices, finance and equipment. Many researchers have argued that the choice of route architecture and cost model are key success factors to the survival of any airline (Abdullah, Munisamy & Satar, 2014; Anderson, 2016; Dichter & Bowcott, 2016).

The choice of preferred route architecture and cost model is an important factor in the allocation of these resources (Rhoades & Tiernan, 2014). A single model to determine the optimal flight network, albeit desirable, generally leads to large-scale problems of the Non-deterministic Polynomial time hardness (NP-Hard) class (Hane, 1995; Klabjan, 2004). It is a common practice to divide the problem into smaller problems such as schedule generation, fleet assignment and crew assignment, solved in consecutive steps, seeking to compute a solution at feasible times (Gomes & Gualda, 2015).

According to Caetano and Gualda, airlines route architecture and operational planning encompasses the definition of the flights to be offered, of the aircraft to be used for each flight, and of the crew to perform each of these flights. These decisions are usually associated to results of three interrelated processes that, in turn, may be divided into smaller sub problems, usually solved sequentially, as shown below:

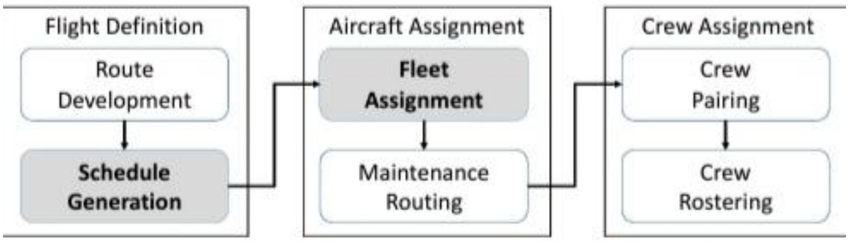


Fig 2.1: Airline route architecture and operational planning stages
Source: Caetano & Gualda, 2010

The route architecture model proposed by Caetano and Gualda (2011) is based on previous models by Berge and Hopperstad (1993), Sherali (2006) and Lohatepanont and Barnhart (2004). It is structured as a space-time network, as shown below. Since the arrival slot time constraints are based on the flight arrival time, the space-time network includes explicit arcs for maintenance after flight, during which the aircraft is unavailable, so that the flight arcs ends at the correct time, even if the aircraft is unavailable for a longer period of time.

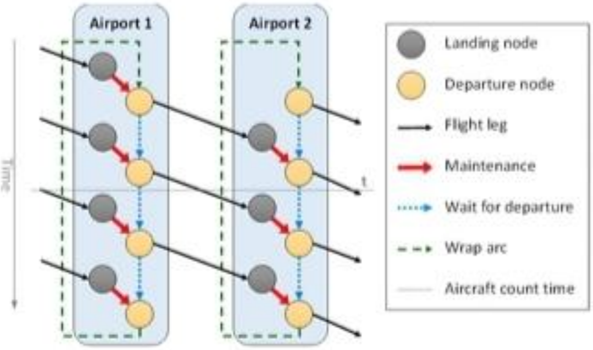


Fig 2.2: Space-time network

Source: Caetano & Gualda, 2011

If one fleet cannot execute a direct flight between two airports because of its range limitation, the network for that fleet shall not include the arcs representing that flight, different fleet networks may include different sets of arcs. The same rationale applies when one aircraft cannot operate at an airport, no flight arc should connect that fleet to the restricted airport. In this paper route architecture consists hub & spoke route architecture and Point-to-point route architecture, while cost model consists Low cost model, hybrid cost model, and full service model.

Hub & Spoke Route Architecture

Hansson, Ringbeck and Franke (2002) defined Hub & Spoke route architecture as a routing system whereby passengers departing from any non-hub (spoke) city bound to another spoke in the network are first flown to the hub where they connect to a second flight to the destination. Inbound and outbound flights are tightly timed and coordinated to minimize connection time (McShan & Windle, 1989). According to Button (2002), The H&S system serves network destinations with the fewest routes of any alternative design. For example, five destinations require only four routes with one hub and four spoke cities but ten routes are required if the same destinations are connected with a point-to-point system. Consequently, for any given level of frequency and number of destinations, the H&S system requires the fewest number of aircraft (Button, 2002).

According to Riccardo et al (2017), the advantages of the H&S system derive from consolidating the travel demand of each spoke city to most or all of the destinations in the network. Economic advantages increase with passenger density and network growth, positively affecting both supply and demand. Passengers prefer to use a single airline for their entire journey, so the ability to serve many cities of varying sizes confers a competitive advantage (Riccardo et al, 2017). Passengers making hub connections benefit from closely timed flights, single check in, more convenient gate and facility locations, and reduced risk of lost baggage. Knowing that an airline likely serves a desired destination saves the passenger search and transaction costs (Riccardo et al, 2017). Familiarity with the airline's product lessens uncertainties and increases loyalty, particularly when linked to loyalty programs (Price, 2017). As destinations in the network grow and more passengers funnel through the hub, flight frequency can be increased. High frequency allows the passenger to match flights with desired itinerary times (Gillen & Morrison, 2005); major network carriers operate ten or more connecting complexes per day. Increases in both number of destinations served and frequency also provides a bigger base over which to spread advertising and promotional expenses.

Although the advantages of hub & spoke route architecture system in gathering and dispersing passengers are many, the costs of operating the system are high. In the last twenty years, the limits of the H&S model have become particularly evident, and, in a reversal of earlier predictions, the foundations of the model have been questioned (Yan, Fu & Oum, 2008). According to Rosestein (2012), typically about 40% of all network carrier passengers have the hub as their origin or destination. The remainder only passes through the hub(s) to make outbound connections. Extensive facilities and substantial personnel are needed solely to accommodate these connecting passengers. The passenger service agents, gates, lounges, baggage facilities, ramp and maintenance personnel dedicated to passenger connections are not necessary if flights operate non-stop between passengers' origin and destination (Donoghue, 2002).

Point-to-Point Route Architecture

Lott (2005) defined point-to-point architecture as a route system which connects each origin and destination via a non-stop flight. According to Lott (2005), the counterpoint to the complexity of the hub & spoke system is the simplicity of point-to-point architecture which connects each origin and destination via a non-stop flight. A non-stop flight is the least expensive means to serve markets where demand is sufficient to support larger, mainline aircraft. Eliminating the intermediate stop at the connecting hub provides an average savings of more than 30% (Lott, 2005).

According to Oliveiraa, Ferrer, and Parasuramanc (2012), the point-to-point system offers other benefits. Point-to-point flights reduce total travel time, primarily by eliminating the intermediate stop, but also by avoiding circuitous routings and increasing aircraft block speeds, making passengers to value the reduction in travel time. Without the schedule constraint of connecting complexes, aircraft turn times can be minimized, aircraft can be utilized more fully creating an opportunity to generate more revenue, gates can accommodate more operations per day and airport personnel can be utilized fully throughout the day. Flight crew utilization may also increase (Price, 2017).

Hub & spoke and point to point route architecture have advantages best suited for certain markets which make an eventual predominance of one system unlikely. In the hub-and-spoke (HS) network configuration all destinations are linked to a main airport called hub. The main advantages of this configuration are that it makes a great deal of origins and destinations relatively well interconnected with a low number of routes, and the possibility to achieve economies of scale and economies of density. It also offers the opportunity to applyeconomies of scope by centralizing in the hub the maintenance services and staff dedicated to aircraft operation. On the other hand, the fact that an airline has a particular airport as hub may deter other airlines from operating in this airport (Aguirregabiria & Ho, 2010). Table 2.1 presents the characteristics of Hub & Spoke and Point-to-Point route architecture for proper clarification.

Table 2.1: Characteristics of Hub & Spoke and Point-to-Point route architecture System

Attribute	Hub and Spoke	Point-to-Point
Scope	Optimized by connecting service to wide geographical area and many destinations	Each route serves a single city-pair. Individual routes may be dispersed.
Connectivity	Most passengers connect at hub(s) for a continuing flight(s) to destination	No connections provided (although incidental or "rolling hub" connections are common)
Dependence	Each route highly dependent on other routes for connecting passengers	Routes operate independently, traffic is not affected by demand from other routes
Demand	Varying demand in any given city-pair may be offset by demand from other markets	Only varying frequency and pricing available to counter demand variance
Market Size	Efficiently serves cities of greatly varying size	Requires high density markets with at least one end-point being a high demand origin/destination
Frequency	Supports high daily frequency to all destinations	Generally lower frequency depending on market type and density
Pricing	Frequency and coverage appeal to business travelers providing a margin for higher business fares	Both business and leisure passengers are generally price-seeking
Asset Utilization	Limited by network geography, connection timing, and hub congestion	No network constraints on utilization
Cost of Operation	Hub connections significantly increase cost per available seat mile, somewhat offset by use of larger mainline aircraft	Lowest cost per available seat mile per city-pair
Fleet Requirement	Large range in seating capacity is necessary to match capacity with traffic, usually requires more than one fleet type	Suited to a single fleet type

Source: Cook and Godwin (2014).

Low Cost Model

The term originated within the airline industry referring to airlines with a lower operating cost structure than their competitors (Benoit, 2019). The low cost model is one in which a low-cost carrier or low-cost airline (occasionally referred to as no-frills, budget or discount carrier, and abbreviated as LCC) is operated with an especially high emphasis on minimizing operating costs and without some of the traditional services and amenities provided in the fare, resulting in lower fares and fewer comforts (Cook & Godwin, 2014). To make up for revenue lost in decreased ticket prices, the airline may charge extra fees such as for carry-on baggage

Bowcott, (2017) in his view defined Low Cost Carriers (LCCs) or Low Cost Airlines (LCA) as any carrier with low ticket prices and limited services regardless of their operating costs. According to Bowcott, (2017), low cost carriers (LCC) have grown in the last three decades and have become a tempting alternative to Full Service Airlines (FSA). Low Cost Carriers utilize a business model that reduces operational costs. In order to compensate revenue loss in tickets, they may charge customers for auxiliary services like meals, priority boarding and baggage. This type of service airlines is one of the fastest growing economic segments and at times, LCCs were the only sector growing in periods of economic and political uncertainty. According to Carey, Ross & Seitzman (2017), these carriers have been demonstrating sustained growth, with gradually increasing fleet sizes, number of passengers served, revenues, and in many cases profits. It is typical to start operating with three or so aircraft, and then steadily add capacity. Their growth rates in their first years may reach 100% which then soothes to 30-60% at the two to eight year point.

The low cost business model was first introduced by Southwest Airline, and then it spread to include Europe then Asia. Their lower fares are considered their main competitive advantage. According to Truit and Haynes (2012), these airlines manage to lower their fares by adopting highly efficient operational strategies which help them cut their costs and smoothly adapting to market changes.

LCCs are characterized by a business model that relies primarily on some key elements. These include: Service Offering: The unbundling of fares is one of the characteristics of the low-cost airline business model, which concentrates on separating the product into distinct elements (Binggeli, Dichter & Weber, 2013). These elements are sold separately. This results in cost reductions and offers opportunities for revenues. Food and beverage for instance are offered for an extra charge. Most LCCs have no pre-assigned seating arrangements and operate on a first-come, first-served basis. However, some LCCs such as EasyJet have started issuing "speedy boarding" tickets that can be purchased in advance. Also LCCs have firm rules concerning luggage weights per passengers. Some tickets don't include any checked-in luggage and have to be purchased separately (Saxon, 2019).

Another fundamental characteristics of the low-cost business model has been point-to-point service, which allowed for lowering the cost structure by providing a simple operation and management model (O'Connell & Williams, (2005). Offering point-to-point services also lets airlines schedule their services at the right time of the day to compete with other airlines without being subject to the imperatives of a connecting wave-system.

A major disadvantage of low cost model is that low cost airlines are increasingly competing on the basis of price, especially in markets with a high low cost carrier (LCC) presence, so yields in large markets are low (Damos, Boyett & Gibbs, 2013). Lott (2006) submitted that there are few, if any, opportunities remaining for LCCs to enter overpriced and underserved markets. To continue expansion, LCCs are forced into competition with each other rather than only with legacy carriers.Low-cost travel is becoming the dominant way of flying within Europe and figures of low-cost growth are stunning (Lott, 2006).

Hybrid Cost Model

Franke (2004) define hybrid cost model as the alternative approach to the traditional low-cost business model. The low-cost airline business model can take a number of forms (Francis, Humphreys, Ison, & Aicken, 2006).) and costs savings can be achieved from different sources (O'Connell & Williams, 2011). While some identify low-cost carriers as those airlines that have a distinctive feature, such as using a single-fare class over their whole network of routes (Fageda and Sanchez, 2009), others use other methods, such as the product and organizational architecture (POA) approach, to classify and relate key elements of airline business models (Benny & Jen-Hung, 2012).

The increasing difficulty for defining the low-cost airline business model is, in fact, a sign of the coexistence of several business models that are categorized under the low-cost carrier label (Benny & Jen-Hung, 2012). This is an indication of the existence of some level of institutional plasticity, as airlines try to stretch the prevailing institutional agreements and understandings without deviating in excess from the dominant development path of the low-cost carrier business model (O'Connell & Williams, 2011). The level of deviation from the traditional low-cost business model by some low-cost carriers is starting to be of such a degree that some scholars begin to agree that we might have scope for defining a hybrid low-cost carrier (Franke, 2004).

Full-Service Model

As defined by ATAG (2019), a legacy or full service network carrier (FSNC) is an airline that focuses on providing a wide range of pre-flight and on-board services, including different service classes, and connecting flights. Since most FSNCs operate a hub-and-spoke model, this group of airlines are usually also referred to as hub-and-spoke airlines. In most European countries, the (former) national carrier operates as an FSNC.

Full service airlines are characterized by different aircraft types, from small regional feeder aircraft to B747/B777/ A340/A380 long range wide body aircraft, domestic and worldwide flights with focus on the respective home country, hub-and-spoke network (feeder flights from the respective hubs), often complemented by selected decentralised non-hub flight, wide range of O&D's (origin & destinations) offered via the respective hub, high frequencies, two to four service classes, dedicated services in business and first class.

Examples are Air France/KLM, Lufthansa, British Airways, Iberia, Austrian Airlines, LOT or the multi-national airline Scandinavian (SAS). While most of the former national carriers in larger EU countries are now either fully or at least to a major extent privatized, some (often smaller) EU countries still have significant interests in their respective national carriers. The USA is the only country in which quite a significant number of independent, fully privatized FSNCs operate. In many African and Asian countries, in contrast, only one state-owned FSNC operates. Apart from (former) national carriers, there are additional, independently owned and operated FSNCs in some of the larger EU countries. Some of the most prominent examples are British Midland and Virgin Atlantic (UK), Air One (Italy), Spanair and Air Europa (Spain) and Aegean Airlines (Greece). Virgin Atlantic, however, is not really a network carrier as it focuses on long haul flights out of London and Manchester only. In Germany, the only noteworthy FSNC besides Lufthansa used to be BA's subsidiary Deutsche BA (later sold to private investors and renamed dba) which had operated a dense intra-German network until it was taken over by hybrid carrier Air Berlin in 2006.

The major advantages of full service airlines is that they dominate the longer transatlantic routes and offer passengers a variety of comfort options. Cost is their major disadvantage, which is the major reason many of them are unable to compete (Mason & Alamdari, 2007).

Route Profitability

Lohmann and Koo (2013) defined route profitability as the evaluation of the returns on an airline route using models with variables of aircraft productivity, employee productivity, fuel consumption productivity and other costs associated with the particular route. The knowledge of route profitability helps airlines to take decisions on what route to keep, close, expand and reduce frequency (Lohmann & Koo 2013). In measuring route profitability, airlines are concerned with many performance variables including ton kilometers per aircraft; average flight distance; average speed of aircraft, average payload capacity per aircraft, Average kilometers performed per aircraft; average aircraft daily working time. Route profitability calculation requires deep knowledge of all airline processes, cost drivers, revenue and cost structure as well as a wide range of traffic and financial performance indicators (Hansson, Ringbeck & Franke, 2002). Route profitability models have been used by airlines in network planning and management as shown in the table below.

Network Management: Planning and Controlling Processes of an Airline

Phases	Strategic Network Planing	Operational Network Planning	Revenue Management
Processes	■ Market analysis ■ Capacity planning (long term)	■ Flight scheduling ■ Fleet assignment ■ Rotation planning ■ Crew management	■ Pricing ■ Yield management
Time horizon	■ 5-2 years prior to departure ■ Long-term	■ 2 years – 4 weeks prior to departure ■ Middle- up to short-term	■ 0,5 years – departure ■ short-term

Figure 2.3: Phases and processes of network management

Source: Hansson, Ringbeck & Franke, 2002.

According to McShan and Windle, (1989), as depicted in the model below, the fundamental idea of route profitability analysis is to allocate cost and revenues on a flight level basis. But, not all costs and revenues are caused directly by an individual flight. That's the reason why airlines have to apply specific allocation formulas or cost and revenue drivers for correct calculation. For this quantitative performance data such as number of block hours, flight hours, available seat kilometers (ASK), revenue passenger kilometers (RPK) or distance flown are used. Basic inputs for any route and network profitability analysis are the operating statistics of an airline.

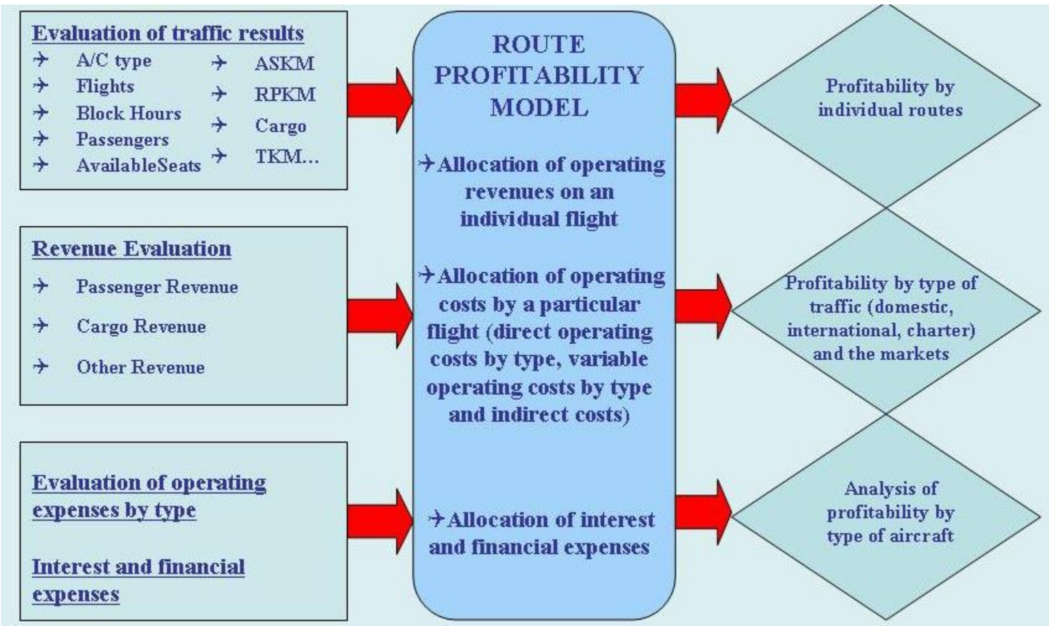


Figure 2.2: Route Profitability Modelling Process

Source: **McShan and Windle, 1989**

**Key

ASKM - Available seats kilometres
RPKM - Revenue passenger kilometres
TKM - Transported cargo (freight and mail), tonne kilometres

III. Theoretical Review

The underpinning theory of this study are the empty core theory and Pels network optimality theory. The theory was proposed by Edgeworth in 1881. It was based on the assumption of the "empty core" problem in economics, which is essentially a characterization of markets where too few competitors generate supra-normal profits for incumbents, which then attracts entry. However, entry creates frenzied competition in a war-of-attrition game environment: the additional competition induced by entry results in market and revenue shares that produce losses for all the market participants. Consequently, entry and competition leads to exit and a solidification of market shares by the remaining competitors which then earn supra-normal profits that once again will attract entry. The cut throat competition in the airline industry, as a result of few product differentiation (homogeneity) make the empty core theory very suitable as a theoretical underpin for the dependent variables of this study. In the airline industry, cut-throat competition impacts passenger load factor, route profitability, market share, firm competitiveness and firm profitability. This theory is relevant to this study as it attempts to explain the intense rivalry in the airline business. It also addresses the independent variable firm competitiveness and market share.

Critics of the theory (Aivazian& Callen, 1981; 2003; Coase, 1981) have suggested that the fundamental problem with the empty core concept is that its roots lie in models of exogenous market structure that impose (via assumptions) the conditions of the empty core rather than deriving it as the result of decisions made by potential or incumbent market participants. In particular, for the empty core to perpetuate itself, entrants must be either ill-advised or have some unspecified reason for optimism.

The theory was proposed by Eric Pels in year 2000. It proposes the relative value of market size to achieve lower costs per available seat miles (ASM) versus economies of density. Pels (2000) explored the optimality of airline networks using linear marginal cost functions (MC) and linear, symmetric demand functions:

$MC=1-\beta Q$

$P=\alpha-Q/2$

Where β is a returns to density parameter and α is a measure of market size.

The Pels model demonstrates the importance of fixed costs in determining the dominance of one network structure over another in terms of optimal profitability. In particular, the robustness of the hub-and-spoke network configuration claimed by earlier authors (Hendricks, 1995) comes into question. In this three-node network, the Pels model generates two direct markets and one transfer market in the hub-and-spoke network, compared with three direct markets in the fully connected network. This theory is relevant to this study in that it provides clarity on airline network configuration and connectivity model in order to detect the actual topology and its development. Moreover, it will prove useful to this study in identifying the spatial hubs which is crucial in preventing competitive disadvantage.

Shy (2011) criticised the assumptions of the theory. His work shows that profit levels on a fully connected full service network are higher than on a hub and-spoke network when variable flight costs are relatively low and passenger disutility with connections at hubs is high. Watt and Strogatz (1998) argue that complex networks appeared not to have a random formation, but instead are locally organized structures of nodes and clusters, leading to Small World (SW) networks. These SW networks tend to have a connectivity distribution with an inverse relationship between the number of nodes and the number of connecting links.

Empirical Review

The study of Abdullah, Munisamy, and Satar, (2014) highlights the various empirical findings regarding factors affecting efficiency in airlines as outsourcing, business model, cost model, route architecture, ownership and control, liberalization & deregulation, open skies policy, cooperation amongst airlines, code sharing, Labor unions and governance structure. Kanta & Ahlan (2015) found that Airlines assume more costs because they have to react against perturbations of flight schedule. However, introducing padding, backup resources or re-scheduling improves reliability resulting in extra costs. Backup mechanisms obligate to assume more fixed costs, but increasing the quality of service.

The study by Rosenstein (2012), found out that when comparing operating margins to other carriers for the 3rd quarter of 2012, Spirit airline leads the industry at 13.7%. In comparison, JetBlue was 5.0% and Southwest was 4.0%. Cost per available seat mile (CASM), 10.20 compared to: (a) Southwest 11.05, (b) JetBlue 12.55, (c) Delta 16.03, and (d) American Airlines 16.93. Spirit does not care about market share, and it expects every route in its network to be profitable. If it is not, the route's frequency is downgraded or dropped.

Elian & Cook (2013) in their study of the ultra-low cost carrier, Spirit Airlines concluded thatSpirit's financial performance since completing the transition to the ULCC business model has been well above the industry average. Spirit's target segment of passengers, focused primarily on price, is structurally attractive and expecting continued growth m the medium term. Evaluating the known strategic risks, Spirit should not face a serious competitive challenge m most markets. As a result, Spirit should dominate the price sensitive U.S. air travel market m the short to medium term as it has achieved a sustainable competitive advantage based on Porter's cost focus strategy.

Sarker, Hossan & Zaman (2013) in their study on sustainability and growth of Low cost carriers (LCC)found out that Focus on unbundled low cost model and need based outsourcing would be the ideal ways to overcome recession. An alliance with network carriers is beneficial to LCC's as they facilitate travel at low cost for international passengers travelling on domestic routes in all countries worldwide with a rise in market share for LCC's.

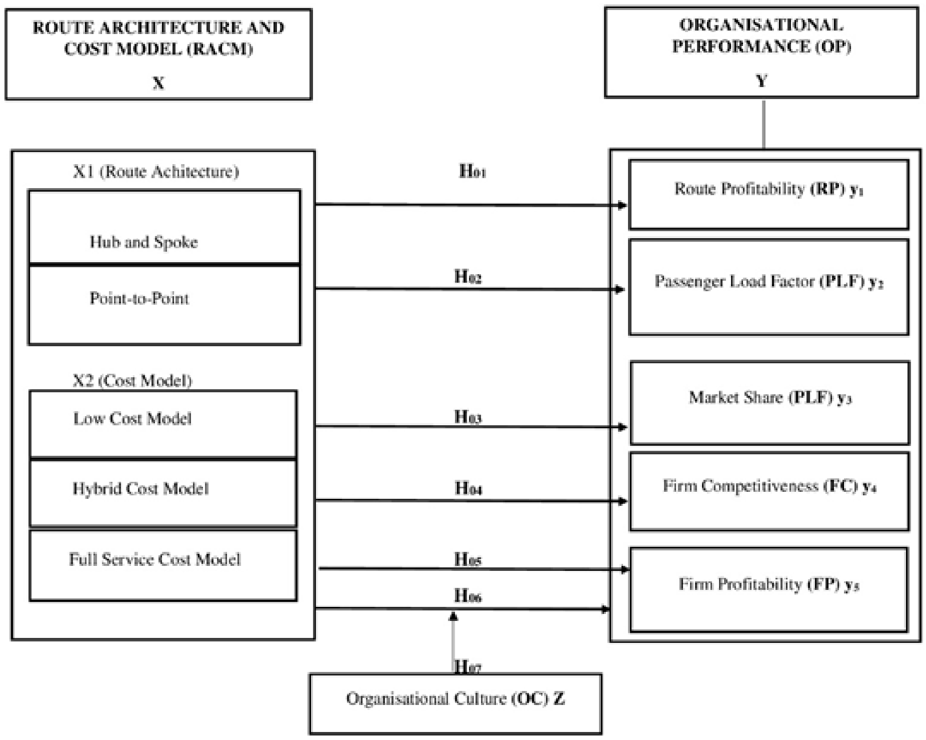
Stevenson (2012) revealed thatwhile other airline fleets can employ 10 or more types of aircraft, Southwest uses just one, the Boeing 737. This results in all manner of cost-saving efficiencies from mechanic training to parts inventory, fleet interchangeability, parking etc. Southwest also doesn't assign seat numbers. Which means that if a plane is swapped out, and a new one's brought in with a different seat configuration, there's no need to adjust the entire seating arrangement and issue new boarding passes. Most other airlines charge to check bags. Southwest has resisted the trend for its marketing and operations benefits. Other carriers use a hub-and-spoke system. Southwest's flights are generally point-to-point. The plane lands, goes through turnaround, and often heads right back where it came from. With less interdependence, the network can survive a problem at a single airport.

Conversely, the empirical research ofFeldman (2000) found that route architecture and cost model has no significant effect on route profitability of airlines, same position was held by Franke (2004). Likewise, Donoghue (2002) also found that other factors apart from route architecture and cost model are responsible for the route profitability of airlines. The reason for this negative finding could be as a result of the country in which this study was conducted. It is in light of the foregoing that this study hypothesizes:

H_0: Route architecture and cost model have no significant effect on route profitability of selected airlines in Nigeria.

Conceptual Framework

The conceptual framework that was used in this research depicts the various variables under study. The study dependent variable was route profitability while independent variables wereairline route architecture (hub & spoke route architecture and Point-to-point route architecture) and cost model(Low cost model, hybrid cost model, and full service model). These variables led to the conceptual framework of the study as illustrated in figure 1.



IV. Methodology

This study adopted a cross-sectional survey research design. Survey design has the advantages of describing the relationships and effects between the study variables. It also enables the researcher to describe the situations in details about the focus group as they exist.

The study population consists of senior management staffof local airlines operating in Nigeria licensed by the Nigeria Civil Aviation Authority (NCAA). The selected airlines areArik Airline, Aero Contractors, Dana Air, Medview Airline, Air Peace and Overland aviation. The population of senior management staffof selected local airlines as at the time of this research is one hundred and seventy (170) (NCAA, 2020). The selected airlines were justified becausethey are present in Lagos, and account for 90% of domestic air travels in Nigeria. They also represent a cross section of route architecture and cost model dimensions (low cost model, hybrid model, full-service model, hub & spoke route architecture, point-to-point route architecture) which were used in the study. The study focused on senior managers because they have knowledge and experience about the strategic operations, strategic policies and decision-making processes of the airlines.Full enumeration was done on the airline senior staff.

The sampling units for the study consisted all senior employees of indigenous airlines operating from Muritala Mohammed airport Ikeja, Lagos. Lagos State was chosen because the state had the largest population of airlines and air passengers in Nigeria. The respondents that were selected in this study enabled the researcher to obtain facts and reliable responses to compare the results of this studywith earlier studies carried out in this area, and make conclusion.

Total enumeration (or census) method was used as the target population is small in number (170). Several studies such as Abosede, 2018; Kaiser, 2017 and Ogungbangbe, 2017, in their studies investigating top management staff employed the total enumeration method since the population was small.

Primary data was collected by administration of questionnaires. All the items used in the questionnaire were measured using a 6-item scale ranging from "strongly disagree' (1) to "strongly agree" (6). The -point Likert-type scale is consistent with Bendig, 2019; Homburg, Klarmann & Schmitt, 2010; Vorhies and Morgan, 2005.Reliability was measured using the Cronbach's Alpha at an average level of 0.7%.Fornell and Larcker (1981) andSerbetar & Sedlar (2016) argued that a Cronbach's Alpha equal or greater than 0.7 is regarded to be an indication of reliability. Therefore, the researcher considered the Alpha coefficient greater than 0.7 to indicate reliability of the research instrument. A pilot test was conducted to test the construct validity of the data collection instruments. Azman Airline at the Nnamdi Azikwe Airport, Abuja was used conduct the pilot study and it was not part of the airlines selected for the actual study where management staff were given the questionnaire.The results of pilot study showed that the variables had exceeded the value of 0.70 with an overall reliability coefficient of 0.87, indicating that they met the adequate standards of reliability analysis. However, the reliability coefficients of the research instrument for each sub-variable of the study is presented in table 1 below:

Table 1: Reliability Coefficients of the Research Instrument

S/N	Variables	No. of Items	Cronbach's Alpha Coefficient	Comments
1	Low cost model	5	0.75	Reliable
2	Hybrid cost model	5	0.83	Reliable
3	Full service model	5	0.89	Reliable
4	Hub & Spoke route architecture	5	0.90	Reliable
5	Point to point route architecture	5	0.91	Reliable
6	Route profitability	5	0.92	Reliable

The descriptive and inferential statistics were used to analyze thedata. Descriptive statistics was used to describe the variable. It also provides the views and opinions of the respondents on sustainable marketing and corporate image. Multiple regression analysis is used to predict the value of dependable variable based on the value of two or more independent variables. The study hypotheses were therefore tested using multiple regression analysis where the significant level was set at 0.05. In this regression analysis, standardized coefficients (Standardized Beta) were used for all analyses (Jaccard et al., 1990). Diagnostic tests such as normality, linearity, and multicollinearity tests were conducted to confirm whether the data collected fitted well in the model. The null hypotheses were either rejected at $p<0.05$ level.

The equations to test the hypotheses formulated are:

$RP = \beta_0 + \beta_1 HS + \beta_2 PTP + \beta_3 LCM + \beta_4 HCM + \beta_5 FSM + \varepsilon_{i\ldots\ldots}$ Eqn 1

Where:

RP = Route profitability

HS = Hub & spoke route architecture

PTP = Point-to-point route architecture

LCM = Low cost model

HCM = Hybrid cost model
FSM = Full service model

V. Results

Diagnostic Tests
Normality Test

The results in Table 2 show that the variables are normally distributed with skewness and kurtosis values ranging between -3.0 and + 3.0 as recommended by George and Mallery (2010). This implies that the study variables namely low cost model, hybrid cost model, full service model, hub and spoke route architecture, point to point route architecture, route profitability, market share, firm competitiveness, firm profitability, passenger load factor, and corporate culture are normally distributed and hence further tests can be carried out on the data.

Table 2: Table Results of Normality Diagnostic Test

Variables	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Low Cost Model	-0.409	0.193	-1.699	.384
Hybrid Cost Model	0.090	0.193	-1.797	.384
Full Service Model	-0.116	0.193	-.994	.384
Hub and Spoke Route Architecture	-2.681	0.193	1.647	.384
Point to Point Route Architecture	-2.181	0.193	2.850	.384
Route Profitability	-3.281	0.193	1.607	.384

Source: Field Survey Results (2020)

Linearity Test

According to the findings as illustrated in Table 3 the variables show both positive and negative correlation to each other. The results indicate that the variables organizational performance and low cost model had a strong positive relationship as indicated by a correlation coefficient of 0.878. The results also show that there is a significant negative linear relationship between organizational performance and hybrid cost model ($r(158) = -0.752, p<0.05$), full service model ($r(158)= -0.808, p<0.05$), hub and spoke route architecture ($r(158) = -0.287, p<0.05$), and point to point route architecture ($r(158)= -0.363, p<0.05$). This implies that there is a linear positive relationship.

Table 3 Results of Pearson's Correlation Linearity Test

		Route Profitability	Decision
Route Profitability	Pearson Correlation	1	Linear
	Sig. (2-tailed)		
	N	158	
Low Cost Model	Pearson Correlation	0.878**	Linear
	Sig. (2-tailed)	.000	
	N	158	
Hybrid Cost Model	Pearson Correlation	-0.752**	Linear
	Sig. (2-tailed)	.000	
	N	158	
Full Service Model	Pearson Correlation	-0.808**	Linear
	Sig. (2-tailed)	.000	
	N	158	
Hub And Spoke Route Architecture	Pearson Correlation	-0.287**	Linear
	Sig. (2-tailed)	.000	
	N	158	
Point To Point Route Architecture	Pearson Correlation	-0.363**	Linear
	Sig. (2-tailed)	.000	
	N	158	

Source: Field Survey Results (2020)

Multicollinearity test

Table 4.3 shows that the VIF for low cost model = 0.123, hybrid cost model = 0.276, full service model = 0.246, hub and spoke route architecture = 0.148, and point to point route architecture = 0.121. The mean VIF for the variables is 6.176. Table 4.11 shows that the variables have a VIF that is less than 10 and tolerance value more than 0.1 ruling out the possibility of multicollinearity. Therefore, the results imply that there was no multicollinearity problem among the variables and hence the level of multicollinearity in the model can be endured.

Table 4.3: Results of Multicollinearity Test

Coefficients[a]			
Model		Collinearity Statistics	
		Tolerance	VIF
	Low Cost Model	0.123	8.159
	Hybrid Cost Model	0.276	3.629
	Full Service Model	0.246	4.067
	Hub And Spoke Route Architecture	0.148	6.751
	Point To Point Route Architecture	0.121	8.274
	Mean VIF	0.1828	6.176

Source: Field Survey Results (2020)

Hypothesis Testing

The hypothesis earlier formulated was tested using linear multiple regression analysis. Table 4 shows the results of hypothesis testing.

Table 4: Summary of multiple regression analysis foreffects of Route architecture and cost model on route profitability of selected indigenous airlines in Nigeria (n=158)

Model	*B*	Sig.	T	ANOVA (Sig.)	R	R^2	Adjusted R^2	F (df)
(Constant)	10.123	0.017	2.405	0.0001[b]	0.718	0.515	0.499	32.259 (5, 152)
Hub and spoke	0.598	0.000	3.784					
Point to Point	-0.177	0.285	-1.072					
Low cost Model	0.268	0.002	3.218					
Hybrid cost model	-0.031	0.580	-0.554					
Full cost model	-0.167	0.069	-1.832					
Predictors: (Constant), Hub and spoke, Point to point, Low cost model, Hybrid cost model and Full cost model								
Dependent Variable: Route Profitability								

Source: Field Survey Results (2020)

Interpretation

The analysis in Table 4 reveals the result of the multiple regression analysis on the effect of effect of route architecture (Hub and spoke architecture and Point to point architecture) and cost model (Low, Hybrid and Full cost model) on route profitability of selected indigenous airlines in Nigeria. Based on the result of the analysis, hub and spoke architecture ($\beta = 0.598$, $t = 3.784$, $p<0.05$) and low cost model ($\beta = 0.268$, $t = 3.218$, $p<0.05$) have positive and significant effect on route profitability of selected indigenous airlines in Nigeria while point to point architecture ($\beta = - 0.177$, $t = -1.072$, $p>0.05$), hybrid cost model ($\beta = - 0.031$, $t = -0.554$, $p>0.05$) and full cost model ($\beta = - 0.167$, $t = -1.832$, $p>0.05$) have a negative and insignificant effect on route profitability of selected indigenous airlines in Nigeria. The result inferred that out of all the sub-variables of route architecture and cost model, only hub and spoke architecture and low-cost model have significant effect on route profitability which implies that only these sub-variables are pertinent in improving route profitability of selected indigenous airlines in Nigeria.

The result also shows that a strong positive relationship existing between route architecture, cost models and route profitability as shown by the correlation coefficient of R=0.718. The coefficient of multiple determination, adjusted R^2 is 0.499 ($F_{(5, 152)} = 32.259$, $p<0.05$) indicates that route architecture and cost models only accounts for about 49.9% of the changes in route profitability of selected indigenous airlines in Nigeria while the remaining 50% is accounted for by other factors not captured in the model.

The multiple regression model is expressed as thus:

$RP = 10.123 + 0.598HS + 0.268LC + e_i$ ……………………………………………..… eq. i

Where:

RP = Route Profitability

HS = Hub and Spoke architecture

LC = Low cost model

The regression model shows that route profitability of selected indigenous airlines in Nigeria would be 10.123 in the absence of low cost model, hybrid cost model, full service model, hub and spoke route architecture and point to point route architecture. The analysis also showed only hub and spoke architecture and low cost model significantly affect route profitability in that when hub and spoke architecture and low-cost model are improved by one unit, route profitability would increase by 0.598 and 0.268 respectively. This indicates that an increase in hub and spoke architecture and low cost model would lead to a subsequent increase in route profitability of the selected indigenous airlines in Nigeria. The result of the analysis indicates that indigenous airlines in Nigeria should improve their hub and spoke architecture and improve on the adoption of the low-cost model to increase their route profitability. Also, the F-statistics (df = 5, 152) = 32.259 at $p = 0.0001$ ($p<0.05$) indicates that the overall model is significant in predicting the effect of route architecture and cost model on route profitability of selected indigenous airlines in Nigeria. Therefore, the null hypothesis which states that route architecture and cost model have no significant effect on route profitability of selected indigenous airlines in Nigeria was rejected.

VI. Discussion

The findings indicated that route architecture and cost model had significant effect on route profitability of selected indigenous airlines in Nigeria. The result affirmed the study of Kanta & Ahlan (2015) that Airlines assume more costs because they have to react against perturbations of flight schedule. However, introducing padding, backup resources or re-scheduling improves reliability resulting in extra costs. Backup mechanisms obligate to assume more fixed costs, but increasing the quality of service.The study by Rosenstein (2012), found out that when comparing operating margins to other carriers for the 3rd quarter of 2012, Spirit airline leads the industry at 13.7%. In comparison, JetBlue was 5.0% and Southwest was 4.0%. Cost per available seat mile (CASM), 10.20 compared to: (a) Southwest 11.05, (b) JetBlue 12.55, (c) Delta 16.03, and (d) American Airlines 16.93. Spirit does not care about market share, and it expects every route in its network to be profitable. If it is not, the route's frequency is downgraded or dropped.

In line with this, Elian and Cook (2013) in their study of the ultra-low cost carrier, Spirit Airlines concluded thatSpirit's financial performance since completing the transition to the ULCC business model has been well above the industry average. Spirit's target segment of passengers, focused primarily on price, is structurally attractive and expecting continued growth m the medium term. Evaluating the known strategic risks, Spirit should not face a serious competitive challenge m most markets. As a result, Spirit should dominate the price sensitive U.S. air travel market m the short to medium term as it has achieved a sustainable competitive advantage based on Porter's cost focus strategy. Sarker, Hossan & Zaman (2013) empirically established that Focus on unbundled low cost model and need based outsourcing would be the ideal ways to overcome recession. An alliance with network carriers is beneficial to LCC's as they facilitate travel at low cost for international passengers travelling on domestic routes in all countries worldwide with a rise in market share for LCC's.

Corroborating the individual regression statistically significant results of route architecture and cost model,Stevenson (2012) revealed thatwhile other airline fleets can employ 10 or more types of aircraft, Southwest uses just one, the Boeing 737. This results in all manner of cost-saving efficiencies from mechanic training to parts inventory, fleet interchangeability, parking etc. Southwest also doesn't assign seat numbers. Which means that if a plane is swapped out, and a new one's brought in with a different seat configuration, there's no need to adjust the entire seating arrangement and issue new boarding passes. It further established that most other airlines charge to check bags. Southwest has resisted the trend for its marketing and operations benefits. Other carriers use a hub-and-spoke system. Southwest's flights are generally point-to-point. The plane lands, goes through turnaround, and often heads right back where it came from. With less interdependence, the network can survive a problem at a single airport.

VII. Conclusion And Recommendations

The study found out thatroute architecture and cost model have significant effect on route profitability of selected indigenous airlines in Nigeria through hub and spoke architecture and low cost model. Therefore, airlines companies should carefully choose the routes they fly into, the flight mode and pattern as well as the equipment and resources deployed to service their routes based on individual demand patterns, rather than the present method adopted by indigenous airlines in Nigeria where in most observed cases, any available equipment is deployed to routes regardless of the route profitability of servicing the route with that particular equipment.

The findings of this research can enable airline managers to understand the complexities of the relationship between the variables of the study as it has been established that the survival rate of airlines in Nigeria is the lowest in West Africa, due to the lack of deep understanding by airline entrepreneurs and investors in the economics and complexities of aviation businessand the effect of route architecture, cost model and organizational performance of airlines.

Also, the finding of this study will provide information to government and policy makers in Nigeria on the key variables of cost model and route architecture that will improve airline organizational performance. Policy makers will use the outcome of this study to re-orientate airline entrepreneurs on best practices to sustain their operations profitably. This would not only be beneficial to airline firms, but also to the Nigerian economy as the industry is an important aspect of the nation's economy.

Suggestions For Further Studies

Given that the context of this study was limited to selected airlines in Nigeria, it is therefore suggested that other scholars to carry out a similar study on other airlines companies and to compare their results with the present research.

Again, future studies could be replicated using other airline business model dimensions like finance, equipment choice and organizational structure to expand the examined relationships and provide further validation of the proposed model.

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