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Original Article

Influence of Runway Capacity and Air Traffic Capacity on the Growth of Aviation Business. Evidence From Wilson Airport, Kenya

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Keywords: *Business Growth, Runway Capacity, Air Traffic Capacity*

ABSTRACT

The study focused on the effects of runway capacity and air traffic control on the growth of aviation businesses. The guiding objectives of this study were: to determine the effect of runway capacity on the aviation business growth in Kenya and to evaluate the effect of air traffic control capacity on aviation business growth in Kenya. The study was guided by resource-based theory. The study employed an explanatory research design. The study targeted 117 respondents comprising 92 operational managers at Wilson Airport, 25 air traffic controls, and Kenya Airport Authority employees based at Wilson Airport. A Census survey was used in this study to collect information from all participants in the population. The study collected primary data using questionnaires. In testing for reliability, Cronbach's alpha coefficient was applied. Statistical Package for the Social Sciences (SPSS) version was used for data analysis. The study findings revealed that runway capacity positively and significantly affects aviation business growth. Air traffic control capacity has a positive and significant effect on aviation business growth). It can be concluded that runway capacity at Wilson Airport is insufficient. Night-hour flying can enhance runway capacity, and by large, aviation growth as AOC holders can fly more due to increased operating hours. The aerodrome owner and operator should ensure that it boosts the existing runway capacity either by optimizing the operations or expanding to cater to business growth. KAA and KCAA, the regulators, should consider boosting the runway capacity through increasing navigation aids to enable the introduction of night flying. The study recommends that future researcher's study on the influence of public, and private partnerships to increase the ground movement capacity on aviation growth can also be conducted.

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INTRODUCTION

Air transportation has had a trajectory of increased growth in the last decades and the projection is anticipated to continue bulging more in the next years. The basis for prediction for traffic growth tendencies is expanded demand in greater aviation connectivity, the same is expected to translate into a higher workload for airports and other different airspace services users (Zuniga et al., 2016).

A host of factors affect firm growth such as business age, size and industry (Penrose, 1959). Hence, sales growth need not match with other parameters of firm growth that policymakers might take an interest in. For example, profits and employment may decline even if sales increase. Increased sales can result at the expense of profit margins reducing prices or, with no impact on employment. This may be partly related to contextual such as sector-specific trends or structural issues such as the age of business or the impact of top executive strategic decision-making.

Airport capacity expansion can be a contentious issue. The average rate of projected demand for air travel is 4–5% per year (Airbus, 2018; Boeing, 2018). Capacity for growth at the world's major airports is however limited. Much as airspace, aircraft parking, or terminal capacity has capacity challenges, runway capacity is the most stringent constraint on growth. In the year 2008, up to 15% of all flights were from capacity-constrained airports. The number is projected to increase over time (Gelhausen et al., 2013)

Airport congestion problems that lead to significant flight delays have been occasioned by demand growth for air transport services. Additionally, airport capacity expansion has had constraints that arise from political, physical and institutional factors. Almost one-third of flight delays in 2013 exceeded an average time delay of 26 min (Eurocontrol, 2014). There is a multiplier effect across the entire network that arises from schedule disruptions and delays. A result of delays is airport operational bottlenecks, congestion and passenger dissatisfaction that have both economic and environmental in the entire air transport system. Data as of 2012, indicated that air traffic management disorganizations in the European Union led to 10.8 million minutes of flight delays with costing implications worth billions of dollars to airspace users and passengers, as well as carbon emission emissions (IATA, 2014).

In South Africa the capacity of the landside facilities (passenger and cargo terminals, road access) and other airfield facilities (taxiways, apron stands) can in most instances be increased, in one way or another, to equal or exceed the capacity of the runway system. Airport capacity and delays have received a significant amount of attention, from

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airport professionals and the public at large, as airport traffic delays have increased. Some airport stakeholders believe that the most significant threat to the long-term sustainability of the global air transportation system is the inability of runway capacity to keep up with growing air traffic demand at many of the world's most important airports (Tilana, 2011).

The solutions advocated by airport operators and airlines are to build additional facilities at congested airports or to find ways to make more efficient use of existing facilities. The efficient use of existing facilities is considered a better option because it requires less capital investment and avoids many of the challenges related to increasing the size of the airport and infringing on the surrounding communities at airports where available airport land has been developed (Lohmann, & Vianna, 2016). A third option that is advocated is not to increase capacity but to manage demand by channeling it to off-peak times or alternative sites. The basis behind the recommended approaches to prevent or reduce delay is that capacity and demand must somehow be brought into equilibrium.

THEORETICAL REVIEW

The Resource Based Theory

This study was guided by the Resource Based View Theory developed by Wernerfelt in 1984. This theory that anchors on organisational strategy emphasizes the people element in strategy development and highlights the motivation, politics, and cultures of organizations and the desires of individuals (Jackson et al, 2014). Resource-based theory provides a process approach to strategy formulation. It helps to explain firm performance results from internal organization resources rather than industry-level factors. Resource-based theories promote the development of business strategies that can leverage a firm's unique resources.

Organisational resources are broadly defined as all types of resources that give a firm a competitive edge. They include all capital resources, information resources, organizational processes, physical resources, human resources, and even human resources that can be leveraged by a firm for competitive advantage. Of these resources; resources that represent unique firm strengths that can be leveraged for competitive advantage. Such rare resources are assumed that resources they be heterogeneous and not perfectly mobile between firms in an industry.

Four characteristics being that they are valuable, rare, inimitable, and no substitutable. These features do distinguish the unique firm resources as being relevant to how may result in a competitive advantage or sustainable competitive advantage for the firm. A sustainable competitive advantage can be achieved when valuable and rare resources can be protected from imitation and substitution.

One major critique of resource-based theory has been definitional problems in its conceptualization. Priem, & Butler (2016) observed that because valuable resources and competitive advantage are closely intertwined leading to a possible tautological problem within the originally conceived constructs. Critics of the human resource-based theory state that the consideration of the impact of resource availability and value on a firm competitive advantage emphasized by the resource-based theory has remained influential within the strategic literature.

This theory is relevant to this study since it proposes that the airport should compare its skills with those of the markets and other firms and should not outsource core competencies or competencies involving special skills or strategies. Resource-based theory contends that the possession of strategic resources provides an organisation with a golden opportunity to develop competitive advantages over its rivals. The resource-based view (RBV) emphasizes the firm's resources as the fundamental determinants of competitive advantage and performance.

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LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Runway Capacity

The definition of airport capacity refers to the predictable number of runway movements that under conditions of continuous demand can be operated per unit of time – usually, per hour (De Neufville, 2020). Forecasts of airport capacity utilization are usually given in terms of yearly movements. The association between hourly and yearly capacity is typically straightforward (Wilken et al., 2011). Although at most airports - airspace, terminal or aircraft parking capacity may have an impact, it is the runway capacity, that is the main constraint (Berster et al., 2015). Airport capacity in any given hour depends on multiple factors such as whether the airport is slot controlled or not, weather conditions, distribution of arrivals and departures on different runways. In some instances, regulators can limit effective airport capacity. An example is the Düsseldorf (DUS) airport which operated at single runway capacity because of environmental restrictions despite capacity expansion to two runways back in 1993 (Gelhausen et al., 2013).

Airport runway capacity expansions are central to all airport research and planning for improvement. There is a steady rise in air travel growth. Domestic trends in Indonesia are at 16.25% increase in passengers. Juanda International Airport in Surabaya contributes 9.78% of the total national passengers. Three options for expanding airport capacity have been short-listed in the UK by the UK Airports Commission. These include expansion of Gatwick with an additional runway and expansion of runway capacity at Heathrow. The influence of the expansion of airport capacity depends on the macro-economic aviation industry and airline users' stakeholders (Helsey, & Codd, 2014).

Tittle, McCarthy, & Xiao, (2013) discussed airport runway capacity and economic development, using an aggregate production function. The study results indicated a positive correlation of real gross metropolitan product with both the number of runways and the maximum length of runway available at a given airport. Further a negative cross product between the two, suggested a trade-off between the number of flights possible and the size of the aircraft that can use the airport. By focusing on runways at commercial airports, the estimate impact of reducing congestion that sets in at take-offs and landings nears the technical limit for safe operations as air activity increases. Nevertheless, the study took place in United States and other studies need to be done in Kenya on runway capacity.

Airline schedule adherence is dependent on aircraft turnaround. Airport operational efficiency is crucial for high customer satisfaction that impacts economic productivity positively (Nosedal Sanchez, & Piera Eroles, 2018). In Germany, grid locks are costly as ground operations are processed sequentially, to service the aircraft. One key parameter of operational aim of the air transport industry is the gate-to-gate punctuality. An analytical model is proposed to simulate the efficiency of aircraft turnaround operations at airports (Wu, & Caves, 2014). To limit system costs by balancing trade-offs between schedule promptness and aircraft utilization in Australia, Proper use of schedule buffer time in aircraft turnaround time is exploited (Schmidt, 2017).

Mei et al., (2014) assessed the capacity of closely-spaced parallel runways. The study advanced analytical models for ascertaining the ultimate arrival, and mixed operating capacity of closed-spaced runways. The models are applied to calculate the ultimate capacity of closed-spaced runways at Shang hai/ Pudong Airport. Runway capacity of closely- spaced parallel runways has been widely attached studied due to its importance. however, runway capacity using dependent approach procedures which promises greater potential has not yet been paid due attention. The study results show that the method accurately factors the operating characteristics Nevertheless, the study majored on

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capacity of closely-spaced parallel runways as compared to my study objective runway capacity.

The existing airport capacity could not meet current air transport needs and it is necessary to carry on the improvement. Therefore, how to increase the runway capacity under the maximum limit is urgently to be solved. The study presents many factors influencing runway capacity. Among those factors, the number and the length of the intervals between continual landing airplanes are the most important factors affecting the runway capacity. Assuming that arrival flow characteristics fit the form of Weibull distribution or normal distribution, a system model is used to derive computing models of the runway capacity, and relationships among different computing models are analysed. The computing capacity of a certain airport is in agreement with reality. However, the study based on arrival flow characteristics as compared to my study objective just runway capacity.

Air Traffic Capacity

The work of air traffic controllers encompasses that they guide the planes both in the sky and on the ground. Hence, they take the responsibility to coordinate air traffic to ensure each flight takes off, lands, or passes through safely. Their work is enabled by utilizing technology that permits them to take cognizance of all air traffic in a given area. Civil aviation air traffic undergoes many random turbulences. Air traffic controllers are in constant communication with pilots to alert them when to take off and land, and keeping them abreast to issues with the weather (Lehouillier et al., 2014). Air traffic controllers watch the real traffic and ensure that it is free from collision. They aim to keep hazard in the whole airspace under the air traffic controller in control. The air traffic management service takes care that the flow capacity in each sector, called capacity of the air traffic sector, is not exceeded. Air traffic control is predicted to largely increase over the next decades. The interactions between costs due to ground holding regulation and costs due to en-route air traffic control (Vossen et al., 2012). With that in mind, a traffic simulator including the computations of regulation delays, aircraft trajectories and air conflict resolution is described. The costs of air traffic control remain negligible whether regulation is performed or not.

In the case of Poland, growth in industry has resulted to air traffic delays, inefficiencies, and attendant costs. This growth is projected to continue bulging. Such steady growth has implications on air traffic controller workload. The introduction of new technology and procedures can have positive outcomes on airspace capacity. Air traffic controller workload utilizes a framework for modelling airspace capacity. The factors that affect controller workload using simulation modelling is aided by appropriate analytical techniques to estimate airspace capacity (Bongo, 2018). Within a given context such as the European air traffic control difficulties, airspace capacity is evaluated and suggested outlines are outlined for estimating airspace capacity. The results from the study analysis, together with a workload-based capacity measure, are used to provide airspace capacity estimates.

Janic (2014) examined modelling effects of different air traffic control operational procedures, separation rules, and service disciplines on runway landing capacity. The analytical models are developed and applied to the generic case of a single runway according to the "what–if" scenario approach for calculating the runway landing capacity. This enables carrying out the sensitivity analysis of the landing capacity with respect to the most influential factors the air traffic capacity advanced operational procedures, separation rules, service disciplines, and aircraft fleet mix. Nevertheless, the study focused on modelling effects of different air traffic control operational procedures as compared to this research study objective which is air traffic control capacity.

Landry (2011) assessed human centred design in the air traffic control system. A review of the current air traffic control system is undertaken from the

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perspective of human centred design, focusing on the development and problems of the system. The current system revolves around the operators in the system (mainly air traffic controllers and pilots), rather than being designed based on specific engineering analyses. This human centred focus has helped make air transportation remarkably safe, but has also made the air traffic control system somewhat inscrutable. This opaqueness of how the system operates poses significant problems for current attempts to transform the system into its "next generation" with significantly improved capacity. Nevertheless, the study majored on human centred design in the air traffic control system as compared to my study objective air traffic control capacity.

The situation is no different in Kenya where low-cost carriers and regional airlines have taken competition a notch high, leading to a stiff competition for local passengers. This has brought fare prices to all-time lows, which is expected to prevail in the middle term. Growth has been, however, limited by the available capacity. In Wilson Airport, the Kenya Civil Aviation Authority is considering freezing the issuance of new Air Service Licenses and AOCs in light of the available capacity (Simon, 2016).

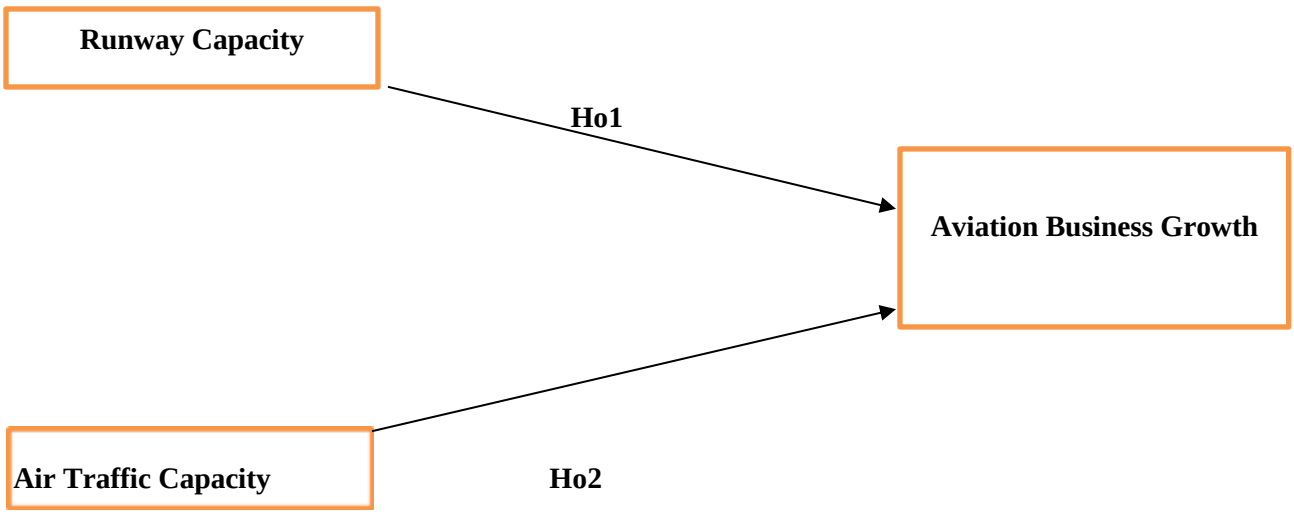
Hypothesis formulation

The following hypothesis guided this research:

H_{01}: There is no significant effect of runway capacity on aviation business growth

H_{02}: Air traffic control capacity does not significantly affect aviation business growth

Figure 1: Conceptual Model



RESEARCH METHODOLOGY

Study Design

The study employed an explanatory research design. The design describes the relationships (Zikmund *et al*., 2010) that exist between the runway capacity, air traffic capacity and aviation business growth.

Target population

The study collected data from senior employees in the 92 AOC Holders at Wilson Airport. The employees targeted by the study are the 92 operations managers of all the 92 AOC holders in Wilson Airport. An additional 25 air traffic controls and Kenya Airport Authority employees based at

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Wilson Airport were targeted because they had required information concerning the effects of airport capacity on the aviation business growth. In total, 117 respondents were targeted. Having undertaken a census survey, the researcher was able to collect complete information.

RESULTS AND DISCUSSIONS

Out of the 117 questionnaires that were distributed, 89 fully filled ones were collected. This represented a response rate of 76.07%. According to Zikmund et al., (2010), if a study realizes a response rate of at least 70%, this is considered significant and the results therein can be relied upon to make conclusions.

Reliability and Correlation Results

Before undertaking inferential analysis; reliability of questionnaire was scrutinized and also the correlation of variables.

Table 1: Results of Pearson Correlation and Cronbach Alpha Test

Variable (n = 164)	Reliability	Correlation		
Aviation Business growth	.918	1		
Runway capacity	.943	.706**	1	
Air Traffic Capacity	.865	.469**	.530**	1

Note: Correlation is significant at ** p <.01, (2-tailed)

The table 1 displays the results of a Cronbach's Alpha test assessing the internal consistency reliability of the data instrument. Each factor comprised five items, and the associated Cronbach's Alpha coefficients reveal the level of reliability for the measurement scales. Notably, runway capacity had the highest score (α = 0. 706), air traffic capacity (α = 0. 865) and aviation business growth yielded a Cronbach's Alpha (α = 0.918). They indicate a reasonable level of internal consistency. These findings suggest that the questionnaire items measured each factor reliably.

Finally, the correlation analysis findings show that runway and air traffic capacity have a positive and significant linear relationship with aviation business growth. Runway capacity has the highest relationship with r = .706, p < .01, while air traffic capacity is followed at r = .469, p < .01. Furthermore, the findings show that runway capacity has a significant association with the air traffic capacity, as shown by r = .530, p<.01

Regression results

The influence of the independent factors (runway capacity, and air traffic control) on the dependent variable (aviation business growth) was determined using regression analysis

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.721[a]	.521	.4873	.40836

a. Predictors: (Constant) RC, ATC

Table 2 shows that the R was 0.721 while the R square was 0.521. This implies that runway capacity and air traffic control account for approximately 52.1% of the variation in aviation business growth.

The model in Table 2 was further examined for its significance using ANOVA. The results of ANOVA for training programs, organisation structure and AIM implementation are presented in Table 3.

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Table 3: ANOVA Results

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	292.707	4	73.177	4.9	.0473[b]
	Residual	1254.43	84	14.934		
	Total	1547.14	88			

a. Dependent Variable: Aviation Business Growth
b. Predictors: (Constant) RC, ATC

The F-statistic of 4.9 and the related P value of 0.0473 are shown in Table 3. This suggests that runway capacity and air traffic capacity have a statistically significant effect on aviation business growth at the 95% confidence level.

Table 4: Beta Coefficients

		Unstandardized Coefficients			
	Model	B	Std. Error	t	Sig.
1	(Constant)	1.1809	.925	1.276	.218
	RC	.149	.006	2.263	.004
	ATC	.112	.005	1.991	.000

The multiple regression analysis reveals that the two independent variables—runway capacity and air traffic capacity culture—are significantly associated with the aviation business growth. The multiple regression analysis, as depicted in the Beta Coefficient table (Table 4), provides insights into the relationship between the dependent variable, "aviation business growth," and a set of independent variables, namely runway capacity (RC) and air traffic capacity (ATC). Runway Capacity (RC) exhibits a positive impact with a coefficient of 0.149. This implies that an increase of one unit in RC is associated with a 0.149 unit increase in the "Aviation business growth," suggesting that enhancing runway capacity contributes to the growth of the aviation business.

Air traffic capacity (ATC) has a beta coefficient 0f 0.112, indicating a positive and significant influence on aviation business growth. A one-unit increase in ATC is associated with a substantial 0.112 unit increase in the "aviation business growth." This underscores the importance of air traffic capacity in ensuring the successful growth of the aviation business.

Hypothesis testing

The hypothesis ($H_0$1) stated that there is no significant relationship between runway capacity and aviation business growth at 5% significant level. The results revealed p value less than 0.05 (Table 4), hence leading to the rejection of null hypothesis one. As a result, the study revealed that at Wilson Airport, there is a significant association between runway capacity and aviation business growth.

The hypothesis ($H_0$2) stated that there is no significant relationship between Air traffic control capacity and aviation business growth at 5% significant level. The results revealed p value less than 0.05 (Table 4) thus leading to the rejection of null hypothesis two. As a result, the study revealed that at Wilson Airport, there is a significant association between Air traffic control capacity and aviation business growth.

CONCLUSION

Wilson Airport has an insufficient capacity according to a combined 67% of the respondents. To improve the runway capacity, the introduction of night flying could increase the capacity utilization of runway capacity, as the number of operating

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hours for the runway will increase from 14 hours daily to 24 hours.

The following aspects influence runway capacity, and by extension aviation business growth, to a very large extent: the number of runways; aircraft fleet mix and performance; and runway utilization levels. The following two factors affect runway capacity to a large extent: actual scheduled hourly capacity including fleet mix in wake vortex categories; and the overall departure/arrival split. Finally, the runway occupancy times (ROTs) affect aviation growth to a moderate extent. Runway capacity has strong positive significant relation with aviation business growth with a correlation coefficient of 0.706. Runway capacity had a positive and significant effect on aviation business growth at 5% significant level.

There was a unanimous agreement that the number of air traffic controllers manning the airspace in Wilson Airport is sufficient. The number of aircraft influence aviation growth to a very large extent, while the number of hand-offs in the air traffic control influences aviation growth in Wilson Airport to a large extent, same with aircraft proximity to each other and sector boundary, and the presence of weather. Hence, the air traffic controllers are productive enough to support aviation business growth as the needs of aviators increase. There was a positive relationship between air traffic capacity and aviation business growth and significant effect on aviation business growth at 5% significant level.

Managerial Implications

The aerodrome owner and operator should ensure that it boosts the existing runway capacity either through optimizing the operations or an expansion to cater for business growth. KAA and KCAA, the regulators, should consider boosting the runway capacity through increasing navigation aids to enable the introduction of night flying.

As aviation grows, it is important to continuously increase the number of air traffic controllers to match the anticipated growth in aviation business at Wilson Airport. It is also important to continuously train and develop the existing air traffic controllers to adopt a modern means to run the air traffic flow management at all times, in changing technological environments.

Limitations

The model's explanatory power, while significant, may not capture all relevant factors influencing aviation business growth. Unobserved variables or external factors that were not considered in the study could contribute to a more comprehensive understanding of the phenomenon. A similar study can be conducted to determine the influence if the other factors that determine the remaining 52% of the changes in aviation business growth. Similarly, a study can be conducted on the influence of night flying on aviation business growth at Wilson Airport

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