Aviation business growth; Does ground movement capacity and air space capacity matter?

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ABSTRACT

Growth in any firm's business is critical as a long-term objective of such a firm. The study thus focused on the influence of ground movement capacity and air space capacity on the growth of aviation businesses at Wilson Airport. The guiding objectives of this study were: to establish the effect of ground movement capacity on aviation business growth in Kenya and to assess the effects of airspace capacity on in Kenya. The study was guided by theory of constraints. The study employed an explanatory research design. The study targeted 117 respondents 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. The Statistical Package for the Social Sciences (SPSS) was used for data analysis. Inferential data were analyzed using correlation and multiple regressions. The study findings revealed that ground movement capacity has a positive and significant effect on aviation business and airspace capacity has a positive and significant effect on aviation business growth. Ground movement capacity was an important determinant of aviation business growth. Kenya Civil Aviation Authority and Kenya Airports Authority should pool resources and increase the ground movement equipment and facilities. The study recommends that future researcher's study on the influence of public, private partnership to increase the ground movement capacity on aviation growth can also be conducted.

Keywords: *Airspace capacity, Aviation business growth, Ground movement capacity.*

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Highlights of this paper

- Airport infrastructure affects aviation business growth.
- Aviation business growth is adversely affected by the insufficient ground equipment and facilities.
- Airspace capacity constrictions leads to flights delays, hence lowering aviation business growth.

1. INTRODUCTION

A report by African Development Bank (2012) echoes that the notwithstanding the substantial progress in the aviation sector, made during the past decade, Africa still lags in terms of poor infrastructure, resources constraint and connectivity adequacy when compared with other regions. It is therefore critical that African countries invest in soft as well as hard infrastructure to support the industry.

Business growth is a multidimensional concept. Business growth metrics are copious (Barringer, Jones, & Neubaum, 2005; Delmar, Davidsson, & Gartner, 2003; Delmar & Wiklund, 2008). Definions and measurement of business growth incorporates constructs such as absolute or relative changes in sales, assets, employment, productivity, profits, and profit margins (Allinson, Braidford, Houston, & Stone, 2006; Davidsson, Achtenhagen, & Naldi, 2005; Delmar & Davidsson, 1997). The variant measures of growth are instrumental in understanding the phenomenon of growth (Delmar & Davidsson, 1997) but overall, these disparities render systematic knowledge accumulation and comparisons problematic. Although the growth measures are related, they have significant (Delmar et al., 2003).

While as the demand for air transport services has been growing rapidly, institutional constraints on expanding airport infrastructure, alongside political and physical limitations, have led to acute congestion in the airports as well substantial problems on delays. Almost one-third of flights in the European union were delayed, with the average delay time per flight exceeding 26 min (Euro Control, 2014). The schedule disruptions and flight delays in busy airports have a multiplier effect that proliferates the airport network. Airport congestion and delays negatively impact both the economic and environmental outcomes of the entire air transport system. Furthermore, airports experience cumbersome operational bottlenecks and passenger dissatisfaction (International Air Transport Association (IATA), 2014).

Airports therefore need to utilize corporate resources efficiently. Appropriate investment of resources would positively impact aviation business growth. Airport projects such as new or improved runways, terminal expansions, and entirely new airports curb inefficiencies and spour growth. Airline strategic decision-making is crucial and its impact on passenger demand, flight delays and aircraft carbon emissions (Evans & Schäfer, 2011). While as that is the ideal , the local context existing from airport to airport may cause limitations in as far as the extent to which airport capacity can be expanded.

2. THEORETICAL REVIEW

2.1. Theory of Constraints

The theory of constraints (TOC) was introduced by Goldratt (1990). The theory of constraints (TOC) is a management philosophy whose main tenet is the identification and addresing the most critical limiting factor which is also reffred ti as the constraint. The fundamental anchorage under this paradigm postulates that any manageable system faces several constraints that limit the achievement of its organizational goals (Moyo & Emuze, 2023).

This theory holds that at the minimum, there is at least one constraint. What is then suggested is a focus procedure to recognize that constraint and organize the rest of the processes around it. In identifying the constraint or constraints, the theory then proposes measurement and control of the constraint using three key parameters- the throughput, operational expense and inventory (Costas, Ponte, De La Fuente, Pino, & Puche, 2015).

Constraints can be internal or external. Internal constraints are such as where the system fails to generate sufficient supply to match demand. External constraints include where supply exceeds demand (Schragenheim, Camp, & Surace, 2019). From the premise of the theory of constraint, oin the absence of constraints - organisational sales revenues would be infinite. By exploiting the constraint, organisations can maximise productivity and efficiency . To focus processes through the constraints, TOC proposes five key steps are: constraints identification, strategy formulation on exploiting the identified constraints, strategy prioritization, increasing capacity through constraint throughput, and monitoring and evaluation of the necessary feedback loops (Golmohammadi, 2015).

In applying theory of constraint to airport capacity, all the primary bottlenecks such as runway availability , ground handling systems can be evaluated. For instance, if the runway capacity is the primary constraint , no matter how efficient other processes are, the total number of flights the airport can handle is limited. By focussing efforts on maximizing runway utilization- the aiport can increase the flow of flights. Once the most critical constraint is addressed, the airport can move to the next limiting factor to ensure continuous improvement in airport efficiency.

3. LITERATURE REVIEW AND HYPOTHESIS FORMULATION

3.1. Ground Movement Capacity

Ground handling operations refer to all the range of services that support the aircrsft while on the ground (Fitouri-Trabelsi, Mora-Camino, Cosenza, & Weigang, 2015). They comprise all the services required by aircraft between landings and take-offs. These services are categorized as follow: ramp, on-ramp, and on-board services (El Asri, Fakhrulddin, Al-Humairi, & Almhanna, 2018). These services include aircraft refuelling, baggage handling, passenger onboarding, catering, cleaning and maintainence checks. The main goal is ensurng quick turnaround and efficient operations. Primarily, to eliminate, or at least reduce delays, ground movement operational performance must be on point (Wang & Kulkarni, 2011). The ground handling teams are invested in coordinating with airlines to manage loading, unloading cargo and ensuring efficiencies to minimize delays. Unfortunately, there is not much literature that tackles ground movement operational issues all together (López, Marmier, & Fontanili, 2019).

Ground operative procedures are at the airports encampus all tasks performed on the airside to ensure safe and efficient aircraft operations. It is imperative that advancements in ground operations, specifically process reliability and passenger comfort, are developed while dealing with increasing passenger traffic in the next years (Schmidt, 2017). An introduction to aircraft ground operations focusing on the aircraft turnaround and passenger processes. The turnaround time (TAT) of aircraft has been defined by IATA's Aircraft Handling Manual (AHM) 810 which provides standardized procedures and best practises to ensure safety, efficiency amd consistency across global airports.

Kociubiński (2013) examined regulatory challenges of airport slot allocation in the European Union. From the onset of commercial aviation, take-off and landing rights are allocated on a first-come first-served basis. Barely is there any synchronization between carriers and/or airport management. Access to runways has become increasingly difficult, as the air traffic plummets and airports congestion upsurges. From the late 1960s, the major international airports are marked by characteristics that peak times such as long queues of airport holding areas are a common sight. The phenomena have resulted in serious inefficiencies in carriers' air operations. Each airport has a specified capacity. The total numbers of slots per day are dependent on factors that include technical, safety, and environmental to provide spacing between aircraft, etc. As a comeback, to this situation - the notion of a 'slot' was coined. A slot means the right to use a runway at a specified time on a specified day.

More crucial than slots, surprisingly is the total number of active runways at a given airport. The number of slots at any given airport is rigid, though the demand is constantly rising. Runways are a vital element. Extensive

technical and electronic infrastructure is required to construct a runway. It is requisite that advanced technologies and the use of high-quality materials are applied. Furthermore, the construction of such infrastructure attracts the sentiments and participation of residents and environmental activists. Many are the times that some stakeholder groups are typically fiercely opposed to such construction. Such tussles can impede the process of construction and can take many years should legal challenges also be brought to the fore. However, the study focused on European Union and other studies need to be done in African Union (Ali, Guleria, Alam, Duong, & Schultz, 2019).

The chances of missed connections can be significantly reduced by operationally maintaining higher turnaround time and minimum connection time and by bringing down delays at the airport (Dijk, Santos, & Pita, 2019). Decpite its world class infrsturacture (Changi Airport) and advanced systems , factors such as peak time congestion maintanence needs and flight scheduling can extend turnaround times. However, the study took place in Singapore and other study need to be done in Kenya. Singapore Changi Airport budget terminal was used as a case study to demonstrate the impact of operational uncertainties on these passenger connections (Meissner, Rahn, & Wicke, 2021). The framework adopted in this study may also help to identify the gates which are more prone to missed connections given operational uncertainties and different flight scenarios (Shone, Glazebrook, & Zografos, 2021).

Jin (2019) assessed a framework for the analysis of aircraft turnaround at congested airports. Airlines have considered innovative operational framework to alleviate the delay, emphasize the time efficiency of ground operations. The research work presented in the study held that, an essential cause of departure delay is ground processes. Some of the strategies suggested for improvement for aircraft turnaround process that require little or no investment from the airlines is addressing ground processes. It is also important to improve the integration of work procedures including all stakeholder's involvement for optimal resources. However, the study focused on enhancing turnaround time as compared to this study objective ground turnaround capacity.

3.2. Airspace Capacity

Airspace capacity refers to the maximum number of aircraft that can safely operate in a specific volume of airspace at any given time. Airspace capcity has been constrained by manual air traffic controller workload. However, a fundamental relationship between the level of structuring of traffic and resulting properties, such as efficiency and safety, is not well established, and different studies in this field report contradictory findings (Bulusu, Sengupta, Mueller, & Xue, 2018). The ability to handle high traffc volumes is essential to maintaining safety and minimizing delays especially in busy airspaces The current en-route airspace design is cantered on predefined airways, sectors, and ground-based Air Traffic Controllers (ATCo). Even if, improvements to air traffic systems and procedures have led to increased capacity improvements, the current centralized system architecture has been widely reported to be nearing saturation levels. To keep pace with the ever-growing demand for air transportation, it is necessary to investigate novel methods of organizing and structuring traffic to increase en-route airspace capacity (Sunil et al., 2016).

A study by Zahra (2017) evaluated air space availability for flight operational safety at Abdul Rachman Saleh Airport. This airport was selected due to the critical aspect of flight operational safety with restricted air space conditions. The study task was assessing plane movement patterns against topography conditions. Moreover, the evaluation was done against airspace conditions and the weight and capacity of each plane. The aspects were correlated with flight distance, runway full-length, plane fuel consumption, and weather conditions around the airports. Abdul Rachman Saleh Airport is physically situated in Pakis Village Malang District or 17 km to east of Malang City. This Airport located at Bromo valley and is sandwiched between several mountains as Semeru Mountain (3676m) on east, Arjuno Mountain (3339m) at the North, Kawi Mountain (2551m) and Pander man Mountain at the

west. Given the results of the analysis obtained from the longitudinal direction of the runway, Abdul Rachman Saleh Airport's safety flight operation against topography conditions was qualified and ensured safety flight operational.

Sunil et al. (2016) study investigated airspace structure and capacity for extreme traffic densities. There has been an increasing interest on personal and unmanned aerial vehicles that affect air traffic. What is anticipated of the excitement of those two aircraft types is a large number of small aircraft flying over urban areas. The study in that context was the Metropolis project whose objective was to investigate the influence of airspace structure on capacity, complexity, safety, and efficiency for high - density airspace. A matter of interest in the future; include what is required in terms of airspace organization. Nevertheless, the study focused airspace structure as compared to air space capacity which is objective of this study.

Juričić, Škurla Babić, and Francetić (2011) examined Zagreb terminal airspace capacity analysis. Zagred airport plays a key role in Croatias ait travel network. Air traffic congestion problem has been analysed and several case study scenarios have been simulated. A suggested solution is investment of modern technologies that would enable the reduction in air-traffic controllers' workload. The results of the simulations conducted indicate that, in the conditions of surged traffic loads- the working technology and the airspace organization of Zagreb Terminal Airspace had restricting factor at peak-hour workloads. However, the study focused on Zagreb terminal as compared to this study which focusses on air space capacity.

Chang, Solak, Clarke, and Johnson (2016) discussed on models for single-sector stochastic air traffic flow management to assess and predict variations in air traffic within a specific airspace sector. By modelling these stochastic variables, air traffic controllers can better estimate capacity. Of these factors, weather is the most significant cause of delays in airport and airspace operations. Considering weather-related uncertainty, air traffic flow management involves controlling air traffic through allocation of available airspace capacity to flights.. It demonstrated through actual flight schedule data that a simplistic but implementable approximation procedure is an effective solution approach for these models. Nevertheless, the study focused on reduced airspace capacity as compared to this study objective general air space capacity.

Key considerations that have been put in place include how the airside and landside capacities have influenced the growth of the aviation sector and aviation businesses in Kenya. The facility has witnessed a number of airplane incidents, notably from Silverstone Airlines, whose planes either skidded off the runway or crashed into another. Stakeholders have also raised concern over the state of the facility's runway. The transit traffic has grown by 8.2 percent while freight traffic increased by 11.1 percent from 331,327 tons to 368,128 tonnes (Kanyi, 2016). Wilson Airport is one of the busiest domestiv airports in East Africa, primarily handling regional and domestic flights, as well as charter operations. Its capacity is influenced by size of runways and availability of ground handling services.

Considering this, growth of aviation business in Wilson Airport was considered considering ground movement capacity and airspace capacity as none such studies have been conducted locally.

The following hypothesis guided this research:

H_{01}: Ground handling capacity does not significantly affect aviation business growth.

H_{02}: Air space capacity does not significantly affect aviation business growth.

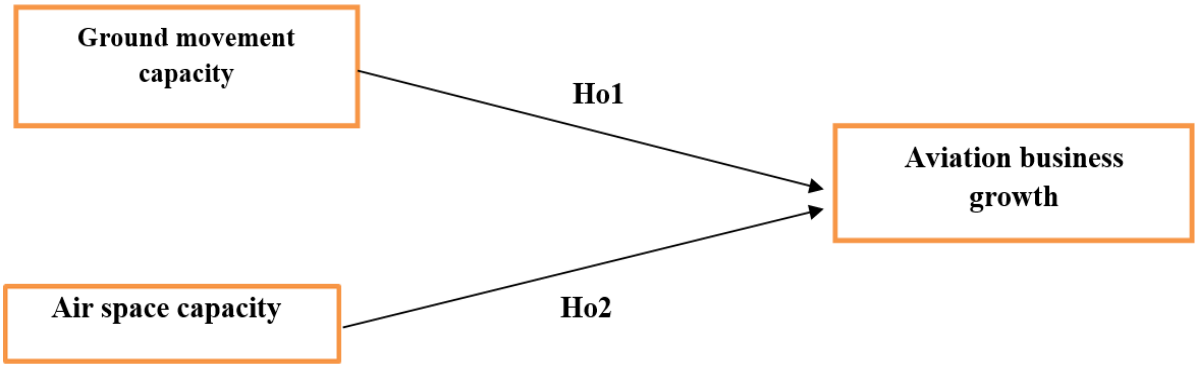

Figure 1. Conceptual framework

The Figure 1 : conceptual framework illustrates the relationship between the independent variables (ground movement capacity and airspace capacity) and the dependent variable (aviation business growth).

4. RESEARCH METHODOLOGY

4.1. Research Methodology

4.1.1. Study Design

The study employed an explanatory research design to establish the causal relationships between ground movement capacity, air space capacity and aviation business growth. The emphasis was on studying the situation or a problem to explain the relationships between variables as supported by Zikmund, Babin, Carr, and Griffin (2010).

4.1.2. 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 Wilson Airport were targeted because they had required information concerning 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.

4.2. Results and Discussions

Out of the 117 questionnaires that were distributed, 89 fully filled questionnaires received response. 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.

Prior to undertaking inferential statistics, 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	Correlation	Correlation
Aviation business growth	0.918	1		
Ground movement	0.877	0.539**	1	
Airspace capacity	0.916	0.553**	0.421**	1

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

Table 1 displays the results of a Cronbach's Alpha test assessing the internal consistency reliability of the data instrument. Each factor comprises five items, and the associated Cronbach's Alpha coefficients reveal the level of reliability for the measurement scales. Notably, aviation business growth had the highest score (α = 0.918) and was followed by airspace capacity (α = 0.916). ground movement capacity yielded Cronbach's Alpha (α = 0.877). All the variables had a reasonably high level of internal consistency. These findings suggest that the questionnaire items measuring each factor.

Finally, findings of the Correlation analysis show that ground movement capacity and airspace capacity have a positive and significant linear relationship with aviation business growth. Airspace capacity has the highest relationship with r = .553, p < .01, while ground movement capacity and aviation business growth followed r = .539, p < .01. Furthermore, the findings show that airspace capacity has significant association with the ground movement capacity, as shown by r = .421, p<.01.

4.2.1. Regression Results

The influence of the independent factors (ground movement, and air space capacity) 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	0.721[a]	0.521	0.487	0.408

Note: a. Predictors: (Constant) GM, ASC.

Table 2 shows that the R was 0.721 while the R square was 0.521. This implies that ground movement and air space capacity accounts for approximately 52.1% of the variation in aviation business growth.

Table 3. ANOVA results.

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	292.707	4	73.177	4.9	0.047[b]
	Residual	1254.43	84	14.934		
	Total	1547.14	88			

Note: a. Dependent variable: Aviation business growth.
b. Predictors: (Constant) GM, ASC.

Table 3. ANOVA (Analysis of Variance) is a statistical method used to compare means to determine if there are statistically significant. The F-statistic of 4.9 and the related P value of 0.047 are shown in the Table 3 . This suggests that ground movement capacity and air space capacity have a statistically significant effect on aviation business growth at the 95% confidence level.

Table 4. Beta coefficients.

Model		Unstandardized coefficients		t	Sig.
		B	Std. error		
1	(Constant)	1.181	0.925	1.276	0.218
	GM	0.162	0.071	2.294	0.000
	ASC	0.131	0.064	2.146	0.003

The multiple regression analysis reveals that the two independent variables—ground movement and air space capacity—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 ground movement (GM) and airspace capacity (ASC).

Each independent variable's beta coefficient reveals its specific impact on aviation business growth. Ground movement (GM) has a coefficient of 0.162, indicating that for each one-unit increase in GM, there is an expected corresponding increase of 0.162 units in the "aviation business growth." This positive coefficient is underscored.

Air space capacity (ASC) has a coefficient of 0.131, indicating that each one-unit increase in ASC leads to a 0.131 unit increase in the "aviation business growth." This beta coefficient emphasizes the beneficial role that improvements in air space play in the aviation business growth.

4.2.2. Hypothesis Testing

The first hypothesis (H01) states that there is no significant relationship between ground movement and the implementation of aviation business growth. Ground movement capacity has a positive and significant effect on 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. This implies ground movement capacity was an important determinant aviation business growth, hence leading to the rejection of null hypothesis one.

The second hypothesis (H02) asserts that there is no significant relationship between airspace capacity and aviation business growth. The results revealed a p value less than 0.05 (Table 4). As a result, the null hypothesis (H02) is rejected, indicating that there is sufficient evidence to support a significant relationship between Air space capacity and the aviation business growth based on the data and analysis conducted.

4.3. Conclusion

Aviation business growth is adversely affected by the insufficient ground equipment and facilities at Wilson Airport. Ground movement capacity has a positive and significant effect on aviation business growth at 5% significant level. This implies ground movement capacity was an important determinant aviation business growth, hence leading to the rejection of null hypothesis one. The airspace around Wilson Airport is congested, and this affects flight movement due to delays caused as a result. This has a negative effect on the number of flights taking off and landing per day, hence lowering aviation business growth in Kenya. Airspace capacity has a positive and significant effect on aviation business growth at 5% significant level. This implies airspace capacity was an important determinant aviation business growth, hence leading to the rejection of null hypothesis two.

4.3.1. Managerial Implications

Kenya Civil Aviation Authority and Kenya Airports Authority should pool resources and increase the ground movement equipment and facilities. This can be done in conjunction with airline operators at Wilson Airport, in a bid to enhance the ground movement capacity to enhance aviation business ground at the airport. Better coordination is needed to space out flights and reduce the congestion in the airspace around the airport. It is important to understand the actual causes of the congestion to address the airspace congestion through a root cause analysis.

4.3.2. Limitations and Further Research

The study's generalizability may be constrained by its specific context and sample characteristics. Hence further research on the same variable can be conducted in diverse contexts as different industries or diverse region.

A study on the influence of public private partnership to increase the ground movement capacity on aviation growth can also be conducted. It is also important to study the influence of air traffic controllers' workload on the aviation business growth in Wilson Airport.

REFERENCES

African Development Bank. (2012). *Annual Report.* Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Annual_Report_2012.pdf

Ali, H., Guleria, Y., Alam, S., Duong, V. N., & Schultz, M. (2019). *Impact of stochastic delays, turnaround time and connection time on missed connections at low-cost airports.* Paper presented at the Proc. 13th USA/Europe Air Traffic Manage. R&D Seminar.

Allinson, G., Braidford, P., Houston, M., & Stone, I. (2006). *Myths surrounding growing a business small business service.* Retrieved from http://dro.dur.ac.uk/15043/1/15043.pdf?DDD2+dbr1gfa=

Barringer, B. R., Jones, F. F., & Neubaum, D. O. (2005). A quantitative content analysis of the characteristics of rapid-growth firms and their founders. *Journal of Business Venturing, 20*(5), 663-687. https://doi.org/10.1016/j.jbusvent.2004.03.004

Bulusu, V., Sengupta, R., Mueller, E. R., & Xue, M. (2018). *A throughput based capacity metric for low-altitude airspace.* Paper presented at the 2018 Aviation Technology, Integration, and Operations Conference.

Chang, Y.-H., Solak, S., Clarke, J.-P. B., & Johnson, E. L. (2016). Models for single-sector stochastic air traffic flow management under reduced airspace capacity. *Journal of the Operational Research Society, 67*(1), 54-67. https://doi.org/10.1057/jors.2015.53

Costas, J., Ponte, B., De La Fuente, D., Pino, R., & Puche, J. (2015). Applying Goldratt's theory of constraints to reduce the bullwhip effect through agent-based modeling. *Expert systems with Applications, 42*(4), 2049-2060. https://doi.org/10.1016/j.eswa.2014.10.022

Davidsson, P., Achtenhagen, L., & Naldi, L. (2005). *Research on small-firm growth: A review.* Paper presented at the 35th EISB Conference, Barcelona, September 2005.

Delmar, F., & Davidsson, P. (1997). *High-growth firms and their contribution to employment: The case of Sweden 1987-96.* Paris: OECD Working Party on SMEs.

Delmar, F., Davidsson, P., & Gartner, W. B. (2003). Arriving at the high-growth firm. *Journal of Business Venturing, 18*(2), 189-216. https://doi.org/10.1016/S0883-9026(02)00080-0

Delmar, F., & Wiklund, J. (2008). The effect of small business managers' growth motivation on firm growth: A longitudinal study. *Entrepreneurship Theory and Practice, 32*(3), 437-457. https://doi.org/10.1111%2Fj.1540-6520.2008.00235.x

Dijk, B., Santos, B. F., & Pita, J. P. (2019). The recoverable robust stand allocation problem: A GRU airport case study. *Spectrum, 41*(3), 615-639. https://doi.org/10.1007/s00291-018-0525-3

El Asri, H., Fakhrulddin, A., Al-Humairi, A., & Almhanna, N. (2018). Aircraft ground handling operations: A literary review. https://doi.org/10.20944/preprints201810.0074.v1

Euro Control. (2014). *Seven-Year I. F. R. Flight movements and service units forecast: 2014-2020 eurocontrol.* Retrieved from https://www.eurocontrol.int/sites/default/files/content/documents/official-documents/forecasts/seven-year-flights-service-units-forecast-2014-2020-feb2014.pdf

Evans, A., & Schäfer, A. (2011). The impact of airport capacity constraints on future growth in the US air transportation system. *Journal of Air Transport Management, 17*(5), 288-295. https://doi.org/10.1016/j.jairtraman.2011.03.004

Fitouri-Trabelsi, S., Mora-Camino, F., Cosenza, C. A. N., & Weigang, L. (2015). Integrated decision making for ground handling management. *Global Journal of Science Frontier Research: F Mathematics and Decision Sciences, 15*(1), 17-31.

Goldratt, E. M. (1990). *What is this thing called the theory of constraints?* Croton -on-Hudson, NY: North River Press.

Golmohammadi, D. (2015). A study of scheduling under the theory of constraints. *International Journal of Production Economics, 165*, 38-50.

International Air Transport Association (IATA). (2014). *Worldwide slot guidelines* (6th ed.). Canada: Montreal.

Jin, H. (2019). A framework for the analysis of aircraft turnaround at congested airports. Unpublished Doctoral Dissertation, Georgia Institute of Technology.

Juričić, B., Škurla Babić, R., & Francetić, I. (2011). Zagreb terminal airspace capacity analysis. *Promet-Traffic&Transportation, 23*(5), 367-375. http://dx.doi.org/10.7307/ptt.v23i5.155

Kanyi, P. (2016). Assessment of the appropriateness and adequacy of the existing physical infrastructure in mitigating aviation risks at Wilson Airport, Kenya. *IOSR Journal of Humanities and Social Science, 21*, 51-62. https://doi.org/10.9790/0837-02107015162

Kociubiński, J. (2013). Regulatory challenges of airport slot allocation in the European Union. *Wroclaw Review of Law, Administration & Economics, 3*(1), 28-47. https://doi.org/10.2478/wrlae-2013-0003

López, E. C., Marmier, F., & Fontanili, F. (2019). *Bus fleet size dimensioning in an international airport using discrete event simulation.* Paper presented at the Winter Simulation Conference(WSC), 464-475. https://doi.org/10.1109/WSC40007.2019.9004878.

Meissner, R., Rahn, A., & Wicke, K. (2021). Developing prescriptive maintenance strategies in the aviation industry based on a discrete-event simulation framework for post-prognostics decision making. *Reliability Engineering & System Safety*, 107812. https://doi.org/10.1016/j.ress.2021.107812

Moyo, C., & Emuze, F. (2023). Building a lean house with the theory of constraints for construction operations in Zimbabwe: A conceptual framework. 870-881. https://doi.org/10.24928/2023/0112

Schmidt, M. (2017). A review of aircraft turnaround operations and simulations. *Progress in Aerospace Sciences, 92*, 25-38. https://doi.org/10.1016/j.paerosci.2017.05.002

Schragenheim, E., Camp, H., & Surace, R. (2019). *Throughput economics: Making good management decisions.* New York: Productivity Press. https://doi.org/10.4324/9780429020124.

Shone, R., Glazebrook, K., & Zografos, K. G. (2021). Applications of stochastic modeling in air traffic management: Methods, challenges and opportunities for solving air traffic problems under uncertainty. *European Journal of Operational Research, 292*(1), 1-26. https://doi.org/10.1016/j.ejor.2020.10.039

Sunil, E., Hoekstra, J., Ellerbroek, J., Bussink, F., Vidosavljevic, A., Delahaye, D., & , & Aalmoes, R. (2016). *The influence of traffic structure on airspace capacity.* Paper presented at the ICRAT 2016, 7th International Conference on Research in Air Transportation, Jun 2016, Philadelphia, United States.

Wang, Y., & Kulkarni, D. (2011). Modeling weather impact on ground delay programs. *SAE International Journal of Aerospace, 4*, 1207-1215. https://doi.org/10.4271/2011-01-2680

Zahra, D. B. (2017). Evaluation of airspace availability in relation to flight operational safety at abdul rachman saleh airport. Doctoral Dissertation, Sepuluh Nopember Institute of Technology November. http://dx.doi.org/10.12962/j23373539.v6i2.26260.

Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2010). *Business research methods.* Mason: Cengage Learning.