Effect of Airport Ground Operations Management on Aviation Safety Performance in Kenya

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Abstract

The study sought to examine the role played by airport ground operations management on aviation safety performance in Kenya. The independent variables of the study were aircraft apron movement control and aircraft refueling procedures whereas the dependent variable is aviation safety performance. Underpinning theory is risk management theory. Explanatory research design was used, the target population comprised of 258 airport ground operations crew working for five domestic airline companies operating from Jomo Kenyatta International Airport, Kenya. A census of all the 258 staff attached to four different departments was carried out. Structured questionnaires were used to collect data, they were administered in person and use of research assistants. Descriptive and inferential statistical analysis techniques were used for data analysis. The findings from the study revealed that aircraft apron movement control had a significant influence on aviation safety performance of the selected domestic airline companies in Kenya ($\beta = 0.220$; $P=0.000$). Additionally, aircraft fueling procedures was found to significantly influence the aviation safety performance Kenya ($\beta = 0.616$; $P=0.000<0.05$). The study concluded that failure to fully embrace airport ground operations protocol had a hand on compromised aviation safety of selected domestic airline companies in Kenya the study recommends the need for management to uphold employee development and employee safety as a way of promoting employee performance thus steering organizational performance. These findings emphasize the critical role that effective ground handling practices play in enhancing aviation safety.

Keywords: Airport Ground Operations, Aviation Safety Performance, Apron Movement Control, Aircraft Fueling Procedures, Kenya.

Background

Safety has been one of the main objectives in civil aviation, as its early years. The safety of civil aviation is very important (Tu et al., 2024). Safety is the lifeline of flight and the key to the country. In recent years, the development of aviation technology has greatly improved the safety of flight systems. Flight accidents caused by mechanical faults have been reduced year by year. Among the causes of current aviation accidents, human accidents account for more than 70% (Shyur, 2008; Hobbs and Williamson, 2003). Aviation is one of the most complex and regulated industries around the world. From its early years, while its operations were growing rapidly, and tragic accidents with great loss of life and cost had started to occur, safety arose as a major factor in its operations. International Civil Aviation Organization (ICAO) is the United Nation's specialized agency which works with 191-member States and industry groups to set common standards and recommended practices (SARPs) and policies to implement safe, efficient, financially and ecologically sustainable activity in civil aviation (Chatzi, 2019).

Since aircraft ground handling makes it easier to move passengers, cargo, and aircraft from one place to another, it has grown to be one of the most important aspects of air travel. The swiftly expanding sector has brought about significant transformation in the analysis of aviation mishaps, so augmenting potential hazards and complicating safety concerns. An aircraft's ground handling during a ramp turnaround is a difficult and hectic task. It handles a variety of jobs and tools that are used concurrently to cut down on downtime and boost output (Musa & Isha 2020). Surface movement in an airport setting are mostly guided by the "see and be seen" principle which keeps a safe distance between vehicle and/or planes on the airport movement, ground-based aircraft need a lot of supporting vehicles (Pestana & Reis, 2011).

Problem

Kenya's aviation sector is a key component of the Country's economic growth by facilitating trade, commerce, tourism and connectivity. Jomo Kenyatta International Airport is East Africa's aviation hub, this calls for effective airport ground operations management, this has significant impact on aviation safety performance. Kenya has witnessed exponential growth in its aviation sector, however the incidents and accidents related to ground operations continue to pose a serious safety risk. Aviation safety has witnessed I continuous improvement globally in the recent past, though there has been occurrence of catastrophic accidents and other incidents, with devastating consequences for the concerned. To date there has been little research on how airport ground operation procedures affect aviation safety, in particular Kenya and the African context. This can be attributed to a relatively small frequency of accidents, evidenced by previous studies with difficulty in demonstrating consistent results. Owing to the dynamic nature of the aviation industry, airport ground operations management is crucial in ensuring aviation safety and efficiency of air travel. The complexity of apron movement control and aircraft refueling procedures can't be underscored. Regardless of growing emphasis and attention towards aviation safety, incidents related to ground operations continue to pose risks, hence potential threats to aircraft integrity and passenger safety. Empirically, the relationship between airport ground operations and aviation safety performance remains under explored, this paper aims at bridging the existing contextual gap in Kenya.

Literature

Airport Ground Operations

Airport ground operations, also referred to as ground handling, cover those services required by an airline between landing and take-off of the aircraft, such as marshaling of aircraft, (un)loading, refueling, cleaning, catering, baggage handling, passenger handling, cargo handling, aircraft maintenance, and aviation security services (Kovynyov & Mikut 2018). The efficiency and safety of ground handling operations is an important topic in airport management and has been the subject of several studies and of commercial tools concerned with aircraft-to-gate assignment, taxi planning, staff scheduling, passenger buses allocation and movements). Modern airport management is faced, among other challenges, with increasing congestion of the apron area where several operations take place: aircraft taxiing, passengers and crew embarking and disembarking, refueling, cleaning, and many others which might compromise aircraft safety (Giovanni A, 2014).

Scheduled passenger airline service has become very safe. With one passenger fatality per 7.1 million air travelers, 2011 was the safest year on record for commercial aviation worldwide (Michaels & Pasztor, 2011; Oster et al 2013). The International Air Transport Association reported that the global airline accident rate was one accident for every 1.6 million flights, a 42 percent improvement since 2000 (Hersman, 2011; Oster et al 2013). The improvement in safety during flight has led to increased attention to on-ground risks in the industry e hazards that occur before take-off and after landing e as the quest for improving commercial aviation continues (Pasztor, 2011; Oster et al 2013). Competitive pressures in the aviation industry not only occur on the 'airside' of the value chain but are especially increasing on the 'groundside'. in this context, ground handlings' aviation safety is one of the biggest concerns (Bevilacqua, M et al., 2014).

Effective planning and scheduling is crucial for the safety of Airport ground operations, since decisions are interconnected with each other and the potential for flight delays due to knock-on effects is rather high. Careful planning for the day of operations is essential, operations range from passenger disembarking/boarding, baggage unloading/loading, refueling, cabin cleaning, catering, toilet and potable water servicing, and aircraft push-back. Precedence relations do apply e.g. refueling often cannot start before passengers have disembarked due to safety regulations (Gök et al., 2020). The ground handling processes are concluded at the moment the anti-collision lights are turned on by the airplane crew. Then the engine starting procedure commences, and the airplane is moved away from the apron (Kwasiborska, 2010).

Aircraft Apron Movement Control

The authority of the Apron Movement Control (AMC) includes air traffic control, flight coordination, and communication with pilots, slot management, navigation systems, and emergency handling within the region (Kementerian 2019; Subroto et al 2023). Apron Movement Control are airport personnel responsible for supervising flight operations in the airside area who have a license and rating (Marwati, 2022; Subroto et al 2023). Apron is an area that functions as an aircraft service including aircraft maneuvers and aircraft parking equipped with markings because the apron area is an active area with various types of aircraft and ground vehicle activities, so safety and security are the top priorities. Strict protocols and procedures are implemented to ensure operational safety, including access control to the apron area (Subroto et al 2023). The apron is an important part of the airport infrastructure that supports aircraft operations and provides services for passengers, cargo, and the aircraft itself.

Ground handling is related services to support aircraft operational service activities at airports, The role of the Apron Movement Control (AMC) unit in supporting the aviation security and safety system in Airports by; carry out inspections in the runway, taxiway and apron areas and to control on the air side by issuing provisions relating to the operation of vehicles on the air side and Supervise violations committed by ground handling units that do not use airport passes, expired driving license signs, licenses and irregular placement of Ground Support Equipment (Salsabilla, et al., 2023).

Aircraft apron movement controls encompass a set of guidelines and safety measures used for moving aircraft on the ground without engine power. These procedures ensure the safe and efficient relocation of aircraft for reasons such as parking or maintenance. The process involves meticulous pre-towing inspections, communication between ground personnel and the tug operator, the use of specialized towing equipment like tow-bars and tugs, adherence to safety protocols including choking and braking, and thorough post-towing checks. These procedures prioritize the safety of personnel, aircraft, and other ground operations, in alignment with aviation regulations and industry training standards. Aircraft towing is a critical operation that demands meticulous planning, coordination, and strict adherence to safety protocols to ensure the utmost safety of personnel, aircraft, and equipment involved. To carry out these operations, a systematic approach is followed, encompassing various procedures that need to be meticulously executed.

Aircraft Refueling Procedures

Commercial aircraft are normally fueled with single or dual connections at the bottom side of the wing. Ground refueling vehicles can be distinguished in dispenser pipeline systems and refueling trucks. The time required for positioning and connecting as well as disconnecting and removing is about 2.5 min (Mangold et al., 2022; Airbus, S. A. S, 2005). For faster refueling of long-range aircraft, it is typically necessary to refuel on both sides of the wing in parallel. Jet A-1 has the property of an accumulator building up static electricity due to friction as it flows through a pipe (*API 2003*). The discharge of this static electricity can cause ignition of the fuel in explosive mixtures (Mangold et al 2022; Kazda & Caves,2015: API 2008). The refueling process of LH2 can be divided into the following steps: connecting, purging, chill-down, refueling, purging, and disconnecting (Mangold et al 2022).

At large international airports, aircraft can be refueled either by fuel trucks or using dedicated underground pipeline systems. The latter, hydrant refueling, is considered to be an optimal fueling method as it increases safety, shortens the aircraft turnaround time and cuts the overall costs. However, at smaller airports, implementation of this system can lead to high investment costs (Hromadka & Cíger 2015). There are basically two ways to refuel aircraft at airports with significant portion of regular international traffic. The first option is the usage of fuel trucks which transfer fuel from their own tank into the aircraft which is connected with the fuel truck by the hose. The other option is utilization of dedicated underground piping system which delivers fuel from fuel storage (so called fuel farm) directly to the aircraft. A special vehicle called dispenser is used to connect aircraft tank inlets with an underground piping system. One hose connects dispenser and aircraft tanks, the second connects dispenser with hydrant valve. This valve is buried in the apron pavement in a special fiberglass pit. Hydrant systems are considered as an optimal fuelling method since they provide environmentally friendly, fast and reliable refueling method with overall positive impact on safety and efficiency of everyday airport operations.

Fuel storage and aircraft refueling were simple tasks in the early days of the flight. The aircraft could not carry a lot of fuel because piston engines consumed little fuel. Tankers or barrels were used to refuel the aircraft. When jet aircraft were introduced in the late 1950s, the needs for fuel storage and supply to aircraft were drastically altered, both in terms of quantity and quality. Even the new aircraft needed more fuel, it still needed to be refueled in less than an hour on average (Kazda & Caves, 2015). The fundamental conditions for fuel service at an airport are to guarantee high fuel purity, ample fuel supply, quick and affordable fuel delivery to aircraft, environmental protection, and high safety standards of the operation.

Aviation Safety Performance

The adverse safety outcomes come in various ways such as collisions, incidents and injuries. Against their predictors, incidents and injuries are often viewed interchangeably. (Sulzer-azaroff, Loafman, Merante and Hlavacek, 2013; Musa & Isha 2020). In addition, accident concepts are often confused with injuries, with some researchers only marking incidents that result in injuries requiring medical attention (Visser et al., 2007; Musa & Isha 2020). The Heinrich's triangle distinguished safety outcomes as the major injuries, minor injuries and no injury accidents. However, the Heinrich concept was introduced to initiate the idea that near misses and other less severe outcomes (such as weaknesses in the system) will contribute to major accidents (Heinrich, 1931; Musa & Isha 2020). Using near miss as a predictor needs to be clear especially in context of major hazards causation and potential risks. For the purpose of this study, the researcher defines the safety outcomes within the context of accidents and near misses only.

The ever-increasing drive for operational efficiency ensures that aircraft operations are run against a backdrop of measures and targets designed to ensure that the operation is being managed and run efficiently. With such a data driven operation, to keep safety in the top priority, the desire to measure and track safety is strong. Where accidents occur often, the measure of safety could potentially be a simple task of measuring their frequency, however, the absence of accidents does not necessarily imply a high level of safety (Rose, A. 2006). "Safety is no accident." It is not a coincidence that this slogan appears often in Federal Aviation Administration (FAA) literature, correspondence and advisory circulars. It is a frequent reminder to all of us that reliability and safety in aviation is a team effort and that all individuals are responsible for doing their part towards the maintenance of a safe flying environment (Waikar, & Nichols, 1997).

The aviation industry has traditionally been good at learning from its accidents: a global network of governments run accident investigation organizations and the high media profile given to any major aviation disaster helps to ensure this. As commercial aviation successfully reduces its accident rate the opportunity for learning from accidents diminishes and learning from potential accidents becomes more important (Rose, A. 2004). Despite the statistics that support the safety of air travel, major aviation disasters generate big headlines and draw significant public interest, often disproportionately to their effect on population survival. Such attention has, however, helped to drive the aviation industry to the great success of the low accident rates that it enjoys today (Flight International, 2004). Major aviation nations take such accidents very seriously at a state level with most having a government lead accident investigation organization that conducts investigations into air disasters (Rose, A. 2004). According to the International Civil Aviation Organization's (ICAO) Safety Management Manual (International Civil Aviation Organization, 2018), aviation safety is defined as follows: the state in which hazard identification and safety risk management continuously reduce the possibility of harm to people or property damage to, and maintain at, an acceptable level. According to Chaves (2020), this definition captures the reality that safety professionals deal with on a daily basis: while having zero accidents and incidents is a goal to strive for, human fallibility means that man-made and man-designed systems can never be completely free of errors that could cause harm. According to the International Civil Aviation Organization (2018), these errors and/or factors can be broadly classified into three categories: technical, human, and organizational. Each of these categories is essentially linked to a specific period in the development of aviation safety.

Risk Management Theory

Risk management theory provides structured approaches and methodologies for systematically identifying, evaluating, mitigating, and monitoring potential risks within various contexts, such as business, operations, or projects (Button, 2017). This theory aims to enhance decision-making by addressing uncertainties and potential adverse events, ultimately promoting the preservation of assets, the achievement of objectives, and the optimization of outcomes while minimizing the negative impact of risks. The study's relevance on the effects of ground handling practices on aviation safety performance in Kenya is significantly augmented by the incorporation of risk management theory (Koo, 2018). Given the intricate and safety-sensitive nature of aviation operations, this theory provides a structured framework to systematically evaluate and mitigate potential hazards associated with various dimensions of ground handling practices. Within the study's scope, aircraft apron movement control offers indispensable tools for recognizing, assessing, and addressing risks inherent in passenger handling practices, cargo handling practices, and aircraft fueling procedures

Hypotheses

Ho$_1$: There is no significant relationship between apron movement control and aviation safety performance in Kenya.
Ho$_2$: There is no significant relationship between aircraft refueling procedures and aviation safety performance in Kenya.

Conceptual Framework

Independent variables   Dependent Variable

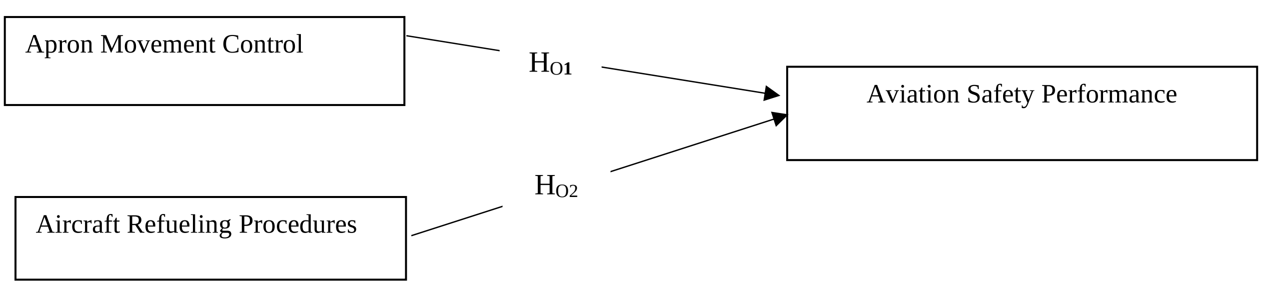

Figure 1: Conceptual Framework

Methodology

Research Design

This study employed an explanatory research design. An explanatory analysis delineates the causal links among the various components in this instance (Saunders et al., 2009). The design is appropriate for the study as it allows the researcher to perform the investigation in authentic environments and employs probability of sampling. This facilitates the derivation of statistical inferences regarding broader populations and allows for the generalization of findings to practical scenarios.

Target Population & Sample size

The target population consisted of ground operations crew directly engaged in aircraft apron movement control and aircraft refueling procedures from five domestic passenger airlines operating from Jomo Kenyatta International Airport (JKIA). The five airlines serve as the unit of analysis, while the personnel directly responsible for airline safety constitute the unit of observation. The five airlines are Kenya Airways, Jambo Jet, Bluebird, Skyward, and Safari Link. The personnel are drawn from five departments: safety, ground operations, flight operations and dispatch. A census survey was carried out to collect data from a sample of 258 ground crew staff working for the five domestic airline companies, see table 1 below. The data collection exercise was carried out between August to September 2023. The questionnaire was validated by professionals from the industry who were also specialists in the area of study (Sharma et al. 2022). The survey recorded a response of 173 questionnaires out of 258 respondents, yielding a response rate of 67.6%.

Table 1: Target Population

Airline/Department	Safety	Ground Ops	Flight Ops	Dispatch	Total
Kenya Airways	19	18	13	45	95
Jambo Jet	8	16	8	15	47
Blue Bird	7	15	10	8	40
Sky Ward	5	13	10	12	40
Safari Link	3	11	12	10	36
Total	42	73	53	90	256

Reliability and Validity

Reliability

We assessed both the reliability and the validity of the measures following the guidelines outlined by Anderson and Gerbing (1988). First, we computed Cronbach's α for each scale, and all coefficients were greater than 0.70, exceeding an acceptable level as shown in table 2 below. The reliability findings demonstrate that Aircraft Apron Movement Control (0.719), Aircraft Fueling Procedures (0.744), and aviation safety performance (0.728) are all considered reliable and appropriate for further investigation. Reliability is considered as a measure of consistency or the frequency by which the measuring entity or the questionnaire is giving the same results after repeated attempts (Toke et al., 2012; Jha et al, 2023). Cronbach's alpha value is the prime indicator of internal consistency. Numerous researchers have mentioned that Cronbach's alpha value above 0.7 is an acceptable indicator of internal consistency reliability (Morgan et al., 2007; Jha, et al 2023). Thus, the framework having Cronbach's alpha

Table 2: Reliability Analysis

	Reliability Statistics	
Variable	**Cronbach's Alpha**	**N of Items**
Aircraft Apron Movement Control	0.719	5
Aircraft Fueling Procedures	0.744	5
Aviation Safety Performance	0.728	5

Validity

Validity analysis is implemented to check to the extent to which the values from a measure represent the variable they are intended to measure (Jha et al. 2023). In the first instance, the validity analysis is categorized into four different methods as follows: content validity, predictive validity, concurent validity and construct validity (APA, 1954). The test's validity was evaluated by principal components factor analysis of the main variables. This analysis evaluated the unrotated factor solution and identified the requisite number of factors to account for the variance in the variables (Jarvis, Mackenzie, and Podsakoff 2003). The principal components factor analysis yielded a KMO test statistic of 0.779. Kaiser (1974) asserts that KMO values exceeding 0.5 are statistically adequate. The score of 0.779 in this study indicates that the sampling was sufficient. Alongside the KMO test, Bartlett's test of sphericity produced a very significant value of 2560.314 with 105 degrees of freedom and $P<0.05$. Bartlett's Test of Sphericity yields a P value of 0.000, indicating a robust connection among the components in the sample. The findings herein underscore the necessity for further statistical analysis to be conducted. The factor analysis yielded four components, each possessing Eigenvalues exceeding 1. This signifies that each factor can account for greater variance than an individual variable. The four factors combined represent 79.82% of the variance.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.779
Bartlett's Test of Sphericity	Approx. Chi-Square	2560.314
	Df	105
	Sig.	.000
Total Variance Explained		79.82%

Table 4 shows the results of the rotated component matrix (using varimax with Kaiser Normalization rotation). Principal component analysis extraction method was used to extract the components. Table 4 contains the loadings of each variable on each factor but all loadings less than 0.30 were suppressed using Field (2009) recommendation. The idea of rotated component matrix is to reduce the number factors on which the variables under investigation have high loading

Table 4: Rotated Component Matrix

	Component			
	1	2	3	4
Ground handling personnel receive proper training on hazardous materials handling and storage.	.913			
The airline's safety management system includes specific measures to monitor and improve ground handling safety.	.866			
We require the into-plane refuelling franchisees to display a red flag at the fuel hydrant point to alert other personnel in the vicinity that aircraft refuelling is taking place.	.856			
Work activities which may generate a source of ignition are not carried out in the refuelling zone	.855			
We conduct regular emergency response training to ensure the refuelling crew is conversant with the contingency procedures in alerting the Airport Fire Contingent (AFC) and the Apron Control Centre (ACC) in the event of fuel spillage or fire.	.824			

Our airline encourages a culture of reporting safety incidents and near-misses among ground handling personnel.	.810			
Our towing crew members comprehend the rationale behind the apron movement control.	.726			
Our airline promotes open communication between ground handling personnel and flight crews regarding safety concerns.		.944		
Ground handling teams are actively involved in safety-related discussions and decision-making processes.		.943		
Aircraft resources and functionality are employed appropriately during towing operations.		.886		
Our pilots ensure that aircraft towing is conducted accurately according to the manufacturer's guidelines.		.880		
Our fueling inspection is conducted for compliance to the airport fire safety standards listed in the Airport Certification Manual		.790		
Adherence to the manufacturer's and airline's operating philosophy is emphasized during aircraft apron movement controls.			.788	
Aircraft engines are not allowed run during the refueling operations			.552	.900
Our towing operation procedures are suitable for a variety of scenarios.			.604	.650
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 5 iterations.				

Model Specification

To test the hypotheses, the study adopted a linear regression model for the purpose of analysis. The following sets of equation were used.

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + + \varepsilon$

Where:

Y: Represent: Aviation safety performance

X_1: Represent: Aircraft Apron Movement Control

X_2: Represent: Aircraft Fueling Procedures

β_0: Represent: Constant

$\beta_1 - \beta_2$: Represent: Regression coefficients

ε: Represent: Error term

Results and Discussion

Diagnostic Tests

Williams, Grajales, and Kurkiewicz (2019), along with many other scholars, highlights the significance of confirming if the data is consistent with the assumptions of the statistical processes that were used in the study. Tests of assumptions are important for the examiner to verify the characteristics of the data and determine the appropriate model for the study, which guarantees unbiased, consistent, and efficient estimations. The study conducted tests on the regression assumptions to assess the degree of conformity between the data and the assumptions. Deviation from assumptions can lead to distorted estimates of relationships (distorted standard errors), unreliable confidence intervals, and significance tests (Osborne &

Waters, 2019). The four assumptions of multiple regressions are linearity, homoscedasticity, normality, and collinearity (Schmidt & Finan, 2018).

Hernandez (2021) states that data is considered normal if its distribution follows a normal distribution in each individual item and in all linear combinations of items. The normal distribution is characterized by a symmetrical bell-shaped curve, with a mean (μ) of 0 and a variance of 1. A histogram, depicted in Figure 2, is a visual depiction of the normal distribution of a quantity. This demonstrates the perceived simplicity of use while assuming a normal distribution, as illustrated by the bell-shaped curve.

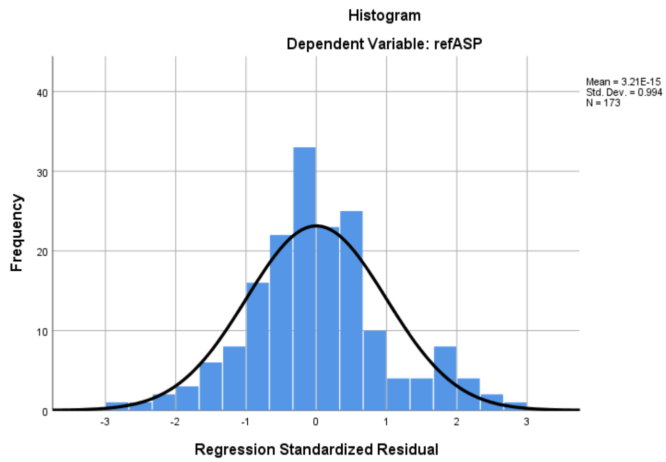

Figure 2

Generally, the linearity assumption posits that the response variable can be represented as a function of the predictor variables. Hence, multiple regression can be employed to evaluate the linear correlation between the dependent and independent variables. In this study, the linearity assumption was assessed by visually examining the P-P plot of the scores, which were expected to follow a straight line. Additionally, the coefficient of determination (R2) was calculated to further evaluate linearity, as depicted in Figure 3. Linear models provide predictions by fitting a straight line that has a constant slope, representing the change in the dependent variable for a constant change in the independent variable.

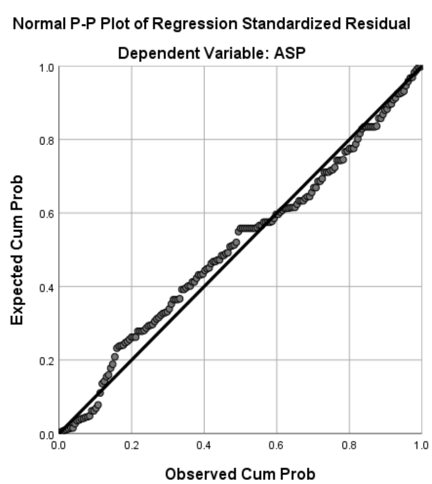

Figure 3

Homoscedasticity is the assumption that the variability of a variable is unequal across the range of values of a second variable that predicts it (Vinod, 2008). As illustrated by the residual scatter plot (Figure 4), the variance of residuals is assumed to be constant for all predicted values of the dependent variable, implying homoscedasticity. The residuals are distributed randomly around 0, resulting in a rather uniform distribution. When the residuals are not uniformly distributed, heteroscedasticity exists. Osborne and Waters (2002) recommend that residuals be between -2 and/or +2 points.

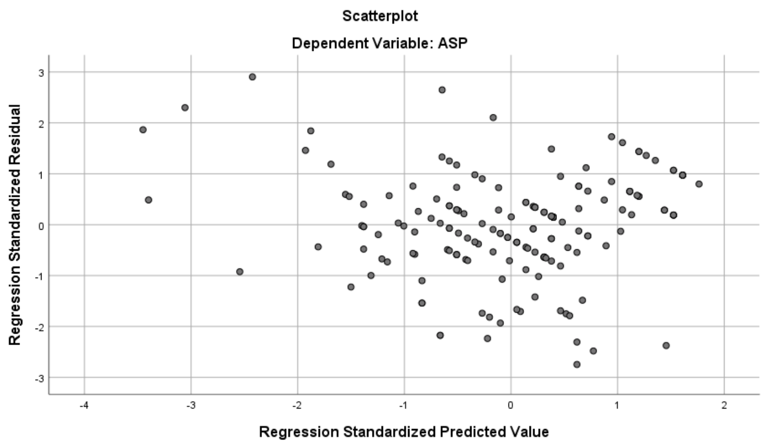

Figure 4

Multicollinearity Test

Multicollinearity refers to the absence of association between independent variables (Williams et al., 2019). Multicollinearity occurs when there are high correlations between numerous independent variables, or when one independent variable is almost a linear combination of other independent variables (Williams et al., 2019). We utilized the idea of tolerance and its counterpart, the variance inflation factor (VIF), to detect the existence of multicollinearity. The VIF values are less than 10, and the tolerance values are close to 1, hence there is no multicollinearity between the predictor variables.

Table 5: Multicollinearity Test

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Aircraft Apron Movement Control	.838	1.193
	Aircraft Fueling Procedures	.838	1.193

Descriptive Statistic, Correlation Analysis

Table 6 shows the summary statistics for the sampled variables. Aircraft Apron Movement Control (AAMC) had a mean of (M=3.65 and SD = 1.15). Aircraft Fueling Procedures (AFP) (M = 3.86, SD = 0.97) and Aviation Safety Performance (ASP) had a mean of (M = 3.73, SD = 0.99). The variables were assessed for their correlations using Pearson's correlation analysis Bougie and Sekaran (2019). According to the findings presented in Table 4.2, the variables exhibit a positive correlation. The data shown in Table 6 depict results of the correlation which revealed that all the variables were positively and significantly related to firm performance.

Table 6: Descriptive Statistic Correlation Analysis

	MEAN	STD	ASP	AM	AF
Aviation Safety Performance	3.73	0.99	1		
Aircraft Apron Movement Control	3.65	1.15	.500**	1	
Aircraft Fueling Procedures	3.86	0.97	.715**	.402**	1
**. Correlation is significant at the 0.01 level (2-tailed).					

Regression Analyses

Test for Direct Effect

The first objective of this study sought to establish the effect of aircraft apron movement control on aviation safety performance in Kenya. It was hypothesized that there was no significant relationship between aircraft apron movement control and Aviation safety performance in Kenya. Regression analysis results revealed a positive and statistically significant effect of aircraft apron movement control and aviation safety performance ($\beta = 0.220$, $p = 0.000$, <0.05). It was thus concluded that aircraft apron movement control affect aviation safety performance in Kenya. This aligns with the findings of (Zhang, Tian, Pan, Chen, & Zou, 2022), which indicate that aircraft apron movement control positively influences aviation safety. While empirical studies specifically targeting apron control practices may vary, research generally supports the notion that robust ground handling processes, training, and technology integration significantly enhance safety performance. While empirical studies specifically targeting apron control practices may vary, research generally supports the notion that robust ground handling processes, training, and technology integration significantly enhance safety performance. Apron control practices play a crucial role in maintaining aviation safety performance. The apron is the area of an airport where aircraft are parked, loaded, unloaded, refueled, and boarded. Effective apron control is essential for ensuring safe aircraft movements and preventing accidents on the ground.

The study further sought to determine the effect of aircraft fueling procedures on Aviation safety performance in Kenya. It was postulated that there is no significant relationship between aircraft fueling procedures and Aviation safety performance in Kenya. Regression results showed that aircraft fueling procedures had a positive and significant effect on aviation safety performance ($\beta = 0.616$, $p = .000$, <0.05). Extant research such as Kaspers, et.al., (2019) indicate that adherence to established fueling protocols can significantly reduce the risk of incidents related to fuel contamination, improper fuel types, and other fueling errors that directly impact safety performance. By implementing strict procedures and providing comprehensive training programs for employees involved in handling fuels, organizations can effectively reduce the risk of incidents related to improper fueling practices thus enhancing aviation safety performance.

Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.545	.218		2.496	.013
	Aircraft Apron Movement Control	.220	.048	.253	4.583	.000
	Aircraft Fueling Procedures	.616	.056	.613	11.101	.000

	Model Summary					
	R	0.752				
	R-Square	0.565				
	Std. error of the Estimates	0.45434				
	R-Square Change	0.565				
	Change Statistics					
	F Change	110.471				
	Sig.	0.000				

Conclusion

The findings of this study provide persuasive evidence that both the processes for fueling aircraft and the control of the movement of aircraft apron contribute considerably to the improvement of aviation safety performance in Kenya. The considerable positive coefficients bring to light the significance of putting in place robust ground handling practices in order to reduce hazards and improve operational safety. As a consequence of this, it is strongly suggested that airlines and other stakeholders in the aviation industry make the establishment and adherence to tight ground handling rules and training programs a priority in order to further elevate safety standards within the industry. The continuation of study in this field is absolutely necessary in order to acquire a deeper comprehension of the complexity of ground handling and the influence it has on the outcomes of aviation safety.

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