EdinBurg Peer-Reviewed Journals and Books Publishers
Journal of Finance and Accounting
Vol. 5||Issue 7||pp 84-100||November||2025
Email: info@edinburgjournals.org||ISSN: 2789-0201

Moderating Role of Regulatory Framework in the Relationship between Seal Integrity Testing Procedures and Trade Facilitation at Selected Airports in Kenya

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Accepted: 01 October 2025 || Published: 06 November 2025

Abstract

The study was motivated by persistent inefficiencies in cargo security processes, including seal tampering, which increase trade costs and undermine Kenya's competitiveness as a regional logistics hub. This research project sought to assess the moderating effect of the regulatory framework on the effect of Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya. The research was guided by two specific objectives: to assess the effect of Seal Integrity Testing Procedures (SITP) on trade facilitation and to determine the moderating role of regulatory framework on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation. The theoretical foundation of the study draws on New Trade Theory and Situational Crime Prevention Theory. An explanatory research design was employed, utilizing structured questionnaires to collect primary data. The total population was estimated at 1,850 individuals. The sample size was 329 respondents, including clearing agents, customs officials, and logistics managers. Data was collected from Jomo Kenyatta International Airport (JKIA), Wilson Airport, and Eldoret Airport. The study used stratified random sampling, as per Yamane's formula, to ensure representativeness across stakeholder groups. Data analysis involved descriptive statistics (means, frequencies) and inferential statistics (multiple regression analysis) to test the null hypotheses. The moderating effect of the regulatory framework on the effect of Seal Integrity Testing Procedures (SITP) on trade facilitation was assessed through a hierarchical regression model. Regression of coefficients showed that seal integrity testing procedures had a positive and significant effect on trade facilitation at JKIA, Wilson, and Eldoret Airports ($\beta=0.561$, $p=0.000$). The study found that the regulatory framework has a moderating effect on Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya ($p<0.05$). The study concluded that seal integrity testing procedures in trade have been shown to positively impact trade facilitation by streamlining processes, reducing delays, and enhancing the security and efficiency of cross-border trade. KRA should adopt a risk-based approach to seal integrity checks, prioritizing high-risk containers based on pre-defined criteria (for example, origin, type of goods, previous compliance record). Policy interventions should therefore emphasize the adoption of a regulatory framework for maximum trade facilitation at Kenyan airports.

Keywords: *Seal Integrity Testing Procedures (SITP), trade facilitation, regulatory framework*

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Vol. 5||Issue 7||pp 84-100||November||2025
Email: info@edinburgjournals.org||ISSN: 2789-0201

How to Cite: Mumo, J., Gitonga, D., & Koske, N. (2025). Moderating Role of Regulatory Framework in the Relationship between Seal Integrity Testing Procedures and Trade Facilitation at Selected Airports in Kenya. *Journal of Finance and Accounting, 5*(7), 84-100.

1. Introduction

Trade facilitation is the simplification and harmonization of global trade procedures for the gathering, presenting, transmitting, and processing of data necessary for the movement of goods in global trade, resulting in increased trade (Mutai, 2022). Trade facilitation gives developing nations an advantage in their ability to join the world's supply chains (van der Marel & Shepherd, 2020). Cargo security protocols are essential for trade facilitation as they ensure the integrity and safety of goods, preventing theft, damage, and other risks while promoting efficient and secure movement of cargo (Wandera, 2020).

The global trade landscape has increasingly prioritized cargo security as a critical component of trade facilitation, particularly in mitigating risks such as theft, tampering, and illicit trafficking. According to the World Customs Organization (2021), cargo-related security breaches cost the global economy approximately $9.6 billion annually, with developing nations bearing a disproportionate share due to weaker enforcement mechanisms. Air cargo, which accounts for 35% of global trade by value (IATA, 2023), is particularly vulnerable due to the high-value nature of goods transported and the rapid transit times that reduce opportunities for thorough inspections. In response, international bodies such as the International Air Transport Association (IATA) and the World Trade Organization (WTO) have advocated for standardized security protocols, including Seal Integrity Testing Procedures (SITP), to enhance supply chain resilience. However, despite these frameworks, disparities persist between developed and developing nations, with African airports experiencing 40% higher cargo security incidents compared to global averages (UNODC, 2022). This gap underscores the urgent need for localized research on how cargo security protocols influence trade facilitation, particularly in high-traffic international airports.

In Africa, air cargo security remains a pressing concern due to the continent's growing role in global trade, facilitated by initiatives such as the African Continental Free Trade Area (AfCFTA). The AfCFTA aims to boost intra-African trade by 52.3% by 2030 (AfCFTA Secretariat, 2023), yet cargo security inefficiencies continue to hinder seamless trade flows. A 2023 report by TradeMark Africa revealed that 25% of air cargo delays in East Africa stem from security-related bottlenecks, including seal tampering (15%), inadequate risk profiling (30%), and poor staff training (20%). These inefficiencies inflate trade costs by an estimated $1.2 billion annually across the region, undermining the competitiveness of African exporters (World Bank, 2023). The lack of standardized SAT programs for cargo handlers further exacerbates vulnerabilities, with only 45% of staff at these airports undergoing mandatory training, compared to 85% in major African hubs like Johannesburg and Cairo (Flight, 2023). These statistics highlight the critical need to evaluate how cargo security protocols at Kenya's airports impact trade facilitation metrics such as clearance times, compliance costs, and supply chain transparency.

Within the East African Community (EAC), harmonized cargo security measures have been slow to materialize, despite the EAC Customs Management Act (2021) mandating the adoption of stringent security protocols. Rwanda's Kigali International Airport has emerged as a regional benchmark, reducing cargo theft incidents by 45% through mandatory SITP (EAC Trade

Report, 2023). In contrast, Kenya's airports lag, with only 50% of cargo subjected to seal integrity checks and 40% undergoing advanced risk profiling (Adago, 2021). This disparity has led to cross-border cargo diversion, where traders opt for routes with stricter security but higher costs, further fragmenting regional trade networks (Mwesigye, 2021). For Kenya, this translates into delays of up to 48 hours for cargo transiting through JKIA, Wilson Airport, and Eldoret Airport, compared to 24 hours at Kigali International Airport (Irandu, 2018). These inefficiencies not only escalate logistics expenses but also deter foreign investment, as businesses prioritize markets with predictable and secure trade environments.

At the national level, Kenya's Vision 2030 and National Trade Policy (2022) emphasize the role of JKIA, Wilson Airport, and Eldoret Airport as premier air cargo hubs, yet persistent security gaps threaten this ambition. A 2023 audit by the Kenya Airports Authority (KAA) revealed that 30% of cargo theft incidents at these airports involved compromised seals, while 20% resulted from insider collusion due to inadequate staff training (Midigo, 2023). These shortcomings have tangible economic repercussions: Kenya loses approximately $200 million annually due to cargo-related fraud and delays (KNBS, 2023), undermining its position as a gateway to East Africa. The cargo security framework at JKIA, Wilson Airport, and Eldoret Airport is anchored on three pillars, including Seal Integrity Testing (SITP). While SITP reduces tampering by 35% in ports with automated seal checks (Customs-Trade Partnership Against Terrorism, 2023), its manual application at these airports yields only a 15% reduction (Flight, 2023). This study, therefore, sought to bridge this gap by examining how SITP influences trade facilitation at JKIA, Wilson Airport, and Eldoret Airport.

A regulatory framework plays a crucial role in moderating the relationship between cargo security protocols and trade facilitation. While strong security measures are essential, they can also create friction in trade flows. A well-designed regulatory framework balances these competing needs by establishing clear, consistent, and efficient security standards that minimize disruption to trade. It can also promote transparency and predictability, further enhancing trade facilitation (Yahaya, 2025). In addition, a robust regulatory framework fosters trust among various stakeholders, including governments, businesses, and consumers. When businesses have confidence in the security measures in place, they are more likely to comply with regulations and participate actively in international trade (Nganga, 2023).

1.1 Problem Statement

Trade facilitation at airports is crucial for economic development, leading to reduced trade costs, increased trade volume, and greater competitiveness for businesses. Efficient trade procedures, such as streamlined customs processes and the use of digital technologies, are vital for reducing trade barriers and fostering economic growth, especially for developing and emerging economies (TradeMark Africa, 2024). The persistent cargo security breaches at Jomo Kenyatta International Airport (JKIA), Wilson Airport, and Eldoret Airport continue to undermine trade facilitation, leading to delays, revenue losses, and compromised supply chain integrity. Despite the implementation of security protocols such as Seal Integrity Testing Procedures (SITP), these airports remain vulnerable to tampering, theft, and smuggling.

According to the World Customs Organization (2021), approximately 30% of global air cargo shipments face security risks, with developing nations like Kenya experiencing higher incidences due to inadequate enforcement mechanisms. At JKIA, Wilson, and Eldoret airports, 15% of cargo delays are directly linked to seal tampering and unauthorized access, costing

traders an estimated $50 million annually in demurrage and storage fees (TradeMark Africa, 2024). These inefficiencies not only inflate trade costs but also erode Kenya's competitiveness as a regional logistics hub under the African Continental Free Trade Area (AfCFTA), where seamless cargo movement is critical for intra-African trade growth. A 2024 study by the International Air Transport Association (IATA) found that only 45% of staff at these airports undergo mandatory security training, compared to 85% in major African hubs like Johannesburg and Cairo (Flight, 2023). This training deficit contributes to improper seal verification, further impeding trade facilitation.

Moreover, the Kenya Association of Freight Forwarders (KAFF) 2023 report indicates that 30% of cargo disputes at JKIA, Wilson, and Eldoret airports stem from security-related inefficiencies, prolonging clearance times by an average of 48 hours (Oloo & Gikonyo, 2024). Kenya, as a key logistics hub, faces unique challenges, with JKIA, Wilson Airport, and Eldoret Airport collectively handling over 350,000 metric tons of cargo annually (KCAA, 2023), yet struggling with reported security breaches affecting 12% of shipments (KRA, 2022). These delays have far-reaching economic repercussions, discouraging foreign investment and undermining Kenya's Ease of Doing Business Index ranking (Abdulla, 2011). The reliance on outdated or manual processes, such as inconsistent seal integrity checks, further exacerbates bottlenecks. For instance, only 50% of cargo at these airports undergoes rigorous seal integrity testing, leaving the remainder vulnerable to tampering (Midigo, 2023). A regulatory framework is essential in balancing cargo security protocols and trade facilitation. It establishes clear, efficient security standards, minimizes disruption, promotes transparency, and enhances trade facilitation (Yahaya, 2025). A robust framework fosters trust among stakeholders, promoting compliance and active participation in international trade (Nganga, 2023).

Past studies have been conducted, but little has been done on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation. Alqaryouti (2021) focused on customs trade facilitation and compliance for e-commerce using blockchain and data mining. The study was done in Dubai, thus showing a contextual gap. Wandera (2020) focused on the effect of electronic cargo monitoring on trade facilitation in Kenya. The study focused on Busia one-stop border post, thus showing a contextual gap. Adago (2021) focused on the effect of the adoption of the electric cargo tracking system on excise revenue collection in Kenya. The study's dependent variable was excise revenue collection, thus showing a conceptual gap. This study, therefore, sought to determine the effects of Seal Integrity Testing Procedures (SITP on trade facilitation at selected airports in Kenya, with a focus on Jomo Kenyatta International Airport (JKIA), Wilson Airport, and Eldoret Airport.

1.2 Research Objectives

i. To investigate the effect of Seal Integrity Testing Procedures (SITP) on trade facilitation at JKIA, Wilson, and Eldoret Airports.
ii. To determine the moderating role of the regulatory framework on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya.

1.3 Research Hypotheses

$H0_1$: Seal Integrity Testing Procedures (SITP) have no statistically significant effect on trade facilitation at JKIA, Wilson, and Eldoret Airports

H0$_2$.To determine the moderating role of the regulatory framework on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya

2. Literature Review

2.1 Theoretical Review

2.1.1 New Trade Theory

New trade theory, introduced by Krugman (1983), offers a different perspective compared to classical trade theories. It explains why countries engage in intra-industry trade, trade within the same industry, rather than simply inter-industry trade. This theory builds on the foundational work of Bernard et al. (2003) and Melitz (2003), who further developed the idea by addressing firm heterogeneity and the nature of trade. Unlike classical theories that primarily focus on comparative advantage and the exchange of different goods between countries, the new trade theory reveals that a significant portion of global trade involves the exchange of similar types of products between countries.

The theory's ability to explain this phenomenon relies on several key assumptions. First, consumers have a preference for variety, which drives demand for different versions of similar products. Second, markets are characterized by firms that offer various product types within the same industry, rather than a single standardized product. Third, there are increasing returns to scale in production, meaning that as a firm's production volume increases, its average cost of producing each unit decreases. This happens because the firm can spread its fixed costs over a larger number of units, thus achieving greater efficiency and cost savings.

Paul Krugman's contributions to new trade theory highlight two primary ways in which international trade can stimulate economic growth. The first is through trade-based economies of scale. By participating in international markets, firms can increase their production volumes, which lowers their per-unit costs and enhances their competitiveness. The second way is by optimizing the allocation of resources. International trade enables countries to better allocate resources between different sectors, such as material goods and knowledge-based industries, thereby boosting overall economic productivity and growth (Chen, 2009).

Krugman's model also demonstrates how trade can lead to the regional concentration of major industries due to external economies of scale. This means that industries tend to cluster in specific regions where they can benefit from shared resources, skilled labor, and other advantages. According to Krugman (1991), the long-term effects of trade are often cumulative and self-reinforcing, meaning that once an industry begins to concentrate in a region, it attracts more firms and resources, further strengthening the industry's position.

New trade theory also provides insights into the globalization process, suggesting that poorer developing countries might face challenges in developing certain industries due to their distance from the economies of scale enjoyed by more industrialized nations. This is not necessarily due to a lack of comparative advantage but rather because mature enterprises in developed countries benefit from significant scale advantages that developing countries may struggle to match.

Overall, new trade theory and NTT offer valuable perspectives on how trade facilitation can support developing countries in competing on a global scale. By understanding these theories, policymakers and researchers can better appreciate the complexities of international trade and

the importance of creating policies that help developing countries leverage trade for economic growth.

The new trade theory is the main theory in the study. This is because the theory, in addition to comparative advantages, includes other aspects such as the role of policy and institutions, reduction of transaction costs, and security and trust as trust enablers. Therefore, since the study focuses on the regulatory framework to stand in place of policy and institutions and represents the security and trust aspect, the new trade theory can link all variables to trade facilitation.

2.1.2 Situational Crime Prevention Theory

Situational Crime Prevention Theory, proposed by Ronald V. Clarke (1980), argues that criminal acts can be deterred by altering environmental conditions, a principle directly applicable to Seal Integrity Testing Procedures (SITP) and Security Awareness Training (SAT) at JKIA, Wilson, and Eldoret airports. The theory's "routine activity approach" suggests that theft and tampering thrive in low-surveillance environments, justifying the need for tamper-proof seals (SITP) and staff vigilance (SAT). A 2022 study by Irandu revealed that JKIA's implementation of electronic seals reduced cargo pilferage incidents by 47%, while SAT-trained staff detected 30% more security breaches compared to untrained personnel (Irandu, 2018). Globally, the Airports Council International (ACI) reports that airports employing situational prevention tactics, such as randomized inspections and employee competency drills, lower cargo-related crimes by 35% (Minnaar, 2004). At Wilson and Eldoret airports, SAT programs have improved compliance with the WCO's SAFE Framework, reducing human-error-related delays by 25% (World Customs Organization, 2021). Clarke's theory thus supports the study's hypothesis by illustrating how SITP's physical deterrents and SAT's behavioral training collectively enhance trade facilitation through minimized security risks and streamlined inspections. For instance, Johannesburg International Airport reduced cargo theft by 50% after integrating situational prevention measures, a benchmark for Kenya's aviation security strategy (Midigo, 2023). By applying this theory, the research underscores the causal relationship between proactive crime prevention and efficient trade flows, aligning with Kenya's AfCFTA commitments to secure and expedited cargo clearance. The theory also highlights the need for real-time monitoring (an aspect of RAPP) to disrupt criminal opportunities, though this study focuses on SITP as the primary intervention at Kenya's airports.

2.2 Empirical Review

2.2.1 Seal Integrity Testing Procedures (SITP) and Trade Facilitation

Seal Integrity Testing Procedures (SITP) are critical for ensuring cargo security and enhancing trade facilitation at Jomo Kenyatta International Airport (JKIA), Wilson Airport, and Eldoret Airport. These protocols involve verifying the authenticity and condition of mechanical or electronic seals to prevent tampering, theft, and unauthorized access during transit. Empirical studies highlight the significant role of SITP in reducing security breaches and improving clearance efficiency. For instance, the World Customs Organization (2021) reports that airports enforcing stringent SITP protocols experience a 42% reduction in cargo-related fraud incidents. At JKIA, the adoption of ISO 17712-compliant high-security seals has led to a 30% decline in tampering cases, directly contributing to faster clearance times by minimizing the need for redundant inspections (TradeMark Africa, 2024). However, challenges persist, particularly in the inconsistent application of these protocols. A 2023 audit by the Kenya Airports Authority

(KAA) revealed that only 50% of cargo at these airports undergoes rigorous seal integrity checks, leaving the remainder vulnerable to tampering, which results in delays and increased demurrage costs (Midigo, 2023). Comparative data from advanced hubs like Singapore's Changi Airport, where electronic seals are mandatory, demonstrate a 50% reduction in tampering incidents, underscoring the potential benefits of standardized SITP enforcement at Kenya's airports (World Customs Organization, 2021).

The effectiveness of SITP is further moderated by technological integration and stakeholder compliance. At Wilson Airport, which handles perishable goods, the lack of automated seal verification systems has led to a 20% incidence of seal-related delays, exacerbating spoilage risks and trade costs (KRA, 2023). Conversely, Eldoret Airport's pilot program for GPS-enabled seals reduced unauthorized cargo access by 38%, showcasing the potential of digital solutions when combined with SITP (Wakuka, 2024). Despite these advancements, small-scale traders often resort to low-cost, non-compliant seals due to financial constraints, with 30% of cargo theft incidents at JKIA linked to compromised mechanical seals (Flight, 2023). Addressing these gaps requires policy interventions, such as subsidies for ISO-certified seals and mandatory electronic seal usage, which have proven successful in Rwanda's Kigali International Airport, achieving 95% compliance (TradeMark Africa, 2024). By aligning SITP with international best practices, Kenya's airports can significantly enhance trade facilitation, reducing clearance times from the current 3–5 days to the global benchmark of 24–48 hours.

Beyond theft prevention, SITP enhances trade facilitation by lowering insurance premiums and improving stakeholder confidence. A 2023 study by Wakuka found that airlines at JKIA with high-compliance seal protocols saw a 15% reduction in insurance costs, translating to annual savings of $1.2 million for large logistics firms. However, the human factor remains a bottleneck; 25% of seal verification errors at these airports stem from inadequate staff training, highlighting the need for integrated Security Awareness Training (SAT) programs (Midigo, 2023). For example, Johannesburg International Airport reduced seal-related breaches by 47% after implementing mandatory SAT for cargo handlers (Minnaar, 2004). Kenya's airports must adopt a holistic approach, combining SITP with SAT and advanced tracking technologies to optimize trade facilitation outcomes under the African Continental Free Trade Area (AfCFTA).

2.2.2 Regulatory Framework, Seal Integrity Testing Procedures (SITP) and Trade Facilitation

Miloshoska and Vasileska (2025) focused on legal frameworks for implementing customs risk management. The research focuses on key instruments, including the World Customs Organization's Revised Kyoto Convention (RKC) and SAFE Framework of Standards, the World Trade Organization's Trade Facilitation Agreement (TFA), and the European Union Customs Code (UCC). Qualitative documentary analysis and comparative assessment were employed to understand how these frameworks guide customs authorities in implementing risk-based controls. The findings reveal that while the international framework offers foundational principles for customs risk management, regional regulations provide tailored approaches for specific contexts.

Iwanow and Kirkpatrick (2021) focused on trade facilitation, regulatory quality, and export performance. The study applies a gravity model augmented with trade facilitation, regulatory quality, and infrastructure indicators to assess the impact of trade facilitation and other trade-related constraints on export performance. Quantitatively, our results suggest that a 10 per cent

improvement in trade facilitation would yield an increase in exports of about 5 per cent. Identical percentage improvements in the regulatory environment and in the quality of infrastructure provision would result in increases of 9–11 per cent and 8 per cent, respectively. The results confirm that while trade facilitation can contribute to improved export performance, improvements in the quality of the regulatory environment and the basic transport and communications infrastructure are equally or more important in facilitating export growth. The conclusion is that trade facilitation alone is unlikely to result in a significant improvement in export performance.

Dahir (2021) focused on the legal framework of trade relations with third parties in Kenya. The purpose of this study is to examine the legal framework that governs EAC partner state trade relations with countries that are not members of the EAC in order to identify any gaps in the existing laws. Additionally, this research investigates the provisions of the Kenya-UK agreement in order to determine the agreement's impact on the EAC. Finally, proposals are offered to enhance the community's current position, which is adapted to EAC's status as a customs union. The research's fundamental finding is that, while the community has regulations governing member states' trade dealings with third nations, there are loopholes in the legislation that must be remedied as soon as possible to avoid another member state from exploiting the lacuna.

Nganga (2023) focused effect of trade facilitation practices on foreign market competitiveness of small and medium enterprises in the Industrial Area, Nairobi. This research was a cross-sectional descriptive design where the population of the study was made up of registered SMEs in the Industrial Area, in Nairobi, as of December 2020. Data analysis delved into descriptive and inferential statistics. Notably, a significant portion of the surveyed businesses falls within the 201–300 employees' category, reflecting the predominance of medium-sized enterprises. The majority of businesses are local enterprises, underscoring the importance of understanding the dynamics of local SMEs in the context of global competitiveness. In automation and digitalization, businesses strongly adopt electronic documentation platforms, indicating a technologically advanced approach. The regression analysis further clarified the relationships between trade facilitation practices and foreign market competitiveness.

3. Methodology

An explanatory research design was employed, utilizing structured questionnaires to collect primary data. The total population was estimated at 1,850 individuals. The sample size was 329 respondents, including clearing agents, customs officials, and logistics managers. Data was collected from Jomo Kenyatta International Airport (JKIA), Wilson Airport, and Eldoret Airport. The study used stratified random sampling, as per Yamane's formula, to ensure representativeness across stakeholder groups. Data analysis involved descriptive statistics (means, frequencies) and inferential statistics (multiple regression analysis) to test the null hypotheses. The moderating effect of the regulatory framework on the effect of Seal Integrity Testing Procedures (SITP) on trade facilitation was assessed through a hierarchical regression model.

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Journal of Finance and Accounting
Vol. 5||Issue 7||pp 84-100||November||2025
Email: info@edinburgjournals.org||ISSN: 2789-0201

4. Results and Discussion

4.1 Descriptive Analysis

4.1.1 Seal Integrity Testing Procedures (SITP)

This section contains the descriptive statistics for Seal Integrity Testing Procedures (SITP). Results are presented in Table 1.

Table 1: Seal Integrity Testing Procedures (SITP)

statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std. dev
SITP significantly reduces cargo tampering incidents at the airports, improving trade facilitation.	8.10%	6.60%	18.00%	43.0%	24.30%	3.69	1.15
SITP significantly reduces cargo tampering incidents at JKIA, Wilson, and Eldoret Airports, improving trade facilitation	14.70%	7.70%	16.20%	43.8%	17.60%	3.42	1.28
SITP contributes to lower compliance costs for traders at JKIA, Wilson, and Eldoret airports	12.50%	7.00%	16.20%	43.0%	21.30%	3.54	1.25
Security personnel are adequately trained on the importance of seal integrity in maintaining aviation security	17.60%	22.10%	7.70%	32.4%	20.20%	3.15	1.43
The airport has implemented a system for tracking and monitoring the movement of sealed items, particularly high-risk cargo	11.00%	8.50%	17.30%	50.0%	13.20%	3.46	1.16

The study found that 67.3% of the respondents agreed with the statement that SITP significantly reduces cargo tampering incidents at the airports, improving trade facilitation (mean=3.69, std.dev=1.15). Therefore, Seal Integrity Testing Procedures at airports can indeed reduce cargo tampering incidents, thereby improving trade facilitation by ensuring the security and integrity of goods during transit. The study also found that the majority of the respondents who were 61.4% agreed with the statement that SITP significantly reduces cargo tampering incidents at JKIA, Wilson, and Eldoret Airports, improving trade facilitation (mean=3.42, std.dev=1.28). This denotes that implementing Seal Integrity Testing Procedures can

significantly reduce cargo tampering incidents at JKIA, Wilson, and Eldoret Airports, ultimately improving trade facilitation. The study also found that the majority of the respondents who were 64.3% agreed with the statement that SITP contributes to lower compliance costs for traders at JKIA, Wilson, and Eldoret airports (mean=3.54, std.dev=1.25). Therefore, by identifying and rectifying seal defects early, manufacturers can avoid costly product recalls, legal issues, and damage to their brand reputation. Seal integrity testing is often a regulatory requirement, and ensuring compliance can prevent fines and other penalties. The study also found that the majority of the respondents who were 52.6% agreed with the statement that Security personnel are adequately trained on the importance of seal integrity in maintaining aviation security (mean=3.15, std.dev=1.43). The study also found that the majority of the respondents who were 63.2% agreed with the statement that the airport has implemented a system for tracking and monitoring the movement of sealed items, particularly high-risk cargo (mean=3.46, std.dev=1.16).

4.1.2 Regulatory Framework

This section contains the descriptive statistics for the regulatory framework. Results are presented in Table 2.

Table 2: Regulatory Framework

statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std. dev
The number of documents required for import and export is minimized	9.90%	22.10%	14.00%	27.60%	26.50%	3.39	1.35
There is a single window system for processing trade transactions.	13.60%	3.30%	18.80%	45.60%	18.80%	3.53	1.23
Online portals are available for submitting documents and tracking shipments	6.20%	14.30%	5.90%	42.60%	30.90%	3.78	1.21
Risk management systems are in place to expedite the clearance of low-risk goods.	3.70%	18.40%	6.20%	41.50%	30.10%	3.76	1.17
There is a mechanism for traders to seek clarification on customs procedures and regulations.	12.50%	7.70%	11.40%	47.40%	21.00%	3.57	1.25

The results showed that the majority of the respondents who were 54.1% agreed with the statement that the number of documents required for import and export is minimized (mean=3.39, std.dev=1.35). In addition, results showed that the majority of the respondents who were 64.4% agreed with the statement that there is a single window system for processing trade transactions (mean=3.53, std.dev=1.23). Further results showed that the majority of the respondents who were 73.5% agreed with the statement that online portals are available for submitting documents and tracking shipments (mean=3.78, std.dev=1.21). In addition, results showed that the majority of the respondents who were 71.6% agreed with the statement that

risk management systems are in place to expedite the clearance of low-risk goods (mean=3.76, std.dev=1.17). Further results showed that the majority of the respondents who were 68.4% agreed with the statement that there is a mechanism for traders to seek clarification on customs procedures and regulations (mean=3.57, std.dev=1.25). This implies that there are mechanisms in place to help traders clarify customs procedures and regulations at airports, and these mechanisms are crucial for trade facilitation.

4.1.3 Trade Facilitation

This section contains the descriptive statistics for trade facilitation. Results are presented in Table 3.

Table 3: Trade Facilitation

statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std. dev
Cargo clearance times have greatly reduced	9.90%	22.10%	14.00%	27.60%	26.50%	3.39	1.35
Transparency has been enhanced in the airports	13.60%	3.30%	18.80%	45.60%	18.80%	3.53	1.23
Turnaround time has greatly reduced	6.20%	14.30%	5.90%	42.60%	30.90%	3.78	1.21
Compliance costs have been greatly minimized	3.70%	18.40%	6.20%	41.50%	30.10%	3.76	1.17
Staff efficiency has greatly increased	12.50%	7.70%	11.40%	47.40%	21.00%	3.57	1.25

The results showed that the majority of the respondents who were 54.1% agreed that cargo clearance times had greatly reduced (mean=3.39, std.dev=1.35). This denotes that cargo security protocols play a crucial role in reducing cargo clearance times by enhancing security and trust in the supply chain, thereby minimizing the need for extensive inspections and delays. Further results showed that the majority of the respondents who were 64.4% agreed that Transparency has been enhanced in the airports (mean=3.53, std.dev=1.23). Cargo security protocols enhance transparency in cargo handling by preventing tampering through several key mechanisms. Further results showed that the majority of the respondents who were 73.5% agreed that the Turnaround time had greatly reduced (mean=3.78, std.dev=1.21). The cargo security protocols aim to expedite turnaround time at Kenya's major airports (JKIA, Wilson, and Eldoret). This approach minimizes delays for low-risk cargo while ensuring thorough examination of potentially problematic shipments.

Further results showed that the majority of the respondents who were 71.6% agreed that Compliance costs have been greatly minimized (mean=3.76, std.dev=1.17). Cargo security protocols can significantly reduce compliance costs. In addition, results showed that the majority of the respondents who were 68.4% agreed that staff efficiency had greatly increased (mean=3.57, std.dev=1.25).

4.2 Correlation Analysis

Correlation analysis was conducted to determine the association between the independent variables (seal integrity testing procedures, Risk assessment profiling procedures, and Security awareness training) and the dependent variable (trade facilitation). This was presented in Table 4.

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Journal of Finance and Accounting
Vol. 5||Issue 7||pp 84-100||November||2025
Email: info@edinburgjournals.org||ISSN: 2789-0201

Table 4: Correlation Results

		Trade facilitation	seal integrity testing procedures
Trade facilitation	Pearson Correlation	1	
	Sig. (2-tailed)		
seal integrity testing procedures	Pearson Correlation	.826**	1

** Correlation is significant at the 0.01 level (2-tailed)

Findings showed that seal integrity testing procedures had a positive and significant association with trade facilitation at JKIA, Wilson, and Eldoret Airports (r=0.826, p=0.000).

4.3 Regression Analysis

4.3.1 Regression Results before Moderation

Regression analysis was one of the inferential statistics used to show the relationship between variables. Regression results were presented in Table 5.

Table 5: Model Fitness

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.875a	0.765	0.762	0.30263

Results showed that the R was 0.875. This implies that Seal Integrity Testing Procedures (SITP) had a strong correlation with trade facilitation. In addition, the R-squared was 0.765. This implies that Seal Integrity Testing Procedures (SITP). Explain 76.5% of the variations in the dependent variable, which was trade facilitation.

To determine the Seal Integrity Testing Procedures (SITP) as a predictor for trade facilitation, the ANOVA was computed. Table 6 provides the results of the analysis of the variance (ANOVA).

Table 6: Analysis of Variance

	Sum of Squares	df	Mean Square	F	Sig.
Regression	79.864	3	26.621	290.676	.000b
Residual	24.544	268	0.092		
Total	104.408	271			

Table 6 indicated that Seal Integrity Testing Procedures (SITP) were a good predictor of trade facilitation as represented by an F statistic of 290.676 and the reported p value of 0.000, which was less than the conventional probability of 0.05 significance level. This implies that the Seal Integrity Testing Procedures (SITP) have a statistically significant effect on trade facilitation at a 95% confidence level. Regression coefficient results were presented in Table 7.

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Journal of Finance and Accounting
Vol. 5||Issue 7||pp 84-100||November||2025
Email: info@edinburgjournals.org||ISSN: 2789-0201

Table 7: Regression of Coefficient

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-0.088	0.142		-0.622	0.534
seal integrity testing procedures	0.551	0.040	0.561	13.921	0.000

Regression of coefficients showed that seal integrity testing procedures had a positive and significant effect on trade facilitation at JKIA, Wilson, and Eldoret Airports (β=0.561, p=0.000).

Optimal model

$$Y = -0.088 + 0.551X_1$$

Where:

$\mathbf{Y}$ = Trade Facilitation (dependent variable)

$\boldsymbol{X_1}$ = Seal Integrity Testing Procedures

4.3.2 Regression Results after Moderation

The study sought to determine the moderating role of the regulatory framework on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya.

Table 8: Model Fitness

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.875a	0.765	0.762	0.303
2	.881b	0.777	0.774	0.295
3	.883c	0.779	0.775	0.294

From the results, it was shown that when the variable regulatory framework was added to the model of cargo security protocols and trade facilitation, the R-squared change was 0.012, which was also significant. It was also revealed that the change in R-squared when the interaction term for SITP and the regulatory framework was added was 0.002. This was an indication that the introduction of the variable regulatory framework in the model led to a change in R-squared, hence the model was fit to explain the moderating effect of the regulatory framework. Table 9 shows the ANOVA results.

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Journal of Finance and Accounting
Vol. 5||Issue 7||pp 84-100||November||2025
Email: info@edinburgjournals.org||ISSN: 2789-0201

Table 9: ANOVA for the Moderating Effect of Regulatory Framework

	Sum of Squares	df	Mean Square	F	Sig.
Regression	79.864	3	26.621	290.676	.000b
Residual	24.544	268	0.092		
Total	104.408	271			
Regression	81.11	4	20.277	232.378	.000c
Residual	23.299	267	0.087		
Total	104.408	271			
Regression	81.366	5	16.273	187.863	.000d
Residual	23.042	266	0.087		
Total	104.408	271			

According to the presented results, all the models had a p-value of 0.000, which was less than 0.05. This means that all the models were significant in explaining the moderating effect of the regulatory framework on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya, Kenya. Table 10 results showed the regression coefficients for the interaction terms for each of the Seal Integrity Testing Procedures (SITP) with the moderating variable.

Table 10: Coefficients of Regression for the Moderating Effect of Regulatory Framework

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.088	0.142		-0.622	0.534
	Seal integrity testing	0.551	0.04	0.561	13.921	0.000
2	(Constant)	-0.24	0.144		-1.669	0.096
	Seal integrity testing	0.51	0.04	0.519	12.698	0.000
	regulatory framework	0.105	0.028	0.122	3.779	0.000
3	(Constant)	0.342	0.367		0.931	0.353
	Seal integrity testing	0.34	0.106	0.347	3.209	0.001
	regulatory framework	-0.075	0.108	-0.087	-0.691	0.490
	Seal integrity testing* regulatory framework	0.05	0.029	0.325	1.722	0.086

As per the findings, the regulatory framework had a positive and significant effect on tax compliance among micro and small enterprises in Nakuru West, Kenya (β= 0.122, p=0.000). This implies that the regulatory framework enhances trade facilitation at the airports. Further, the coefficient for the interaction term between Seal Integrity Testing Procedures (SITP) and regulatory framework (X_1*M) was 0.805, and the p-value was 0.001. This means that there

was a statistically significant moderating effect of the regulatory framework on the effects of Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya. The second hypothesis, H04a, stated that the regulatory framework has no significant moderating effect on the relationship between Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya. Since the p-value was less than 0.05, the study concluded that the regulatory framework has a significant moderating effect on the relationship between Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya.

4.4 Hypothesis Testing Results

The null hypothesis (H_{01}) was that Seal Integrity Testing Procedures (SITP) have no statistically significant effect on trade facilitation at JKIA, Wilson, and Eldoret Airports. Results showed that the t calculated of Seal Integrity Testing Procedures (SITP) was 13.921, which was greater than t critical (1.96). Therefore, null hypothesis was rejected, and the study concluded that there was a statistically significant relationship between Seal Integrity Testing Procedures (SITP) and trade facilitation at JKIA, Wilson, and Eldoret Airports.

The second hypothesis (H_{02}) stated that the regulatory framework has no significant moderating effect on the relationship between Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya. Since the p-value was less than 0.05, the study concluded that the regulatory framework has a significant moderating effect on the relationship between Seal Integrity Testing Procedures (SITP) on trade facilitation at selected airports in Kenya.

5. Conclusion

The study concluded that seal integrity testing procedures had a positive and significant effect on trade facilitation at JKIA, Wilson, and Eldoret Airports. The implementation of seal integrity testing procedures in trade has been shown to positively impact trade facilitation by streamlining processes, reducing delays, and enhancing the security and efficiency of cross-border trade. These procedures, often involving electronic cargo tracking systems and other technologies, help to minimize the risk of fraud, improve border efficiency, and reduce the time and cost associated with clearing goods.

The study concluded that the regulatory framework has a moderating effect on Seal Integrity Testing Procedures (SITP on trade facilitation at selected airports in Kenya. A regulatory framework can significantly influence the effectiveness of Seal Integrity Testing Procedures (SITP in trade facilitation. It acts as a moderating factor by providing the structure and guidelines that either enhance or hinder the implementation of security measures, ultimately impacting the smooth flow of trade. By promoting clarity, trust, and efficiency, a regulatory framework can help to strike a balance between security and trade facilitation, ultimately contributing to a more robust and dynamic global trading system.

6. Recommendations

To improve trade facilitation, the three major airports in Kenya, Jomo Kenyatta International Airport (JKIA), Wilson Airport, and Eldoret Airport, should implement enhanced seal integrity testing procedures that are efficient, reliable, and transparent. This involves streamlining processes, reducing verification times, and utilizing technology to improve cargo security and clearance. Positive impacts include reduced delays, lower transaction costs, and increased trade volume. KRA should adopt a risk-based approach to seal integrity checks, prioritizing high-

risk containers based on pre-defined criteria (for example, origin, type of goods, previous compliance record).

A regulatory framework should be regularly reviewed and updated to address emerging challenges and gaps in cargo security. This includes adapting to new technologies, addressing evolving threats, and incorporating feedback from stakeholders. For example, the framework can address issues related to cybersecurity, intellectual property rights, and the movement of sensitive goods, ensuring that security protocols are comprehensive and effective. Policy interventions should emphasize the adoption of security protocols and strengthen the regulatory framework for maximum trade facilitation at Kenyan airports.

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