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Effect of the Electronic Customs Risk Analysis System on Trade Facilitation among Clearing and Forwarding Companies at Malaba Border Post, Kenya

Annsharon Karimi Riungu[1*], Collins Kipkiyai [2], Daniel Kirui[2]
[1]Tax Administration, Kenya School of Revenue Administration
[2]School of Business and Economics, Moi University
Corresponding Author Email: riunguannsharon@gmail.com

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Abstract

Trade facilitation is the streamlining and harmonization of international trade procedures that impede the flow of goods, people, and vehicles across international borders, resulting in increased business costs, delays in goods clearance, and reduced commodity flows. One of the main tools for ensuring that trade facilitation is completely achieved across national borders is the One-Stop Border Post. The study, therefore, was to determine the effect of the electronic customs risk analysis system on trade facilitation among clearing and forwarding companies at Malaba Border Post, Kenya. The theory that guided the study was New Trade Theory (NTT and Risk Management Theory. The study used an explanatory research design. The target population was 1086 clearing and forwarding agents in Kenya, and a sample size of 292 respondents. Since 292 of the targeted 254 respondents fully completed and submitted their responses. Structured questionnaires were used to collect primary data, which were analyzed using descriptive and inferential statistics. The study found that the electronic customs risk analysis system had a significant and positive effect on trade facilitation ($\beta = 0.480$, $p = 0.000$). Given the positive effect of the electronic customs risk analysis system on trade facilitation, the study recommends that government agencies, such as the Kenya Revenue Authority (KRA), develop policies that mandate and incentivize data sharing among government departments and private-sector stakeholders. This will enrich the risk engine's data pool, enabling more precise targeting of high-risk consignments and faster clearance for legitimate trade. Future studies should investigate how variables such as digital literacy impact facilitation of trade activities at border clearing and forwarding companies at Malaba Border Post, Kenya.

Keywords: *Electronic Customs Risk Analysis System, Trade Facilitation, Clearing and Forwarding Companies*

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1. Introduction

Coordinated border control and trade facilitation remain essential in international trade to ensure that products and services arrive at their intended destinations in a reasonable timeframe and at a fair price. The requirement for quick and unrestricted cross-border movement of goods

and services has also been linked to the global trend toward trade liberalization. In order to facilitate trade worldwide by facilitating the flow of goods and services across all key border points, the World Trade Organization (WTO) states that the trade facilitation framework was first introduced at the 1996 Singapore Ministerial Conference and subsequently adopted at the Doha Development Agenda (DDA) (Australian Customs and Border Protection Service, 2021).

Trade facilitation is becoming a more critical issue globally as the demand for the free movement of products and services grows, driven by increased trade, lower tariffs following the Uruguay Round of trade liberalization, and the rising availability of modern technologies. In particular, international trade at borders is associated with complex and multiple border procedures, excessive and numerous documentation requirements, a lack of transparency in rules and regulations, limited use of modern customs techniques, excessive permit processing times, and a lack of coordination and cooperation. between customs authorities. and other inspection bodies. Dealing with international borders becomes more complex with many state actors involved (Wheelen & Hunger, 2008). When these variables are combined, they result in lost business and expensive trade transaction fees (TTC). TTCs typically account for 2–15% of the value of traded goods (OECD, 2022).

Electronic Customs Risk Analysis is a modern customs management approach that uses data analytics and digital tools to assess and manage the risk levels associated with cargo, traders, and transactions before goods arrive at the border. The system leverages historical data, predictive algorithms, and real-time information to identify shipments at high risk of issues such as smuggling, undervaluation, misclassification, or non-compliance with trade regulations. This proactive method enables customs authorities to focus inspection efforts on suspicious consignments while allowing low-risk goods to pass with minimal intervention, thereby enhancing both trade facilitation and border security (Amah, 2021).

Clearing and forwarding firms are specialized entities that manage the logistics involved in international cargo movement. They handle customs brokerage, ensuring that goods comply with local regulations and are cleared through customs efficiently (Bottalico, 2021). These firms also organize the transportation of goods across multiple carriers and routes, a process known as freight forwarding. Furthermore, they manage all necessary documentation, including bills of lading, invoices, and certificates of origin, ensuring that shipments adhere to international trade laws and standards (Haque et al., 2020).

KRA has taken an integrated, comprehensive approach to improve its systems, especially in customs operations. Transformation began by reducing challenges related to the processing of import and export cargo, making local and international business more efficient. The integrated and comprehensive approach is likely to benefit the government, manufacturers, traders, and consumers. The approach focuses on infrastructure, such as One-Stop Border Posts and information technology, KRA (2022).

KRA is focused on ensuring compliance with standards and the adoption of best practices and procedures to improve the competitiveness of Kenyan products both locally and across borders. In the past, Kenyan businesses have faced many trade restrictions both locally and internationally. Transactions previously took longer to conclude because of lengthy procedures. KRA has put in place mechanisms to ensure local businesses and cross-border trade thrive. In addition, KRA has automated its systems to eliminate Customs challenges that hampered cross-border trade. OECD (2022). Various programs have been implemented to

reform Customs operations and improve trade. They include implementing the Single Window Concept through a project known as the Community-Based System (CBS). This is an ICT system that integrates all trade facilitating agencies and business communities with KRA.

Malaba Border, located between Kenya and Uganda, is one of the busiest and most critical crossing points in East Africa. It plays a significant role in facilitating trade along the Northern Corridor**,** which links the port of Mombasa to landlocked countries such as Uganda, Rwanda, Burundi, South Sudan, and parts of the Democratic Republic of Congo. The border has been transformed through the implementation of the One Stop Border Post (OSBP) system, which aims to reduce clearance time and enhance trade efficiency by allowing joint processing of goods and travelers by both Kenyan and Ugandan authorities (East African Community (EAC), 2020).

1.1 Problem Statement

Trade facilitation remains a critical component for enhancing cross-border trade efficiency, especially at major entry points such as the Malaba border post between Kenya and Uganda. Despite several reforms introduced by the Kenyan government and regional bodies such as the East African Community (EAC), significant challenges persist, particularly among clearing and forwarding companies. The Malaba border, one of the busiest transit points in East Africa, handles over 60% of cargo traffic moving from the Port of Mombasa to landlocked countries such as Uganda, Rwanda, and the Democratic Republic of Congo (KRA, 2024).

According to the Northern Corridor Transport Observatory Report (2024)**,** delays averaging 32 to 40 hours persist due to inefficiencies in customs clearance procedures, limited adoption of electronic systems, and inadequate infrastructure. These inefficiencies increase logistics costs and reduce the competitiveness of regional trade. These issues hinder the timely clearance of goods and affect businesses' ability to meet contractual obligations. As a result, trade facilitation goals under the World Trade Organization's Trade Facilitation Agreement and the EAC Customs Protocol are not fully realized. It is against this backdrop that the current study will determine the effect of electronic customs risk analysis on trade facilitation among clearing and forwarding companies at Malaba Border Post, Kenya.

2. Literature Review

2.1 Theoretical Review

2.1.1 New Trade Theory

New Trade Theory (NTT), developed by Paul Krugman in the late 1970s and early 1980s, emphasizes the role of economies of scale, product differentiation, and network effects in international trade (Krugman, 1980). Unlike classical trade theories, which focus solely on comparative advantage, NTT suggests that countries can gain from trade by specializing in certain industries, even if they lack an absolute advantage. This perspective highlights that trade patterns are influenced not only by resource endowments but also by market size, firm-level efficiency, and reductions in trade costs.

In the context of trade facilitation, NTT underscores the importance of reducing procedural barriers and improving logistics to enable firms to exploit economies of scale (Baldwin & Evenett, 2009). Measures such as single-window customs systems, electronic documentation, and streamlined border procedures lower transaction costs, shorten lead times, and increase predictability for exporters and importers. By facilitating smoother and faster trade, countries

allow firms to access larger markets, enhance specialization, and benefit from the scale efficiencies emphasized by NTT, ultimately boosting trade volumes and national competitiveness.

Furthermore, NTT suggests that trade facilitation can promote industrial clustering and integration into global value chains. By reducing the "friction" of cross-border trade, countries can attract foreign investment and enable local firms to participate more effectively in specialized production networks (Krugman, 1980; Baldwin & Evenett, 2009). This creates a reinforcing cycle in which improved trade processes support greater economies of scale, which in turn encourage further trade and industrial growth.

In addition, recent work on trade facilitation in preferential trade agreements (PTAs) emphasizes that making cross-border processes smoother supports the NTT mechanism of demand aggregation and specialization among countries (Neufeld, 2025). By simplifying documentation, harmonizing regulations, and speeding up border procedures, such reforms essentially reduce the "distance" or friction between markets, thereby increasing the effective size of the market in which firms operate, a key tenet of NTT. Therefore, the linkage between trade facilitation and NTT is not merely theoretical but increasingly supported by the latest policy-oriented literature. The theory supports trade facilitation.

2.1.2 Risk Management Theory

Risk Management Theory provides a foundational framework for understanding how organizations identify, assess, and respond to potential threats that could hinder their objectives. In the context of customs and trade facilitation, this theory is especially relevant to the development and implementation of Electronic Customs Risk Analysis (ECRA) systems. According to Kaplan and Garrick (1981), risk is defined not merely by the likelihood of an event but also by its potential consequences. Therefore, customs administrations apply risk management to focus on high-risk shipments such as those involving smuggling, tax evasion, or security threats while facilitating the smooth clearance of low-risk goods.

Through ECRA, customs authorities use data analytics, past compliance records, and real-time tracking to prioritize inspections, allocate resources efficiently, and ensure national security without disrupting legitimate trade. This approach aligns with the principles of ISO 31000, which emphasizes a structured, integrated, and proactive risk management process. For example, Kenya's Integrated Customs Management System (iCMS) and the Regional Electronic Cargo Tracking System (RECTS) use electronic risk profiling to manage customs risks along major corridors, such as the Malaba Border Post. By embedding risk management into ICT systems, customs can enhance decision-making, reduce corruption, and promote voluntary compliance. Ultimately, Risk Management Theory supports the strategic shift from random inspections to intelligence-led, targeted interventions in border operations.

Moreover, in his "Risk Society" theory, Beck (1992) argued that modern institutions are increasingly preoccupied with preventing and managing risks, especially those related to globalization and transnational trade. This aligns well with the customs sector, where digital risk analysis tools are used to monitor cross-border threats, including illicit trade, terrorism, and fraud. In the East African context, the Kenya Revenue Authority's deployment of tools such as iCMS and RECTS reflects a risk-aware governance model that aims to strike a balance between trade facilitation and enforcement. The theory supports Electronic Customs Risk Analysis.

2.2 Empirical Review

2.2.1 Trade Facilitation

Trade facilitation refers to the simplification, modernization, and harmonization of export and import processes to reduce costs and enhance the efficiency of cross-border trade. It involves measures such as streamlining customs procedures, improving logistics, adopting digital documentation, and enhancing transparency in trade regulations. The objective is to minimize trade barriers, reduce delays, and improve overall trade efficiency, benefiting businesses and economies worldwide. According to the World Trade Organization (WTO), trade facilitation is defined as: The simplification and harmonization of international trade procedures, including activities, practices, and formalities involved in collecting, presenting, communicating, and processing data required for the movement of goods in international trade" (Smith, 2024).

Further, KRA has introduced the Integrated Customs Management System (*i*CMS), which significantly reduces the time taken to clear goods at ports of entry. Unlike the previous Simba System, *i*CMS enables KRA to receive declarations of goods way before the ships dock at the port. This will reduce the time required to clear goods, as they will have already been verified upon arrival. *i*CMS is indeed a game-changer in trade facilitation.

As to the OECD Trade Facilitation Indicators, the WTO Agreement on Trade Facilitation could lower trade costs by 10% for OECD nations and by 13.5% to 15.5% for non-OECD nations (OECD, 2013). WCO (2020) lists a number of tools and instruments that facilitate trade, such as the use of information and communication technology (ICT), improved infrastructure, a legal framework, stakeholder cooperation, increased staff capacity, and interagency coordination through coordinated border management. The value of ICT through automation is more evident when comparing the time required for customs clearance through automated versus paper-based processes. Trade facilitation also aims to improve security and transparency, speed up trade procedures, reduce administrative barriers, and integrate technology into the trading process.

2.2.2 Electronic Customs Risk Analysis System

Komarov (2021) analyzed the basic principles and requirements of international standards for customs risk management. The stages of establishing customs risk management in Ukraine and the prospects for its development are established. Particular attention is paid to implementing international law enforcement information systems to ensure legal compliance throughout the supply chain. The role of risk management maturity in the introduction of integrated risk management within customs authorities is emphasized. On the basis of quality management, change management, and knowledge management, ways of implementing integrated customs risk management were proposed, and innovative models for integrated risk management in the activities of the Ukrainian customs authorities were developed.

Nkurunziza and Uwera (2021) evaluated the effects of integrating an electronic risk profiling system into the ASYCUDA World platform in Rwanda. The study found that physical inspections fell from 78% in 2014 to 42% in 2020. Regression analysis confirmed a significant correlation between the use of risk-based profiling and reduced customs clearance times. The findings highlighted improvements in cargo flow, trader satisfaction, and customs compliance. The authors concluded that the system's automation and transparency features greatly

contribute to trade facilitation by reducing delays and enhancing accountability in the clearance process.

In Kenya, Owino and Were (2022) assessed the impact of ECRAS on customs performance at Mombasa Port. Using secondary data from 2012 to 2016, the study showed that the introduction of the Cargo X system reduced average container dwell time from 11 to 6 days. The findings attributed this improvement to the system's ability to quickly identify compliant traders, thus accelerating clearance for trusted consignments. The authors concluded that ECRAS enhances trade facilitation by reducing port congestion, minimizing opportunities for corruption, and improving the reliability of customs procedures.

2.3 Conceptual Framework

According to Mugenda (2008), a conceptual framework is a concise description of the phenomenon under study, accompanied by a graphical representation of the major variables. The independent variable was the electronic customs risk analysis system, while the dependent variable was trade facilitation.

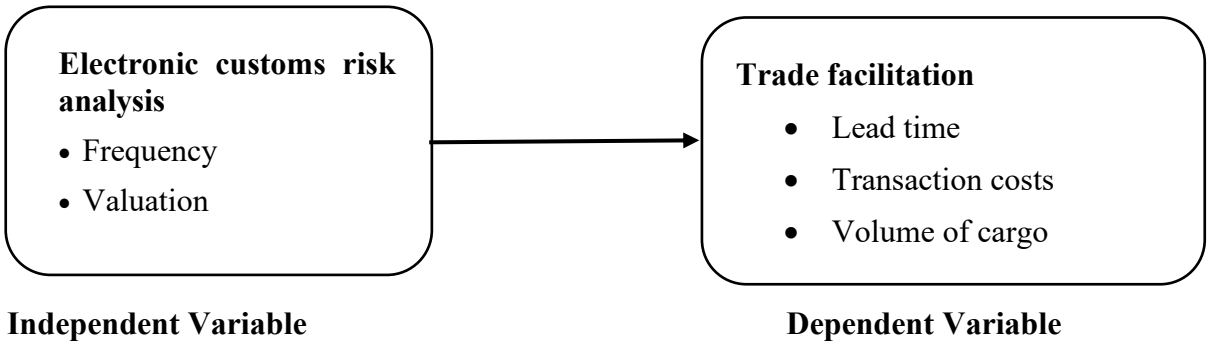

Figure 1: Conceptual Framework

3. Methodology

A research design is a plan or structure that gives a solution to a problem by answering research questions (Cooper & Schindler, 2010). This study used an explanatory research design. Yousaf (2018) explains that an explanatory research design uses a causal relationship between variables to study the effect of one variable on another. Explanatory research design allows a researcher to understand a subject and to find out how and why things happen. A population is a group of objects or individuals that have the same form of characteristics, and is the total performance of elements about which inference is made to all possible cases that are of interest in the study (Sekeran & Bougie, 2010). The target population was 1086 clearing and forwarding agents in Kenya, KRA (2025), and the sample size was 292 respondents. A data collection instrument is the tool used by a researcher to collect raw data from the field (Mugenda & Mugenda, 2003). Closed-ended questions were included in the study questionnaire.

The collected data from the respondents was checked for completeness to ensure the number of respondents remained consistent. Frequencies and percentages were used to summarize the data, while tables were used to present the findings. Both descriptive and inferential tests were used in the analysis where applicable. Data were summarized using descriptive statistics, such as the mean and standard deviation. Inferential statistics included regression analysis and

correlation analysis. The regression model was employed. The data was thereby presented using tables and pie charts. The linear regression model is denoted by the equation:

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

Where, Y = Trade facilitation (Dependent variable)

X_1= Electronic Customs Risk Analysis System

β_1 = beta coefficient

ε = Error term

Figure 2 showed that the questionnaire achieved a notably high response rate of 87.0%, with 254 of the targeted 292 respondents fully completing and submitting their responses, and a corresponding non-response rate of 13.0% (38 participants).

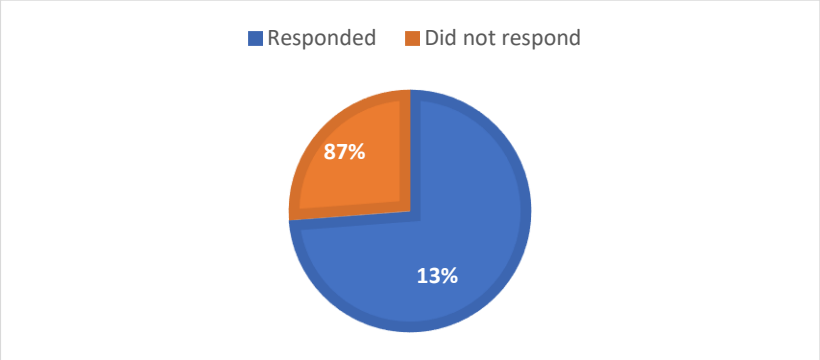

Figure 2: Response Rate

3.1 Reliability Analysis

Reliability refers to the degree to which an instrument yields consistent measurement across time and across items in the instrument (Collis & Hussey, 2014). While Bell (2015) suggested that reliability is the extent to which your data collection techniques or analysis procedures yield consistent findings. Typically, reliability coefficients of 0.70 or higher are considered adequate (DeVaus, 2012). Nunnally (1978) argued that a Cronbach's alpha value of 0.7 and above proves that the research instrument used is reliable. This study adopted a coefficient of 0.7 as the benchmark for reliability. Table 1 showed that Cronbach's alpha for trade facilitation was 0.868, and for the electronic customs risk analysis system, it was 0.973. All results were above 0.7, indicating that the latent variables had high intra-item reliability.

Table 1: Test of Reliability

Factor	Number of Items	Cronbach's Alpha score	Conclusion
Trade facilitation	0.868	5	Reliable
Electronic customs risk analysis system	0.973	5	Reliable

4. Results and Discussion

4.1 Descriptive statistics

4.1.1 Descriptive Statistics Electronic Customs Risk Analysis System

Table 2: The descriptive statistics for each item pertaining to the Electronic Customs Risk Analysis System are reported as follows. The item “Electronic customs risk analysis system helps in identifying high-risk consignments accurately” received a mean score of 4.05 (SD = 0.835), which falls between Agree and Strongly Agree on the Likert scale, indicating a high level of agreement. The standard deviation suggests a low degree of variability in the responses. For the statement “Electronic customs risk analysis system has reduced cargo clearance time at border points,” the mean was 4.07 (SD = 0.851), indicating consensus among respondents with low response variability. The item “The system enhances predictability and planning for importers/exporters” yielded a mean of 4.02 (SD = 0.864), indicating that respondents generally agreed with the statement, and the low standard deviation indicates low variability. Regarding the statement “Customs officers regularly use the risk analysis system when processing import and export declarations,” the mean score was 4.06 (SD = 0.841), signifying agreement and low variability in responses. Finally, the item “Electronic valuation analysis helps detect under-invoicing and over-invoicing cases” had a mean of 3.97 (SD = 0.867), placing it just below the Agree threshold but still reflecting a positive tendency, with a low standard deviation. The aggregated mean of 4.03 for all items confirms an overall consensus among respondents, falling within the Agree range of the Likert scale.

Table 2: Electronic Customs Risk Analysis System

n= 254	Mean	Std. Deviation
Electronic customs risk analysis system helps in identifying high-risk consignments accurately	4.05	.835
Electronic customs risk management system has reduced unnecessary inspection.	4.07	.851
Risk analysis is frequently updated to reflect emerging threats.	4.02	.864
Customs officers regularly use the risk analysis system when processing import and export declarations.	4.06	.841
Electronic valuation analysis helps detect under-invoicing and over-invoicing cases	3.97	.867
Aggregated Mean	4.03	

4.1.2 Descriptive statistics Trade Facilitation

Table 3 shows that the item "The OSBP has reduced clearance time at the border" received a mean score of 3.97 (SD = 0.810), indicating that, on average, respondents agreed with the statement. The standard deviation suggests a moderate degree of variability in the responses. For the item "Integration system has reduced physical handling and damage to goods," the

mean was 4.04 (SD = 0.835), indicating that respondents, on average, agreed with this statement. The standard deviation reflects a moderate spread of responses. Regarding the statement "I have observed reduced truck turnaround time due to the conveyor belt system," the mean score was 3.96 (SD = 0.842), which also falls within the "Agree" range. The standard deviation shows a moderate level of consensus among respondents. The item "The current infrastructure supports smooth movement of goods across the border" yielded a mean of 4.02 (SD = 0.836), indicating general agreement. The standard deviation indicates moderate variability in scores. Finally, for the statement "The level of transparency and professionalism in customs clearance has improved," the mean was 4.01 (SD = 0.840), again signifying that respondents tended to agree. The standard deviation is consistent with a moderate spread of opinions. The aggregated mean of 4.00 across all items confirms a consistent overall perception of agreement with the positive statements regarding trade facilitation.

Table 3: Trade Facilitation

n= 254	Mean	Std. Deviation
The OSBP has reduced clearance time at the border	3.97	.810
Integration system has reduced physical handling and damage to goods.	4.04	.835
Customs procedures are more transparent and predictable.	3.96	.842
The current infrastructure supports the smooth movement of goods across the border	4.02	.836
The cost documentation and clearance have decreased	4.01	.840
Aggregated Mean	4.00	

4.2 Correlations Analysis

Correlation analysis was used to assess the relationship between each independent variable and trade facilitation. The Pearson correlations range from -1 to +1, and the significance level was set at 95% confidence. The analysis of correlations between predictor variables and trade facilitation among clearing and forwarding companies at the Malaba Border Post revealed several significant relationships. Table 4 found a strong, significant positive correlation between the electronic customs risk analysis system and trade facilitation ($r = .628$, $p = .022$). This indicates that the implementation of data-driven risk management tools is closely linked to more efficient trade operations by streamlining the clearance process for low-risk consignments.

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Table 4: Represents the correlation statistics

	Trade facilitation	Electronic customs risk analysis system
Trade facilitation	1	0.628*
Electronic customs risk analysis system	0.628*	1
Sig.	0.022	

**. Correlation is significant at the 0.05 level (2-tailed).

4.3 Regression Analysis

The model summary showed that the electronic customs risk analysis system has a positive correlation to trade facilitation at 62.8% or (R = 0.628). The results reveal that electronic customs risk analysis system caused a variation of 39.4% or (R^2=0.394 and adjusted R^2 =0.387) on trade facilitation

Table 5: Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	0.628	0.394	0.387	0.42086

a. Predictors: (Constant), Electronic customs risk analysis system

ANOVA shows an F statistic of 306.829 and a p-value = 0.000 < 0.05, indicating that the variation in trade facilitation is significantly explained by the model.

Table 6: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86.219	1	86.219	306.829	0.000
	Residual	71.017	252	0.281		
	Total	157.236	253			

a. Dependent Variable: Trade Facilitation

The hypothesis H_{01} stated that the electronic customs risk analysis system has no significant effect on trade facilitation. This study aimed to investigate the effect of the electronic customs risk analysis system on trade facilitation among clearing and forwarding companies at the Malaba Border Post. The study found that the electronic customs risk analysis system has a significant effect on trade facilitation (p=0.000 <0.05).

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Table 7: Regression Coefficients

Model		Standardized Coefficients		Unstandardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.573	0.252		2.274	.024
	Electronic customs risk analysis system	0.480	0.043	0.418	11.163	.000

a. Dependent Variable: Trade Facilitation

4.4 Discussions of findings

The objective of the study was to determine the effect of the electronic customs risk analysis system on trade facilitation among clearing and forwarding companies at Malaba Border Post, Kenya. The correlation matrix showed a significant, positive correlation between the electronic customs risk analysis system and trade facilitation ($r = .628$, $p = .022$). This indicates that the implementation of data-driven risk management tools is closely linked to more efficient trade operations by streamlining the clearance process for low-risk consignments. The regression found that the electronic customs risk analysis system had a significant and positive effect on trade facilitation ($\beta = 0.480$, $p = 0.000$). This result affirms the transformative power of data-driven selectivity, corroborating the World Customs Organization's (2022) finding that advanced risk management systems are pivotal to facilitating legitimate trade by allowing low-risk consignments to be cleared rapidly while focusing resources on high-risk cargo. Therefore, the Null hypothesis H01 was rejected.

5. Conclusion

The objective of the study was to determine the effect of the electronic customs risk analysis system on trade facilitation among clearing and forwarding companies at Malaba Border Post, Kenya. The study concludes that the electronic risk analysis system was a significant predictor of trade facilitation, affirming its power to expedite low-risk consignments. This research contributes new knowledge by revealing that the performance of this data-driven selectivity tool is context-dependent; its capacity to facilitate trade is substantially greater where infrastructural reforms ensure reliable operational conditions, thereby maximizing the system's intelligence and efficiency. The null hypothesis was rejected, confirming that the electronic customs risk analysis system significantly enhances trade facilitation.

6. Recommendations

Given the positive effect of the electronic customs risk analysis system on trade facilitation, the study recommends that government agencies such as the Kenya Revenue Authority (KRA) develop policies that mandate and incentivize data sharing among various government departments and private-sector stakeholders. This will enrich the risk engine's data pool, enabling more precise targeting of high-risk consignments and faster clearance for legitimate trade.

Future studies should investigate how variables such as digital literacy impact facilitation of trade activities at border clearing and forwarding companies at Malaba Border Post, Kenya.

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