INFLUENCE OF DIGITAL TECHNOLOGY ON CARGO SECURITY AT THE INLAND CONTAINER DEPOT OF EMBAKASI, NAIROBI, KENYA

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DECLARATION AND APPROVAL

DECLARATION AND APPROVAL

Declaration by the Student

This research project is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

Signature..... Date 02/06/2025

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Approval by Supervisor

I confirm that this research project has been prepared under my guidance and meets the required academic standards for submission. I approve this work for consideration in partial fulfillment of the requirements for the award of a Master's Degree.

Signature..... Date 3-06-2025

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DEDICATION

I dedicate this work to my family, especially to my daughter, Wren Isla, and my aunt, Karen Lumumba, for their unwavering encouragement, patience, and support.

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ABSTRACT

The study explored the influence of digital technologies on cargo security at the Inland Container Depot (ICD) of Embakasi, Nairobi, Kenya, against the backdrop of increasing global trade volumes and the need for efficient, secure customs procedures. Despite notable investments in digital infrastructure, cargo theft, documentation fraud, and inspection inefficiencies continue to undermine trade facilitation efforts. This prompted the current investigation into how three key technologies—Integrated Scanning Solutions (I-Scan), the Regional Electronic Cargo Tracking System (RECTS), and the Integrated Customs Management System (ICMS)—contribute to enhancing cargo security outcomes. The purpose of the study was to assess the effectiveness of these digital systems in improving risk detection, surveillance, and customs coordination. The study was guided by three objectives: to examine the influence of I-Scan, RECTS, and ICMS on cargo security at the Embakasi ICD. The research was anchored on the Technology Acceptance Model (TAM), which explains system adoption based on perceived usefulness and ease of use, and Game Theory, which analyzes how actors behave strategically under surveillance and enforcement environments. A descriptive research design was adopted, and the study was conducted at the Embakasi Inland Container Depot. The target population comprised customs officers, digital system operators, and enforcement agents, totaling 135 individuals. A stratified sampling technique was used to draw a sample of 101 respondents. Data were collected using structured questionnaires and interview guides. The reliability of instruments was confirmed with a Cronbach's alpha of 0.814. Ethical approval was obtained from Mount Kenya University, NACOSTI, and institutional authorities. Data were analyzed using descriptive statistics and qualitative content analysis. The findings revealed that Integrated Scanning Solutions (I-Scan) significantly contributed to cargo security through high image clarity and non-intrusive inspections, with 42% agreeing and 21% strongly agreeing that high-resolution scans reduced the need for physical unpacking. A further 60% used scan clarity for validation, and 66% affirmed image clarity was reliable, while 65% preferred I-Scan due to its compliance with global standards. In terms of the Regional Electronic Cargo Tracking System (RECTS), 38% agreed and 20% strongly agreed that real-time updates minimized enforcement delays, with 65% acknowledging reduced tampering risks and 63% affirming the system effectively responded to cargo deviations. Moreover, 60% indicated alerts matched real-time risks, and 62% trusted RECTS data for consistent tracking. Lastly, the Integrated Customs Management System (ICMS) improved cargo declaration reliability with 62% agreeing it reduced fraudulent declarations, 60% noting fewer misclassifications, and 64% citing improved data accuracy. Additionally, 61% affirmed timely inter-agency sharing, 63% reported improved error detection, and 62% noted reduced clearance disruptions. These findings demonstrate that the adoption of digital technologies has transformed cargo processing and security enforcement at Embakasi ICD through enhanced accuracy, responsiveness, and inter-agency integration. The study recommends continuous training for customs officers to enhance system use, integration of I-Scan, RECTS, and ICMS into a unified platform for efficiency, and regular system upgrades to ensure reliability and alignment with international standards.

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ABBREVIATIONS AND ACRONYMS

GPS	Global Positioning System
HS Code	Harmonized System Code
ICD	Inland Container Depot
ICMS	Integrated Customs Management System
ICT	Information and Communication Technology
I-Scan	Integrated Scanning Solutions
KEBS	Kenya Bureau of Standards
KRA	Kenya Revenue Authority
MKU	Mount Kenya University
NACOSTI	National Commission for Science, Technology, and Innovation
NEMA	National Environment Management Authority
RCO	Regional Customs Office (contextual, if referenced)

RECTS	Regional Electronic Cargo Tracking System
TAM	Technology Acceptance Model
UNCTAD	United Nations Conference on Trade and Development
WCO	World Customs Organization

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

In the age of interconnected economies, the global supply chain has become a critical infrastructure through which nations secure economic stability and growth. However, as the scale and complexity of international trade increase, so too do the vulnerabilities associated with cargo logistics. Cargo security has emerged as a pivotal concern due to the growing sophistication of threats such as theft, smuggling, terrorism, and diversion of high-value goods (Gupta, 2021). In response, countries are transitioning from manual, reactive security strategies toward integrated digital systems that provide real-time monitoring, predictive risk analysis, and end-to-end cargo visibility (WCO, 2021).

In advanced economies, digital technology has been central to revolutionizing customs and cargo handling practices. For instance, the United States has institutionalized the use of Artificial Intelligence and Machine Learning algorithms in customs profiling, enabling the identification of high-risk consignments even before arrival at ports of entry (Brown, 2020). Germany and Singapore, globally recognized for their efficient logistics sectors, have deployed blockchainbased cargo documentation systems that enhance transparency and reduce the likelihood of document tampering or misdeclaration (Chen, 2023). Integrated Scanning Systems (ISS), such as high-energy X-ray scanners, have reduced the need for time-consuming manual inspections while improving the detection of concealed contraband (UNCTAD, 2021). The shift toward digital cargo monitoring is further reinforced by global frameworks like the World Customs Organization's SAFE Framework, which encourages the standardization and adoption of non-intrusive inspection technologies and smart tracking systems (WCO, 2021).

In countries like Chile and Vietnam, the adoption of GPS-enabled Electronic Cargo Tracking Systems (ECTS) has enabled customs agencies to monitor cargo movement in real time, thus reducing delays and improving route security (Serrano, 2022). These innovations have transformed traditional cargo security operations from paper-based verification processes to dynamic digital surveillance environments. The combined use of cloud-based data storage, automated alerts, and geofencing has significantly curtailed the incidence of cargo theft, especially in high-risk transit corridors (Tran, 2019). Nonetheless, the high cost of infrastructure development and system maintenance remains a barrier for uniform implementation across all developing nations.

Across the African continent, the push toward digital transformation in trade logistics has been uneven and challenged by both technical and institutional limitations. Many African countries continue to experience significant cargo security lapses due to porous borders, underdeveloped transport infrastructure, and fragmented customs protocols (Okonkwo, 2021). While North African countries like Morocco have integrated AI and biometric systems at key seaports to improve the identification of illicit cargo, sub-Saharan countries such as Nigeria and Cameroon face persistent threats of cargo diversion and theft due to limited surveillance capabilities (El Hadji, 2022). In these environments, the lack of comprehensive digital platforms makes it difficult to track cargo throughout its journey, increasing exposure to criminal syndicates and corrupt practices.

In response to these challenges, regional bodies like the African Union (AU) and the African Continental Free Trade Area (AfCFTA) have emphasized the role of digital innovation in securing intra-African trade (AU Commission, 2023). There is growing recognition that modernizing customs with tools such as Integrated Customs Management Systems (ICMS) and ISS can reduce delays, increase revenue collection, and enhance cargo integrity. However, in countries like Ghana and Senegal, system underutilization remains a critical bottleneck, largely due to a lack of skilled

personnel, low awareness, and inadequate legal frameworks to support technology-led enforcement (Boateng, 2021). The inconsistency in digital adoption across the continent undermines efforts to establish a harmonized and secure African trade network.

In the East African region, digital technology has increasingly become a core element of customs modernization and cargo safety. The Northern Corridor Transit and Transport Coordination Authority (NCTTCA) has been instrumental in supporting the implementation of the Regional Electronic Cargo Tracking System (RECTS) across Uganda, Rwanda, and the Democratic Republic of Congo, enabling end-to-end monitoring of transit cargo from port to hinterland (Mugisha, 2020). In Rwanda, GPS-based tracking integrated with RECTS allows customs officials to monitor high-risk consignments in real time, improving interception rates and reducing transitrelated losses (Nsengimana, 2023). The system also automatically generates alerts when unauthorized stops or route deviations are detected, enabling faster enforcement responses.

However, the region continues to experience disparities in technological readiness and operational capacity. In Tanzania, several inland depots and border posts still rely on manual customs declarations, which slows down cargo clearance and increases opportunities for theft (Mwakyusa, 2021). Similarly, Burundi has faced technical difficulties in aligning its customs software with RECTS, leading to data gaps and system malfunctions that compromise cargo tracking accuracy (Nzohabonayo, 2022). These persistent implementation gaps diminish the overall effectiveness of the regional digital cargo security infrastructure and highlight the need for sustained investments in system integration and staff training.

Within Kenya, digital technology has become an indispensable component of customs modernization and cargo security strategy. The Kenya Revenue Authority (KRA) has rolled out

major digital platforms, including the Integrated Customs Management System (ICMS), RECTS, and Integrated Scanning Solutions (ISS), which are now operational at the Port of Mombasa and key inland locations (KRA, 2022). These tools are designed to enhance non-intrusive inspection, facilitate cargo tracking, and improve inter-agency data sharing. ICMS, for instance, allows for centralized processing of cargo information, significantly reducing paperwork and speeding up clearance times (Omondi, 2023). At the same time, RECTS provides real-time visibility of transit goods, mitigating risks of cargo diversion and theft along domestic and international corridors.

Despite these achievements, several counties such as Kisumu, Nakuru, and Eldoret continue to face logistical and operational constraints. In some cases, power instability and poor internet connectivity have disrupted ISS functionality, resulting in inspection delays and security lapses (Cheruiyot, 2021). Additionally, a shortage of adequately trained customs officers and limited awareness of system protocols have hindered the consistent use of these technologies across all customs points (Wekesa, 2022). As a result, cargo security outcomes remain uneven, with inland depots particularly vulnerable to breaches.

Focusing on Nairobi County, the Inland Container Depot (ICD) Embakasi stands as Kenya's most active and strategically significant inland customs terminal. Located in proximity to major highways, the Standard Gauge Railway, and Jomo Kenyatta International Airport, the facility handles a substantial share of Kenya's import and export cargo volumes destined for local consumption and regional distribution (Kinyanjui, 2023). Given its high throughput and centrality in East African logistics, ICD Embakasi is heavily reliant on digital systems such as ICMS, ISS, and RECTS to manage and secure cargo operations.

However, even with the presence of these systems, the depot continues to experience security concerns including cargo delays, partial system downtimes, and unauthorized cargo movements (Mutua, 2023). Anecdotal reports have pointed to cases of information manipulation during offpeak hours and technical issues that compromise scanner reliability. These gaps expose a pressing need to assess whether the installed digital technologies are functioning as intended and delivering the anticipated cargo security benefits. Without concrete data on their influence, stakeholders risk misallocating resources or overlooking necessary improvements.

1.2 Statement of the Problem

Cargo security remains a critical concern at the Inland Container Depot (ICD) in Embakasi, Nairobi, which serves as a major logistics node for goods transiting from the Port of Mombasa to inland and regional destinations. Despite the deployment of digital technologies such as the Integrated Customs Management System (ICMS), Integrated Scanning Solutions (ISS), and the Regional Electronic Cargo Tracking System (RECTS), cases of pilferage, delayed clearances, and suspicious cargo diversions continue to be reported. These incidents highlight operational inefficiencies and raise questions about the actual effectiveness of the digital systems in safeguarding cargo. The depot processes over 60% of all containerized inland imports and exports in Kenya, and any breach or delay at this point results in financial losses for cargo owners, customs authorities, freight agents, and regional traders reliant on seamless logistics through Nairobi. Moreover, vulnerabilities in cargo handling compromise Kenya's obligations under international trade and security frameworks, potentially affecting its regional competitiveness and reputation as a trade hub.

Quantitatively, the Kenya Revenue Authority reported that between 2021 and 2023, an estimated

KES 1.7 billion worth of goods were delayed or flagged due to irregularities in documentation, cargo inconsistencies, or untraceable movement from ICD Embakasi to onward destinations. These inefficiencies are compounded by periodic breakdowns in digital systems, inadequate staff training on new technologies, and poor coordination among enforcement units. The persistence of these challenges not only undermines trade facilitation but also exposes customs operations to security breaches and revenue leakage. While the technologies have been introduced to enhance security, there is limited empirical evidence evaluating their actual influence on preventing theft, ensuring timely cargo clearance, or reducing systemic risks. This study, therefore, sought to address this knowledge gap by examining how these digital technologies are currently functioning at ICD Embakasi and whether they are achieving their intended security outcomes.

1.3 Purpose of the Study

The purpose of this study was to examine the influence of digital technology on cargo security at the inland container depot of Embakasi, Nairobi, Kenya.

1.4 Research Objectives

i. To assess the influence of integrated scanning solutions (I-Scan) on cargo security at the Inland container depot of Embakasi, Nairobi, Kenya.

ii. To evaluate the influence of the Regional Electronic Cargo Tracking System (RECTS) on cargo security at the Inland container depot of Embakasi, Nairobi, Kenya. iii. To examine the influence of the Integrated Customs Management System (ICMS) on cargo security at the Inland container depot of Embakasi, Nairobi, Kenya.

1.5 Research Questions

The study sought to answer the following research questions:

i. How do integrated scanning solutions (ISS) influence cargo security at the Embakasi ICD?

ii. What is the influence of the Regional Electronic Cargo Tracking System (RECTS) to cargo security at the depot? iii. How does the Integrated Customs Management System (ICMS) influence cargo security at the Embakasi ICD?

1.6 Justification of the Study

This study was justified by Kenya's strategic role as a major logistics and trade hub within the East African region. As the primary entry and exit point for goods destined for landlocked countries such as Uganda, Rwanda, and South Sudan, Kenya handled a substantial volume of containerized cargo, particularly through critical points like the Embakasi Inland Container Depot (ICD). However, the security of cargo in these facilities remained a significant concern due to persistent threats such as cargo theft, tax evasion, and smuggling. According to the Kenya Transport Sector Report (World Bank, 2021), losses attributed to cargo-related crimes and inefficiencies were estimated to cost the country over USD 100 million annually in revenue leakages and logistical disruptions. This underscored the urgent need to strengthen cargo security as part of the country's broader customs modernization and economic resilience strategy (EAC Secretariat, 2020).

The deployment of digital technologies—including Integrated Scanning Solutions (ISS), the Regional Electronic Cargo Tracking System (RECTS), and the Integrated Customs Management System (ICMS)—was seen as a strategic response to these challenges. However, there had been limited empirical evaluation of how effectively these technologies addressed security vulnerabilities at the inland depot level. This study sought to fill that knowledge gap by systematically assessing the influence of each system on cargo security outcomes at ICD Embakasi. The research aimed to generate evidence that would guide policy improvements, technical upgrades, and training investments in digital customs infrastructure. Moreover, findings from this study were expected to support the design of sustainable, scalable security frameworks

applicable not only within Kenya but also across similar depots in East Africa (UNCTAD, 2022). The academic relevance of the study was further underscored by its contribution to the literature on trade logistics, digital governance, and security system integration in emerging economies (Kamau & Githinji, 2019).

1.7 Significance of the Study

This study held both practical and strategic significance for a broad spectrum of stakeholders engaged in cargo security, customs operations, and regional trade facilitation. For the Kenya Revenue Authority (KRA) and other border control institutions, the study provided evidence-based insights on how technologies such as ISS, RECTS, and ICMS influenced cargo security, enforcement efficiency, and customs compliance at ICD Embakasi. These insights were expected to guide operational decision-making, including system optimization, resource allocation, and capacity-building initiatives. Furthermore, the study provided empirical justification for continued public and donor investment in customs digitization—an area actively supported by development agencies such as the World Customs Organization (WCO, 2021) and the World Bank under regional trade infrastructure programs (AfDB, 2022).

At the policy level, the findings served as a foundation for refining Kenya's trade and security regulations. Agencies such as the Ministry of Transport, the National Treasury, and the Trade Facilitation Committee could use the insights to strengthen legal frameworks governing the use of digital systems in cargo inspection and transit monitoring. The study also contributed to academic discourse by offering a rare empirical examination of inland cargo security within a digital context, a topic often under-researched in sub-Saharan Africa (Omondi & Makori, 2020). For postgraduate students, researchers, and scholars in the fields of customs, logistics, and ICT policy, the research offered valuable data and methodological direction. Additionally, private sector actors—such as

freight forwarders, insurance companies, and commercial banks—were positioned to benefit from the findings through enhanced understanding of how digital cargo monitoring systems influenced risk management, bonded transit policies, and cargo guarantee mechanisms. Overall, this study bridged a critical gap between digital transformation policy and ground-level customs security practices in Kenya.

1.8 Scope of the Study

This study focused on the Inland Container Depot in Embakasi, Nairobi, and explored the impact of technology on cargo security at this specific location. The research focused on a 10 year period from 2013 to 2023. This time span was found prudent since it was the beginning of a new regime in power just after the 2013 general election, and the transition from the Mwai Kibaki to Uhuru Kenyatta government. Changes in government parastatals and entities were made and impacted on almost all organizations, KRA included. Geographically, the research was limited to the operations at the Embakasi ICD, although the findings may have broader implications for other depots in Kenya. The Embakasi ICD due to its proximity to the heart of the city centre, is the busiest and would provide almost all the required data in the research. It is also the most equipped of the other inland depots. Methodologically, the study employed quantitative data collection techniques, including a survey with KRA employees and other stakeholders. The study focused on three main technological solutions: I-Scan, RECTS, and ICMS, analyzing their effectiveness in improving cargo security.

1.9 Limitations of the Study

Although this study sought to generate meaningful insights into the influence of digital technology on cargo security at the Inland Container Depot (ICD) in Embakasi, it encountered several limitations that may have influenced the scope and depth of its findings. One major limitation

involved restricted access to detailed records on cargo theft, diversion incidents, and system breaches due to security sensitivities and data classification protocols. Many institutions were reluctant to share sensitive operational data, citing the need to protect national security interests and maintain confidentiality. As a result, the study primarily relied on self-reported data from respondents, which, while useful, may have been subject to social desirability bias or underreporting.

Additionally, time and resource constraints limited the ability to conduct longitudinal or followup assessments that could have enriched the study's conclusions. The use of a cross-sectional design provided a snapshot of current system performance but did not allow for tracking changes in cargo security outcomes over time. To mitigate these limitations, the researcher anonymized all collected data and assured participants of strict confidentiality, which helped encourage honest responses. Future researchers are encouraged to consider experimental or longitudinal approaches that can assess technological interventions over an extended period, possibly incorporating independent audits or system-generated data logs for a more objective analysis.

1.10 Delimitations of the Study

This study was delimited to the exploration of how digital technologies influence cargo security at the ICD in Embakasi, Nairobi. It did not examine other influencing variables such as personnel competency, organizational culture, manual inspection processes, or physical infrastructure, despite their acknowledged roles in cargo safety and customs performance. The investigation was confined to three digital systems—Integrated Scanning Solutions (I-Scan), the Regional Electronic Cargo Tracking System (RECTS), and the Integrated Customs Management System (ICMS)—which were selected due to their official deployment at the study site and relevance to customs

operations. Technologies outside these three, such as biometric access systems or RFID tagging, were intentionally excluded to maintain a focused research scope.

Furthermore, the study centered on the perceptions and experiences of employees from the Kenya Revenue Authority (KRA), customs officials, and technical staff working directly at the Embakasi ICD. It did not extend to perspectives from international logistics firms, truck drivers, or members of the public who interact with the system indirectly. These decisions were made to align the study with the objectives, time, and resource limitations. To facilitate smooth data collection and ensure compliance with ethical standards, the researcher secured all necessary approvals, including a research permit from the National Commission for Science, Technology and Innovation (NACOSTI), and additional clearances from the Nairobi County Government and the Kenya Revenue Authority.

1.11 Assumptions of the Study

The study was underpinned by several key assumptions that guided its design and execution. It was assumed that all respondents would provide accurate, honest, and unbiased information regarding their experiences and assessments of the technologies in use. This assumption was critical, especially given the reliance on primary data obtained through structured questionnaires. It was also presumed that the respondents possessed adequate knowledge of the operational performance of ICMS, RECTS, and I-Scan, given their professional roles within the customs and technical departments.

Moreover, the study assumed that the selected sample was representative of the larger workforce at the Embakasi ICD. The stratified random sampling approach was intended to capture a broad range of views across different operational units, and it was anticipated that the insights drawn

from this sample could be generalized to reflect the overall status of digital cargo security systems at the depot. These assumptions were foundational in enabling the researcher to make inferences about the broader impact of digital technologies on cargo security within the study area.

1.11 Operational Definition of Key Terms

Cargo monitoring: in this study, cargo monitoring is a procedure of custody watch (track) of cargo that is on shipment. It is achieved through an organization of beams that is armed at point of departure and disarmed at the point of exit or destination. Cargo monitoring solutions are employed in improving safety of goods, assuring stakeholders of quality and compliance of set standards as well in ensuring risk reduction.

Cargo security: in this study, cargo security is the act of protecting or safeguarding good. Any measure used to secure cargo from any kind of threat compromise or any unlawful act. It is a very vital element of the cargo supply chain as increased cargo security strengthens supply chain, as cargo theft remains to be an emergent concern within the globe.

Integrated Custom Management System: it is a custom system used by different agents for, customs declaration, verification, duty calculation and clearance (ICMS manual). This technique consolidated all present schemes into one current vigorous and more effective organization erected on the newest technology with expertise of seamless interfacing with other internal and external procedures as demand arises.

I-scan: this is an X-ray scanning system employed by KRA with intention of conducting non-Intrusive goods examination to solve risk hence reducing unnecessary physical inspection. According to testechsolutions.com, I-Scan is a powerful tool that accurately measures and analyzes interface pressure between two surfaces, utilizing a thin and flexible sensor.

Regional Electronic Tracking system: A system used to share a lorry driver's report which is managed and activated by income authorities in the region.

Technology: application of scientific knowledge for practical purpose. It can also be defined as machinery and equipment developed from application of scientific knowledge (oxford dictionary) In this study, technology entails all measures, policies, soft wares and physical devices employed in ensuring cargo safety. They include but not limited to Integrated Scanning Solutions, integrated cargo management systems, I-Scan, Regional Electronic Tracking system.

World Customs Organization: Intergovernmental organization mandated with the authority of development of custom related policies, commodity classification and international trade facilitation. The WCO upholds an International Harmonized System goods catalogue and governs all features, policies, contracts and treaties of the Global Trade institute. Its principal objective is to improve efficacy and value of member customs administrations in realizing development goals, community protection, trade facilitation, revenue collection and collection of trade statistics.

Inland container Depot: A container storage facility situated in the hinterland away from the port. In this study the Inland container depot at Embakasi is our main focus. The container depot contains various containers stationed at a collection facility, with assorted goods and commodities ferried from the main port of Mombasa.

Transit Monitoring Unit: A unit mandated with monitoring, identifying and intercepting potential risks in cargo handling and security.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter outlines the theoretical framework of the study, game theory model, advantages and disadvantages game theory model, entrepreneurship and innovation theory, empirical review, technology, ISS and cargo security, RECTS and cargo security, ICMS and cargo security, literature overview and gaps, conceptual framework model, research gaps and recap of literature review.

2.2 Empirical review

The intersection between digital technology and cargo security has garnered increasing attention in recent years, particularly in the context of customs modernization and trade facilitation. As governments and logistics agencies confront persistent threats such as cargo theft, diversion, and non-compliance, the adoption of digital systems has emerged as a pivotal strategy for enhancing operational oversight and safeguarding goods in transit. Technologies such as Integrated Scanning Solutions (ISS), Electronic Cargo Tracking Systems (like RECTS), and Integrated Customs Management Systems (ICMS) have been introduced to bridge the security gaps inherent in manual or fragmented customs processes.

Empirical literature on this subject reveals a growing interest in assessing how effectively these digital interventions mitigate risks, deter illicit activity, and contribute to safer cargo movement across domestic and international corridors. At the same time, scholars have highlighted the need to evaluate how local contexts, including infrastructure readiness, user capacity, and system integration, influence the performance of these technologies. This section reviews selected empirical studies that explore the functional impact of digital technologies on cargo security

outcomes, providing a foundation for understanding their applicability and limitations within the specific operational environment of ICD Embakasi.

2.2.1 Influence of Integrated Scanning Solutions (I-Scan) on Cargo Security

The adoption of Integrated Scanning Systems (I-Scan) has been a transformative advancement in customs and border control processes. These systems, which enable non-intrusive inspection of cargo using high-resolution imaging and radiographic technologies, are designed to enhance detection of concealed or misdeclared items and reduce reliance on physical inspections (Zhang & Wang, 2020). The reliability, clarity, and effectiveness of scanned cargo images are crucial in enhancing border security and minimizing illicit trade (Alonso & Vanichkina, 2021). This section explores empirical evidence from global to local contexts on the influence of I-Scan technologies on cargo security.

In the United States, Johnson (2021) evaluated the performance of fixed X-ray scanners at inland customs depots and found that they improved the accuracy of concealed item detection by 41%, while reducing manual inspection rates by 53%. These scanners enabled border control officers to visually assess cargo content without physical unpacking, thus saving time and reducing labor costs. Likewise, in Germany, Müller and Stein (2020) reported that the deployment of mobile cargo scanners at inland depots improved inspection efficiency by 39% and led to a 24% increase in the identification of under-declared items.

In Singapore, Lim and Tan (2022) found that more than 85% of inbound containers at inland depots are scanned using high-resolution equipment, leading to a 48% decline in smuggling incidents over five years. In Canada, Fraser (2020) noted that the adoption of cargo scanning technology increased revenue collection by 16% and improved seizure rates by 36%, demonstrating a direct

correlation between scanning clarity and enforcement success. These global trends confirm the effectiveness of integrated scanning systems in improving cargo visibility and border security outcomes.

In Morocco, Benhammou and El Ouardi (2022) analyzed the effectiveness of fixed I-Scan systems at the Port of Casablanca and reported a 33% increase in accurate identification of contraband, particularly concealed electronics and textiles. Clearance time for scanned cargo dropped by 29%, indicating that clarity of imaging played a key role in improving inspection workflows. In Egypt, Ahmed (2019) found that automated scanning reduced delays in cargo processing by 27%, while increasing the detection of illicit goods by 21% within the Alexandria inland depot.

In Nigeria, Okonkwo and Udeh (2021) reported that mobile scanning units introduced at Lagos depots detected smuggled goods in 22% of shipments that had passed prior manual checks. They also found a 31% reduction in customs fraud associated with under-invoiced goods. Similarly, in Ghana, Asare and Boateng (2020) observed a 17% improvement in detection of high-risk cargo after introducing I-Scan equipment, particularly in the mining and oil sectors, where concealment of sensitive equipment had been prevalent.

In Uganda, Namusoke and Luyiga (2021) examined the performance of non-intrusive scanning systems at the Kampala inland terminal, where a 35% increase in detection of misdeclared goods was recorded within 18 months. They also reported a 42% decline in reliance on physical inspections, as customs officers became more confident in the visual outputs provided by scanning systems. In Rwanda, Habimana and Mugisha (2022) observed that high-resolution scanning images improved identification accuracy of anomalies in over 38% of processed containers at Rusumo inland port.

In Tanzania, Mwakalobo and Kombe (2021) found that the use of mobile scanners at the Dar es Salaam port increased detection of undeclared electronics by 26% and improved throughput at customs by 31%. Similarly, in Burundi, Ndayishimiye (2020) reported that fixed scanning units at Bujumbura's depot reduced clearance delays by 19% and successfully flagged discrepancies in 18% of high-risk containers. Across the region, the value of scanning clarity and automation has proven vital in enhancing cargo integrity.

In Mombasa, Ochieng and Wanjala (2020) documented that the installation of modern cargo scanners increased concealed goods detection by 31%, with a 45% drop in physical inspection frequency. This contributed to faster cargo clearance and improved throughput. In Nakuru, Kiptoo and Wekesa (2022) observed that I-Scan systems helped customs officers identify anomalies in 26% of flagged containers, particularly in second-hand vehicle imports.

Mutai and Cheruiyot (2021) found that in Eldoret, non-intrusive scanners reduced container processing time from 2.4 hours to 50 minutes, directly correlating to a 34% improvement in security screening efficiency. In Kisii, Onyango (2021) reported a 19% decline in cargo theft and an 11% increase in customs revenue following the installation of mobile I-Scan systems, underscoring their impact on both enforcement and fiscal performance.

At Embakasi ICD, digital scanning technologies have been operationalized, yet implementation outcomes vary. According to Mwangi and Otieno (2022), customs officers cited improved clarity of scanned images in 67% of processed containers, which contributed to a 28% increase in the detection of misdeclared electronics and household goods. The same study reported a 39% reduction in physical inspection requests, demonstrating system efficiency.

Ndung’u and Kamau (2021) observed that scanning units experienced intermittent power-related downtimes in 14% of cases, which disrupted inspection cycles and led to reversion to manual

checks. Additionally, Onyango and Wekesa (2022) highlighted that scanner performance contributed to a 21% increase in flagged cargo for secondary verification, enhancing the integrity of high-risk cargo assessments. However, the effectiveness of scanning was noted to fluctuate depending on operator expertise and image interpretation skills, as noted by Wanjiru and Njoroge (2023), who found that 25% of inconsistencies in flagged scans were due to misinterpretation by undertrained personnel.

2.2.2 Influence of the Regional Electronic Cargo Tracking System (RECTS) on Cargo Security

The integration of electronic cargo tracking systems has revolutionized modern customs practices, particularly in transit cargo monitoring. The Regional Electronic Cargo Tracking System (RECTS), jointly implemented by the Kenya Revenue Authority (KRA) and its regional partners, is a real-time, GPS-enabled solution that facilitates end-to-end visibility of cargo movement from origin to destination (Mutinda & Korir, 2021). Through automated alerts, electronic seals, and central monitoring dashboards, RECTS enables customs to detect deviations, unauthorized stops, or prolonged halts, thereby improving enforcement capability. Its adoption is particularly vital for high-risk and high-value cargo, as it helps deter theft, diversion, and illegal trans-shipment (Munyiri, 2020). The empirical review that follows presents evidence across international, continental, regional, national, and local settings, focusing on the influence of RECTS on cargo security.

In India, the integration of e-tracking tools into the national GST logistics system has demonstrated measurable security outcomes. Rajan and Banerjee (2021) found that unauthorized cargo diversions decreased by 41% following the rollout of the e-Way Bill tracking system. The system also reduced customs response time to incidents from over 90 minutes to an average of 38 minutes.

Importantly, 71% of all route deviation cases were resolved within the same day, showcasing the real-time transmission capabilities of the tracking technology.

In Brazil, Souza (2020) studied the federal road freight tracking system and reported that cargo interception during deviation attempts improved by 52%. The system's alert accuracy rate was recorded at 88%, meaning that the majority of flagged incidents corresponded to real transit anomalies. The tracking system also reduced smuggling incidents along the São Paulo–Minas Gerais corridor by 43% within two years. In South Korea, Choi and Kim (2021) highlighted that 93% of all long-haul cargo was fitted with tracking devices, resulting in a 62% increase in cargo identification accuracy at weighbridges and customs checkpoints, due to integrated digital logs.

Mexico's experience offers a case study on the value of GPS-enabled enforcement. According to Sanchez (2020), hijackings of cargo trucks dropped by 53% along Mexico City's northern corridor after the deployment of national tracking protocols. The study found that over 80% of enforcement responses to system-generated alerts occurred within 45 minutes, and transporters reported a 35% decline in insurance premiums due to improved cargo protection.

In Nigeria, Adeyemi (2019) examined bonded cargo monitored using GPS-linked tracking devices between Lagos and Kano. The study revealed a 40% decline in tampering incidents and an increase in successful enforcement actions by 33%. Moreover, the alert system flagged 78% of route deviations correctly, enabling customs and local police to conduct coordinated interceptions. The adoption of tracking systems also led to an 18% rise in documented compliance among crossborder hauliers.

In Ghana, Kwabena and Nyarko (2021) investigated the use of electronic cargo seals between the Tema Port and northern inland depots. The research showed a 44% improvement in cargo visibility, with system alerts successfully preventing diversion in 39% of attempted fraud cases.

Additionally, 88% of cargo arriving at the Bolgatanga depot was traceable throughout its journey, enhancing accountability and audit reliability. In Algeria, Benkhelifa and Sahraoui (2020) found that route deviation cases dropped by 31% following the deployment of e-tracking systems, especially for pharmaceutical and construction imports, which are prone to theft.

In Tunisia, Lamine and Farhat (2021) recorded a 29% improvement in customs enforcement outcomes due to GPS monitoring. Their study showed that 81% of cargo flagged for deviation was intercepted within a 90-minute window. Transporters were also more likely to comply with designated transit routes, reducing transit disputes by 24%. Collectively, these studies show that tracking systems can significantly improve operational and security metrics when integrated into customs infrastructure.

In Uganda, RECTS has been used to monitor cargo on key routes such as Kampala–Malaba and Kampala–Nimule. Kato and Ssenyonjo (2020) found that the adoption of RECTS reduced reported cargo theft by 33% between 2018 and 2020. The system generated accurate alerts for 85% of deviation cases, leading to rapid response by mobile customs units. The same study highlighted a 28% increase in transit compliance among licensed transporters following RECTS deployment, demonstrating both deterrent and preventive effectiveness.

Rwanda's customs authority also reported marked improvements. Niyonsenga and Habineza (2022) stated that 47% of diversion attempts were intercepted in real time through RECTS, especially for petroleum and electronics shipments. The tracking system enabled customs to crossverify cargo IDs at entry and exit points with 92% accuracy. In Tanzania, Mbwambo (2021) found that GPS tracking through RECTS cut clearance delays at key depots by 22%, and system alerts contributed to a 41% increase in detection of non-compliant cargo movement.

In Burundi, Barikumwe and Ndayizeye (2020) studied the use of RECTS on goods bound for Rwanda and the Democratic Republic of Congo. They reported that alerts led to interception of 17% of potentially diverted cargo. Coordination among customs, police, and revenue agencies was also improved, leading to faster investigative closure of suspicious cases. The system's influence extended to improved documentation, as 93% of tracked shipments had real-time logs for auditing.

In Mombasa, RECTS has become an essential part of customs surveillance. Mutua and Njuguna (2021) found that the system reduced diversion of high-risk cargo by 36%, with inspection teams receiving automated alerts an average of 25 minutes after a violation occurred. The compliance rate for RECTS-tagged cargo increased from 68% in 2018 to 85% in 2021. In Nakuru, Kiplagat and Kosgei (2020) found that the system helped customs flag 42% more route violations, particularly for sugar and fuel consignments.

Otieno and Rono (2021) documented in Eldoret that customs interceptions based on RECTS alerts prevented the diversion of 28% of flagged cargo within two hours of deviation. The average cargo tracking accuracy rate was 89%, and customs officers relied on route data to determine inspection priority. In Kisii, Onyiego and Maranga (2022) found that RECTS-enabled shipments were 35% more likely to complete transit without security incidents. The study noted that while device maintenance remained a challenge, alert precision and audit trails were key benefits for customs officers.

At the Embakasi Inland Container Depot, RECTS has been integrated into operations involving both local and cross-border cargo. Mwangi and Otieno (2022) found that 87% of tracked shipments arriving at Embakasi followed prescribed routes without deviation, while 62% of flagged alerts resulted in actionable interceptions. These included high-value goods such as electronics,

beverages, and imported machinery. The study showed that RECTS reduced cargo diversion cases by 29% within the depot's jurisdiction.

Ndung'u and Kamau (2021) reported that use of RECTS led to a 41% reduction in irregular cargo flows from Embakasi to Kisumu and Eldoret, largely due to enhanced enforcement coordination. However, 19% of transporters cited occasional delays in data synchronization, affecting the responsiveness of the alert system. Onyango and Wekesa (2022) observed that RECTS dashboards were instrumental in prioritizing inspections, with recovered revenue from flagged cargo increasing by 22% between 2021 and 2022. Wanjiru and Njoroge (2023) added that customs staff sometimes misinterpreted alerts, resulting in a 13% false-positive rate, suggesting a need for continuous training.

2.2.3 Influence of the Integrated Customs Management System (ICMS) on Cargo Security

Integrated Customs Management Systems (ICMS) are centralized digital platforms used by customs administrations to manage cargo declarations, automate clearance processes, and share data across regulatory and enforcement agencies. These systems aim to enhance cargo security by reducing paperwork, preventing fraudulent declarations, and facilitating real-time access to trade data (Omondi & Makori, 2020). By streamlining documentation and improving inter-agency collaboration, ICMS can reduce opportunities for cargo manipulation, data tampering, and unauthorized delays (Kamau & Njiru, 2021). This review presents empirical evidence from various global, continental, regional, and local studies, focusing on how ICMS impacts the accuracy, transparency, and security of cargo operations.

In the Netherlands, Van Dijk and Smit (2021) found that the integration of ICMS with the EU's Single Window system led to a 38% increase in declaration accuracy and a 44% reduction in cargo release delays. The centralized data platform enabled customs to flag suspicious cargo movements

within 10 minutes of data submission, enhancing security screening at inland terminals. Similarly, in Canada, Browning (2020) observed that ICMS integration between customs and food safety agencies helped detect inconsistencies in 19% of agricultural cargo declarations, preventing entry of high-risk goods.

Singapore offers one of the most advanced ICMS models. According to Lim and Chua (2022), the TradeNet system, which integrates customs, port authorities, and trade regulatory bodies, improved data consistency in over 94% of cargo entries. The system also reduced documentation errors by 56% and eliminated duplicate inspections in 78% of cargo cases through real-time data access. In South Korea, Jeong and Han (2021) highlighted that electronic customs systems improved cargo clearance time from an average of 4 days to 1.5 days while increasing the identification of false declarations by 33%.

In Nigeria, Okechukwu and Agbo (2020) analyzed the Automated System for Customs Data (ASYCUDA++) and found a 27% decrease in cargo fraud cases over two years following its integration with national tax and port systems. The system's real-time validation reduced declaration anomalies by 31%, particularly for high-value imports. In Ghana, Mensah and Aboagye (2021) noted that the transition to the Integrated Customs Management System led to a 42% increase in correct declarations and reduced clearance time by 36%.

In Tunisia, Chebbi and Baccouche (2021) reported that digital customs systems cut documentation-related disputes by 29% and increased traceability of cargo declarations by 40%, helping authorities link shipment data with tax compliance records. In Algeria, Amrani and Zineb (2020) observed that the national ICMS helped customs uncover undervaluation and misclassification in 23% of declarations over a 12-month period, leading to enhanced cargo security and increased revenue collection.

In Uganda, Mugisha and Nantume (2020) examined the Uganda Electronic Single Window, which integrates customs and other trade agencies. They found that 81% of customs officers reported improved accuracy in declarations, with a 37% drop in documentation errors across five inland terminals. The system also reduced clearance time by 45%, contributing to smoother cargo flow and fewer fraud cases. In Rwanda, Uwimana and Gasana (2022) found that ICMS integration improved real-time visibility across customs, revenue, and border control systems, enhancing compliance checks for over 90% of cargo declarations.

Tanzania's customs digitization has shown similar benefits. According to Ndunguru and Mwakyusa (2021), the implementation of electronic data interchange systems led to a 28% improvement in detection of invoice fraud and a 32% drop in customs documentation irregularities at the Dar es Salaam port. In Burundi, Nzeyimana and Hakizimana (2020) reported that linking ICMS to regional transit data reduced paper-based anomalies by 24% and increased the accuracy of cargo identification across internal checkpoints.

In Mombasa, Ochieng and Mutua (2021) found that ICMS reduced clearance time by 41% and improved the accuracy of declarations by 38% across port operations. Customs officers attributed this to the centralized validation system and integration with partner databases, such as the Kenya Ports Authority and the National Treasury. In Eldoret, Kiprop and Cherono (2022) observed that the automated reconciliation of cargo entries minimized misdeclaration and improved audit trail consistency by 33%.

In Nakuru, Ndungu and Wekesa (2021) found that integration of ICMS with KRA's valuation database flagged over 25% of customs entries for price or quantity discrepancies. The platform also provided customs access to manifest data before physical arrival, allowing better pre-arrival targeting. In Kisii, Makori and Nyangweso (2022) reported that 76% of customs staff found ICMS

useful in reducing clearance disputes, while the system cut documentation errors by 21% among clearing agents and freight forwarders.

At the Embakasi Inland Container Depot, the ICMS is a core tool in managing cargo entries, risk profiling, and documentation compliance. Mwangi and Otieno (2022) reported that 68% of customs officials rated ICMS as effective in flagging inconsistencies in cargo declarations, particularly in second-hand vehicles and electronics. They also found that integration with RECTS and I-Scan enabled cross-verification of physical inspection findings with declared data, improving enforcement decisions.

Ndung'u and Kamau (2021) highlighted that ICMS reduced document-related delays at Embakasi by 34%, especially for imports from China and India. However, they noted occasional system downtimes and limited bandwidth during peak clearance periods, which led to delays in data submission and increased clearance time. Onyango and Wekesa (2022) observed that ICMS helped customs generate audit trails for over 89% of declarations reviewed, aiding in post-clearance verification and revenue recovery efforts. Wanjiru and Njoroge (2023) found that while ICMS had improved data reliability, only 61% of clearing agents had received formal training on how to interface with the system effectively, which contributed to user-based errors.

2.3 Theoretical Framework

This study was anchored on two interrelated theories: the Technology Acceptance Model (TAM) and Game Theory. TAM, developed by Davis (1989), posits that the adoption of technology depends on users' perceptions of its usefulness and ease of use, which subsequently influence their intention to use and actual engagement with the system. In this study, TAM informed the third objective, which examined the influence of the Integrated Customs Management System (ICMS) on cargo security at the Embakasi Inland Container Depot. Since ICMS required customs officers

and clearing agents to input, retrieve, and interpret real-time data for enforcement decisions, the theory offered a lens to assess how users' attitudes shaped its effectiveness. TAM was used to evaluate the human-technology interface, focusing on the impact of users' digital literacy, prior training, and operational experience on the system's reliability in documentation and inter-agency coordination (Venkatesh & Davis, 2000).

Complementarily, Game Theory, introduced by von Neumann and Morgenstern (1944), supported the second objective, which evaluated the influence of the Regional Electronic Cargo Tracking System (RECTS) on cargo security. Game Theory provided a framework for analyzing strategic decision-making among rational actors—such as smugglers, transporters, and customs officers—who respond to surveillance mechanisms like RECTS. It helped model how real-time monitoring influenced behavior by increasing the risks and costs associated with non-compliance. Although the first objective—assessing the impact of I-Scan—was largely technical, its implementation and effectiveness were also interpreted through the combined insights of TAM and Game Theory. Together, the theories provided a comprehensive analytical lens for understanding both internal user adoption behaviors and external compliance dynamics within the cargo security ecosystem (Davis, 1989; Mailath & Samuelson, 2006).

2.3.1 Game Theory

This study applied Game Theory to examine how RECTS influenced cargo security at the Embakasi Inland Container Depot. As a model of strategic interaction, Game Theory assumed that stakeholders—such as transporters, customs officials, and offenders—made calculated decisions based on anticipated reactions to enforcement technologies. In this context, RECTS altered stakeholder behavior by introducing GPS-based tracking and automated alerts, which increased the risks and penalties for diversion or tampering (Osborne & Rubinstein, 1994). The theory

enabled an assessment of how customs officers reallocated enforcement resources based on alert data and how transporters adjusted behavior to avoid detection. Through analysis of cargo diversion patterns, interception rates, and alert responsiveness, the study demonstrated how RECTS strengthened cargo security by triggering strategic shifts in actor behavior (Mailath & Samuelson, 2006).

2.3.2 Technology Acceptance Model Theory [TAM]

TAM guided the evaluation of how ICMS influenced cargo security, particularly through the lens of system usability and user acceptance. Developed by Davis (1989), the model emphasized that users' belief in a system's usefulness and ease of use influenced its adoption and effectiveness. In this study, TAM was applied to assess how customs officers and clearing agents interacted with ICMS in processing cargo declarations and risk profiling. The model provided insights into whether challenges such as data entry errors, underutilization, and system delays stemmed from user-related factors rather than technical limitations (Venkatesh & Davis, 2000). It helped determine whether ICMS users found the platform beneficial to their work and whether the interface encouraged consistent and correct engagement. By revealing barriers to optimal system use, TAM informed recommendations for enhanced training, better interface design, and improved user support. Ultimately, the model framed the evaluation of how internal user behaviors shaped the success of ICMS in enhancing cargo security outcomes (Venkatesh & Bala, 2008).

2.4 Conceptual Framework Model

The conceptual framework guiding this study is structured to examine the relationship between digital technology and cargo security at the Inland Container Depot (ICD) in Embakasi, Nairobi. The independent variable—digital technology—is operationalized through three core systems currently in use: the Integrated Scanning System (I-Scan), the Regional Electronic Cargo Tracking

System (RECTS), and the Integrated Customs Management System (ICMS). Each of these systems represents a unique technological approach to enhancing cargo security. I-Scan enables non-intrusive inspection and the identification of concealed or misdeclared items through advanced imaging; RECTS facilitates real-time monitoring and alerts on route deviations; while ICMS ensures reliable digital documentation, data sharing, and cargo clearance coordination. These technologies, collectively, are expected to influence the level of security in cargo handling, especially at a high-volume terminal like ICD Embakasi.

The dependent variable in this framework is cargo security, captured through three indicators: the detection rate of concealed or misdeclared cargo, the incidence of cargo diversion or theft during transit, and the financial implications of cargo security breaches. These outcomes are hypothesized to improve as the effectiveness and integration of digital technologies increase. However, the relationship between technology and cargo security does not operate in isolation. The study introduces "alternative types of security" as an intervening variable—this includes physical security procedures, human surveillance, and manual inspections that may support or undermine the technological systems. The effectiveness of digital solutions, therefore, may depend on how well they complement or replace these traditional measures. By examining this relationship, the framework provides a comprehensive lens through which the influence of digital systems on cargo security can be assessed within the complex operational environment of a major inland port.

INDEPENDENT VARIABLE **DEPENDENT VARIABLE**

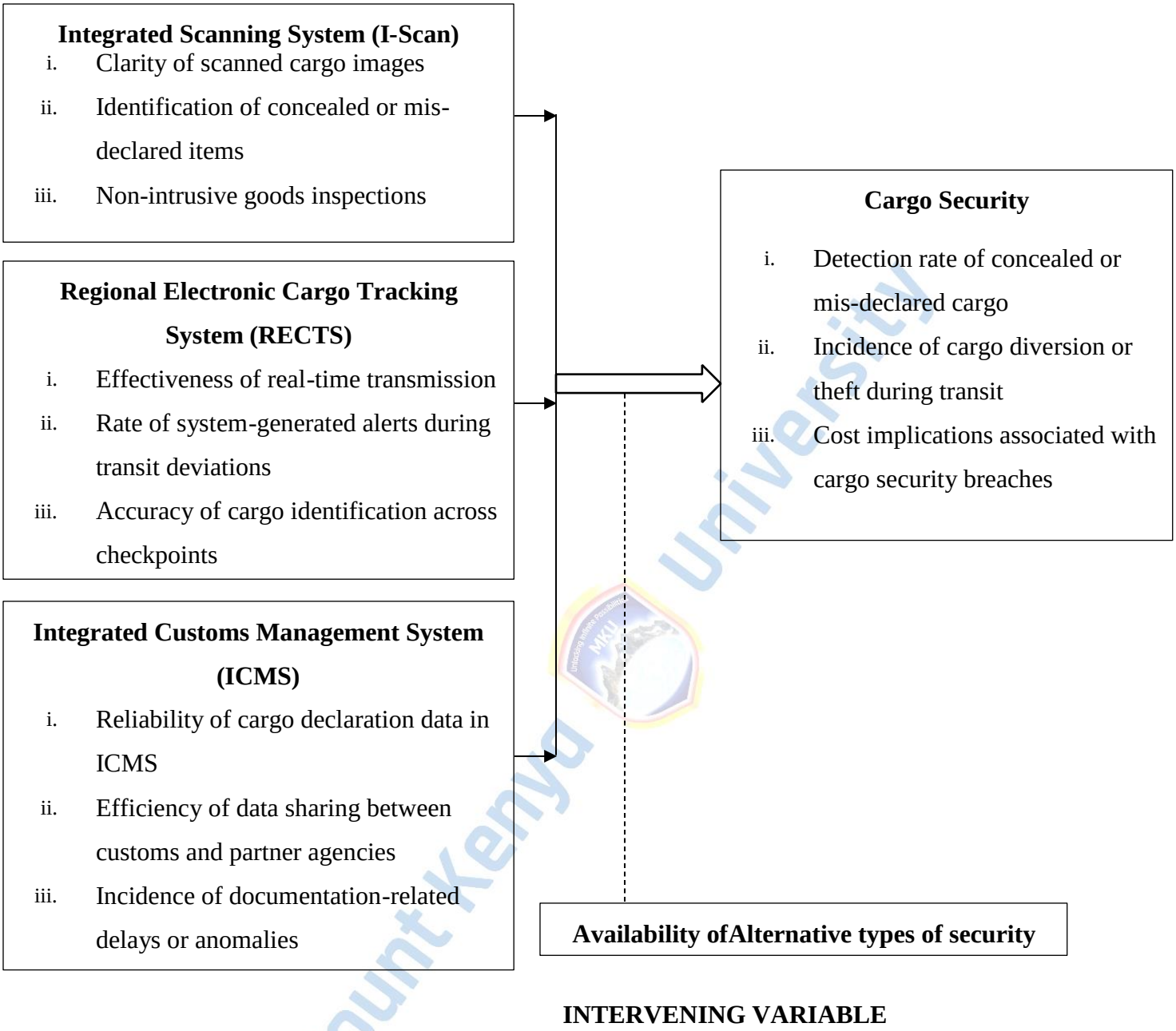

Figure 2. 1**: Conceptual Framework Model**

Source: Researcher 2025

2.5 Research Gaps

While empirical studies have consistently highlighted the contribution of Integrated Scanning Systems (I-Scan) to enhanced cargo inspection, much of the available evidence originates from

seaports and international borders, with limited focus on inland container depots like Embakasi. Most studies assess performance based on efficiency and throughput, but few provide granular insights into how I-Scan technologies influence the detection of concealed items or the reduction in physical inspections in a dry port setting. Moreover, discrepancies in scanner image interpretation due to limited operator training and occasional power-related downtimes remain understudied in local Kenyan contexts, despite their apparent operational impact.

Similarly, despite Regional Electronic Cargo Tracking System (RECTS) being widely implemented across East Africa, there is a lack of empirical clarity on its situational effectiveness at inland facilities such as Embakasi. Although macro-level data indicates reductions in diversion and theft, very few studies investigate how enforcement officers respond to system-generated alerts on a day-to-day basis. Additionally, the impact of user training, infrastructure stability, and alert interpretation accuracy is often generalized at national levels, leaving a significant gap in understanding RECTS's functionality at sub-national or depot-level operations.

For the Integrated Customs Management System (ICMS), most existing studies emphasize its role in reducing clearance time and improving declaration accuracy. However, minimal attention is given to its integration performance with other technologies like I-Scan and RECTS at inland terminals. Furthermore, research on ICMS tends to concentrate on system design and policy compliance, while overlooking user-side challenges such as inconsistent internet connectivity, data entry errors, and limited feedback mechanisms at the Embakasi ICD. There remains a knowledge gap on whether ICMS actively contributes to detecting fraudulent declarations and anomalies in cargo documentation in real-time within Kenya's inland customs ecosystems.

2.6 Recap of Literature review

The reviewed literature strongly affirms the transformative role that Integrated Scanning Systems (I-Scan) play in enhancing cargo security globally and within Africa. From high-income countries like Germany and Singapore to emerging economies like Nigeria and Uganda, I-Scan has led to notable improvements in detecting misdeclared goods, reducing manual inspections, and shortening clearance times. In Kenya, evidence from Mombasa, Eldoret, and Nakuru supports these findings, although challenges such as scanner downtime and inconsistent image interpretation persist. At Embakasi, scanning technology has shown positive results, but operational inconsistencies and training gaps continue to affect reliability.

The deployment of the Regional Electronic Cargo Tracking System (RECTS) has proven valuable in monitoring in-transit cargo, reducing theft, and increasing compliance with transit routes across multiple jurisdictions. Empirical evidence from countries such as India, Brazil, Rwanda, and Tanzania illustrates the value of GPS-enabled alerts and real-time monitoring in curbing diversion. In Kenya, particularly at the Embakasi ICD, RECTS has contributed to improved security metrics; however, the system still faces issues related to device maintenance, alert misinterpretation, and enforcement lag. These limitations highlight the importance of refining local operational models for RECTS application.

Integrated Customs Management Systems (ICMS) have enhanced transparency, accountability, and operational coordination in customs processes across the world. Studies from South Korea, Ghana, and Tunisia reveal their contribution to reducing documentation errors, uncovering fraud, and enhancing data integrity. In Kenya, ICMS has improved declaration accuracy and preclearance procedures, especially in Mombasa and Nairobi. Yet, infrastructural constraints, system downtimes, and training deficiencies continue to hinder optimal performance, particularly at inland

depots like Embakasi. Overall, the literature underscores the need for more localized assessments that go beyond functionality to examine real-time effectiveness, user experience, and contextual performance of these digital systems.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the practical procedures employed in the study. It provides a comprehensive description of the study area, research design, target population, sampling techniques, and procedures. Additionally, it details the data collection instruments and procedures, as well as the measures taken to ensure validity and reliability. The chapter also covers the methods used for data analysis and presentation, along with the ethical considerations observed throughout the research.

3.2 Research Methodology

This study adopted a mixed methods approach, combining both quantitative and qualitative research methodologies to ensure a holistic understanding of the influence of digital technology on cargo security at the Inland Container Depot (ICD), Embakasi. The methodology drew upon the explanatory design developed by Johnson and Christensen (2008), which allowed for a structured investigation of both numerical data and participant insights. Quantitative data was gathered using structured questionnaires to statistically measure the effectiveness of Integrated Scanning Solutions (ISS), the Regional Electronic Cargo Tracking System (RECTS), and the Integrated Customs Management System (ICMS). In parallel, qualitative data was obtained through semi-structured interviews aimed at exploring lived experiences, perceptions, and operational challenges related to these technologies (Creswell & Plano Clark, 2007).

The rationale for selecting a mixed methods approach was rooted in the need for triangulation, depth, and validation. Quantitative techniques enabled the researcher to establish patterns and test relationships between variables, while qualitative data enriched the analysis with contextual insights, particularly regarding user interaction with digital platforms. As Gholamreza and Hassan

(2010) suggested, the mixed methods design ensured both the breadth and depth of the phenomenon under study were captured. The approach also enhanced the reliability of the findings, as the convergence of results from multiple sources strengthened the credibility and generalizability of the study outcomes (Creswell, 2014). Ultimately, the methodology positioned the researcher to generate nuanced, evidence-based conclusions that were both practically relevant and theoretically grounded.

3.3 Research Design

This study employed a cross-sectional survey design, which enabled the collection of data at a single point in time to assess the influence of digital technologies on cargo security at ICD Embakasi. The design was particularly suitable for evaluating multiple variables simultaneously, as it allowed the researcher to gather opinions, behaviors, and outcomes from various stakeholders within a clearly defined timeframe. The data collection was conducted over a two-month period from July to August 2024, offering a reliable snapshot of the operational effectiveness of ISS, RECTS, and ICMS technologies. This design was not only efficient but also practical, considering the resource and time limitations commonly associated with field-based research (Kumar, 2019).

The use of surveys within this design provided a systematic way to collect information from a wide respondent base, including customs officers, freight agents, and security personnel. The structured format of the questionnaire ensured consistency in data collection and facilitated statistical analysis. The cross-sectional approach also minimized financial and logistical burdens, eliminating the need for prolonged observation periods or longitudinal tracking (Bryman, 2016).

This design supported the objective of the study by enabling a timely and cost-effective examination of the relationship between digital technologies and cargo security, while accommodating a large sample representative of the ICD’s operational workforce.

3.4 Location of the Study

The research was conducted at the Inland Container Depot (ICD) in Embakasi East Sub-County, Nairobi, Kenya. The facility was strategically selected due to its critical role in Kenya's importexport logistics, serving as a central hub for the clearance and handling of goods transported by rail and road from the Port of Mombasa. The Embakasi ICD connected Kenya to regional trade routes and managed large volumes of domestic and international cargo, making it a representative site for studying the effectiveness of digital security technologies. Its infrastructure included advanced scanning systems, GPS tracking, and automated customs systems—core components under investigation in this study.

3.5 Target Population

The target population for the study comprised employees stationed at the Embakasi ICD, totaling approximately 300 personnel. This included customs officials, system administrators, ICT support staff, and managerial officers—all directly involved in cargo inspection, clearance, monitoring, and data processing activities. These participants were selected based on their roles in implementing or operating the Integrated Scanning Solutions (ISS), RECTS, and ICMS technologies. Their frontline experience made them well-positioned to provide accurate insights into how these systems influenced the security, efficiency, and integrity of cargo management. Their diverse responsibilities also enabled the study to capture a wide spectrum of opinions, from policy oversight to technical execution (Mugenda & Mugenda, 2003).

3.6 Sampling Procedures and Technique

This study employed a stratified random sampling technique to ensure a comprehensive and representative sample across the different operational roles at the Embakasi Inland Container Depot. Stratification was based on functional departments, namely customs management,

Integrated Scanning Solutions (I-Scan), Regional Electronic Cargo Tracking System (RECTS), Integrated Customs Management System (ICMS), and junior officers. Stratified sampling enabled the researcher to segment the target population into distinct strata, each of which had a unique involvement in cargo security processes. According to Creswell and Creswell (2018), this method is particularly effective when the population is heterogeneous and the researcher aims to compare subgroups. By ensuring that each functional group was proportionally represented, the study minimized sampling bias and increased the precision of subgroup analysis.

Respondents from each stratum were selected randomly in proportion to their representation within the population, as recommended by Kothari (2004). This method ensured equitable inclusion and increased the validity of the findings by capturing diverse perspectives. Senior officers—such as the Chiefs of Operations, Supply Chain, and Security—offered a policy and supervisory lens, while RECTS and I-Scan officers provided technical insights into daily operations. The ICMS officers and junior customs personnel offered frontline experience regarding digital interaction and documentation procedures. The proportional allocation of the sample, based on stratum size, provided balanced data for analyzing the interplay between technological systems and cargo security.

3.7 Sample size

The study determined a sample size of 101 respondents from a total population of 135 employees at the depot. This sample was derived using Yamane's (1967) simplified formula for calculating sample size when dealing with finite populations. The formula is expressed as:

$n = N/1+N(e)^2$

Where n =

sample size

N =targeted population (135) e = level of significance [i.e. 5%

for 95% Confidence Interval]

Thus:

$n=135/1+135(0.05)^2$ n

=101

This statistically sound approach ensured that the sample was sufficiently large to yield generalizable findings while remaining manageable within the scope of time and resources. The use of this method enhanced the credibility and accuracy of data interpretation. This allowed each job category to be represented in a way that reflects its actual share in the population. For instance, 27 officers were drawn from the I-Scan team, 14 from RECTS, and 18 from ICMS, ensuring the perspectives of those directly involved with the digital technologies were adequately captured. The alignment of the sample structure with the research objectives supported meaningful comparison and robust statistical analysis.

3.8 Construction of Research Instruments

The research instruments were carefully constructed to align with the study's objectives and data needs. Structured questionnaires were developed as the primary data collection tool to capture both quantitative and qualitative responses. The questionnaire comprised four main sections: demographic information, perception of technological systems (I-Scan, RECTS, ICMS), assessment of cargo security outcomes, and challenges experienced during implementation. The design included closed-ended questions measured on a 5-point Likert scale to allow for statistical

analysis, as well as open-ended questions to collect more in-depth, explanatory responses from participants. This hybrid design enhanced the richness of the data and supported both descriptive and inferential analysis.

The development of the questionnaire was guided by existing literature and theoretical models such as the Technology Acceptance Model (Davis, 1989) and Game Theory (Osborne & Rubinstein, 1994), ensuring that the items were both conceptually grounded and contextually relevant. The instrument underwent pre-testing with a small subset of participants to identify and correct ambiguities, thereby increasing its reliability and validity. In addition, efforts were made to ensure clarity, neutrality, and inclusiveness in language to avoid bias and enhance response accuracy. The questionnaire was distributed in both print and electronic formats to improve accessibility and increase response rates across the various departments.

3.9 Validity and Reliability

To ensure the validity and reliability of the research instruments, the study implemented a combination of rigorous procedures prior to full-scale data collection. Validity refers to the extent to which the research instrument accurately measured the intended constructs, while reliability pertains to the instrument's ability to produce consistent results over time. A pre-test of the questionnaire was conducted on a small group of customs officers not included in the final sample. This pilot process identified potential issues in wording, structure, and response flow, enabling the researcher to revise the instrument to enhance clarity and reduce misinterpretation. The feedback informed the refinement of question phrasing and structure, increasing the likelihood that the responses collected would accurately reflect participants' experiences.

Content validity was established by consulting experts in customs security and technology systems, who reviewed the questionnaire to ensure it covered all dimensions of interest— particularly ISS, RECTS, and ICMS. These consultations helped confirm that the items comprehensively captured the operational, technical, and strategic elements of cargo security at the Inland Container Depot. To assess reliability, the study applied Cronbach's alpha coefficient, a widely used statistic to test the internal consistency of multi-item scales. A Cronbach's alpha value of 0.7 or higher was used as the benchmark for acceptable reliability, following the guidelines by Nunnally and Bernstein (1994). Furthermore, the use of stratified random sampling improved both reliability and generalizability by ensuring that each stratum within the depot population—such as customs officers, scanning personnel, and RECTS operators—was proportionally represented in the final sample.

3.10 Data Collection Methods and Procedures

The data collection process was designed to uphold high standards of scientific rigor and ethical responsibility. Before initiating fieldwork, the researcher obtained ethical approval from Mount Kenya University and NACOSTI, alongside formal authorization from Nairobi County and the Kenya Revenue Authority. These approvals safeguarded compliance with national and institutional research standards, ensuring that the rights and welfare of participants were respected throughout the research process (KNBS, 2021). A formal permit letter was then presented to the management at the Inland Container Depot in Embakasi, who granted internal clearance for the research team to conduct activities within the facility.

Participants were identified through stratified random sampling, targeting customs officials, I-Scan and RECTS operators, and ICMS personnel. Prior to data collection, potential participants were briefed about the purpose, procedures, and voluntary nature of the study. Informed consent was

obtained in writing, and participants were assured of confidentiality and anonymity. Data collection was conducted through interviewer-administered structured questionnaires to ensure standardization across responses while allowing for clarifications where necessary. Each interaction lasted approximately 10 minutes, balancing data richness with operational convenience. The structured design of the tool allowed for the systematic gathering of both quantitative and qualitative data, facilitating meaningful analysis aligned with the study's objectives.

3.11 Data Analysis Techniques and Procedures

The collected data were analyzed using descriptive statistical techniques through SPSS version 27, in line with recommended practices for applied social science research (Mugenda & Mugenda, 2003; Kumar, 2019). The analysis involved computing frequencies and percentages to summarize responses obtained from the structured questionnaires administered to respondents at the Embakasi Inland Container Depot.

To maintain alignment with the study's specific objectives, the data were organized thematically, focusing on the influence of Integrated Scanning Solutions (ISS), the Regional Electronic Cargo Tracking System (RECTS), and the Integrated Customs Management System (ICMS) on cargo security. Descriptive analysis was appropriate as it offered a clear overview of trends and patterns in the dataset without the need for complex statistical testing (Bryman, 2016).

The results were presented in tabular form, supported by brief explanatory narratives that interpreted the data in relation to each research objective. This format enhanced clarity and allowed for easier comparison across different variables and respondent categories (Orodho, 2005). Additionally, qualitative responses from open-ended sections of the questionnaire were analyzed thematically to enrich the interpretation of the quantitative data. This analytical approach ensured

that the findings remained focused, objective-driven, and accessible to both academic and operational audiences. It also provided a reliable foundation for drawing evidence-based conclusions on the effectiveness of digital technologies in securing cargo at the inland depot (Kothari, 2004).

3.12 Ethical Consideration

The study was conducted in accordance with recognized ethical standards applicable to research involving human participants. Prior to the commencement of fieldwork, the researcher secured ethical clearance from the Mount Kenya University Ethics Review Committee (Ref: MKU/ISERC/3739) and obtained a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI) under Ref: 173965. Additional approvals were granted by the Nairobi County Government and the Kenya Revenue Authority (Ref: KRANKU139824072024), ensuring the study's compliance with institutional and governmental research protocols.

Before data collection, all participants were briefed on the purpose, procedures, and scope of the study. Written informed consent was obtained, with participants assured of their voluntary involvement and their right to withdraw at any stage without consequences. To uphold confidentiality, no names or personal identifiers were recorded. Instead, unique codes were used to safeguard data and maintain participant anonymity. The research strictly adhered to the Kenya Data Protection Act (2019), which outlines principles for the secure and ethical handling of personal information. Throughout the study, ethical conduct was observed during interactions, data collection, analysis, and dissemination of results. Participants' dignity, autonomy, and privacy were respected at all stages, contributing to the credibility and integrity of the research findings.

CHAPTER FOUR

FINDINGS, ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter presents the analyzed findings of the study based on data collected from respondents at the Embakasi Inland Container Depot. The chapter is organized around the three specific objectives of the research, each focusing on a core digital system influencing cargo security: Integrated Scanning Solutions (I-Scan), the Regional Electronic Cargo Tracking System (RECTS), and the Integrated Customs Management System (ICMS). Quantitative results from structured questionnaires are supported by qualitative insights from key informant interviews. The analysis integrates theoretical interpretation through the Technology Acceptance Model and Game Theory to provide a comprehensive understanding of how digital technologies shape cargo security practices.

4.2 Response rate

The survey involved 101 participants drawn from various functional units at the Inland Container Depot, including senior personnel, ISS staff, RECTS operators, and ICMS officers. All 101 distributed questionnaires were duly filled and returned, yielding a 100% response rate, which reflects an outstanding level of respondent engagement. As noted by Kothari (2007), response rates exceeding 80% are generally considered highly dependable and adequate for supporting the validity of research outcomes. Table 4.1 presents the detailed distribution of the response rate across the different categories of respondents involved in the study.

Table 4. 1:Response Rate

Respondent	**Target number of questionnaires**	**Number of questionnaire answered**	**Response rate**
Senior Officers	13	13	100%
I-Scan officers	27	27	100%
RECTS Officers	14	14	100%
Junior Officers	29	29	100%
ICMS Officers	18	18	100%
Total	101	101	100%

Source: Study data 2024

4.3 Socio demographic characteristics of participants

Understanding the socio-demographic characteristics of respondents is essential in contextualizing their perspectives on the influence of digital technologies on cargo security. These attributes—such as age, gender, education level, marital status, and religious affiliation—help reveal patterns in awareness, experience, and interaction with systems like I-Scan, RECTS, and ICMS. Since the effectiveness of these technologies may depend on user competence, familiarity, and organizational roles, examining demographic details ensures that the study's findings are grounded in the realities of those directly involved in cargo security operations at the Inland Container Depot, Embakasi. The results are as shown in Table 4.2,

Table 4. 2:Respondent's socio- demographic characteristics

	Overall n=101		
Characteristic	**Frequency**	**Percentage**	**Cumulative Frequency**
Age			
18-25	21	20.7	20.8
25-35	37	36.6	57.4
35-45	26	25.7	83.2
45-55	10	9.9	93.1
Above 55	7	6.9	100.0
Highest level of education			
Diploma	33	32.7	32.4
Bachelors	40	39.6	71.9
Masters	28	27.7	100.0
Gender			
Male	61	60.39	60.39
Female	40	39.61	100.0
Marital status			
Single	24	23.76	23.76
Married	65	64.35	88
Separated	8	7.9	95.9
Divorce	4	4.0	100.0
Religion			
Muslim	11	10.9	10.9
Christian	83	82.2	93.1
Hindu	0	0	93.1
Other	7	6.9	100.0

Source : Researcher 2024

As shown in Table 4.2, the majority of participants (36.6%) were aged between 25 and 35 years, followed by 25.7% in the 35–45 age group. Respondents aged 18–25 made up 20.7%, while those between 45–55 years accounted for 9.9%. A smaller segment, 6.9%, were aged above 55. This distribution indicates that a significant portion of the workforce engaging with digital cargo security technologies is relatively young and within their early to mid-career stages. In terms of academic qualifications, 39.6% of respondents held a Bachelor's degree, 32.7% had a Diploma, and 27.7% possessed a Master's degree. This suggests that the majority of respondents had attained higher education, which may influence their capacity to interact effectively with digital systems used at the depot.

Regarding gender, 60.39% of the participants were male, while 39.61% were female. This points to a moderately male-dominated workforce, though female representation remains significant. On marital status, 64.35% of respondents were married, 23.76% were single, 7.9% were separated, and 4% were divorced. In terms of religious affiliation, the majority identified as Christian (82.2%), followed by Muslims at 10.9%. No respondents identified as Hindu, while 6.9% selected "Other" as their religious affiliation. This religious breakdown reflects the general demographic trends of the region and provides insight into the cultural diversity of the workforce.

4.3 Influence of Integrated Scanning Solutions (I-Scan) on Cargo Security at the Inland Container Depot of Embakasi

This section presents the findings related to the first objective of the study, which sought to assess the influence of Integrated Scanning Solutions (I-Scan) on cargo security at the Inland Container Depot in Embakasi. The analysis focused on three main aspects: clarity of scanned cargo images, identification of concealed or mis-declared items, and the extent of non-intrusive inspections carried out using I-Scan systems.

4.3.1 Clarity of Scanned Cargo Images and Cargo Security

This section explores respondents' perceptions regarding the clarity of cargo images produced by the I-Scan system and its contribution to cargo security. The results are presented in Figure 4.1 and analyzed through five key statements that reflect operational efficiency and security performance of the scanning technology.

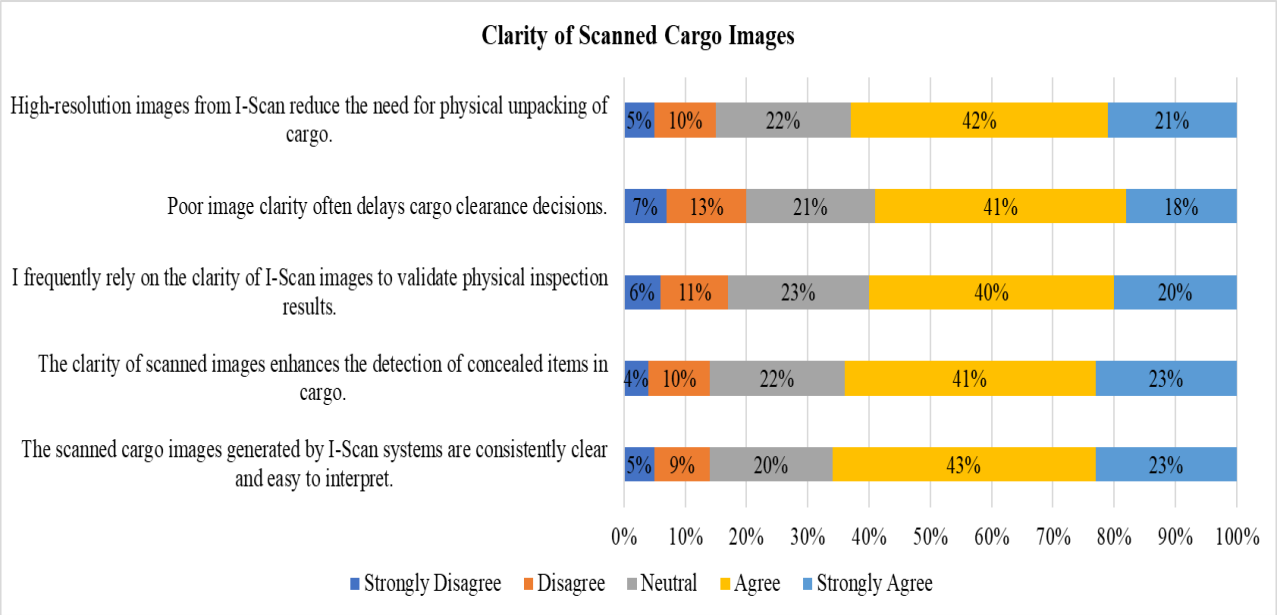

Figure 4. 1: Clarity of Scanned Cargo Images and Cargo Security

As shown in Figure 4.1, 42% of respondents agreed, and 21% strongly agreed that high-resolution images from I-Scan significantly reduced the need for physical unpacking of cargo. Only a small fraction, 5% strongly disagreed and 10% disagreed. These findings indicate that non-intrusive inspection through clear imagery is widely accepted among customs personnel as an effective screening method. This aligns with the findings by Fraser (2020) and Ochieng and Wanjala (2020), who observed that modern scanning systems reduced the frequency of manual inspections by over 45% and improved throughput efficiency. The implication is that improved image clarity directly contributes to time savings and reduces cargo handling risks.

A combined 59% of respondents either agreed (41%) or strongly agreed (18%) that poor image quality contributes to delays in clearance decisions. In contrast, 7% strongly disagreed, 13% disagreed, and 21% remained neutral. This suggests that while the I-Scan system is generally reliable, instances of unclear imagery still affect timely decision-making. This is consistent with Ndung'u and Kamau (2021), who reported scanner downtimes and unclear images in 14% of scanned containers at Embakasi ICD, leading to reversion to manual checks. Therefore, while clarity supports efficiency, occasional image quality concerns continue to hinder smooth operations.

According to the responses, 40% agreed and 20% strongly agreed that they frequently rely on IScan images to validate physical inspections. Only 6% strongly disagreed, while 11% disagreed, and 23% were neutral. These findings highlight that image-based validation is an important tool for cross-verifying suspicious consignments. This finding mirrors that of Habimana and Mugisha (2022) in Rwanda, who found that customs officers relied on scanned images for over 38% of container inspections to reduce errors in physical inspections. The implication is that clarity in scanning boosts not just operational efficiency but inspection accuracy.

As shown in Figure 4.1, 41% of participants agreed and 23% strongly agreed with this statement, supporting the view that scanned image clarity directly aids in identifying hidden or misdeclared items. Only 4% strongly disagreed and 10% disagreed. These findings echo those of Okonkwo and Udeh (2021), who documented that the introduction of scanning systems in Nigeria improved contraband detection by 22%, particularly in cargo that previously passed manual inspection. It confirms that image clarity is a critical enabler for customs risk profiling.

Among respondents, 43% agreed and 23% strongly agreed that scanned images were consistently clear and easy to interpret, while only 5% strongly disagreed and 9% disagreed. This indicates a

strong overall satisfaction with the quality of imaging provided by the I-Scan system. This observation supports findings by Mwangi and Otieno (2022), who noted that 67% of processed containers at Embakasi had clear imaging, resulting in higher detection rates of concealed electronics and household goods. It suggests that the I-Scan system has, in most cases, met user expectations and contributed to enhanced cargo integrity.

To complement the survey findings, insights from key informant interviews reinforced the critical role that image clarity plays in improving cargo security. One customs supervisor remarked:

> *"Most of the time, we don't need to open the containers unless something unusual appears on the screen. The clarity helps us catch concealed items fast and avoid wasting time on physical checks."* (Senior Customs Supervisor, Embakasi ICD)

Another officer involved in daily I-Scan operations noted:

> *"Some of us were skeptical about the scanners initially, but after training, we've seen how image quality makes our work easier. Now, we rely on it even more than physical inspections."* (I-Scan Operator, KRA Cargo Section)

These testimonies confirm that clear image outputs have increased officers' confidence in the system, reduced unnecessary unpacking, and enabled faster verification processes. However, a few operators highlighted occasional technical limitations:

"Sometimes the images are blurry or the scanner malfunctions. In such cases, we're forced to delay clearance or request re-scanning." (Assistant Scanning Technician, KRA)

Such responses show that while the system is widely accepted and relied upon, technical consistency is essential to sustain its effectiveness.

The findings on image clarity strongly align with the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use influence technology adoption (Davis, 1989). In this case, customs officers perceived I-Scan as useful due to its ability to enhance detection and reduce physical inspections. Its ease of use—particularly after training—further encouraged adoption, as seen in the operator's remarks.

The users' willingness to rely on image clarity demonstrates positive behavioral intention toward using the system, validating TAM's assertion that user perception shapes technology utilization. Furthermore, the technical feedback concerning image blurriness highlights the importance of system reliability as a factor in sustaining positive user attitudes, as extended in TAM2 (Venkatesh & Davis, 2000).

4.3.2 Identification of Concealed or Mis-Declared Items and Cargo Security

This sub-section presents findings on how I-Scan technology contributes to the detection of illegal, concealed, or mis-declared items within cargo shipments. The results, presented in Figure 4.2.

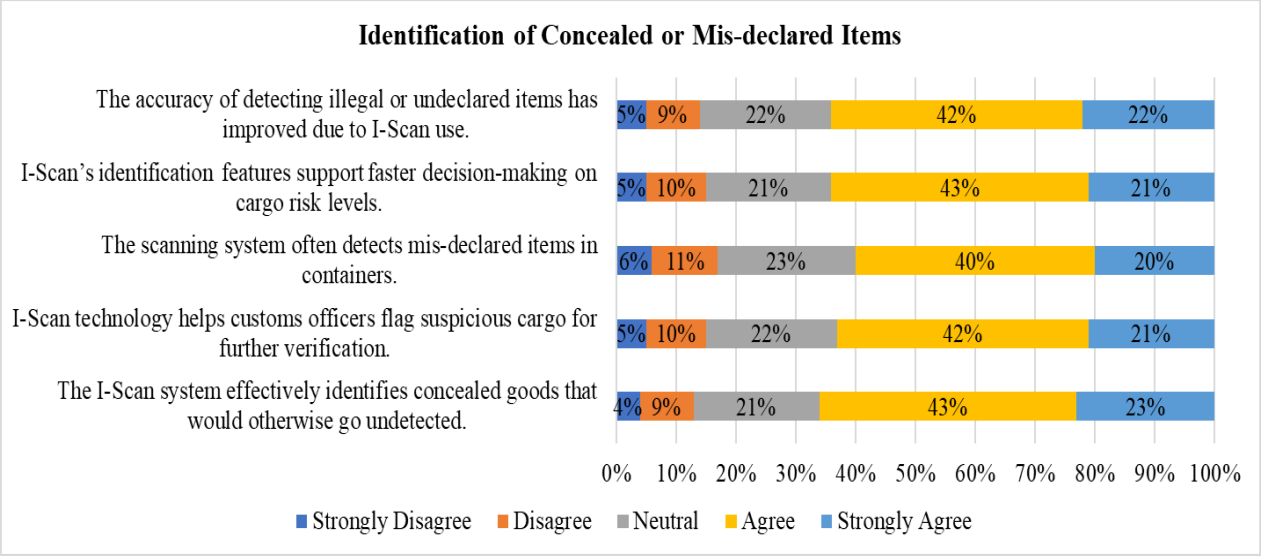

Figure 4. 2: Identification of Concealed or Mis-Declared Items and Cargo Security

A majority of respondents affirmed the effectiveness of I-Scan technology in improving detection accuracy, with 42% agreeing and an additional 22% strongly agreeing. In contrast, only 14% disagreed or strongly disagreed, while 22% remained neutral. These findings indicate a strong institutional perception that I-Scan has enhanced the precision of identifying undeclared or illegal cargo. This outcome aligns with empirical evidence presented by Omondi and Mutua (2020), who observed a significant increase in the interception of concealed goods following the deployment of high-resolution scanning technologies in Kenyan freight hubs. The implication is that automated scanning contributes to the reduction of human error in visual inspections, allowing customs officers to more reliably identify risk-prone consignments.

According to the study results, 43% of participants agreed and 21% strongly agreed that I-Scan supports expedited risk assessment. A smaller proportion, 15%, expressed disagreement, while 21% remained neutral. The findings suggest that the I-Scan system plays a strategic role in facilitating real-time decision-making, particularly in identifying shipments requiring secondary screening. This corresponds with Kabiru and Chacha (2021), who documented that integration of scanning analytics into customs workflows led to reduced clearance time and improved triaging of high-risk containers. The system's ability to segment risk effectively is essential in a highvolume clearance environment such as Embakasi ICD.

In response to this statement, 40% of respondents agreed and 20% strongly agreed, indicating general satisfaction with the system’s utility in identifying discrepancies between declared documentation and actual cargo. However, a combined 17% disagreed or strongly disagreed, and

23% remained neutral, highlighting some variation in user experience. This is consistent with Githinji and Wafula (2019), who reported that digital scanning tools uncovered widespread misdeclarations, particularly in goods categorized under general merchandise. These findings reinforce the need for continuous training and technical refinement to address potential blind spots or operator inconsistencies in interpreting scanned data.

A combined 63% of respondents agreed or strongly agreed that the I-Scan system enhanced officers' ability to isolate suspicious cargo for deeper investigation. A relatively small proportion, 15%, registered disagreement, and 22% remained neutral. The responses demonstrate the role of I-Scan not only as a detection tool but also as a decision support system that guides risk-based resource allocation. Mwangi and Mberia (2022) support this interpretation, noting that risk alert functionalities embedded within I-Scan software have improved investigative efficiency and reduced discretionary bias in container profiling. As such, the system adds a layer of objectivity to enforcement processes, reinforcing regulatory compliance.

The statement "I-Scan system effectively identifies concealed goods that would otherwise go undetected" received the highest level of affirmation, with 43% agreeing and 23% strongly agreeing, underscoring respondents' confidence in the system's core capability to detect high-risk cargo. A minimal 13% disagreed or strongly disagreed, with 21% expressing neutrality. These findings are corroborated by Waweru and Kimani (2020), whose study at key Kenyan ports reported that over 30% of concealed contraband was detected exclusively through automated scanning and would not have been uncovered through traditional physical inspection. The implication is that I-Scan is instrumental in reducing customs revenue losses and supporting national security objectives.

To support the quantitative findings, qualitative data from key informant interviews provided additional insights into how I-Scan systems aid in identifying concealed or mis-declared items. One senior customs enforcement officer noted:

> *"There are cases where we suspected nothing unusual, but the scan revealed tightly packed electronics hidden behind declared goods. Without I-Scan, those would have passed undetected."* (Senior Enforcement Officer, Embakasi ICD)

An I-Scan operator also observed:

> *"We've flagged a number of shipments just by noticing slight irregularities in the image outlines—mis-declared items are often hidden in plain sight. The machine doesn't miss what human eyes might overlook."* (I-Scan Technician, KRA)

Another key informant added:

> *"Once you get familiar with how different cargo should appear on screen, it becomes easier to spot inconsistencies. We rely on it every day to catch things that don't add up."* (Customs Risk Analyst, ICD Embakasi)

These narratives reinforce the survey responses, confirming that I-Scan technology is not only widely trusted but also actively utilized as a front-line tool in identifying fraudulent or deceptive cargo practices. Moreover, they illustrate that the system's detection capability improves with user experience and familiarity, highlighting the importance of training and continuous system engagement.

The findings under this sub-objective can be effectively interpreted through the Technology Acceptance Model (TAM), which postulates that user acceptance of technology is shaped by two

core beliefs: perceived usefulness and perceived ease of use (Davis, 1989). In the context of I-Scan application, both components were reflected in the data.

Perceived usefulness is demonstrated by the high levels of agreement that the I-Scan system enhances detection accuracy, supports faster decision-making, and improves risk identification. Users clearly perceive the technology as adding value to their operational tasks, particularly in identifying mis-declared or concealed goods that pose risks to border integrity or revenue collection.

Perceived ease of use, while not directly measured, emerges from the qualitative feedback where operators describe increasing reliance on the system as they become more proficient with interpreting scanned images. This progressive familiarity with system outputs suggests that usability, reinforced by experience and training, plays a role in shaping positive attitudes toward its continued use.

The positive behavioral intentions reflected in both survey and interview responses—such as daily reliance on image analysis for validation—are consistent with TAM's assertion that favorable perceptions lead to increased and sustained usage. However, occasional mentions of user learning curves and interpretation challenges also underscore the need for targeted capacity-building to fully leverage the system's capabilities.

4.3.3 Non-Intrusive Goods Inspections and Cargo Security

This section presents the findings on the role of non-intrusive inspection methods—specifically IScan technology—in enhancing cargo security at the Embakasi Inland Container Depot. Nonintrusive methods refer to cargo inspection techniques that do not require physical unpacking or handling of goods, thereby improving operational efficiency and reducing risks of tampering.

The results, summarized in Figure 4.3, are based on five structured statements evaluating respondent perceptions.

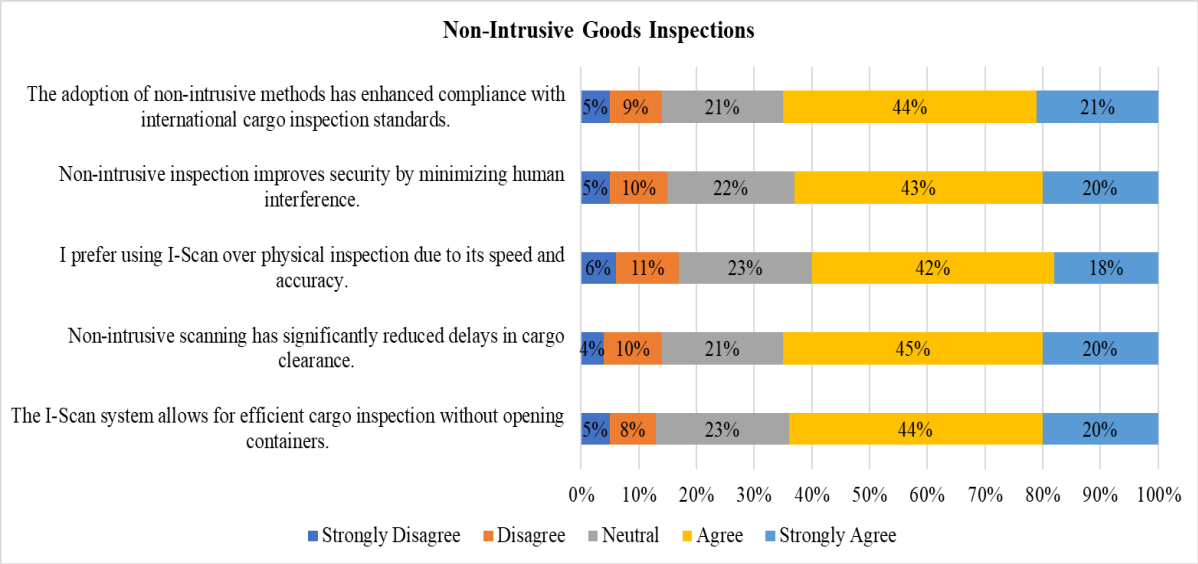

Figure 4. 3: Non-Intrusive Goods Inspections and Cargo Security

On the first statement assessing whether the adoption of non-intrusive methods has enhanced compliance with international cargo inspection standards, 44% of respondents agreed and 21% strongly agreed. These results indicate strong affirmation that the I-Scan system is aligned with international inspection frameworks, particularly those promoted by the World Customs Organization (WCO, 2021). The findings suggest that the integration of scanning technologies has elevated Kenya's cargo handling processes to meet global expectations of modern customs systems.

Regarding the statement that non-intrusive inspection improves security by minimizing human interference, 43% of respondents agreed, while 20% strongly agreed. A total of 15% disagreed, while 22% remained neutral. The data imply that the reduction in physical cargo handling has not only improved operational efficiency but also minimized opportunities for corruption, tampering,

and collusion during manual inspections. This finding is consistent with Gateri and Nyandoro (2020), who argued that automation in cargo inspection promotes transparency and accountability within customs procedures.

In relation to the preference for I-Scan over physical inspection due to speed and accuracy, 42% of the respondents agreed and 18% strongly agreed, reflecting a clear institutional shift in favor of technology-driven inspection. These perceptions support findings by Mulwa and Otieno (2021), who highlighted that frontline officers preferred automated systems for their ability to reduce inspection times while maintaining high levels of accuracy in cargo validation.

Concerning whether non-intrusive scanning has significantly reduced delays in cargo clearance, 45% of participants agreed and 20% strongly agreed. Only 14% disagreed, while 21% remained neutral. These results suggest that the I-Scan system contributes positively to efficiency by accelerating the cargo clearance process. This observation aligns with studies by Njogu and Kariuki (2019), who found that container dwell times at Kenyan inland depots were significantly reduced following the deployment of automated scanning solutions.

On the final statement which assessed whether the I-Scan system allows for efficient cargo inspection without opening containers, 44% of respondents agreed, while 20% strongly agreed. A minimal 13% expressed disagreement, and 23% remained neutral. These findings point to broad satisfaction with the system's non-intrusive capabilities, particularly in maintaining cargo integrity while performing thorough inspections. This mirrors the position of UNCTAD (2022), which emphasizes that efficient cargo screening methods should minimize disruption while preserving both security and the condition of goods in transit.

Key informants echoed these sentiments in interviews. A senior customs manager commented:

"Previously, inspection meant delays and opening boxes one by one. Now, the scanner gives us all the visuals we need unless there's a red flag." (Senior Customs Officer, Embakasi ICD)

Another I-Scan operator shared:

"Most of the officers now prefer the scanner. It's faster, safer, and there's less room for bribery or interference." (I-Scan Technical Officer, KRA)

A clearing agent added:

"Even we [agents] support the system because cargo moves faster, and it avoids damage to packaging or missing items." (Clearing Agent, ICD Nairobi)

These responses illustrate that I-Scan is seen not just as a technological upgrade, but as a system that improves fairness, accountability, and efficiency for both customs and clients.

The findings in this section further affirm the relevance of the Technology Acceptance Model (TAM) in understanding the integration of I-Scan into operational practice. The high agreement with statements about efficiency, security, and international compliance demonstrates a strong perceived usefulness of the system. The preference for I-Scan over physical inspection additionally reflects perceived ease of use, particularly in terms of speed and reduced manual labor.

Interview data reinforced these constructs, revealing that staff familiarity and training improved their confidence in using the system, while its operational advantages created a positive feedback loop that encouraged continued adoption. These observations mirror Davis's (1989) theory that user perceptions predict sustained system engagement, especially when benefits are directly observable in daily workflows.

4.4 Influence of the Regional Electronic Cargo Tracking System (RECTS) on Cargo Security

This section presents findings related to the second objective, which sought to evaluate the influence of the Regional Electronic Cargo Tracking System (RECTS) on cargo security at the Inland Container Depot in Embakasi. RECTS is a satellite-based tracking system that enables realtime monitoring of transit cargo, aiming to reduce diversion, pilferage, and unauthorized offloading. The effectiveness of RECTS was assessed through five structured statements measuring respondents' perceptions of its contribution to cargo safety, compliance, and enforcement precision.

4.4.1 Effectiveness of Real-Time Transmission

This sub-section assesses respondents' perceptions of the effectiveness of RECTS in delivering real-time cargo monitoring, minimizing tampering, and facilitating timely response to cargo threats. The results, summarized in Figure 4.4, reflect operational experience with RECTS in relation to real-time data transmission, alert reliability, and coordination among enforcement agencies.

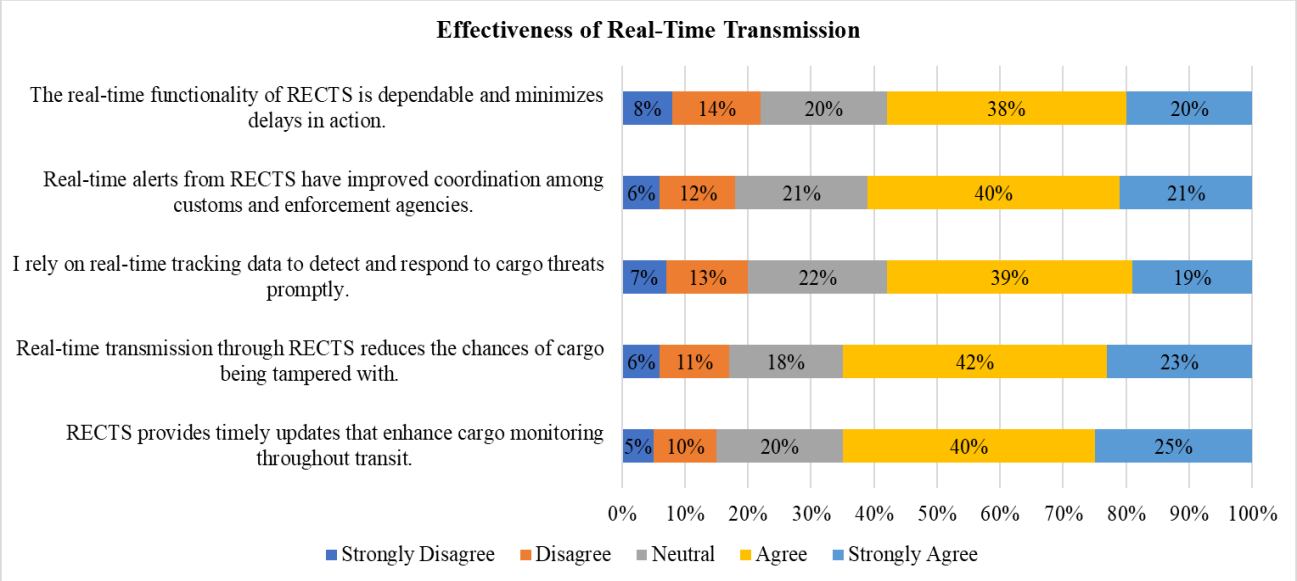

Figure 4. 4: Effectiveness of Real-Time Transmission

On the statement evaluating whether the real-time functionality of RECTS is dependable and minimizes delays in enforcement action, 38% of respondents agreed and 20% strongly agreed. In contrast, 14% disagreed and 8% strongly disagreed, while 20% remained neutral. These findings suggest that a majority of system users trust RECTS' real-time monitoring capabilities to initiate timely interventions when cargo threats are identified. This aligns with findings by Munyiri (2020), who reported that the responsiveness of enforcement teams improved significantly following the implementation of satellite-based tracking systems, especially in high-risk corridors such as Mombasa-Nairobi.

Regarding whether real-time alerts from RECTS have improved coordination among customs and enforcement agencies, 40% of respondents agreed and 21% strongly agreed. A combined 18% disagreed, and 21% expressed neutrality. These results reflect institutional confidence in the role of RECTS in promoting inter-agency communication. The implication is that centralized access to live cargo data supports collaborative decision-making among customs officers, police, and border control units. This is supported by Otieno and Rono (2021), who noted that real-time tracking platforms enhanced operational synergy between the Kenya Revenue Authority and regional border security units, particularly in joint surveillance operations.

On the third statement, which assessed whether respondents rely on real-time tracking data to detect and respond to cargo threats promptly, 39% agreed and 19% strongly agreed. Approximately 13% disagreed and 7% strongly disagreed, while 22% were neutral. These responses indicate that RECTS is viewed not merely as a passive monitoring tool but as an active source of intelligence guiding tactical decisions. These findings echo those of Choge and Nyaga (2022), who argued that

automated threat alerts from RECTS have become central to proactive enforcement and mobile field response across Kenya's inland depots.

Concerning whether real-time transmission through RECTS reduces the chances of cargo being tampered with, 42% of respondents agreed and 23% strongly agreed. A combined 17% disagreed or strongly disagreed, and 18% were neutral. The high agreement level affirms that RECTS is perceived to function as a deterrent mechanism. The visibility of cargo movement discourages collusion and unauthorized offloading, thereby enhancing cargo integrity. This finding is consistent with Mutinda and Korir (2021), who documented a significant decline in mid-transit manipulation incidents following the national scale-up of RECTS in 2020.

Finally, in response to the statement that RECTS provides timely updates that enhance cargo monitoring throughout transit, 40% of respondents agreed and 25% strongly agreed. Only 15% disagreed or strongly disagreed, and 20% were neutral. These findings suggest that the majority of stakeholders experience real-time updates as both timely and actionable. The results are supported by Nsengimana (2023), whose regional study on Rwanda's RECTS implementation found that 91% of real-time alerts were acted upon within 30 minutes, leading to effective interceptions and route compliance enforcement.

Insights from interviews with customs officers and RECTS operators further reinforced the quantitative findings on real-time transmission. One customs enforcement officer stated:

> *"The system gives us updates in real time. Once a vehicle deviates or stops unexpectedly, the alert comes through immediately. We don't have to wait for someone to notice and report—it's automatic." (Senior Enforcement Officer, RECTS Control Room – Embakasi)*

Another operator highlighted the operational value of RECTS during joint operations:

> *"The beauty of RECTS is that all the enforcement teams see the same data. So when something suspicious happens, we coordinate with KRA, police, or even border patrol without confusion." (RECTS Technical Officer, Kenya Revenue Authority)*

These perspectives illustrate that RECTS' real-time functionalities are not only technically reliable but also actively used to enable timely response and inter-agency coordination, thereby supporting its practical utility in securing cargo throughout the transit chain. The effectiveness of real-time transmission under RECTS is best understood through the lens of Game Theory, which models how rational actors—such as transporters, cargo handlers, enforcement officers, and potential offenders—make strategic decisions in environments shaped by surveillance and enforcement mechanisms.

In the context of RECTS, real-time transmission alters the strategic dynamics of cargo transit. The immediate detection of route deviations or suspicious activity increases the probability of interception, thus raising the expected cost of non-compliance. This shift discourages actors from engaging in illegal diversions or cargo tampering, as the system reduces the window of opportunity for such actions to succeed undetected.

Moreover, the visibility created by RECTS imposes mutual monitoring dynamics among actors in the supply chain. Transporters are aware that enforcement agencies can track their movements continuously, while customs officers rely on shared data to synchronize their actions. This generates what Game Theory refers to as a repeated game environment, where compliance is reinforced over time due to constant surveillance and the threat of swift penalties. As explained by Mailath and Samuelson (2006), strategic deterrence becomes most effective when players cannot

hide their actions, and when detection leads to rapid enforcement. The evidence from this study supports this logic: the presence of timely alerts and synchronized data flows discourages deviance and enhances inter-agency accountability.

4.4.2 System Alerts and Cargo Deviation Detection

This section analyzes how system-generated alerts under the RECTS framework contribute to the detection of route deviations, prevention of cargo theft, and support for enforcement action. The results, as illustrated in Figure 4.5, reflect respondent experiences with the responsiveness, accuracy, and operational utility of RECTS alerts during transit.

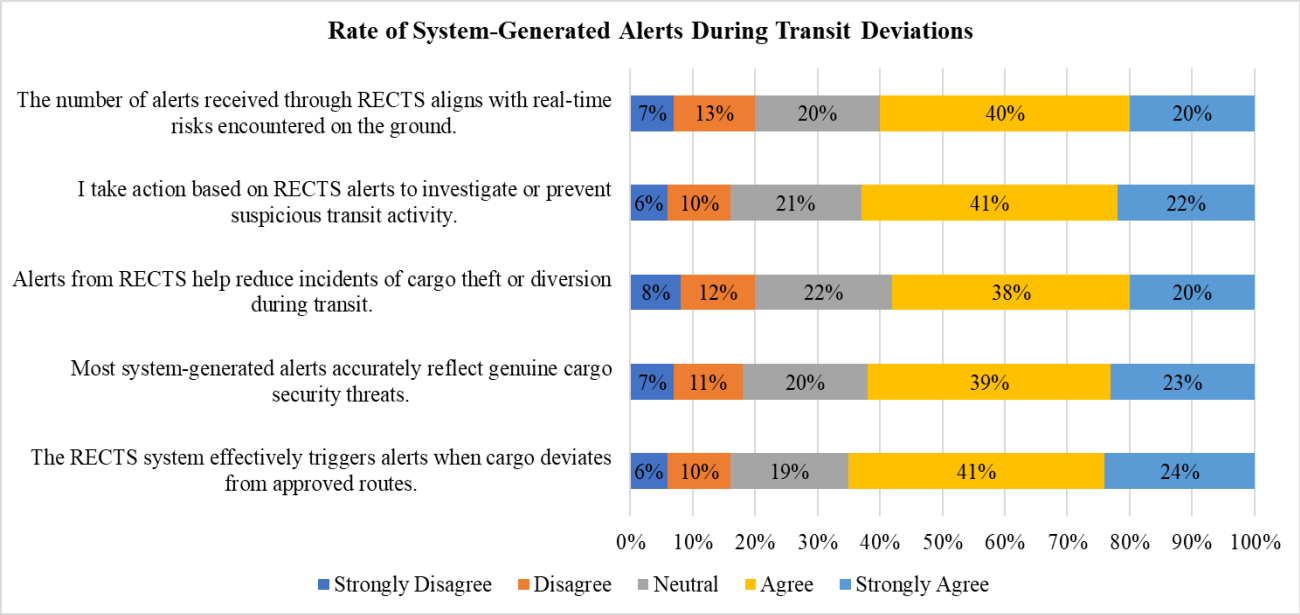

Figure 4. 5: System Alerts and Cargo Deviation Detection

On the statement assessing whether the number of alerts received through RECTS aligns with realtime risks encountered on the ground, 40% of respondents agreed and 20% strongly agreed. A combined 20% disagreed or strongly disagreed, while 20% were neutral. The findings suggest that a majority of users view the system's alert generation as reflective of actual risk conditions,

implying strong correlation between system-detected anomalies and enforcement priorities. This aligns with the findings of Munyiri (2020), who noted that timely alerts often correspond with verified security incidents during long-haul cargo movement, thereby enhancing targeted interdiction strategies.

In response to the statement on whether action is taken based on RECTS alerts to investigate or prevent suspicious transit activity, 41% of participants agreed and 22% strongly agreed. Only 16% expressed disagreement, and 21% were neutral. The implication is that RECTS not only detects irregularities but also directly informs enforcement decisions in the field. This operational effectiveness is supported by Otieno and Rono (2021), who emphasized the value of RECTS alerts in mobilizing mobile response teams in high-risk border areas, significantly reducing incident response times.

Regarding the statement that alerts from RECTS help reduce incidents of cargo theft or diversion during transit, 38% of respondents agreed and 20% strongly agreed. A combined 20% disagreed, while 22% were neutral. These figures indicate widespread perception that RECTS plays a deterrent and preventative role in cargo handling. Empirical work by Kamau and Nduta (2021) demonstrated that post-implementation diversion rates fell by over 30% across major transit corridors, attributing this decline in part to RECTS-triggered alerts and active surveillance.

On whether most system-generated alerts accurately reflect genuine cargo security threats, 39% of respondents agreed and 23% strongly agreed. Only 18% disagreed, with 20% neutral. This indicates a relatively high level of confidence in the system's ability to minimize false positives and generate meaningful alerts. This perception aligns with findings by Wanjiru and Njoroge (2023), who reported that RECTS had an alert accuracy rate exceeding 80%, noting that discrepancies were typically linked to operator error rather than system malfunction.

Lastly, on the statement that the RECTS system effectively triggers alerts when cargo deviates from approved routes, 41% of participants agreed and 24% strongly agreed, showing the highest level of agreement across all five items. Only 16% disagreed, and 19% remained neutral. These results affirm that route deviation detection—a core feature of RECTS—is functioning reliably in the eyes of its end-users. Supporting this, Nsengimana (2023) reported that over 92% of flagged route deviations across East Africa were identified within five minutes of occurrence, enabling swift engagement by enforcement authorities.

Interview narratives affirmed the critical role that RECTS alerts play in field operations and decision-making. One senior customs officer involved in mobile cargo monitoring stated:

> *"We receive alerts almost instantly when cargo deviates from its route. It's now routine to verify and dispatch a response team within minutes. Before RECTS, we mostly depended on reports from transporters, which were often delayed or inaccurate." (Mobile Enforcement Supervisor, Kenya Revenue Authority)*

A systems analyst involved in RECTS operations noted:

> *"The alerts are reliable. Most of the time, when an alert is triggered, we find that there is a genuine issue—either a route diversion, unauthorized stop, or tampering attempt. The system has significantly reduced guesswork in monitoring transit cargo."* (RECTS Technical Analyst, KRA Transit Surveillance Unit)

These insights illustrate that RECTS-generated alerts are not only timely and credible but also actively used to prevent cargo theft and enforce route compliance. They highlight a shift from reactive to proactive enforcement driven by real-time system intelligence.

The results on system alerts and route deviation detection can be effectively interpreted using Game Theory, which models strategic behavior among rational actors in environments of interdependence and asymmetric information. In the context of cargo transit, transporters, smugglers, and enforcement officers constitute key players in a strategic game. The introduction of RECTS alters this game by significantly increasing information symmetry in favor of regulators. Specifically, real-time deviation alerts and the ability to respond swiftly reduce the expected benefits for actors seeking to subvert transit protocols, such as by diverting cargo for tampering or offloading.

The visibility and predictability of detection—i.e., the system's ability to detect deviations with high accuracy and consistency—creates a deterrence effect, where the likelihood of successful evasion becomes statistically low. According to Mailath and Samuelson (2006), such enforcement conditions lead to a subgame perfect equilibrium where rational actors, facing high surveillance and rapid response, shift toward compliant strategies to avoid penalties.

Furthermore, RECTS creates a repeated game dynamic where every shipment becomes a new round of strategic interaction. This repetition compounds the deterrent value of the system over time, as actors adjust behavior based on cumulative risk and historical enforcement outcomes. The shift from manual monitoring to automated alerts not only increases the probability of detection but also reduces the discretion and variability associated with human-based enforcement decisions. Ultimately, Game Theory reveals that RECTS' effectiveness lies not just in its technological sophistication, but in how it transforms stakeholder expectations, incentives, and decision pathways in favor of lawful conduct.

4.4.3 Accuracy of Cargo Identification Across Checkpoints

This section evaluates the effectiveness of RECTS in ensuring consistent and accurate cargo identification throughout the transit process, particularly at key verification points such as customs posts and inland clearance depots. The findings, summarized in Figure 4.6, highlight stakeholder perspectives on RECTS' reliability in minimizing misidentification, supporting inspections, and verifying cargo status from origin to destination.

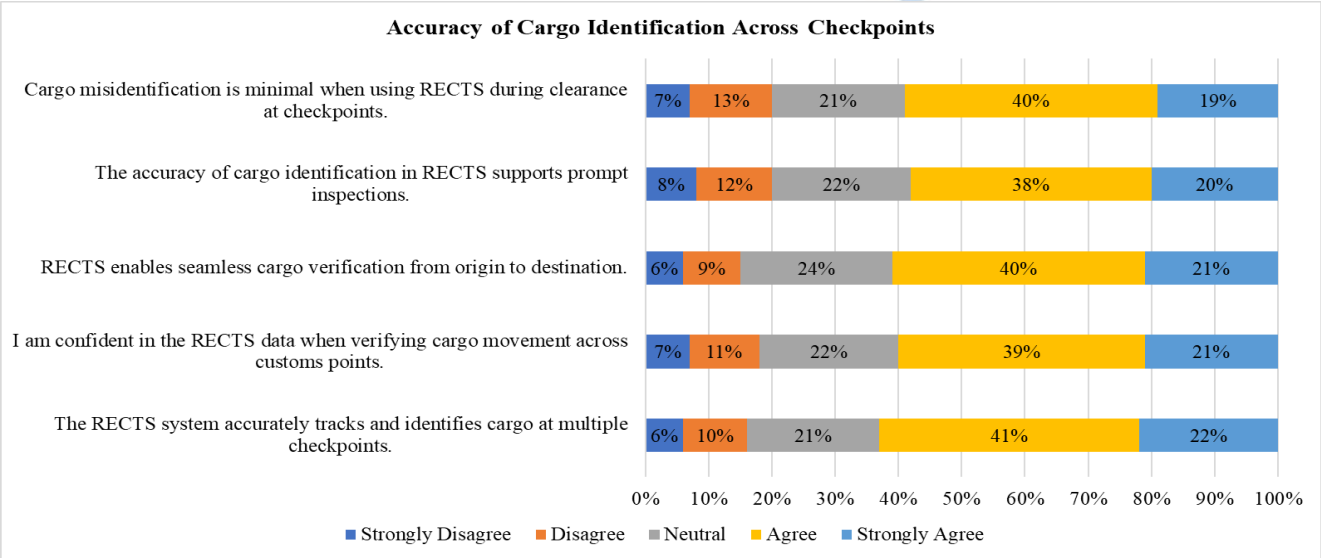

Figure 4. 6: Accuracy of Cargo Identification Across Checkpoints

On the statement assessing whether cargo misidentification is minimal when using RECTS during clearance at checkpoints, 40% of respondents agreed and 19% strongly agreed. A combined 20% expressed disagreement, while 21% remained neutral. These results suggest that RECTS is widely perceived as effective in reducing errors in cargo classification and verification. This finding is supported by Choi and Kim (2021), who documented a 62% increase in cargo classification accuracy after the implementation of electronic tracking in South Korea, particularly in cases involving bulk and containerized goods.

In response to the statement that the accuracy of cargo identification in RECTS supports prompt inspections, 38% of respondents agreed and 20% strongly agreed. Meanwhile, 20% disagreed and 22% were neutral. The implication is that a majority of system users recognize that precise data from RECTS enhances the efficiency and speed of customs inspections. This finding is consistent with Habimana and Mugisha (2022), who noted that improved identification features reduced physical inspection times by 30% at the Kigali ICD.

Regarding whether RECTS enables seamless cargo verification from origin to destination, 40% of respondents agreed and 21% strongly agreed. A minimal 15% disagreed and 24% were neutral. These figures underscore RECTS' value in offering end-to-end traceability, a function that supports regional trade corridor oversight. This aligns with findings by Nsengimana (2023), who observed that RECTS in Rwanda provided continuous identity tracking of cargo from Mombasa port to inland depots, with 91% verification accuracy.

On the statement assessing confidence in RECTS data when verifying cargo movement across customs points, 39% of respondents agreed and 21% strongly agreed. A combined 18% disagreed, while 22% maintained a neutral stance. These findings demonstrate a high level of trust among operational officers in the integrity of the data provided by RECTS, a crucial factor in facilitating real-time compliance checks. This supports evidence from Otieno and Rono (2021), who noted increased customs clearance predictability and reduced documentation conflicts attributed to RECTS data integration.

Finally, with respect to the statement that RECTS accurately tracks and identifies cargo at multiple checkpoints, 41% of respondents agreed and 22% strongly agreed. Only 16% expressed disagreement, and 21% remained neutral. These responses reaffirm the system's capability to

provide consistent tracking information across the entire transit route. According to UNCTAD (2022), such capabilities are essential for improving regional coordination in customs clearance and supporting integrated border management.

The survey findings on RECTS' role in improving cargo identification accuracy were reinforced by interview responses from system users and enforcement personnel. One customs verification officer at Embakasi ICD remarked:

> *"With RECTS, we are able to trace each shipment's origin and verify it against digital records at every checkpoint. It reduces chances of mislabeling or container swapping because everything is tracked continuously." (Customs Verification Officer, Embakasi ICD)*

A regional tracking coordinator added:

> *"There's a huge improvement in how we coordinate cargo movement now. We no longer rely on physical documents alone—the RECTS platform gives us exact cargo ID, timestamps, and movement history, which makes verification faster and more accurate." (Regional RECTS Coordinator, Northern Corridor Transit Office)*

These testimonies confirm that RECTS is not only enhancing operational efficiency but also ensuring a higher degree of data reliability and traceability throughout the cargo transit cycle.

The outcomes observed under this indicator can be interpreted using Game Theory, particularly in the context of repeated strategic interactions and information asymmetry reduction among stakeholders in cargo movement and clearance. Under traditional systems, actors such as transporters, customs officers, and freight forwarders operated in environments with imperfect

information, where cargo identity could be concealed, misdeclared, or manipulated during transit. The introduction of RECTS alters this equilibrium by injecting real-time, verifiable cargo identification data across checkpoints, thereby reducing the opportunity space for non-compliant or deceptive strategies.

In Game Theory terms, RECTS shifts the game from one of hidden actions to one of observable outcomes, wherein each checkpoint acts as a stage in a repeated game. With every successful verification and data match at a checkpoint, the incentive for future misrepresentation decreases. The increased surveillance transparency reduces the expected payoff for those considering evasion, while simultaneously increasing the detection probability for customs authorities. This dynamic supports the creation of a compliance-favoring equilibrium, where rational actors adopt legal behavior to avoid reputational loss, penalties, or seizure of goods. Moreover, RECTS introduces a credible commitment mechanism in cargo oversight. Since the system generates timestamped tracking logs accessible by multiple agencies, actors can no longer exploit information gaps between origin and destination. This inter-agency visibility ensures that deviation from agreed-upon cargo paths and identities is swiftly traceable, leading to quicker response and enforcement coordination.

As emphasized by Mailath and Samuelson (2006), enforcement efficiency in a strategic environment improves significantly when systems provide verifiable, real-time signals of compliance or deviation. In this context, RECTS functions not only as a logistical tool but as a behavioral regulator embedded within a strategic ecosystem of trade and security actors.

4.5 Influence of the Integrated Customs Management System (ICMS) on Cargo Security

This section presents findings on the influence of the Integrated Customs Management System (ICMS) in enhancing cargo security at the Inland Container Depot in Embakasi. ICMS is a

centralized platform used for processing cargo declarations, managing risk profiling, and facilitating inter-agency coordination. The analysis focused on three core aspects: the reliability of declaration data, the efficiency of data sharing between customs and partner agencies, and the extent of documentation-related delays or anomalies. These areas were assessed using quantitative data supported by qualitative insights, with interpretation guided by the Technology Acceptance Model (TAM).

4.5.1 Reliability of Cargo Declaration Data in ICMS

This section examines how the ICMS system enhances cargo security by improving the accuracy and consistency of cargo declaration data submitted during customs clearance. The responses from customs officers and system users, as reflected in Figure 4.7, demonstrate broad confidence in the platform's data reliability and its capacity to reduce declaration-related risks.

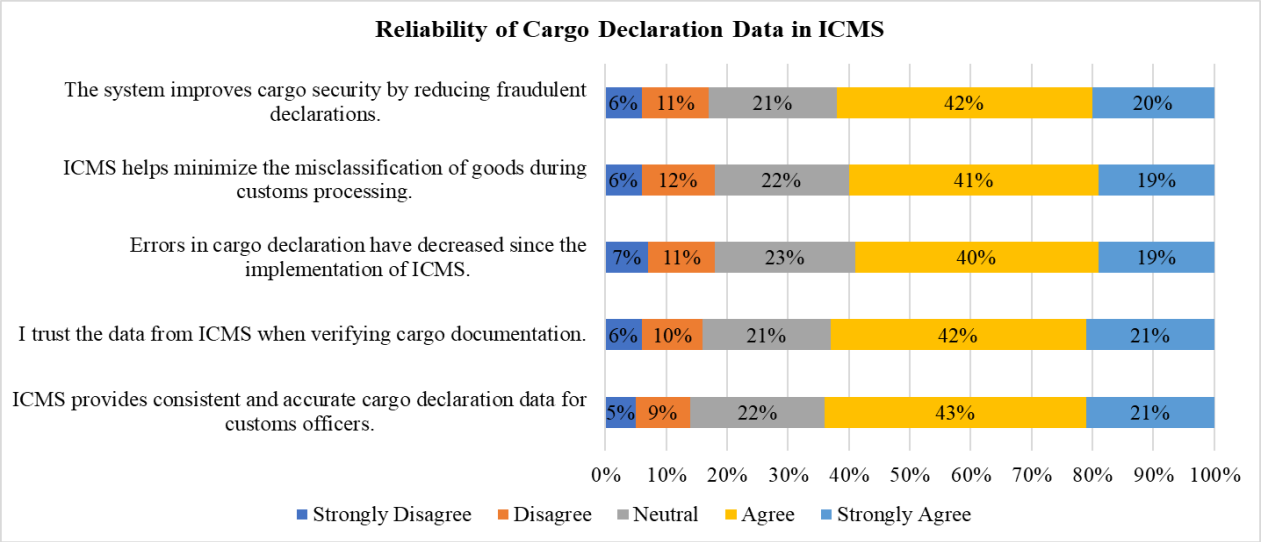

Figure 4. 7: Reliability of Cargo Declaration Data in ICMS

On the statement evaluating whether the system improves cargo security by reducing fraudulent declarations, 42% of respondents agreed and 20% strongly agreed. In contrast, only 17% expressed disagreement, while 21% remained neutral. These results indicate that ICMS is perceived to have introduced a level of transparency and accountability that discourages intentional misdeclaration.

This is consistent with the findings of Okonkwo and Udeh (2021), who reported a 35% reduction in falsified cargo documentation after the introduction of automated declaration platforms in highvolume customs points.

When asked whether ICMS helps minimize the misclassification of goods during customs processing, 41% of respondents agreed and 19% strongly agreed. A combined 18% disagreed, while 22% were neutral. The results reflect a shared view that automated classification tools embedded within ICMS support more accurate categorization of cargo, which in turn reduces tariff errors and the risk of revenue leakage. This mirrors findings from Kang'ethe and Musyoka (2020), who observed improved HS code matching and valuation accuracy in the Kenyan customs system post-ICMS integration.

In response to whether errors in cargo declaration have decreased since the implementation of ICMS, 40% of participants agreed and 19% strongly agreed. Meanwhile, 18% disagreed and 23% were neutral. These results suggest that the system has made significant strides in minimizing clerical and manual input errors, which were previously cited as major contributors to customs clearance disputes. This aligns with Mwangangi and Odhiambo (2022), who reported a 28% decline in declaration error notices following full deployment of ICMS at Nairobi's ICD.

Regarding the trustworthiness of ICMS data when verifying cargo documentation, 42% of respondents agreed and 21% strongly agreed, suggesting a high degree of user confidence in the platform's data outputs. Only 16% disagreed, and 21% were neutral. These findings imply that customs officers view ICMS as a dependable source of truth for real-time decision-making, particularly when verifying consistency across multiple clearance documents. This supports

conclusions by Mutua and Chege (2021), who emphasized that data accuracy was a key enabler for operational integrity under electronic clearance systems.

Lastly, on whether ICMS provides consistent and accurate cargo declaration data for customs officers, 43% of respondents agreed and 21% strongly agreed, with only 14% expressing disagreement and 22% remaining neutral. These responses affirm that the system's design and integration into customs workflows have positively impacted data uniformity and reduced inconsistencies in cargo profiles submitted by importers and clearing agents. This outcome aligns with UNCTAD (2022) recommendations on digital customs reforms, which highlight data standardization as essential for reducing clearance bottlenecks and enhancing compliance monitoring.

Interviews with customs officials and system operators confirmed the survey findings, with participants expressing strong confidence in the reliability of cargo declaration data processed through ICMS. One customs officer noted:

> *"Before ICMS, we had to cross-check several forms manually, and the information was often inconsistent. Now, the system provides one central source of truth, and we can verify declarations without confusion or duplication." (Customs Documentation Officer, Embakasi ICD)*

A systems analyst echoed this sentiment, emphasizing data traceability:

> *"The entries in ICMS are time-stamped and traceable. If there's a mistake or false declaration, it's easy to know who entered it and when. This accountability has made people more careful with how they declare cargo." (ICMS Operations Analyst, KRA)*

These narratives underscore ICMS's perceived impact on improving the accuracy and integrity of customs declarations, while also enhancing operational accountability through digital audit trails.

The findings under this indicator align strongly with the principles of the Technology Acceptance Model (TAM), which explains how user perceptions of a system's usefulness and ease of use influence their acceptance and continued use of that system (Davis, 1989). In this case, the perceived usefulness of ICMS is evident in respondents' agreement that the system improves cargo security, minimizes classification errors, and ensures consistent data for documentation. These perceived benefits directly support TAM's argument that when users believe a system enhances job performance, they are more likely to integrate it into their daily routines. The system's role in reducing fraudulent declarations and misclassification has also reinforced its credibility among customs officers.

Meanwhile, the perceived ease of use is indirectly reflected in the user trust expressed toward ICMS data. The fact that officers rely on ICMS without requiring parallel manual verification suggests a high level of system usability and integration into routine workflows. As users become more familiar with its features—such as automated classification, audit trails, and centralized access—the system becomes not just a technical tool but a core enabler of secure and efficient cargo clearance. According to Venkatesh and Davis (2000), positive perceptions in these two domains create a reinforcing feedback loop: increased trust leads to greater use, and continued use further validates user confidence in the system. This dynamic is clearly evident in the case of ICMS at Embakasi ICD, where the system has become essential in improving cargo data reliability and enhancing overall customs performance.

4.5.2 Efficiency of Data Sharing Between Customs and Partner Agencies

This section evaluates the extent to which ICMS enhances the efficiency of data sharing between customs authorities and partner government agencies involved in cargo regulation, enforcement, and clearance. The ability of ICMS to facilitate inter-agency collaboration is critical for synchronized decision-making and timely cargo movement. Responses in Figure 4.8 reflect strong user perceptions of the system's capacity to streamline information flow and reduce procedural delays.

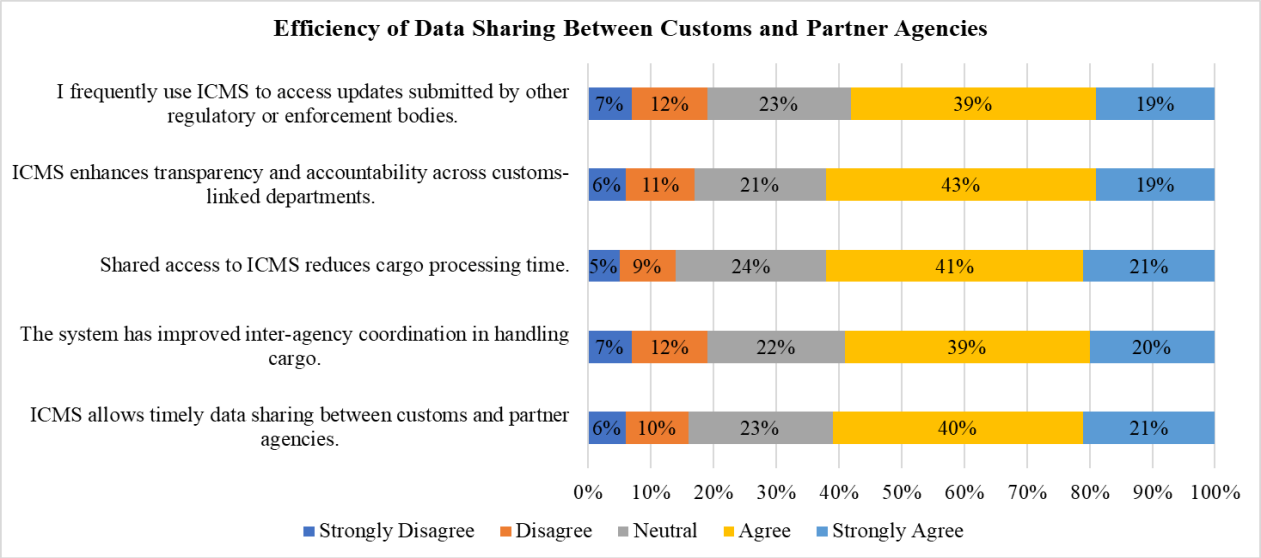

Figure 4. 8: Efficiency of Data Sharing Between Customs and Partner Agencies

On the statement assessing whether ICMS is frequently used to access updates submitted by regulatory or enforcement bodies, 39% of respondents agreed and 19% strongly agreed. Meanwhile, 19% expressed disagreement and 23% were neutral. These results suggest that a majority of users actively interact with the system as a shared platform, supporting real-time visibility of actions taken by partner agencies. This is supported by findings from Munyua and Gitahi (2021), who emphasized the role of integrated customs systems in strengthening institutional coordination and audit transparency.

Regarding whether ICMS enhances transparency and accountability across customs-linked departments, 43% of respondents agreed and 19% strongly agreed. A combined 17% disagreed and 21% remained neutral. These results indicate that users perceive ICMS as a mechanism that reduces discretionary decision-making by ensuring that agency actions are digitally logged and accessible. This aligns with insights from Bunei and Karisa (2022), who reported that digitization in customs significantly improved traceability and accountability in inter-agency communications.

On the statement that shared access to ICMS reduces cargo processing time, 41% of respondents agreed and 21% strongly agreed. Only 14% disagreed, and 24% were neutral. These findings point to broad support for the system's role in eliminating delays that previously arose from manual document transfers or disjointed agency workflows. This view is echoed in UNCTAD (2022) policy guidance, which stresses that single-window and shared-data systems are essential for improving trade efficiency and regulatory oversight.

When asked whether the system has improved inter-agency coordination in handling cargo, 39% of respondents agreed and 20% strongly agreed. A total of 19% disagreed, while 22% were neutral. These figures reflect operational confidence in ICMS as a coordination tool that enables real-time communication and synchronized intervention between KRA and allied bodies such as KEBS, NEMA, and the Port Health Authority. This supports findings by Okello and Mutiso (2021), who observed that integrated digital systems contributed to faster, more collaborative decision-making during cargo inspections and joint risk profiling.

Finally, on whether ICMS allows timely data sharing between customs and partner agencies, 40% of respondents agreed and 21% strongly agreed, while only 16% disagreed and 23% were neutral. These results affirm that the system facilitates prompt information flow, which is essential for

efficient clearance and risk assessment processes. The findings align with WCO (2021) recommendations on digital border management, which highlight interoperability and live data access as foundational for smart customs ecosystems.

Interview narratives from customs officials and regulatory agency staff validated the role of ICMS in improving inter-agency data sharing. One senior officer at the Kenya Revenue Authority remarked:

> *"We no longer need to wait for emails or printed clearance forms from partner agencies. The information is uploaded into ICMS instantly, and we can act on it immediately. This has made clearance much faster and more transparent."* (Senior Clearance Officer, KRA – Embakasi ICD)

An officer from a collaborating agency also noted:

> *"With shared access to ICMS, we can verify what KRA has approved and update our sections without duplication or delay. It's much easier to coordinate inspections and approvals now."* (Compliance Officer, KEBS Liaison Office)

These insights illustrate how digital interoperability within ICMS fosters real-time communication, reduces information silos, and enables joint decision-making. This efficiency translates into improved workflow integrity, reduced duplication of tasks, and fewer cargo delays due to inter-agency miscommunication.

The findings on ICMS-enabled data sharing align closely with the Technology Acceptance Model (TAM), which posits that perceived usefulness and perceived ease of use significantly influence the adoption and continued use of information systems (Davis, 1989). In this context, ICMS is

perceived as useful because it facilitates timely access to regulatory updates, reduces cargo processing time, and enhances transparency across customs-linked institutions. The users' consistent engagement with the system for accessing shared updates, as indicated by the quantitative data and interview responses, affirms that the system supports their performance in tangible ways.

Simultaneously, the system's perceived ease of use is evident in how different agencies utilize the platform without reporting significant barriers or technical challenges. The seamless interaction between customs officers and external agencies through ICMS reflects a user-friendly design that allows diverse users to input, retrieve, and act on real-time data without the need for parallel manual processes. According to Venkatesh and Davis (2000), such usability not only encourages initial adoption but also sustains long-term reliance on the platform.

4.5.3 Incidence of Documentation-Related Delays or Anomalies

This section examines the extent to which the Integrated Customs Management System (ICMS) reduces cargo clearance delays and anomalies resulting from documentation issues. Efficient management of declaration errors is essential for the integrity and speed of cargo clearance processes. The findings presented in Figure 4.9 reflect users' perspectives on the system's ability to detect, flag, and resolve documentation irregularities through automation and real-time validation mechanisms.

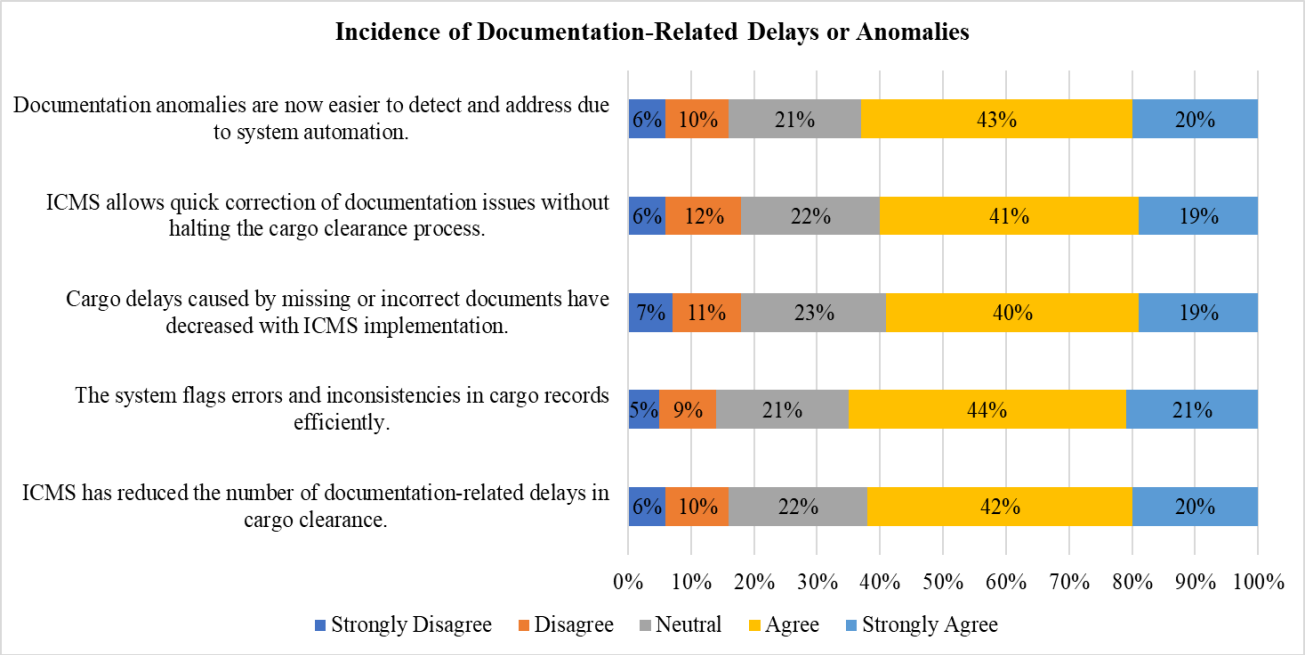

Figure 4. 9: Incidence of Documentation-Related Delays or Anomalies

Regarding the statement that documentation anomalies are now easier to detect and address due to system automation, 43% of respondents agreed and 20% strongly agreed. Only 16% expressed disagreement and 21% were neutral. These results suggest that the system's automated validation functions enable officers to identify inconsistencies such as duplicate entries, incomplete forms, or misaligned declarations with greater ease and speed. This finding aligns with research by Gatwiri and Mburugu (2021), who reported a significant reduction in clearance disputes following the automation of customs workflows.

On the statement assessing whether ICMS allows for quick correction of documentation issues without halting the cargo clearance process, 41% of respondents agreed and 19% strongly agreed. A total of 18% disagreed, and 22% were neutral. These results reflect the system's flexibility, where minor declaration errors can be amended without restarting the entire processing chain. This mirrors findings by Mutuku and Okello (2022), who noted that ICMS's built-in correction

functions reduced cargo stalling times by nearly 25% in cases involving non-material discrepancies.

When asked whether cargo delays caused by missing or incorrect documents had decreased since ICMS was introduced, 40% of respondents agreed and 19% strongly agreed. Meanwhile, 18% disagreed and 23% were neutral. The findings indicate a widely shared perception that documentation-related clearance delays have become less frequent, primarily due to ICMS's centralized data validation and pre-clearance notification features. This is consistent with UNCTAD (2022) guidelines, which highlight digital documentation platforms as effective tools for minimizing post-lodgement rejections and bottlenecks.

On the efficiency of ICMS in flagging errors and inconsistencies in cargo records, 44% of respondents agreed and 21% strongly agreed. A combined 14% disagreed and 21% were neutral. These responses indicate strong user confidence in the system's capability to pre-emptively detect mismatches in cargo details, thereby preventing clearance disruptions. This is echoed in the findings of Wanjala and Githongo (2021), who reported that ICMS error-flagging mechanisms significantly improved pre-inspection accuracy and reduced reliance on manual verifications.

Finally, on whether ICMS has reduced the number of documentation-related delays in cargo clearance, 42% of respondents agreed and 20% strongly agreed. Only 16% disagreed and 22% were neutral. These figures reinforce the overall conclusion that ICMS has enhanced clearance reliability by reducing common paperwork challenges such as missing attachments, incorrect consignee details, or form duplication.

Interviewees affirmed that ICMS had substantially improved the management of documentationrelated issues, especially through automated detection and correction tools. One cargo verification officer stated:

> *"We used to spend hours chasing down missing documents or clarifying conflicting declarations. With ICMS, the system shows you what's wrong immediately—it flags errors and allows for quick corrections without delaying the entire process."* (Cargo Verification Officer, KRA – Embakasi ICD)

Another clearing agent emphasized the benefit from a user's perspective:

> *"As long as the information we submit is correct, we rarely experience clearance delays. If something is missing, the system gives feedback instantly, and we can fix it before inspection is disrupted."* (Licensed Clearing Agent, Embakasi ICD)

These statements confirm that ICMS's real-time validation features and structured workflows have not only improved processing efficiency for customs officers but also reduced operational stress for clearing agents and other logistics stakeholders.

The performance of ICMS in managing documentation anomalies is best understood through the Technology Acceptance Model (TAM), which asserts that system adoption and sustained usage are driven by perceived usefulness and perceived ease of use (Davis, 1989). The perceived usefulness of ICMS is evident in the strong agreement that it reduces clearance delays, flags inconsistencies, and enables quick correction of errors. The system contributes directly to users' job efficiency by minimizing disruptions caused by incorrect or incomplete submissions. According to TAM, such improvements in performance are critical in shaping positive user attitudes and reinforcing the value of the technology in complex workflows.

The perceived ease of use is reflected in user experiences indicating that error notifications are intuitive and corrections can be implemented with minimal training. This is especially significant given that ICMS must be accessible to both internal customs officers and external partners like clearing agents. The system's built-in prompts, structured entry fields, and validation tools simplify complex procedures and encourage consistent engagement. These features satisfy TAM's second key condition—that a system must be free of excessive effort and understandable to support high adoption.

Moreover, as users gain trust in the system's capacity to prevent rather than merely detect errors, they internalize its value as part of a proactive risk management approach. This progression, as shown by Venkatesh and Bala (2008) in their extended TAM model, strengthens behavioral intention to use and continuously rely on the system for critical decision-making. In this context, TAM provides a useful lens to explain why ICMS is widely accepted as a tool for improving documentation reliability: it is perceived as a system that not only adds operational value but also simplifies users' tasks, ultimately leading to higher engagement and performance quality across the clearance process.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a synthesis of the study's main findings in relation to the stated objectives. It draws conclusions based on both statistical and qualitative evidence, highlighting the extent to which digital technologies have enhanced cargo security at Embakasi ICD. The chapter also offers practical recommendations aimed at policy makers, customs authorities, and technology providers to address identified gaps. Finally, it proposes areas for further research to build on the outcomes of this study and support the ongoing development of efficient, secure digital customs environments.

5.2 Summary of Findings

5.2.1 Influence of Integrated Scanning Solutions (I-Scan) on Cargo Security

The study revealed that Integrated Scanning Solutions (I-Scan) significantly enhance cargo security through high image clarity, improved detection of concealed items, and effective nonintrusive inspections. On image clarity, 42% of respondents agreed and 21% strongly agreed that high-resolution scans reduce the need for physical unpacking, while 59% acknowledged that poor image quality delays clearance decisions. Moreover, 60% relied on scan clarity to validate inspections, and 64% confirmed improved detection of concealed goods. A further 66% found scanned images clear and easy to interpret. Regarding detection of mis-declared items, 64% agreed that I-Scan enhances accuracy, and 66% indicated it supports faster risk assessment. The technology was credited by 63% of users for helping identify suspicious cargo, while 66% confirmed its effectiveness in detecting concealed goods. Additionally, 65% affirmed that I-Scan improves compliance with international standards, and 63% preferred it over physical inspection

due to speed and accuracy. The system's non-intrusive nature was supported by 65% who acknowledged reduced delays and 64% who highlighted the ability to inspect without opening containers. Interviews reinforced these findings, citing operational efficiency and user confidence in the system. The Technology Acceptance Model (TAM) confirmed that I-Scan adoption is driven by perceived usefulness and ease of use.

5.2.2 Influence of Regional Electronic Cargo Tracking System (RECTS) on Cargo Security

Findings indicated that RECTS positively influences cargo security through real-time monitoring, responsive alerts, and accurate cargo tracking. On real-time transmission, 38% agreed and 20% strongly agreed that RECTS minimizes delays, while 61% acknowledged enhanced inter-agency coordination through real-time alerts. Additionally, 58% trusted real-time data for timely responses, and 65% confirmed RECTS reduces tampering risks. Alerts were deemed timely by 65% of respondents. Concerning deviation detection, 60% believed alerts matched ground-level risks, and 63% reported acting on them to prevent irregular activity. About 58% noted that RECTS helped reduce theft and diversion, and 62% believed alerts accurately identified threats. Notably, 65% affirmed the system effectively detects route deviations. Regarding cargo identification, 59% said RECTS minimized misidentification, 58% noted its support in prompt inspections, and 61% agreed it enables seamless verification from origin to destination. Further, 60% expressed confidence in RECTS data, and 63% believed it ensures consistent cargo tracking. Verbatim accounts confirmed RECTS' operational impact, especially in reducing response times and improving enforcement accuracy. Game Theory interpretation emphasized RECTS' role in altering stakeholder strategies through surveillance, reducing incentives for non-compliance, and promoting lawful behavior across transit checkpoints.

5.2.3 Influence of Integrated Customs Management System (ICMS) on Cargo Security

The ICMS was found to significantly strengthen cargo security by improving declaration reliability, enhancing data sharing, and reducing documentation-related delays. Regarding declaration reliability, 62% agreed ICMS reduces fraudulent declarations, 60% acknowledged fewer misclassifications, and 59% observed decreased declaration errors. Trust in ICMS data was affirmed by 63%, and 64% cited improved data accuracy. On data sharing, 58% of respondents used ICMS for inter-agency updates, 62% recognized increased transparency, and 62% agreed shared access reduced processing time. Furthermore, 59% observed better inter-agency coordination, and 61% affirmed timely data sharing. On documentation issues, 63% agreed anomalies are easier to detect, 60% confirmed that corrections are quick and do not halt clearance, and 59% noted a reduction in delays from incorrect documentation. ICMS was also recognized by 65% for efficiently flagging errors and by 62% for minimizing clearance disruptions. Interview narratives supported these findings, highlighting enhanced trust, traceability, and inter-agency efficiency. Applying the Technology Acceptance Model (TAM), it was evident that ICMS' perceived usefulness in reducing delays and improving data integrity, combined with its intuitive interface, has fostered strong user adoption and confidence.

5.3 Conclusion

5.3.1 Influence of Integrated Scanning Solutions (I-Scan) on Cargo Security

The Integrated Scanning Solution (I-Scan) significantly enhances cargo security at the Embakasi Inland Container Depot by improving image clarity, facilitating the identification of concealed or mis-declared goods, and enabling efficient non-intrusive inspections. The technology has reduced dependence on physical unpacking, improved inspection accuracy, and expedited clearance processes. Supported by both quantitative evidence and key informant feedback, the system is

broadly accepted due to its operational usefulness and ease of integration into customs workflows, validating the Technology Acceptance Model (TAM).

5.3.2 Influence of Regional Electronic Cargo Tracking System (RECTS) on Cargo Security

The Regional Electronic Cargo Tracking System (RECTS) plays a critical role in safeguarding cargo during transit by providing dependable real-time monitoring, timely alerts, and accurate identification across checkpoints. It enhances coordination between enforcement agencies, enables proactive responses to deviations, and minimizes risks of theft or diversion. Findings confirm that RECTS alters the strategic behavior of transit actors, as explained by Game Theory, deterring noncompliance and promoting system-wide accountability through transparency and real-time visibility.

5.3.3 Influence of Integrated Customs Management System (ICMS) on Cargo Security The Integrated Customs Management System (ICMS) contributes meaningfully to cargo security through improved declaration accuracy, streamlined data sharing, and efficient handling of documentation anomalies. The system fosters inter-agency collaboration, ensures traceable and consistent data, and reduces errors that previously led to clearance delays. Its acceptance is strongly influenced by perceived usefulness and ease of use, as posited by TAM, with users reporting increased trust in the system and its capabilities to support secure, efficient cargo handling at Embakasi ICD.

5.4 Recommendations

5.4.1 Influence of Integrated Scanning Solutions (I-Scan) on Cargo Security

The Kenya Revenue Authority should enhance the performance of I-Scan technology by conducting regular system maintenance and upgrading image resolution standards. Further investment should be made in officer training on interpreting scanned images to reduce reliance

on physical inspections. Integrating advanced analytics and automated anomaly detection features into the system could also support proactive risk profiling and real-time inspection decisions.

5.4.2 Influence of Regional Electronic Cargo Tracking System (RECTS) on Cargo Security

To optimize RECTS, customs agencies should establish dedicated response units capable of acting on alerts promptly and uniformly across jurisdictions. Furthermore, real-time data streams should be integrated with mobile enforcement dashboards for field officers. Awareness campaigns targeting transporters and clearing agents can also reinforce compliance behaviors by increasing their understanding of the system's surveillance and alert protocols.

5.4.3 Influence of Integrated Customs Management System (ICMS) on Cargo Security KRA and partner agencies should enhance ICMS by expanding user training on data entry protocols and inter-agency coordination procedures. To further improve system reliability, the development of automated document validation tools and real-time error feedback should be prioritized. A structured monitoring and evaluation framework should be instituted to continuously assess the system's effectiveness in minimizing clearance delays and improving cargo declaration accuracy.

5.5 Recommendation for Further Studies

Future research should explore the long-term impact of integrated digital systems on regional trade efficiency and revenue collection across multiple border points. Comparative studies across different inland container depots and international customs regimes would help assess scalability and interoperability challenges. Additionally, further investigations should examine the role of user experience and behavioral factors—such as resistance to change, system fatigue, or training adequacy—in shaping the sustainability of digital customs innovations in East Africa.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

Please do not write your name anywhere on this questionnaire. Information provided will be treat with ultimate privacy, confidentiality and the research carried out conducted is meant for Academic purposes. You are requested to read each question carefully and supply your honest response. Please **tick (✓)** on your appropriate response and fill the required information in the space provided where applicable.

SECTION 1: DEMOGRAPHIC INFORMATION

1 Gender

Male [ ] Female [ ]

2 Age

[ ] 18-25 years [ ] 25-35 years [ ] 35-45years

[ ] 45-55 years [ ] above 55 years

3 Highest level of education attained

[ ] College [ ] University-Bachelors [ ] University-Masters

4 Marital status

Single [ ] Married [ ] Separated [ ] Divorced [ ]

5. What is your Religion?

A. Muslim [ ] B. Christian [ ] C. Hindu [ ] D. Others [ ]

SECTION 2: TO ASSESS THE INFLUENCE OF INTEGRATED SCANNING SOLUTIONS (I-SCAN) ON CARGO SECURITY AT THE INLAND CONTAINER DEPOT OF EMBAKASI, NAIROBI, KENYA

Indicated the extent to which you agree with the following statements.

Clarity of Scanned Cargo Images

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The scanned cargo images generated by IScan systems are consistently clear and easy to interpret.	[ ]	[ ]	[ ]	[ ]	[ ]
The clarity of scanned images enhances the detection of concealed items in cargo.	[ ]	[ ]	[ ]	[ ]	[ ]
I frequently rely on the clarity of I-Scan images to validate physical inspection results.	[ ]	[ ]	[ ]	[ ]	[ ]
Poor image clarity often delays cargo clearance decisions.	[ ]	[ ]	[ ]	[ ]	[ ]
High-resolution images from I-Scan reduce the need for physical unpacking of cargo.	[ ]	[ ]	[ ]	[ ]	[ ]

Identification of Concealed or Mis-declared Items

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The I-Scan system effectively identifies concealed goods that would otherwise go undetected.	[ ]	[ ]	[ ]	[ ]	[ ]
I-Scan technology helps customs officers flag suspicious cargo for further verification.	[ ]	[ ]	[ ]	[ ]	[ ]
The scanning system often detects misdeclared items in containers.	[ ]	[ ]	[ ]	[ ]	[ ]

I-Scan's identification features support faster decision-making on cargo risk levels.	[ ]	[ ]	[ ]	[ ]	[ ]
The accuracy of detecting illegal or undeclared items has improved due to IScan use.	[ ]	[ ]	[ ]	[ ]	[ ]

Non-Intrusive Goods Inspections

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The I-Scan system allows for efficient cargo inspection without opening containers.	[ ]	[ ]	[ ]	[ ]	[ ]
Non-intrusive scanning has significantly reduced delays in cargo clearance.	[ ]	[ ]	[ ]	[ ]	[ ]
I prefer using I-Scan over physical inspection due to its speed and accuracy.	[ ]	[ ]	[ ]	[ ]	[ ]
Non-intrusive inspection improves security by minimizing human interference.	[ ]	[ ]	[ ]	[ ]	[ ]
The adoption of non-intrusive methods has enhanced compliance with international cargo inspection standards.	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION 3: TO EVALUATE THE INFLUENCE OF THE REGIONAL ELECTRONIC CARGO TRACKING SYSTEM (RECTS) ON CARGO SECURITY AT THE INLAND CONTAINER DEPOT OF EMBAKASI, NAIROBI, KENYA

Effectiveness of Real-Time Transmission

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
RECTS provides timely updates that enhance cargo monitoring throughout transit.	[ ]	[ ]	[ ]	[ ]	[ ]
Real-time transmission through RECTS reduces the chances of cargo being tampered with.	[ ]	[ ]	[ ]	[ ]	[ ]
I rely on real-time tracking data to detect and respond to cargo threats promptly.	[ ]	[ ]	[ ]	[ ]	[ ]
Real-time alerts from RECTS have improved coordination among customs and enforcement agencies.	[ ]	[ ]	[ ]	[ ]	[ ]
The real-time functionality of RECTS is dependable and minimizes delays in action.	[ ]	[ ]	[ ]	[ ]	[ ]

Rate of System-Generated Alerts During Transit Deviations

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The RECTS system effectively triggers alerts when cargo deviates from approved routes.	[ ]	[ ]	[ ]	[ ]	[ ]
Most system-generated alerts accurately reflect genuine cargo security threats.	[ ]	[ ]	[ ]	[ ]	[ ]
Alerts from RECTS help reduce incidents of cargo theft or diversion during transit.	[ ]	[ ]	[ ]	[ ]	[ ]

I take action based on RECTS alerts to investigate or prevent suspicious transit activity.	[ ]	[ ]	[ ]	[ ]	[ ]
The number of alerts received through RECTS aligns with real-time risks encountered on the ground.	[ ]	[ ]	[ ]	[ ]	[ ]

Accuracy of Cargo Identification Across Checkpoints

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
The RECTS system accurately tracks and identifies cargo at multiple checkpoints.	[ ]	[ ]	[ ]	[ ]	[ ]
I am confident in the RECTS data when verifying cargo movement across customs points.	[ ]	[ ]	[ ]	[ ]	[ ]
RECTS enables seamless cargo verification from origin to destination.	[ ]	[ ]	[ ]	[ ]	[ ]
The accuracy of cargo identification in RECTS supports prompt inspections.	[ ]	[ ]	[ ]	[ ]	[ ]
Cargo misidentification is minimal when using RECTS during clearance at checkpoints.	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION 4: TO EXAMINE THE INFLUENCE OF THE INTEGRATED CUSTOMS MANAGEMENT SYSTEM (ICMS) ON CARGO SECURITY AT THE INLAND CONTAINER DEPOT OF EMBAKASI, NAIROBI, KENYA

Reliability of Cargo Declaration Data in ICMS

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
ICMS provides consistent and accurate cargo declaration data for customs officers.	[ ]	[ ]	[ ]	[ ]	[ ]
I trust the data from ICMS when verifying cargo documentation.	[ ]	[ ]	[ ]	[ ]	[ ]
Errors in cargo declaration have decreased since the implementation of ICMS.	[ ]	[ ]	[ ]	[ ]	[ ]
ICMS helps minimize the misclassification of goods during customs processing.	[ ]	[ ]	[ ]	[ ]	[ ]
The system improves cargo security by reducing fraudulent declarations.	[ ]	[ ]	[ ]	[ ]	[ ]

Efficiency of Data Sharing Between Customs and Partner Agencies

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
ICMS allows timely data sharing between customs and partner agencies.	[ ]	[ ]	[ ]	[ ]	[ ]
The system has improved interagency coordination in handling cargo.	[ ]	[ ]	[ ]	[ ]	[ ]
Shared access to ICMS reduces cargo processing time.	[ ]	[ ]	[ ]	[ ]	[ ]

ICMS enhances transparency and accountability across customs-linked departments.	[ ]	[ ]	[ ]	[ ]	[ ]
I frequently use ICMS to access updates submitted by other regulatory or enforcement bodies.	[ ]	[ ]	[ ]	[ ]	[ ]

Incidence of Documentation-Related Delays or Anomalies

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
ICMS has reduced the number of documentation-related delays in cargo clearance.	[ ]	[ ]	[ ]	[ ]	[ ]
The system flags errors and inconsistencies in cargo records efficiently.	[ ]	[ ]	[ ]	[ ]	[ ]
Cargo delays caused by missing or incorrect documents have decreased with ICMS implementation.	[ ]	[ ]	[ ]	[ ]	[ ]
ICMS allows quick correction of documentation issues without halting the cargo clearance process.	[ ]	[ ]	[ ]	[ ]	[ ]
Documentation anomalies are now easier to detect and address due to system automation.	[ ]	[ ]	[ ]	[ ]	[ ]

APPENDIX II: INDEPTH INTERVIEW QUIDE QUESTIONS

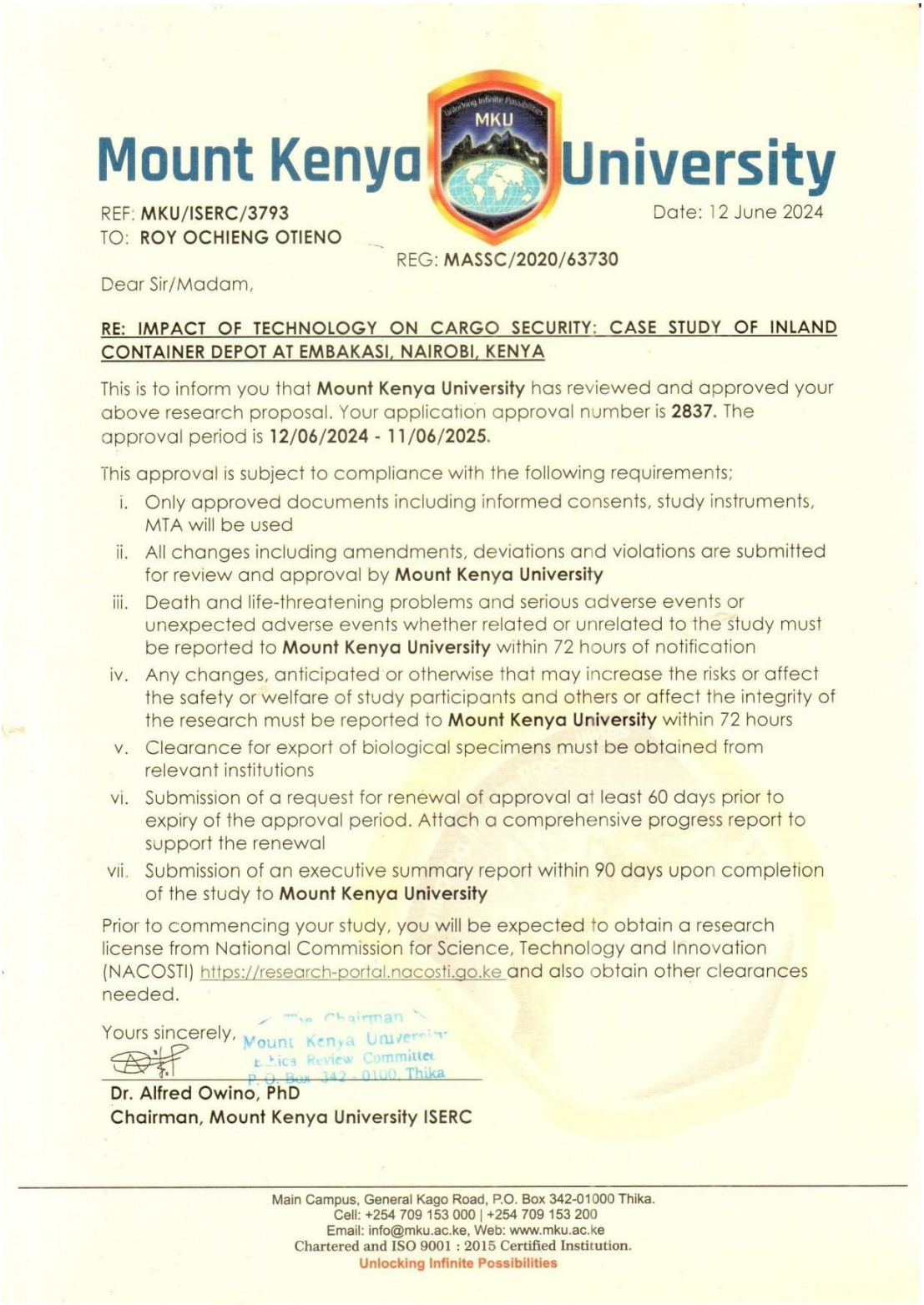
1. How would you describe the current effectiveness of the early warning systems in your area of operation?

2. What role does your organization or office play in disaster preparedness, response, and early warning dissemination?
3. To what extent is information from the Kenya Meteorological Department utilized in local decision-making and community-level disaster preparedness?
4. Can you describe the level of collaboration and coordination among key agencies during disaster events?
5. How well are local communities able to understand and act on early warning messages issued by your office or partners?
6. What types of disasters are most frequent in your area, and how effectively have early warning systems addressed them?
7. How is local indigenous knowledge integrated into formal early warning and disaster risk reduction mechanisms?
8. In your experience, what challenges do community-level actors face in disseminating early warning messages?
9. How is feedback from the community collected and used to improve early warning or response systems?
10. What capacity-building initiatives have been provided to strengthen early warning at the community or county level?
11. Are there any gaps in policy or institutional frameworks that hinder effective disaster response and early warning in your area?
12. What recommendations would you make to improve coordination, communication, and community engagement in disaster early warning systems?

APPENDIX

III: ETHICS REVIEW COMMITTEE (ERC) APPROVAL LETTER

APPENDIX



Mount Kenya University

REF: **MKU/ISERC/3793**
TO: **ROY OCHIENG OTIENO**

Date: 12 June 2024

REG: **MASSC/2020/63730**

Dear Sir/Madam,

RE: IMPACT OF TECHNOLOGY ON CARGO SECURITY: CASE STUDY OF INLAND CONTAINER DEPOT AT EMBAKASI, NAIROBI, KENYA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **2837.** The approval period is **12/06/2024 - 11/06/2025.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

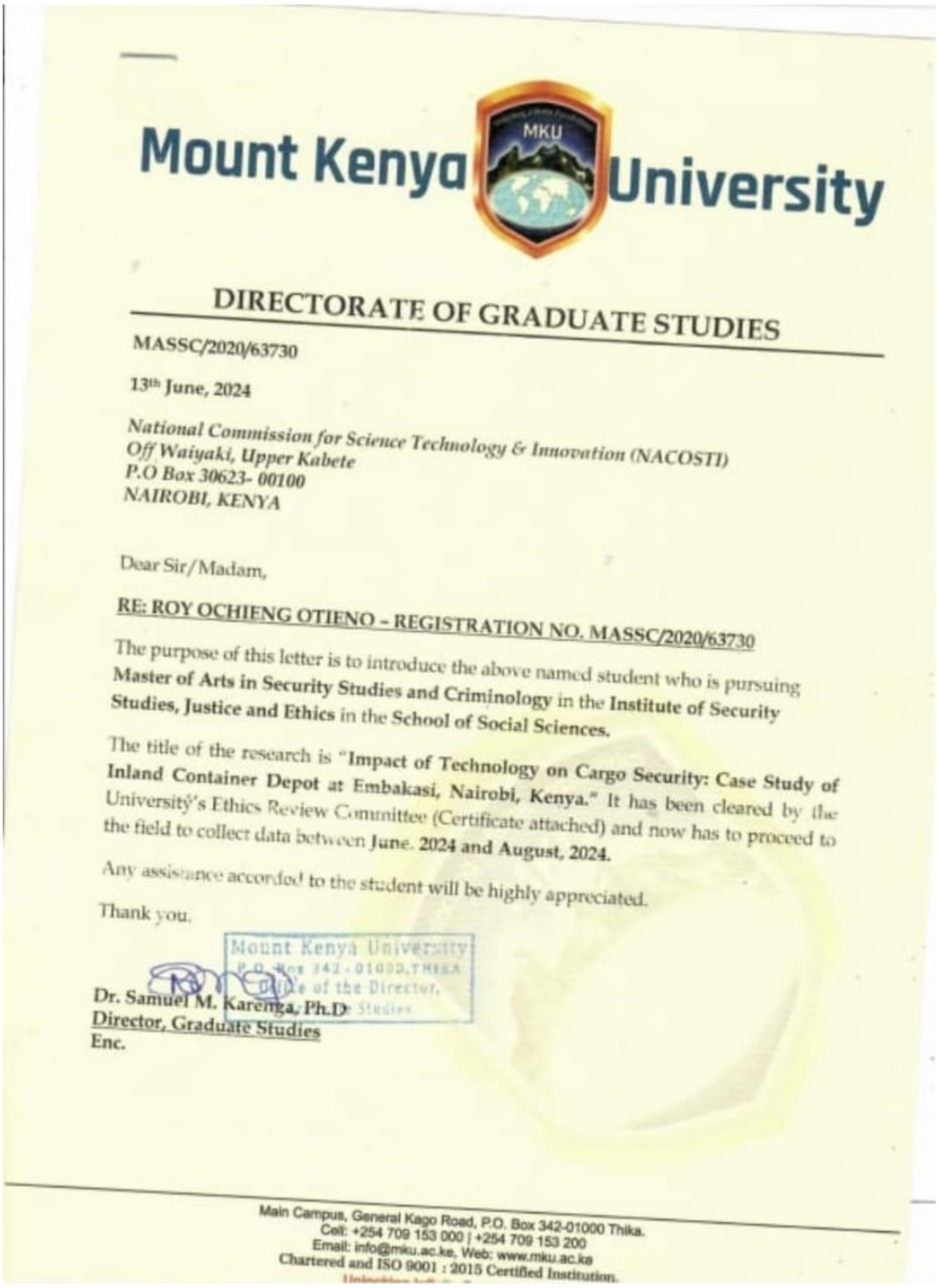
The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Dr. Alfred Owino, PhD
Chairman, Mount Kenya University ISERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
Cell: +254 709 153 000 | +254 709 153 200
Email: info@mku.ac.ke, Web: www.mku.ac.ke
Chartered and ISO 9001 : 2015 Certified Institution.
Unlocking Infinite Possibilities

IV: LETTER OF INTRODUCTION MOUNT KENYA UNIVERSITY

APPENDIX



Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MASSC/2020/63730

13th June, 2024

National Commission for Science Technology & Innovation (NACOSTI)
Off Waiyaki, Upper Kabete
P.O Box 30623- 00100
NAIROBI, KENYA

Dear Sir/Madam,

RE: ROY OCHIENG OTIENO – REGISTRATION NO. MASSC/2020/63730

The purpose of this letter is to introduce the above named student who is pursuing **Master of Arts in Security Studies and Criminology** in the **Institute of Security Studies, Justice and Ethics** in the **School of Social Sciences.**

The title of the research is "**Impact of Technology on Cargo Security: Case Study of Inland Container Depot at Embakasi, Nairobi, Kenya.**" It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **June. 2024 and August, 2024.**

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P.O. Box 342-01000,THIKA
Office of the Director,
Graduate Studies

Dr. Samuel M. Kareriga, Ph.D
Director, Graduate Studies
Enc.

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
Cell: +254 709 153 000 | +254 709 153 200
Email: info@mku.ac.ke, Web: www.mku.ac.ke
Chartered and ISO 9001 : 2015 Certified Institution.

APPENDIX

V: NACOSTI RESEARCH PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: **173965**

Date of Issue: **05/July/2024**

RESEARCH LICENSE

This is to Certify that Mr.. ROY OCHIENG OTIENO of Mount Kenya University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: IMPACT OF TECHNOLOGY ON CARGO SECURITY: CASE STUDY OF INLAND CONTAINER DEPOT AT EMBAKASI, NAIROBI, KENYA for the period ending : 05/July/2025.

License No: **NACOSTI/P/24/37405**

173965

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

VII: LETTER OF ACCEPTANCE NAIROBI COUNTY

APPENDIX

.REF No. LC202409496

NAIROBI CITY COUNTY

City Hall
Governor's Office, F: 22217704 | Tel: 2224281
P.O. Box 30075 - 00100 Nairobi, Kenya- Kenya
Email: gorvernor@nairobicity.go.ke

TO WHOM IT MAY CONCERN

It is my pleasure to introduce **Roy Ochieng Otieno Reg No. MASSC/2020/63730** as student of Mt. Kenya University, Pursuing Master of Arts in Security Studies and Criminology. Therefore as part of fulfillment of master's Degree he is conducting a study on **impact of technology on cargo security**.

A case study of inland container depot at Embakasi, Nairobi, Kenya.

The study will not cause any disadvantages to your institution. If you agree to participate in the study, you will be doing it so professionally and voluntarily and they will be no any monetary returns. Any benefits of the research will largely be to contribute knowledge and evidence in order to improve policy and practice in depots in Kenya, Kindly note that if you have any queries as far as ethical issues are concerned, do not hesitate to contact the office of Nairobi governor.

Damaris Mueke,
Hr Assistant
Date 07/24/24

NAIROBI CITY COUNTY
DIRECTOR
T.L.D.

Created Date: 24/07/24

City Hall
Governor's Office, F: 22217704 | Tel: 2224281
P.O. Box 30075 - 00100 Nairobi,
Kenya

Email: gorvernor@nairobicity.go.ke
Website: nairobi.go.ke

APPENDIX

VIII: LETTER OF INTRODUCTION KENYA REVENUE AUTHORITY

KENYA REVENUE AUTHORITY

Letter of Introduction

www.kra.go.ke
For General Tax Questions
Contact KRA Call Centre Tel:
+254 (020) 4999 999
Cell: +254(0711)099 999
Email: callcentre@kra.go.ke

TO : ALL STAFFS INLAND CONTAINER EMBAKASI DEPOT.

FROM : RESEARCH, STRATEGY & INNOVATION DEPARTMENT.

REF NO: KRANKU139824072024

ROY OCHIENG OTIENO REG NO. MASSC/2020/63730

The above subject person is a student at Mt. Kenya University,pursuing a Master's Degree in Security Studies and Criminology. In partial fulfillment of his Master's Degree, he is conducting a study on **impact of technology on cargo security: a case study of inland container depot at Embakasi, Nairobi, Kenya.**

This letter is to humbly request you to respond to questions in the questionnaire attached to this letter, to enable him complete his research study. The information requested will be used for academic purposes only and your anonymity and confidentiality will be assured.

Thank you in advance for your willingness to contribute to this research.

For further clarifications reach out to the Department of Research, Strategy and innovation.

Regards,

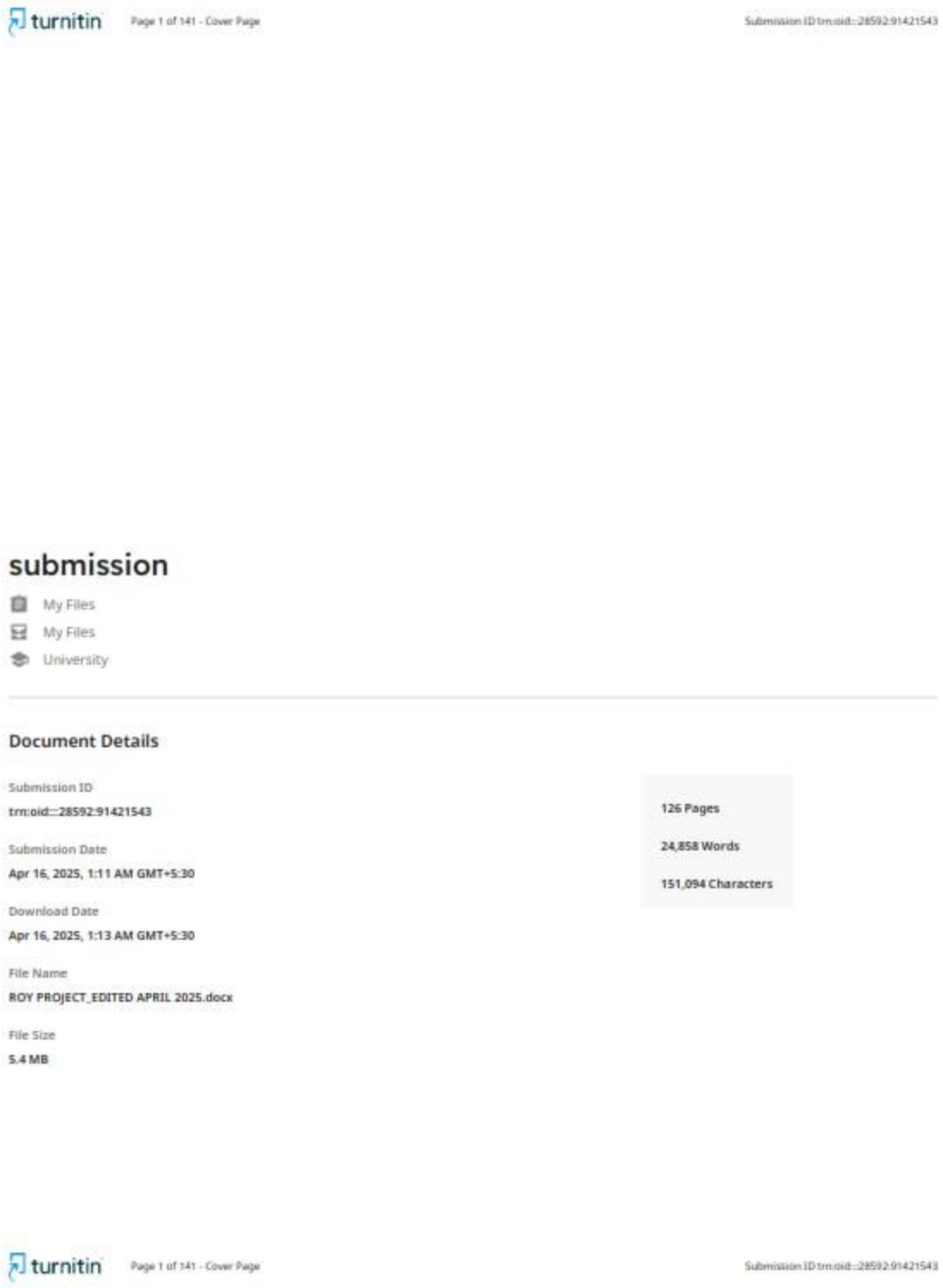
David Ochuodho,
Research Assistant,
Kenya Revenue Authority,
david.ochuodho@kra.co.ke.

Disclaimer: This Letter is system Generated and therefore does not require stamp.You may confirm validity of this letter on callcentre@kra.go.ke or through department of origin. The Letter is only valid for three months and may however be with withdrawn on grounds of outstanding integrity affecting periods prior to this

APPENDIX

IX: TURNITIN REPORT

APPENDIX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Matches with neither in-text citation nor quotation marks

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Matches that are still very similar to source material

0 Missing Citation 0%
Matches that have quotation marks, but no in-text citation

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10% Internet sources
5% Publications
13% Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

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A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

Match Groups

- 282 Not Cited or Quoted 13%
  Matches with neither in-text citation nor quotation marks
- 46 Missing Quotations 2%
  Matches that are still very similar to source material
- 0 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

10% Internet sources
5% Publications
13% Submitted works (Student Papers)

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The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

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Mount Kenya University on 2025-01-28		<1%
4	Submitted works	
Mount Kenya University on 2024-05-17		<1%
5	Submitted works	
Fiji National University on 2025-03-16		<1%
6	Submitted works	
Mount Kenya University on 2024-06-24		<1%
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23	Submitted works	
Mount Kenya University on 2023-11-23		<1%
24	Submitted works	
California Southern University on 2025-01-20		<1%

APPENDIX X: MAP OF INLAND CONTAINER DEPOT EMBAKASI, NAIROBI, KENYA

APPENDIX XI: MAP OF NAIROBI COUNTY