

Interoperability Effectiveness of E-Passport Operations and Citizens' Satisfaction in the Kilimanjaro Region: A Comprehensive Analysis

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Abstract

Citizen dissatisfaction with e-passport services in many countries emanates from issues such as slow processing times, inconsistent service quality, and limited accessibility, especially in remote areas. Technical challenges, lack of reliable support, and insufficient staff training hinders user experiences, affecting trust in the system. Addressing these challenges is therefore of importance to improve efficiency, user satisfaction, and confidence in digital government services. The purpose of this study was thus to measure the relationship between the interoperability effectiveness of e-passport operations towards citizens' satisfaction in the Kilimanjaro region. The study was anchored on the Information Systems Success Model (ISSM) and employed a descriptive research strategy involving a triangulation approach which involves qualitative and quantitative. The study collected primary data using both a structured questionnaire and a Key Informant Interview. The quantitative data collected using a questionnaire was analyzed with the aid of SPSS software using both descriptive and inferential statistics. The study found that e-passport interoperability significantly influences service delivery effectiveness in the Kilimanjaro region. The Government Electronic Payment Gateway (GePG), National Identification Authority (NIDA), and Tanzania Interoperable Payment System (TIPS) each had a positive and significant impact on service effectiveness ($p < 0.05$), with GePG showing the strongest influence ($\beta = 0.789$). Most respondents perceived service delivery as effective, with over 69% attributing improvements to these systems. The study concludes that continuous improvements in payment, feedback, citizen identification systems, and delivery methods are necessary to enhance the effectiveness and user satisfaction of e-passport services. The study therefore recommends that customer service training for staff should be emphasized to ensure prompt, empathetic, and knowledgeable support, which is critical for improving overall user satisfaction.

Keywords: *E-Passport, Interoperability, Citizens' Satisfaction, Kilimanjaro Region, Operational Effectiveness*

1. Introduction

Citizen dissatisfaction with e-passport services in many countries emanates from issues such as slow processing times, inconsistent service quality, and limited accessibility, especially in remote areas (Ahamed, 2024). Additionally, technical challenges, lack of reliable support, and insufficient staff training hinders user experiences, affecting trust in the system (Maime, 2022). Addressing these challenges is therefore of importance to improve efficiency, user satisfaction, and confidence in digital government services. Governments used to provide services to both citizens and business entities through various means such as face-to-face, e-mails, telephones, letters, and advertisements through radio broadcasts among others (Kuteesa et al., 2021). These means of communication have been proven to face challenges for example; services are provided during the day and time established by the Government and in some circumstances not all government personnel are service-oriented. Different researchers have written about how to improve the model by which the government provides services to achieve citizens' satisfaction through the automation of its processes through the use of Information and Communication Technologies through what is known as electronic government (Mohsan et al., 2021; Rathnayake et al., 2024; Hidayat, 2024).

The use of ICT (Information and Communication Technology) and the Internet was introduced to improve public services by shifting their services from manual to electronic services (Al Qudah, 2024). This helps the government to utilize these distribution channels to serve their citizens. Citizen services across borders, throughout the world, are issued through e-passport validation. E-passports or electronic passports contain a contactless smart card used to store digitally signed data and implement security protocols to control access to this data (Mostowski *et al.*, 2024). In Sub-Saharan Africa, e-passport was therefore introduced to open up the horizon of many citizens to travel around the world and promote popular participation and investments in ICT (Munyoka and Manzira, 2013). However, a lack of accountability and transparency is still a common occurrence in most African countries leading to corruption (Oye, 2013).

According to Wamoto (2015), Kenya, initially approved the national ICT policy in 2004 marking the beginning of the e-governance journey, and in 2006 the Ministry of Information Communications (MoICT) was tasked to manage and midwife it to enhance efficiency, effectiveness, democracy, and transparency within public system and administration. Kenya has made strides in transforming public services to a web-based system, serving citizens via online services such as paying taxes, bills, and applications for government documents and tendering to increase the rate of delivering the service to the public (Kilelo, Beru, and Nassiuma, 2015).

Mbilinyi and Warema (2018) discussed a critical situation before e-passport adoption: the service was manual to the citizen like payment, processing, data installation, printing sorting, and filling forms and renewing of passport was all process repeated in Arusha Region. Where the adoption of e-passport was intended to minimize the long process of applying and waiting time to improve government services like revenue collection systems to increase transparency and trust to the citizen, immigration systems like e-passport, e-visa, and e-permit have been improved in Tanzania. Adoption of an e-passport strategy in Tanzania could collect providers,

customers, and the whole administration into a faultless network on swelling value creation. Despite e-government services being in abode, there has been substandard implementation of the same, especially in the e-passport process.

1.1 Statement of the Problem

Citizens' satisfaction with e-passport services is important as it reflects trust in government efficiency, impacting public confidence in digital initiatives (Ahamed, 2022). High satisfaction encourages continued use and promotes a positive reputation for government technology, reducing resistance to similar services in the future. Moreover, understanding user feedback helps authorities improve service delivery, ensuring accessibility, security, and convenience in essential identification processes (Gregory, 2023). There is inadequate effectiveness of electronic passport services to its citizens' satisfaction in Tanzania (Rwegasira *et al.*, 2024). The issue of delay in e-passport is still existing in immigration office due to prolonged processes in issuing that document which leads to dissatisfaction among users of e-passport.

As indicated by Kipingu and Shayo, (2021) excessive document submission during application for e-passport which includes 6 to 7 documents such as birth certificate, affidavit for parent, ward letter, application letter, national identification authority, and proof of travel and invitation letter has still prolonged the time taken in the application of e-passports in Tanzania. Despite official processing timeframes being 7 days for Dar es Salaam residents and 14 days for applicants from other regions like Kilimanjaro, but still, the prolonged waiting times often extends to nearly a month, a pressing issue that has persisted for years. This time taken has been consistently documented and reported in recent research and government reports (Ministry of Information Communication and Technology, 2023). Insufficiency of e-passport services systems interoperates data transformation from the immigration website to other organisation systems like telecommunication banks during the payment process resulting in severe inconvenience and frustration for applicants, disrupting their travel plans and daily lives.

Reviewed studies Kipingu and Shayo (2021); Mbilinyi and Werema (2018) indicated little on the effectiveness of e-passports to its citizens' satisfaction in Tanzania. For example, Shayo (2021) studied factors influencing the adoption of electronic government to provide automated services, while Mbilinyi *et al.* (2018) investigated challenges facing e-government on infrastructure, user characteristics, and perceived benefits of e-government on service in improving the delivery of public services in Tanzania. The study intended to perceive the importance of improving e-passport service to increase citizens' satisfaction in Kilimanjaro Region in order to fill this gap. The rationale of this study was therefore to measure the relationship between the interoperability effectiveness of e-passport operations towards citizens' satisfaction in the Kilimanjaro region.

1.2 Research Objective

To measure the relationship between the interoperability effectiveness of e-passport operations towards citizens' satisfaction in the Kilimanjaro region.

1.3 Research Questions

What are citizens' satisfaction levels with e-passport interoperability effectiveness in service delivery in the Kilimanjaro region?

2. Theoretical Framework

This study was underpinned by the Information Systems Success Model (ISSM). The Information Systems Success Model (ISSM), developed by William De Lone and Ephraim McLean (DeLone & McLean, 2013), is a comprehensive framework designed to assess the success of information systems (IS). The model initially proposed six dimensions: System Quality, Information Quality, Service Quality, Use, User Satisfaction, and Net Benefits. These dimensions help in understanding various aspects of IS achievement, from the system quality and information it provides to its actual usage and the satisfaction it brings to users. Over the years, ISSM has been widely accepted and utilized in evaluating the effectiveness and impact of various information systems, making it a cornerstone in the field of IS research.

The strengths of ISSM lie in its comprehensive nature and multidimensional approach to evaluating information systems success (Adeyemi & Issa, 2020). It provides a clear and detailed framework for assessing various aspects of an information system, from its design and implementation to its use and impact (Nguyen *et al.*, 2015). This holistic approach ensures that all critical dimensions contributing to the system's success are considered (Al-Adwan *et al.*, 2021). Additionally, the model's flexibility allows it to be applied in various contexts and adapted to different types of information systems.

This theory was applied while investigating customers' satisfaction with e-passports users' satisfaction in Kilimanjaro, Tanzania. The model can be employed to assess factors influencing electronic passport services impact various dimensions of system success, especially focusing on system quality and user satisfaction (Hsu, 2023). By applying ISSM, one can analyze whether effective data exchange contributes to higher-quality information and services, leading to greater user satisfaction and perceived net benefits. This application of ISSM is crucial in understanding and improving the relationship between technical efficiency and customer satisfaction in information systems, particularly in the context of electronic passport services.

2.2 Empirical Review

The study by Nguyen *et al.* (2020) investigated the relationships and impacts of service quality, citizens' satisfaction, and switching costs on customer loyalty in the context of e-banking in commercial banks. The researchers analysed the collected data by the use of multivariate linear regression method. Findings revealed that all five factors of service quality; reliability, responsiveness, service capacity, empathy, and tangibility, have positive correlations with citizens' satisfaction. Notably, service capability and tangibility were identified as having the strongest impact. Additionally, the study found a strong and positive correlation between citizens' satisfaction and customer loyalty.

Sofyani *et al.*, (2020) investigated the perception of government employees in the local government (city) of Surabaya, Indonesia. Their study aimed to examine the association between the culture of compliance in information technology (IT) and service quality, accountability, and transparency, with effective IT governance (ITG) acting as an intervening variable. The study employed a quantitative research methodology, using questionnaires as the primary data collection tool. The findings of the study established that the culture of

compliance in IT indirectly associates with service quality, accountability, and transparency through the mediation of effective ITG.

Chen *et al.* (2020) examined the implementation of an integrated travel information system in Taiwan. Their study revealed that connecting e-passport services with border control and travel information systems enhanced security and reduced processing times at airports by more than a third. Three-quarters of travellers reported improved experiences due to this integrated approach. Smith and Brown (2019) investigated the effectiveness of Australia’s Advance Passenger Processing system. They found that integrating this system with e-passport services led to a big reduction in immigration processing times and a 40% increase in the detection of security risks, demonstrating the value of interoperable travel information systems.

In Tanzania, Rwegasira *et al.* (2024) assessed user satisfaction with the e-passport system and its impact on service delivery in Immigration Service Department. Using a descriptive research design with a quantitative approach, the researchers sampled 166 participants, including immigration staff and e-passport applicants, selected through simple random sampling. Data were gathered through questionnaires and analysed using multiple linear regression (MLR) with SPSS version 20. The findings revealed that the quality of the e-passport system specifically improved speed, intuitive interface, and ease of navigation had a significant positive influence on user satisfaction. Information quality factors, such as accuracy, completeness, and up-to-date information, also positively impacted user satisfaction.

2.3 Conceptual Framework

Figure 1 shows the conceptual framework used in this study.

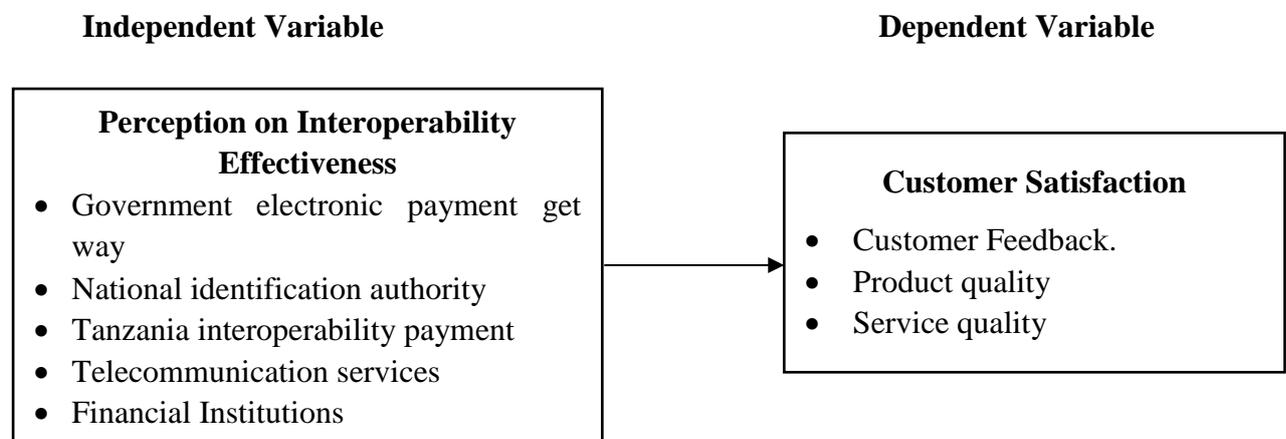


Figure 1: Conceptual Framework

3. Research Methodology

This study employed a descriptive research strategy. The choice of this strategy was pivotal as it primarily served to portray the state of affairs as they existed during the research process. The descriptive approach was instrumental in providing specific answers to the 'who,' 'Why there is a problem of inadequate efficiency of e-passport services “what,” (what is the number of customers satisfied with e-passports), and 'how'(how to solve the problem of electronic e-passport service delay), the questions raised by the investigation. The focus was on detailing

the nature of electronic passport services interoperability in Tanzania and its impact on users' satisfaction.

This study employed a triangulation approach which involves qualitative and quantitative. A triangulation approach requires the use of both qualitative and quantitative approaches. In addition, the researcher optimized the mixed method which requires to use of both quantitative and qualitative methodology in a single study. The study was conducted in the Kilimanjaro Region in Tanzania. The choice of this geographical area was pivotal in understanding the broader implications of electronic passport services across varied regions in Tanzania. The respondents for this study encompassed all Tanzanian citizens in Kilimanjaro region who had had experience in applying for a passport through the Tanzanian immigration website, and immigration department officers. The current population of applicants in Tanzania was 985,342 (Immigration Web site at Management Information System from 2018 up to 2024). This approach is chosen considering that individuals who apply for passports online are typically required to visit Regional immigration offices for interviews and biometric processes like having their photographs and figure print taken. These applicants come from different districts of Kilimanjaro like Moshi District, Moshi Municipal, Rombo, Hai, Same, Siha, and Mwanza.

The sample size was obtained through a formula that correlates to the population and the confidence interval:

$$n = \frac{N}{1 + N\alpha^2}$$

Where: n = Sample size, N = Population size, a = margin error (Yamane, 1967 as quoted by Ajah and Micah, 2021).

The formula agreed a confidence level of 90% in which the margin error is 8%, which as per social science research is acceptable.

Consequently, the analysis of each group was designed based on the response of the respondents available within the time, and this sample size is obtained from the known population:

$$n = \frac{985,342}{1 + 985,342 (0.08)^2}$$

$$n = 156.2 \approx 156$$

Thus, the sample size was 156 respondents.

The study employed convenience sampling, a type of non-probabilistic sampling technique. This decision is based on two key considerations relevant to the context of the Kilimanjaro Region. This study used only primary data that was gathered straight from respondents according to objectives. The data was both quantitative and qualitative in nature. Primary sources of data increased the reliability of the collected data since the data was collected directly from respondents. This triangulation approach ensures a more comprehensive understanding of the electronic passport services' effectiveness and user satisfaction in the Kilimanjaro region, thereby providing a well-rounded assessment of the study.

The analysis of the data was guided by the study objectives and an estimate of the obtained data to discover the pattern that was shown in the information that was acquired about the variables.

To determine the relationship between the interoperability effectiveness of e-passport operations towards user perceptions in the Kilimanjaro region. Quantitative data was analysed through Ordinal Logistic dependent variables that are dichotomous.

The model was specified as follows:

$$Y_i = \begin{cases} 1 = \text{Effective service delivery} \\ 0 = \text{Otherwise} \end{cases}$$

$Y_i = \text{Logit Model}$

$$\text{Log} \left(\frac{\pi_1 + \pi_2 + \dots + \pi_j}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_n} \right) = \beta_0j + \beta_1x_1 + \dots + \beta_px_p$$

$$\left(\frac{\pi_1 + \pi_2 + \dots + \pi_j}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_n} \right) = \beta_0j + \beta_1x_1 + \dots + \beta_px_p \dots \dots \dots \text{Regression}$$

The study employed the proportional model to examine whether the factors influencing the effectiveness of e-passport services had consistent effects across customer groups. The model estimated coefficients similar to probit or tobit regression, where positive values indicated that an increase in a predictor raised the likelihood of reporting higher effectiveness, while negative values reduced that likelihood. The focus was on the direction and significance of the coefficients ($p < 0.05$) to determine whether predictors had meaningful effects. The magnitude of coefficients was understood as showing the relative strength of influence, while marginal effects were used to give probability-based interpretation. This approach allowed the study to capture the underlying choice process of customers rather than relying on simple odds comparisons:

$$\text{Log} \left(\frac{\pi_1 + \pi_2 + \dots + \pi_j}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_n} \right) = \beta_0j + \beta_1x_1 + \dots + \beta_px_p$$

$$\left(\frac{\pi_1 + \pi_2 + \dots + \pi_j}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_n} \right) = \beta_0j + \beta_1x_1 + \dots + \beta_px_p$$

$$\text{Log} \left[\frac{\pi_1 + \pi_2 + \dots + \pi_j}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_n} \right] = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_7x_4$$

Where:

$\text{Log} \left[\frac{\pi_1 + \pi_2 + \dots + \pi_j}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_n} \right]$ = Natural logarithm of the odds

Y = Customer satisfaction in e-passport services administration

β_0 = Constant

β_1 to β_4 = Logistic regression coefficients of the predictor variables

X_1 = Government Electronic Payment Gateway (GePG)

X_2 = National Identification Authority (NIDA)

X₃= Tanzania interoperable Payment System (TIPS)

X₄ = Telecommunication Services

Table 1: Measurements of variables

Variable name	Variable symbol	Meaning	Sign (+/-)
Government Electronic Payment Gateway	GePG	Efficiency and reliability of paying fees through the official platform	+
National Identification Authority	NIDA	Accuracy and reliability of identity verification in e-passport processing	+
Tanzania interoperable Payment System	TIPS	Ability to integrate multiple payment systems seamlessly	+
Telecommunication Services	TS	Availability and reliability of network and mobile services for applications	+
Application process	AP	Time taken, network stability, and IT skills required for application	+
Cost	Co	Distance traveled and fees paid for passport processing	-
Document submission	Ds	Ease, clarity, and accuracy of submitting required documents	+
Speed time	St	Delivery methods and processing duration for receiving passport	+

Qualitative data was collected using an interview guide which was administered to the immigration department officers. The qualitative data collected was analysed thematically using content analysis

The participants were assured on confidentiality and anonymity in handling of data and information. Further, participants were informed that they were free to withdraw from the study at any time without penalty. Respondents participated based on informed consent. The principle of informed consent involves the researcher providing sufficient information and assurances about taking part to allow individuals to understand the implications of participation and to reach a fully informed, considered, and freely given decision about whether or not to do so, without the exercise of any pressure or coercion.

4. Findings and Discussion

The researcher distributed 156 questionnaires to the sampled respondents, out of which 151 questionnaires were fully completed and returned, yielding a response rate of 96.8%. The demographic results revealed that the majority of respondents were male (58.3%), while females accounted for 41.7%. Most respondents were younger, with 17.9% aged 18-24 years and 32.5% aged 25-34 years, indicating that younger, more tech-savvy users dominated the e-passport service user base in Kilimanjaro. A smaller percentage were older, with 19.9% aged 35-44 years, 9.3% aged 45-54 years, 7.3% aged 55-64 years, and 1.3% aged 65 years or older.

In terms of education, 31.8% had attained a college level of education, 21.2% had a bachelor's degree, and 16.6% were high school graduates. A smaller proportion had a master's degree (8.6%), a doctorate (5.3%), or no formal schooling (1.3%).

In terms of employment, 24.5% were part-time workers, 25.2% were employed full-time, and 43% were self-employed in businesses, while students made up 6% and retirees 1.3%. Most respondents (73.5%) resided in Kilimanjaro, while 21.9% were from other districts within Tanzania, and 4.6% were non-residents. Travel frequency varied, with 41.7% traveling internationally occasionally (1-2 times a year), 34.4% frequently (more than 2 times a year), and 19.9% rarely (less than once a year). A small fraction, 3.97%, never traveled internationally, indicating that many e-passport users in the study area were not frequent travelers but still required reliable services. The majority, 90 (59.6%) of the respondents had previous experience with e-passport services, while 61 respondents (40.4%) did not. These results indicate that more than half of the respondents are familiar with the e-passport application process, which means they were able to provide valuable information on the effectiveness and user satisfaction of the current system.

4.1 E-Passport Interoperability Effectiveness

The study sought to examine citizens' perceptions of e-passport interoperability on effectiveness in service delivery in the Kilimanjaro region. This section is on interoperable standards compliance and user satisfaction of e-passport service interoperability in the Kilimanjaro region, Tanzania.

Descriptive analysis results of e-passport interoperability effectiveness

The respondents were asked to indicate the extent to which they agree/disagree with the statements regarding e-passport interoperability, effectiveness of services delivery and citizens' satisfaction. Results are shown in Table 2.

Table 2: Descriptive Statistics on Perception of E-Passport Interoperability

Statement	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree	Mean	Std. Dev.
The electronic passport system adheres to recognized industry standards for interoperability.	17 (11.3%)	30 (20.5%)	27 (18.5%)	30 (20.5%)	43 (29.1%)	3.36	1.38
.I am aware of the electronic passport system's compliance with relevant interoperability standards.	8 (5.3%)	6 (4.6%)	16 (10.6%)	43 (29.1%)	75 (50.3%)	4.15	1.12
The electronic passport services have certifications that endorse their interoperability with other systems.	8 (5.3%)	6 (4.0%)	17 (11.3%)	38 (25.2%)	81 (54.3%)	4.19	1.12
I trust that the electronic passport system is certified for its interoperability capabilities.	27 (17.9%)	8 (5.3%)	28 (19.2%)	49 (32.5%)	38 (25.2%)	3.42	1.39
The documentation regarding the interoperability of the electronic passport system is clear and accessible.	4 (3.3%)	3 (2.6%)	22 (15.2%)	48 (31.8%)	70 (47.0%)	4.17	1
I find the level of transparency about the electronic passport system's interoperability to be satisfactory.	28 (19.2%)	14 (9.9%)	33 (22.5%)	38 (25.2%)	35 (23.2%)	3.23	1.42

The results, as summarised in Table 2, provides analysis on respondents' perceptions of e-passport interoperability. The majority of respondents agreed that the electronic passport system adheres to recognized industry standards for interoperability, as indicated by a mean score of 3.36 and a standard deviation of 1.38. This suggests that while nearly half of the respondents recognize the adherence to standards, there is still a good portion of the respondents that either disagrees or is unsure, indicating room for improvement in communicating and ensuring compliance with industry standards.

Additionally, the majority of the respondents agreed that they were aware of the electronic passport system's compliance with relevant interoperability standards, as reflected by a high mean score of 4.15 and a standard deviation of 1.12. This implies that most customers are well-informed about the system's compliance, which is crucial for building trust and satisfaction. Similarly, a substantial majority of respondents agreed that the electronic passport services have certifications endorsing their interoperability with other systems, like NIDA during citizen identification, RITA during birth certificate approve, Palace as the main controller of

all data transformation of E-passport due to National security and Banks during payment, although some systems like TRA and HEALTH still on progress of improvement as the President of Tanzania *Dr.Samia Suluhu Hassan mentioned on the public speech about the improvement of system interoperability on public services in TRA and Palace*, evidenced by a mean score of 4.19 and a standard deviation of 1.12. This indicates strong user confidence in the certifications and endorsements of the e-passport services, further enhancing trust in their interoperability capabilities.

Key Informant Interviews in objective three; user perception of e-passport interoperability effectiveness in services delivery, revealed that the e-passport system is interoperable with several critical systems, including NIDA, RITA, Palace, and various banks. Challenges mentioned include the need for further integration with TRA and the Health sector, which are still in the process of being improved. President Samia Suluhu Hassan emphasised the importance of ensuring that the port systems can read and integrate with TRA and Presidential systems to achieve true interoperability. Experts highlighted that while significant progress has been made, continuous efforts are required to ensure seamless integration across all relevant systems. An important quotation from an expert stated, *"The interoperability of the e-passport system with NIDA, RITA, and Palace has greatly enhanced the efficiency and security of our national identification processes."* Existing immigration reports also link the e-passport system with these agencies, demonstrating the critical role of interoperability in enhancing the overall effectiveness of e-passport services.

However, the perception of the electronic passport system's certification for interoperability capabilities was more mixed, with most agreeing and a few disagreeing, resulting in a mean score of 3.42 and a standard deviation of 1.39. This suggests that while many customers trust the system's certification, there is still a significant minority that doubts or is unaware of these capabilities. Furthermore, most of the respondents agreed that the documentation regarding the interoperability of the electronic passport system is clear and accessible, as indicated by a mean score of 4.17 and a standard deviation of 1. This high level of agreement suggests that the documentation provided is effective in conveying necessary information to customers.

Conversely, the perception of the level of transparency about the electronic passport system's interoperability was more varied, with most agreeing and others disagreeing, reflected by a mean score of 3.23 and a standard deviation of 1.42. This indicates that there are concerns about the transparency of the system's interoperability, suggesting a need for improved communication and openness to enhance user trust and satisfaction. These descriptive results indicate that while there is generally positive feedback regarding the interoperability of the e-passport system in Kilimanjaro region, there are areas that require attention, particularly in enhancing transparency and reinforcing trust in the system's certification and adherence to standards.

These findings are in agreement with the assertions by Nguyen et al. (2020) that all five factors of service quality; reliability, responsiveness, service capacity, empathy, and tangibility, have positive correlations with citizens' satisfaction. Notably, service capability and tangibility were identified as having the strongest impact. The study also found a strong and positive correlation between citizens' satisfaction and loyalty.

Inferential analysis of e-passport interoperability effectiveness in service delivery

To examine citizens' perceptions of e-passport interoperability on effectiveness in service delivery in the Kilimanjaro region, the study used Ordinal Logistic Regression specifically the Proportional Model to assess whether the odds of factors influencing the effectiveness of e-passport services (Government Electronic Payment Gateway, National Identification Authority and Tanzania interoperable Payment System) was the same among customers ($p < 0.05$). Table 3 shows the Ordinal Logistic Regression results.

Table 3: Regression Analysis Results for e-Passport Interoperability Effectiveness in Services Delivery

Variable	Coefficient	Std. Error	z-Value	P> z	95% Confidence Interval	
					Lower	Upper
GePG	0.789	0.145	5.441	0.000	1.272	2.438
NIDA	0.512	0.132	3.879	0.002	0.253	0.771
TIPS	0.642	0.15	4.090	0.000	0.334	0.950
AP	0.184	0.078	2.368	0.020	0.031	0.337
Co	-0.047	0.088	-2.830	0.007	-0.219	0.125
Ds	0.442	0.101	4.380	0.000	0.244	0.640
St	0.155	0.085	2.820	0.042	-0.012	0.322
_Cons	1.157	0.298	3.883	0.001	1.573	3.741

The regression results in Table 3 reveal that interoperability factors significantly influenced the effectiveness of e-passport services in the Kilimanjaro region. The Government Electronic Payment Gateway (GePG) ($\beta = 0.789$, $p < 0.001$), National Identification Authority (NIDA) ($\beta = 0.512$, $p = 0.002$), and the Tanzania Interoperable Payment System (TIPS) ($\beta = 0.642$, $p < 0.001$) all had positive and significant coefficients, suggesting that improvements in these systems enhanced the likelihood of citizens perceiving e-passport services as effective. Similarly, document submission ($\beta = 0.442$, $p < 0.001$), application process efficiency ($\beta = 0.184$, $p = 0.020$), and speed of service delivery ($\beta = 0.155$, $p = 0.042$) were significant and positive, indicating that streamlined procedures, timely processing, and reduced technical barriers contributed positively to service delivery. On the other hand, cost ($\beta = -0.047$, $p = 0.007$) was negative and significant, showing that higher processing fees and travel expenses reduced perceptions of service effectiveness. The constant term was also significant ($\beta = 1.157$, $p = 0.001$), confirming that baseline perceptions were favorable when interoperability mechanisms functioned efficiently. The findings suggest that effective integration of electronic systems and reduction of costs are critical for enhancing citizens' satisfaction with e-passport services.

These results suggest that improvements in the electronic payment gateway system significantly enhance the effectiveness of e-passport services. A key informant highlighted, *"The integration of GePG has streamlined the payment process, reducing delays and increasing user satisfaction by providing a seamless and efficient payment experience."* These qualitative results support the quantitative results, emphasising the importance of a robust payment system for enhancing overall service delivery.

The empirical implication of these findings is that an efficient electronic payment system is crucial for the successful implementation and effectiveness of e-passport services. This result aligns with existing literature that emphasises the role of efficient payment systems in improving service delivery and user satisfaction in public services. However, it differs from some studies that have not found a significant relationship between payment gateways and service effectiveness, possibly due to differences in the technological infrastructure and implementation strategies. The findings support the theory that technological advancements, particularly in payment systems, are critical for enhancing the effectiveness of public services. By refuting the null hypothesis that the payment gateway has no significant influence, this study underscores the necessity of investing in and continually improving electronic payment systems to ensure the successful operation and user satisfaction of e-passport services.

Similarly, the National Identification Authority (NIDA) showed a significant positive influence on the effectiveness of e-passport services, with a coefficient of 0.512 ($z = 3.879$, $p = 0.002$) and a 95% confidence interval ranging from 0.253 to 0.771. This result implies that a well-functioning identification authority, which ensures accurate and reliable identification services, plays a crucial role in the effectiveness of e-passport services. The Tanzania Interoperable Payment System (TIPS) also significantly influences service effectiveness, with a coefficient of 0.642 ($z = 4.090$, $p < 0.001$) and a confidence interval from 0.334 to 0.950. This highlights the importance of having a seamless payment system that integrates various services, further improving the overall user experience. The significant constant term (coefficient = 1.157, $z = 3.883$, $p = 0.001$, CI: 1.573 to 3.741) suggests an inherent baseline perception of effectiveness in e-passport services, independent of the specific factors analysed. These findings point to the need for continuous improvement in payment and identification systems to enhance the effectiveness and user satisfaction of e-passport services in the region.

These results concur with existing literature on the importance of efficient service delivery and user-friendly processes in enhancing customer satisfaction. The findings support the theory that service quality and efficiency are important determinants of user satisfaction in public services. The study concludes that e-passport services significantly influence users' satisfaction in the Kilimanjaro region. The results are consistent with the conclusions made by Mwaipyana (2014), highlighting that while ICT infrastructures and presentations are present, they are not considered ideal for effective service delivery.

These results empirically demonstrate the necessity of robust identification and payment systems in the effectiveness of e-passport services. The positive coefficients and significant p-values suggest that improvements in these systems are likely to lead to better service delivery and higher user satisfaction. This finding emphasises the need for continuous investment in

and enhancement of technological infrastructure related to identification and payment systems to ensure efficient and reliable e-passport services.

These findings are consistent with existing literature that emphasises the critical role of technological integration in public service delivery. Studies have consistently shown that well-functioning identification systems and interoperable payment systems are essential for effective public service delivery. However, these results differ from some studies that have found less significant impacts of such systems, potentially due to variations in implementation contexts and technological maturity. The positive influence of NIDA and TIPS on e-passport services in this study reinforces the general consensus on the importance of these systems but also suggests that specific regional factors might amplify their impact.

The results support the theory guiding the study, which posits that technological advancements and efficient systems are crucial for enhancing public service effectiveness. By demonstrating the significant positive influence of NIDA and TIPS, the study validates the theoretical framework that highlights the importance of technological infrastructure in improving service delivery. The significant constant term suggests an inherent baseline perception of effectiveness in e-passport services, independent of specific factors analysed, further supporting the theory that fundamental technological systems underpin overall service effectiveness.

The results led to the rejection of (H_0). The study therefore concluded that citizens' perceptions of e-passport interoperability influence the effectiveness of service delivery in the Kilimanjaro region.

These findings are consistent with the outcome of a study by Zhao *et al.* (2017) and Mutuku and Mahihu (2022), who indicated the importance of leveraging technology to improve accessibility and satisfaction with e-government services, including e-passports. Both studies emphasised the critical role of integration in enhancing service delivery and user satisfaction, which is mirrored in the Kilimanjaro context, where interoperability is seen as key to improving service outcomes. The results however diverge from Smith and Brown (2019), who found that integrating Australia's Advance Passenger Processing system with e-passports resulted in a 40% increase in detecting security risks and uniformly high satisfaction levels, suggesting a more seamless implementation in the Australian context.

These findings are in tandem with those of Rwegasira *et al.* (2024), who found that interoperability in the Tanzanian e-passport system, including integration with NIDA and RITA, significantly enhanced user satisfaction by improving service speed and reliability. Similarly, the study supports Chen *et al.* (2020), who demonstrated that integrating e-passport services with border control and travel systems in Taiwan improved security and processing times, fostering user confidence. Likewise, Al-Khouri (2014) found that linking national ID systems with e-passport services in the UAE reduced fraud and enhanced trust, paralleling the findings on interoperability with NIDA in the Kilimanjaro region. However, the findings are contrary to those of Sofyani *et al.* (2020), who reported that a culture of compliance with IT governance indirectly enhanced service quality and accountability through improved transparency. While the current study notes a gap in transparency about interoperability, the

findings suggest that this aspect requires further attention to ensure users feel adequately informed and confident in the system's capabilities.

In addition, table 3 shows the distribution of respondents who perceived the service delivery as effective or otherwise, in relation to the variables (Government Electronic Payment Gateway, National Identification Authority, and Tanzania Interoperable Payment System), along with how these variables influence user satisfaction.

Table 4: Perception Levels of e-Passport Interoperability effectiveness and Influence on Service Delivery

Variable	Effective Service Delivery		Ineffective Service Delivery		Influence on Satisfaction
	f	%	f	%	
Government Electronic Payment Gateway (GePG)	110	72.8%	41	27.2%	Positive and Significant ($\beta = 0.789, p < 0.001$)
National Identification Authority (NIDA)	105	69.5%	46	30.5%	Positive and Significant ($\beta = 0.512, p = 0.002$)
Tanzania Interoperable Payment System (TIPS)	108	71.5%	43	28.5%	Positive and Significant ($\beta = 0.642, p < 0.001$)

The results in Table 4 show that the majority of respondents perceived the e-passport service delivery as effective, with 72.8% of customers indicating that the Government Electronic Payment Gateway (GePG) contributed positively and significantly to service delivery ($\beta = 0.789, p < 0.001$). Similarly, 69.5% of respondents viewed the National Identification Authority (NIDA) as enhancing effective service delivery ($\beta = 0.512, p = 0.002$), while 71.5% believed the Tanzania Interoperable Payment System (TIPS) significantly improved service effectiveness ($\beta = 0.642, p < 0.001$). These results suggest that robust and efficient systems such as GePG, NIDA, and TIPS are vital in ensuring that customers experience satisfactory service delivery.

Conversely, a smaller proportion of respondents perceived service delivery as ineffective, with 27.2% for GePG, 30.5% for NIDA, and 28.5% for TIPS. Despite these figures, the significant positive coefficients indicate that improvements in these systems are likely to further reduce the number of customers dissatisfied with the service delivery. The data support the idea that technological integration, particularly in payment and identification systems, is a key factor in enhancing the effectiveness of public services like e-passports in the Kilimanjaro region.

5. Conclusion

The study concludes that adherence to industry standards for interoperability and effective communication about these standards are essential for user satisfaction. While many customers are aware of and trust the system's compliance with interoperability standards, there is still a need for better communication and transparency to assure all customers. This will help in

building confidence in the system's interoperability capabilities. Moreover, this study concludes that continuous improvements in payment, feedback, citizen identification systems, and delivery methods are necessary to enhance the effectiveness and user satisfaction of e-passport services. The significant positive impact of the Government Electronic Payment Gateway, National Identification Authority, and Tanzania Interoperable Payment System on service effectiveness underscores the importance of robust and efficient supporting systems. These improvements are crucial for reducing delays, increasing reliability, and ensuring a seamless user experience, ultimately leading to higher satisfaction with e-passport services in the Kilimanjaro region.

6. Recommendations

Addressing concerns related to interoperability and communication is essential for improving user perceptions of e-passport services. Although a majority of respondents are aware of the system's compliance with interoperability standards, there remains a need for better communication and transparency regarding the system's capabilities and certifications. The Ministry should enhance its communication strategies to provide clear and comprehensive information about the system's interoperability with other services, such as NIDA and TIPS. Additionally, the Ministry should work on improving the system's integration with relevant databases and services to ensure seamless operation and enhance overall effectiveness. By focusing on these areas, the Ministry will foster greater trust in the e-passport system and improve user satisfaction across the Kilimanjaro region.

The Tanzania Immigration Department should strive to focus on improving the efficiency and reliability of their systems. Specifically, enhancing transaction success rates, reducing documents submission, decentralization of printing citizen identification system should store all document into the system to avoid double visiting, status feedback of application process to be viewed by customers on immigration website, the time required to complete transactions, and reducing the need for customers to visit immigration offices physically should be prioritized. Implementing robust technical solutions and regular system updates can address these inefficiencies. Additionally, customer service training for staff should be emphasised to ensure prompt, empathetic, and knowledgeable support, which is critical for improving overall user satisfaction.

Despite the positive influence of NIDA on e-passport effectiveness, there remains a need for improved communication and user awareness about the identification services provided. NIDA should develop and implement comprehensive communication strategies to inform customers about the importance of accurate identification in the e-passport process and the role of NIDA in ensuring this accuracy. This should involve creating user-friendly guides, providing regular updates on system improvements, and offering customer support to address any concerns related to identification services. Future research should delve deeper into the specific role that each socio-demographic characteristic plays in shaping user experiences and satisfaction levels. For instance, exploring how education and training influence citizens' ability to navigate and utilise e-passport services. The study further recommends that future studies should consider assessing the role of regulatory frameworks on e-passport services in different jurisdictions as this will provide a broader understanding of best practices and policy implications.

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