A STUDY ON THE CHALLENGES FACED BY PUBLIC TRANSPORT USERS IN ADOPTING DIGITIZED FARE SYSTEMS.

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Abstract

The adoption of digitized fare systems in public transportation has gained global attention due to its potential to improve efficiency, security, and convenience. However, the transition from cash-based payments to digital fare collection in Nairobi's public transport sector has faced significant challenges. This study examines the key barriers affecting the adoption of digitized fare systems, including high transaction costs, system failures, fare evasion, mobile loan deductions, and complex fare structures.

A descriptive research design was employed, utilizing a quantitative approach to analyze data collected from 372 respondents, including commuters, transport operators, and policymakers. The study identified key determinants influencing adoption, such as perceived security, ease of use, performance expectancy, social influence, and top management support. Data analysis was conducted using SPSS version 26, applying descriptive and inferential statistical techniques to explore relationships between these variables and user adoption behavior.

The findings indicate that high transaction fees discourage digital fare payments, while network failures and fare reversal concerns create distrust among both commuters and transport operators. Additionally, inconsistent fare structures and the automatic deduction of mobile loans have contributed to the reluctance to fully embrace cashless payment systems. Despite these challenges, the study highlights that digitized fare systems have the potential to enhance Nairobi's transport sector if these issues are effectively addressed.

To facilitate adoption, the study recommends policy reforms, improved technological infrastructure, enhanced cybersecurity measures, and stakeholder collaboration. By implementing these strategies, Nairobi's public transport sector can successfully transition to a secure, efficient, and user-friendly digital fare system, benefiting both operators and commuters.

Key words: digitized fare systems, public transportation, electronic payments, transaction costs, system failures, fare evasion, mobile loans, technology adoption,

1.0 Introduction

1.1 Background of the Study

The evolution of fare collection systems in public transportation has undergone significant transformation, moving from traditional cash payments to more advanced digital payment systems. Many cities worldwide have adopted digitized fare systems, leveraging technology to improve efficiency, security, and convenience for commuters (Tee & Ong, 2016). These systems include mobile money, contactless payment cards, smart cards, and QR-code-based ticketing, all aimed at reducing reliance on cash transactions while enhancing service delivery (Mallat & Tuunainen, 2008).

In Kenya, particularly in Nairobi, public transport is largely dominated by matatus, buses, and commuter trains, operated by both private entities and government agencies. Despite the potential benefits of digitized fare systems, their adoption in Nairobi has faced several challenges. Key barriers include high transaction costs, reluctance from transport operators, concerns over system failures, and fare evasion (Kamau, 2022). Additionally, the informal nature of Nairobi's public transport system, with many independent operators, has complicated the transition from cash to digital payments (NGOTHO, 2020).

Government and private-sector stakeholders have made efforts to integrate digital payment systems into public transport, with initiatives such as the 2014 attempt to introduce the cashless fare system through prepaid cards like My1963. However, these efforts have encountered resistance due to lack of clear policies, limited infrastructure, and the preference for cash transactions among both commuters and transport operators (Kamau, 2022). The rise of mobile money services, such as M-Pesa, has provided an alternative, but challenges such as fare reversals and mobile loan deductions have further hindered seamless adoption.

With the increasing urban population and rising demand for efficient mobility solutions, digitized fare systems remain a crucial aspect of modernizing Nairobi's public transport sector.

Understanding the challenges faced in their adoption is essential for developing a framework that promotes smoother implementation and higher user acceptance. This study explores these challenges and proposes solutions that could enhance the transition to digitized fare systems, ultimately improving Nairobi's transportation ecosystem.

1.2 Problem of Research

Public transportation plays a crucial role in urban mobility, ensuring accessibility and convenience for millions of commuters. However, the inefficiencies of traditional fare collection methods continue to pose significant challenges, particularly in Nairobi's public transport sector. Despite the global shift towards digitized fare systems, the adoption and implementation of such systems in Nairobi have faced considerable obstacles, limiting their effectiveness in enhancing transport efficiency and user experience. One major challenge is the reluctance of public transport operators to adopt digital payment methods. Many operators prefer cash transactions due to concerns over transaction reversals, mobile loan deductions, and high processing fees associated with digital platforms such as M-Pesa. Additionally, fare evasion remains a prevalent issue, with passengers exploiting system loopholes to avoid making payments, leading to revenue losses for operators (Sudarta, 2022). Another significant barrier is the complexity and inconsistency of fare structures. The lack of standardized pricing models, coupled with fluctuating fares based on time of day and route variations, makes it difficult to integrate seamless digital payment solutions. Additionally, frequent system failures, unreliable network connectivity, and the lack of proper digital infrastructure further hinder the adoption of digitized fare systems (CGAP, 2009).

1.3 Objective of the study

a. To determine the various payment challenges faced by public transport systems in adopting digitized payment methods.

1.4 Scope of the study

This study focuses on examining the challenges associated with the adoption of digitized fare systems in Nairobi's public transportation sector. The research covers key aspects of digital fare payment implementation, including technological, economic, operational, and policy-related barriers that affect adoption by commuters and transport operators.

The study is limited to public transport modes such as matatus, buses, tuk-tuk and bodaboda which form the backbone of Nairobi's urban mobility. It does not cover private ride-hailing services like Uber or Bolt, as their payment systems operate differently from mass transit fare collection.

Geographically, the research is confined to Nairobi, where digitized fare systems have been introduced but face slow adoption. The study considers perspectives from key stakeholders, including such as commuters, to gain a comprehensive understanding of the challenges and opportunities in implementing these systems.

1.5 Significance of the study.

- Here are some of the important aspects that will be used to highlight the significance of this study:
- The study provides insights into the barriers preventing the adoption of digitized fare systems, such as high transaction costs, fare reversals, and system failures. By identifying these challenges, transport operators can make informed decisions on how to integrate digital payments while minimizing operational risks.
- The study provides an understanding of the issues related to system failures and fare complexities will help commuters advocate for better payment solutions that enhance their travel experience.
- This research adds to the body of knowledge on digitized fare systems, particularly in developing countries. Future researchers and scholars can use the findings as a reference for further studies on digital payments, public transport innovations, and urban mobility solutions.

2.0 Literature Review

2.1 Introduction

This chapter seeks to explore the challenges faced by public transport systems in adopting digitized fare systems. It also seeks to explore the current state in public transportation fare collection methods around Nairobi with its effectiveness in shaping urban mobility.

2.2 Payment challenges experienced in public transport payments.

Although there has been a lot of adoption of digitized payment systems there still exist some challenges that are experienced in public transport payments. The following represent some of the challenges experienced during payments in Nairobi.

2.2.1 Fare reversal by passengers.

Many public transport operators are reluctant to accept cashless payments because of fear caused by dishonest passengers who try and reverse payments through cashless modes of payments such as M-Pesa, some show fake validation payment messages and others cancel payment transactions. This causes public transport operators to replace all that money that has been lost from their own pockets(Kamau, 2022). In the M-Pesa services provided, it is very possible to reverse payments, especially those paid to wrong numbers, for the reversal to be successful, the message containing the transactions is sent to 456 which is a special line provided by Safaricom to make M-Pesa reversals. Complaints from the public forced Safaricom Company to introduce mechanisms where the reversal request sent by the complaint must be approved, until then the reversal is restricted. However, this still causes fear among most transport operators hence it is a major challenge experienced while making public transport payments.

2.2.2 Mobile loans concern.

When a loan is granted, the institution issuing the load assigns credit officers to monitor loan repayment by making sure that data is being shared to the relevant heads of staffs so as necessary actions are being taken to minimize further losses (NGOTHO, 2020). This enables the institution to be keen to monitor if the borrower is complying with the terms and conditions of the loan application (Mishkin, 2001). According to (Kamau, 2022) , some public transport operators often have mobile money loans which has created a lot of challenges and contributed to their reluctance to adopt enhanced digitized payment systems. The most used mobile loan in Kenya is fuliza which majorly serves the low-income earners. These loans are automatically repaid once money has been deposited into the borrower’s M-Pesa account. The interest fees are deducted including any legal fees incurred during borrowing. The challenge comes when passengers pay fare directly to the conductor’s or driver’s account, the amount is being deducted by fuliza which further causes more losses than profits. To address this Safaricom introduced the Poshi la Biashara mechanism to target the business owners hence no amount be deducted, although there were high concerns due to its high transaction charges.

2.2.3 High transaction costs.

Cashless transactions refer to the economic setting where goods and services are bought or transacted without the use of cash, it can either be through electronic transfer or cheque payment (Tee & Ong, 2016). Mobile transaction payments operate in the presence of mobile commerce and Point of Sales (POS) transactions. Various parties enable mobile transactions to take place, they are; mobile network operators and payment service providers which can be money agents, financial institutions and upcoming companies or startups (Mallat & Tuunainen, 2008). The high costs of transactions discourage passengers from carrying out mobile payments in M-Pesa. Safaricom users are charged 10 shillings while trying to withdraw money from M-Pesa agents while sending money to other networks. It attracts charges amounting to almost 35 shillings, that is for the amount between 100 to 500 shillings. Such charges also apply to other network service providers such as Airtel. Low-income passengers suffer from these high costs of transactions hence the adoption of digitized payments such as QR codes, ticketing and use of smarts which saves costs in fare payments.

2.2.4 Potential system failures and increased burden of validating payments.

According to (CGAP, 2009) there has been frequent delays in systems such as M-Pesa while trying to make payments. In various cases, accessibility has been an issue due to network issues from service providers such as Safaricom. According to various studies, it has been shown that commuters suffer a lot of problems while trying to make fare payments due to frequent delays caused by M-Pesa. This causes a lot of chaos and unnecessary confrontations between commuters and transport providers when it comes to confirming payment messages from commuters. Another problem experienced during checking for payment confirmation is when the network is lost, mobile phones may be stolen in transit or go off due to low power batteries. Time is another essential that is lost during validating payments in public transport systems (Kamau, 2022). It is important for the government and SACCOs or transport business owners to support the development of enhanced digitized cashless fare systems by collaborating with developers to make public transport efficient and effective to benefit all passengers encouraging the use of public transport through enhanced quality of service brought by these digitized systems.

2.2.5 Fare evasion.

Evasion of fare payment systems is another problem experienced in public transport systems in most developing countries across the world. Just like other crimes fare evasion has legal consequences

due to the acts of dishonestly and lack of transparency in public transport systems with the intention to target transport providers. (Zaini Miftach, 2018). Fare evasion takes various forms in public transport systems while passengers make payments. Passengers attempt to board public transport modes by either paying partial fare or they try to avoid fare payment procedures provided by various transport providers. In a case where passengers fail to pay the whole amount, the transport operators fail to verify or are unwilling to confirm the payments from passengers. This problem has been the trend when fares have increased on certain routes. Transit operators have specific payment procedures that ought to be followed by passengers, they include displaying tickets upon entries, scanning tickets through machines, using tokens etc. This causes a lot of intimidation to operators with the thought of avoiding risk of assault (Ronald A. Mauri et al., 1984). Increase fare enforcement strategies allows proper collection and managing of fare according to transport statistics. This can be done by educating transport providers on fare enforcements hence being highly active on any criminal activities of fare evasion (Boehm & Boehm, 2021).

2.2.6 Complexity of fare structures.

Fare structures are normally based on the distance covered by commuters, of which fares are being calculated and estimated using marginal cost per kilometer. Additionally fare structures are applied between the point of departure and destination (Weesie et al., 2009). Complexity of fare structures limits the demand of public transport systems. Passengers like to have many options or alternatives to choose from hence its flexibility and a chance of finding that which matches their needs or preferences. In transport business the main issue that occurs due to complex structures is the passengers' uncertainty about the correct fare estimation and the concern that they might have to pay more than what is normally required (Anciaes et al., 2019). In various cases, it is very difficult to pinpoint the factors that drive the demand changes in fare structures. The factors can either be due to complexity or changes in various fare levels. Complex fare structures in public transport systems are regarded as unfair, this is because many transport providers assume that passengers ought to try to pay extra since some of them do not have any other choice but to adhere to it.

3.0 Research Design and methodology

This section outlines the research approach, data collection methods, sampling techniques, and data analysis procedures used to investigate the factors influencing the adoption of digitized fare systems in Nairobi's public transportation sector.

3.1 Research design.

This study adopts a descriptive research design, which is appropriate for analyzing and interpreting the factors influencing the adoption of digitized fare systems. A quantitative research approach was used, allowing for statistical analysis of commuter and operator perceptions regarding the adoption of these systems.

Additionally, an exploratory approach was incorporated to assess emerging trends, challenges, and stakeholder concerns related to digital fare payment systems. This combination ensures a comprehensive analysis of the adoption process by evaluating both user perspectives and the broader implementation environment.

3.2 Population and sample design.

3.2.1 Population.

According to (Brief, 2023) Nairobi hosts a population of 4,395,749 citizens of which 58.7 percent of this population have access to public transportation modes on a daily basis. The Nairobi population increases in size hence the use of matatus increases which creates a huge demand accounting to 88 percent of all motorized transport systems and 72 percent in smaller towns. In urban slams across Nairobi, 65 percent walk to their workplaces, 2 percent use bicycles as their mode of transport while 32 percent use matatus (Macharia et al., 2021). The target population in this study will be commuters around metropolitan areas such as the Central Business District (CBD) who depend on public transport modes such as buses and matatus. Commuters or passengers are the primary users of public transport systems in Nairobi hence they are a highly diverse group comprising individuals from various educational, professional and socio-economic backgrounds.

3.2.2 Sample and sampling technique.

The most effective technique that will be used in this study is the probability sampling technique. This means that every item in the target population has an equal chance of being selected to participate in the study while gathering data. Additionally, it entails selecting of participants without

bias hence all units of the population will have an equal probability of being selected and cannot be repeated. (Jakobsson et al., 2023) recommended a very effective formula that can be used in determining the sample size of a population, hence it will be used to arrive to the sample size of participants to be sampled in this study. The formula is illustrated below:

$$n = \frac{(Z^2 \times p \times q)}{d^2}$$

Where:

n = sample size

Z= 1.96 i.e. the significance level set at 95% confidence interval which corresponded to Z value of 1.96

p = target population proportion of the total population estimated to have the characteristics being measured.

q = variable which was calculated as (1-p)

d = acceptable error level (set at in this study)

Therefore, the sample size of this study was calculated as follows:

$$n = \frac{1.96^2 \times (0.587) \times (1-0.587)}{0.05^2}$$

$$n = \frac{3.8416 \times (0.587) \times (0.413)}{0.0025}$$

$$n = \frac{3.8416 \times (0.242431)}{0.0025}$$

$$n = \frac{0.931323}{0.0025}$$

$$n = 372$$

From the formula the sample size was three hundred and seventy-two (n=372).

3.3 Data Collection methods.

The survey method will be the primary data collection tool that will be used because they offer high effectiveness in collecting large amounts of data from a large population. Participants will be randomly selected from the target population and assigned questionnaires which will be designed to capture both quantitative and qualitative data to gather data on passenger preferences, satisfaction

and the willingness to use digitized fare systems. The questionnaires will contain numeric scaling which will aid in conducting statistical hypothesis. The questionnaires will be administered electronically and physically which will capture demographic data, passenger satisfaction, factors that influence the implementation of digitized fare systems and finally the benefits of implementing the digitized fare systems in Nairobi's public transport.

3.4 Research Procedure.

Questionnaires will be formed and administered to various participants in the study, numeric scaling will be provided and room for appropriate comments regarding experiences and services offered regarding various public transport modes in sustaining urban mobility. All participants will get a chance to go through the informed consent which describes what the study is all about hence from this they will have a choice to participate in the study by ensuring they understand what their contribution entails and securing their voluntary agreement to participate. After data collection all participants will be debriefed thoroughly about the study to enable them to have a clear understanding of all ethical considerations that have been put in place as required by the Institutional Review Board (IRB) hence maintains the trust between the participant and the investigator/researcher. The collected data will be analyzed statistically using software tools such as SPSS (Statistical Package for the Social Sciences) to measure the number of participants who participated in the study and various experiences from the current fare systems of public transport modes in Nairobi. In this case ethical considerations will be concerned about how to handle and store sensitive data effectively to prevent loss of data once it has been collected. Participants will have the right to decline if she will not be willing to take part in the study, anyone willing will be thoroughly introduced and educated on the need to take part in the study before filling out the questionnaires and surveys. After analyzing relevant data, all generated reports will be stored and submitted.

3.5 Data analysis methods.

This study will employ effective systematic approaches to data analysis to ensure reliability and validity of data being collected. The following represents the steps that will be taken to carry out data preparation:

i. Data coding whereby the type of scales is being determined, for example numerical, rational or interval. According to the study passengers' experiences can be measured using code 5 for strongly agree, 4 agree, 3 for neutral, 2 for disagree and 1 for strongly disagree.
ii. Data entry where the coded data is entered in excel sheets and added to SPSS.
iii. Searching for missing data where due to various reasons participants may not answer all questions from the questionnaire.
iv. Finally, data transformation is where data that is needed is transformed and interpreted.

Descriptive statistics will be used to summarize and illustrate the basic features of the collected data, hence providing clear overview of the sample characteristics and responses. Some of the features include frequencies and percentages that describe different groups of the sample in terms of age and gender on their willingness to adopt digitized fare systems, measures of central tendency such as mean, median and mode that describe the measurement of most common responses and finally measure of dispersion such as standard deviation and variance that describe the variability of responses collected. Inferential statistics will be used to draw conclusions such as regression analysis to measure which factors are most likely to influence the adoption of digitized fare systems. Statistical Package for the Social Sciences (SPSS) is an advanced statistical tool that will be used to carry out data analysis of this study to enable efficient and effective interpretation of data and enhanced accuracy in data. The integrity of data and ethical standards will be followed and maintained throughout this process to enhance confidentiality during reporting and interpretation.

4.0 Research findings and analaytsis

4.1 Response rate

The study targeted a total of 372 Nairobi residents who reside around major Nairobi streets. The study was conducted during peak hours which was between 8:00 am – 17:00 am. The rationale peak hours were important to collect adequate and effective data. The questionnaires were designed for the public who have adequate and satisfactory experience in public transport systems, and they are highly dependable on it daily. Out of the 372 target participants of the sampled population size of about 4 million Nairobi residents, 170 participants were fully responsive to the study and were able

to return their accurate responses filled in the survey questionnaire while the rest were not willing to fill the questionnaires hence this resulted to 46% as the response rate of the study.

4.2 Demographics

4.2.1Age of respondents.

Age is an important demographic factor of this study, this is because individuals of the same age group often share the same experiences, values, beliefs and attitudes. This study established that many respondents were of age between 18 to 25 years while the minority were below 18 years of age. The findings are indicated on the table below.

Table 4.1: Age of Respondents

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-25 years.	79	46.5	46.5	46.5
	25-35 years.	53	31.2	31.2	77.6
	35-45 years.	19	11.2	11.2	88.8
	Above 45 years	14	8.2	8.2	97.1
	Below 18 years.	5	2.9	2.9	100.0
	Total	170	100.0	100.0	

The table above illustrates that the majority (46.5%) of the respondents were aged between 18 to 25 years old, 31.2% were between 25 to 35 years old, 11.2% were between 35 to 45 years old, 8.2% were above 45 years old and finally 2.9% were below 18 years old. The age of each respondent was essential because different age groups have different perceptions and experiences in Nairobi's public transport fare systems.

4.2.2 Gender of respondents.

In most cases, gender influences the types of choices and decisions that people make. Several studies have shown that the type of choices and decisions made by people are mostly influenced by gender. As illustrated in the table below, majority of participants were male compared to female.

Table 4.2: Gender of respondents

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	61	35.9	35.9	35.9
	Male	109	64.1	64.1	100.0
	Total	170	100.0	100.0	

In the study, 64.1% of the respondents were male while 35.9% were female which suggest that the male gender is more likely to adopt to digitized fare systems as compared to female. Additionally, the male gender seems to have more experienced on public transport fare systems than female.

4.2.3 Occupation.

Occupation had the greatest impact in seeking information fare payment information among all participants. The study showed that majority of the participants were students 40.6%, followed by employed 26.5%, unemployed 20.6%, and the minority were self-employed 12.4%. This is illustrated on the table below.

Table 4.3: Occupation

Occupation.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Employed.	45	26.5	26.5	26.5
	Self-employed.	21	12.4	12.4	38.8
	Student	69	40.6	40.6	79.4
	Unemployed.	35	20.6	20.6	100.0

Total	170	100.0	100.0	

Understanding each respondent's occupation helps in tailoring digitized fare solutions to meet the needs and expectations of each group effectively. For instance, employed respondents may look at digitized fare systems to prioritize convenience and efficiency in public transport payment options while on the other hand students may prioritize affordability. The occupation distribution also aids in identifying which groups require may require more education or support to adopt digitized fare systems hence guiding in the development of various strategies to encourage the adoption of digitized fare systems.

4.2.4 Mode of transport mostly used and duration of usage

The mode of public transport used by respondents and the duration for which they have relied on public transport systems provides an understanding that these patterns provide insights into the user preferences and potential areas for enhancing the adoption of digitized fare systems. A crosstab analysis was conducted to observe the relationship between the preferred mode of transport and the duration of usage. The results indicated that Matatus/PSVs are the most preferred means of transport with a percentage of 79.2% where most respondents have used it for more than 10 years making it the most accessible mode of public transport in Nairobi. Additionally motorbike/boda-boda is the second most used means of transportation with a total percentage of 10.6%, followed by taxis or uber with a total of 8.8% and finally three-wheelers (tuktuk) with 2.4%. The findings are illustrated on the table below.

Table 4.4: Mode of transport mostly used and duration of usage

5. Mode of public transport I mostly use * 4. I have used public transport for a period of Crosstabulation

			4. I have used public transport for a period of				
			1-5 years.	5-10 years.	Less than a year.	More than 10 years.	Total
5. Mode of public transport I mostly use	Motorbike/Boda-boda	Count	2	4	1	11	18
		% within 4. I have used public transport for a period of	14.3%	12.5%	25.0%	9.2%	10.6%
	Public Service Vehicle (PSV)/Matatu	Count	10	25	3	95	133
		% within 4. I have used public transport for a period of	71.4%	78.1%	75.0%	79.2%	78.2%
	Taxi/Uber	Count	2	2	0	11	15
		% within 4. I have used public transport for a period of	14.3%	6.3%	0.0%	9.2%	8.8%
	Three-wheelers (tuktuk)	Count	0	1	0	3	4
		% within 4. I have used public transport for a period of	0.0%	3.1%	0.0%	2.5%	2.4%
Total		Count	14	32	4	120	170
		% within 4. I have used public transport for a period of	100.0%	100.0%	100.0%	100.0%	100.0%

The analysis above highlights the usage trends in Nairobi's public transport system which is important for the successful implementation of digitized fare systems. This will encourage long-term users to adopt and promote the use of digitized fare systems in public transportation.

4.2.5 Payment Methodologies.

An analysis was conducted on the various payment methods utilized by respondents including cash, mobile money, e-ticketing, contactless smartcards, OR codes and other digital options. The distribution of these methodologies was analyzed to understand the current preferences and patterns in payment behavior. The results indicated in the table below suggest that Mobile money (83.5%) is the most common form digitized fare payment system in Nairobi's public transportation. 14.1% of the respondents use cash, 1.2% use contactless smartcards and 0.6% use E-ticketing as their preferred mode of fare payment.

Table 4.5 Payment Methodologies

payment methodologies.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	1	.6	.6	.6
	cash	24	14.1	14.1	14.7
	Contactless smartcards.	2	1.2	1.2	15.9

	E-ticketing.	1	.6	.6	16.5
	Mobile money.	142	83.5	83.5	100.0
	Total	170	100.0	100.0	

The reliance on Mobile money among most respondents highlights the need for a gradual transition to digitized payment systems ensuring that all user groups are adequately accommodated. This payment methodology could serve as a foundation for introducing the adoption of enhanced digitized fare systems.

4.3 Payment challenges.

Analysis was done to identify the proportion of participants who experienced specific payment challenges such as high transaction costs, complexity in fare structures, fare evasions, fare reversals and potential system failures. Responses indicating the presence of a challenge were coded as 1 for yes providing insights into the most common challenges faced by respondents.

4.3.1 High transaction costs.

The analysis of high transaction costs as a payment challenge revealed that majority of respondents (65.3%) agree that this challenge is a significant barrier to the adoption and implementation of digitized fare systems in public transportation. On the other hand, 34.7% of respondents do not perceive high transactions as a notable challenge. This challenge can discourage users from adopting digitized fare systems in context of affordability. This concern suggests the need for intervention by developers, transport providers and regulatory bodies to negotiate lower fees with service providers and the government to implement subsidies to offset the cost of digital payments for users. The results are shown in the table below.

Table 4.6 High transaction costs.

High transaction costs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	59	34.7	34.7	34.7
	1	111	65.3	65.3	100.0

	Total	170	100.0	100.0	

4.3.2 Potential system failures.

The findings on potential system failures illustrate that 67.1% of respondents believe that they are not highly affected by this challenge although 32.9% of respondents believe that this is a significant challenge. Although most respondents trust the reliability of digitized fare systems, the substantial minority remain cautious about the potential risks associated with systems downtime or failures. System failures lead to service delays, customer dissatisfaction and revenue loss. To address this challenge, digitized fare systems must be designed with robust infrastructure, implementing fail-safe mechanisms to mitigate impact of failures and establish communication protocols to keep commuters informed of disruptions. The results are shown on the table below.

Table 4.7 Potential system failures

Potential system failures.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	114	67.1	67.1	67.1
	1	56	32.9	32.9	100.0
	Total	170	100.0	100.0	

4.3.4 Fare evasions.

The results on fare evasion as a payment challenge indicate that 87.1% of respondents do not consider it as a challenge but 12.9% of respondents perceive it as a challenge in the context of digitized fare systems. This suggests that digitized fare systems play a significant role in minimizing fare evasions, as they reduce the opportunities for passengers to avoid payments. Digitized fare systems provide transparency and accountability by automating payment processes hence making sure that every passenger pays the required rates. To address this challenge, the following can be considered, deploying technologies such as OR codes, Near Field Communication (NFC) to ensure that each passenger completes their payments before accessing transport services and introducing

real-time monitoring mechanisms to detect and prevent potential evasion cases. The results are shown in the table below.

Table 4.8 fare evasions

Fare evasions.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	148	87.1	87.1	87.1
	1	22	12.9	12.9	100.0
	Total	170	100.0	100.0	

4.3.5 Complex fare structures.

The findings in complex fare structures reveal that 81.2% of respondents do not perceive it as a challenge although 18.8% of respondents perceive it as a significant challenge. The challenge might result due to issues such as difficulty in understanding pricing models such as peak hour rates or distance-based rates, confusion caused by differing payment methods and very limited guidance on fare policies for new users. To address this challenge, the following can be considered, streamlining fare structures into predictable models that are easy to understand and having user friendly interfaces by enhancing the design of digital platforms to display fare information such as costs and fare rules. The results are shown in the table below.

Table 4.9 Complex fare structures

Complex fare structures.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	138	81.2	81.2	81.2
	1	32	18.8	18.8	100.0
	Total	170	100.0	100.0	

4.3.6 Mobile loans concerns

The findings reveal that 87.6% of participants do not view mobile loans as a significant issue while the minority 12.4% view it as a challenge in public transport payment systems. This challenge may be due to: high interest rates which add significant costs to transport expenses, delays in receiving loans may hinder ability to make payments promptly and various loan limits. The following are some of the mitigations that can solve this issue. They are: encouraging the use of mobile wallets or transport cards where they are able to save funds for transport use and enhancing loan distribution process to ensure funds are available immediately they are needed. The results are shown in the table below.

Table 4.10 mobile loans concerns

Mobile loans concerns.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	149	87.6	87.6	87.6
	1	21	12.4	12.4	100.0
	Total	170	100.0	100.0	

4.3.7 Fare reversal.

The findings indicate that majority of respondents 84.1% had no challenges on fare reversal although 15.9% encountered such challenges. This suggests that there are still potential areas of improvement in digitized fare systems. This challenge is due to common issues such as difficulty in accessing systems or procedures to request reversals, transaction discrepancies and instances where refunds are not processed promptly. This issue can be resolved by implementing systems that can detect and resolve errors in real time, hence reducing manual intervention. The results are shown in the table below.

Table 4.11 fare reversal

Fare reversal.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	143	84.1	84.1	84.1
	1	27	15.9	15.9	100.0
	Total	170	100.0	100.0	

5.0 Discussion conculsion and recomendations

5.1 Summary

This study examined the challenges faced by public transport systems in adopting digitized fare systems in Nairobi. Through a combination of literature review, data collection, and analysis, the study identified key barriers hindering the widespread adoption of digital fare payment methods.

The findings indicate that high transaction costs remain a significant deterrent to adoption, with many commuters and transport operators citing the fees associated with mobile money transactions as a primary concern. Potential system failures and network downtime also emerged as notable challenges, causing delays and dissatisfaction among users.

Additionally, the study found that fare evasion persists, particularly in cases where digital systems lack robust enforcement mechanisms. The complexity of fare structures further discourages adoption, as inconsistent pricing models create confusion for both commuters and operators. Moreover, mobile loans were identified as an unexpected obstacle, with some transport operators reluctant to accept digital payments due to automatic loan deductions affecting their cash flow.

Despite these challenges, the study also highlighted opportunities for improving adoption. The widespread use of mobile money platforms such as M-Pesa demonstrates the potential for digitized fare systems if implementation barriers are addressed effectively. The study suggests that enhanced policy frameworks, stakeholder collaboration, and improved technology infrastructure could facilitate the transition to cashless fare systems.

5.2 Discussion.

The main objective of the study is to identify the various challenges faced by public transport systems. The results showed that high transaction costs (65.3%) imposed by mobile payment service providers are the most significant challenges faced by commuters while making fare payments. These results support the research done by (Tee & Ong, 2016) that low-income passengers suffer from these high costs of transactions hence the adoption of digitized payments such as QR codes, ticketing and use of smarts which saves costs in fare payments. Approximately 32.9% of respondents expressed concerns about potential system failures which emphasizes the need for robust and most effective IT infrastructure. This results support the research done by (Bank, 2009) which states, there has been frequent delays in systems such as M-Pesa while trying to make payments, accessibility has been an issue due to network issues from service providers such as Safaricom, hence the need of implementing redundancy mechanisms, regular system updates and real-time monitoring to mitigate technical downtime and provide system efficiency. 12.9% of respondents shown concerns about fare evasion. These results are supported by research done by (Zaini Miftach, 2018) which shows that just like other crimes fare evasion contain acts of dishonestly and lack of transparency in public transport systems with the intention to target transport providers, passengers fail to pay the whole amount, the transport operators fail to verify or are unwilling to confirm the payments from passengers. 18.8% of respondents also recorded concerns about complex fare structures which lead to confusion among commuters. These results support the research done by (Anciaes et al., 2019) which states that the main issue that occurs due to complex structures is the passengers' uncertainty about the correct fare estimation and the concern that they might have to pay more than what is normally required. 15.9% of respondents highlighted concerns on fare reversal. This result is supported by research done by (Kamau, 2022) which states that there is dishonesty among passengers who try and reverse payments through cashless modes of payments such as M-Pesa, some show fake validation payment messages and others cancel payment transactions which leads to financial loss among public transport operators when they have to replace all money that has been lost. Finally, 12.4% of respondents highlighted mobile loans as a challenge in fare payment systems. This results support the research done by (Kamau, 2022) where some public transport operators often have mobile money loans which has created a lot of challenges and contributed to their reluctance to adopt enhanced digitized payment systems.

5.3 Conclusion

The adoption of digitized fare systems in Nairobi's public transport sector presents a transformative opportunity to enhance efficiency, security, and user convenience. However, this study has established that several challenges hinder the successful implementation of these systems. Key barriers include high transaction costs, fare reversals, mobile loan deductions, system failures, fare evasion, and complex fare structures. These challenges have contributed to the slow adoption of cashless payments, with both commuters and transport operators expressing concerns over affordability, reliability, and trust in the system.

Despite these challenges, the study highlights that digitized fare systems remain a viable solution for improving Nairobi's public transport ecosystem. The widespread use of mobile money services such as M-Pesa indicates a growing readiness for digital payments, provided that key issues such as transaction security and cost efficiency are addressed. Additionally, proper regulatory frameworks, stakeholder collaboration, and improved public awareness are crucial in fostering acceptance and adoption of digital fare payment methods.

To ensure a smooth transition, transport stakeholders, policymakers, and technology providers must work together to develop robust, user-friendly, and cost-effective digital payment solutions. Implementing transparent pricing structures, enhancing system reliability, and addressing security concerns will be key to overcoming the existing challenges. By addressing these issues, Nairobi's public transport sector can benefit from a seamless and efficient digitized fare system that enhances mobility, reduces financial risks, and contributes to the broader goal of smart urban transportation.

5.4 Recommendation

Based on the study's findings, several recommendations are proposed to enhance the adoption and implementation of digitized fare systems in Nairobi's public transport sector.

High transaction costs have been identified as a major barrier to digital fare system adoption. The government should collaborate with mobile payment providers such as M-Pesa and Airtel Money to reduce transaction fees for public transport payments. Additionally, subsidies and incentives should be introduced to encourage transport operators to accept digital payments without incurring high costs.

System failures and fare reversals discourage adoption due to lack of trust in digital transactions. To mitigate these issues, transport service providers should implement fail-safe mechanisms to prevent

network downtime and ensure seamless transactions. Digital payment platforms should integrate stronger security measures to prevent fraudulent reversals and fake payment messages.

Complex fare structures contribute to confusion and resistance to digitized fare systems. The government and public transport regulatory bodies should enforce standardized pricing models to ensure fare transparency. Digitized fare systems should also include clear fare calculators and user-friendly interfaces to allow commuters to verify pricing before making payments.

Some transport operators are reluctant to adopt digital payments due to automatic loan deductions and perceived financial risks. To encourage their participation, Safaricom and other mobile money providers should offer business accounts for transport operators that prevent automatic deductions from personal mobile loans. Additionally, sensitization programs should be conducted to educate operators on the long-term financial benefits of digital fare systems.

A lack of strong policies and regulations has slowed the adoption of digitized fare systems. SACCOs should develop policies that mandate and regulate digital fare payments while ensuring fairness for both commuters and operators. Incentives such as tax breaks or operational benefits should be offered to early adopters of digitized fare systems.

Commuters and operators must be well-informed about the benefits and functionality of digitized fare systems. Public awareness campaigns should be launched to educate commuters on how to use digital fare payment methods. Workshops and training sessions should also be organized for transport operators to familiarize them with digital transactions and fraud prevention techniques.

By implementing these recommendations, Nairobi can successfully transition to an efficient, secure, and widely accepted digitized fare system that enhances public transport operations and commuter experience.

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