Influencing the Adoption of Electronic Road Toll System in Zambia

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ABSTRACT

The main objective of the study was to determine the factors influencing the adoption and use of electronic toll system in Zambia with reference to Shimabala toll plaza. To achieve this, the study applied descriptive quantitative research design. The population was over 1360 motorists who pass through the toll gate and are on Local user discount and NRFA staff. For the purpose of this study a total of 300 respondents were considered in the sample. This sample size considered all 300 elements broken down as 290 motorists accessing the toll plaza and 10 NRFA staff (290+10) as the population. The sampling technique for the study was purposive and stratified random sampling technique. Data was analyzed by use of SPSS (Statistical Package for Social Science). The descriptive statistics such as tabulations, percentages, mean, standard deviation and frequencies were used in the data presentation. The results showed that the cost of purchasing the electronic toll card, perceived economic benefits, and accessibility are significant factors influencing the adoption of the electronic toll system in Zambia. Income level and security concerns also play roles, but to a slightly lesser extent. Cost of Purchasing the Electronic Toll Card: The coefficient is 0.412. This positive coefficient suggests that as the cost of purchasing the electronic toll card increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p < 0.001$), indicating that this relationship is unlikely to have occurred by chance. Income Level: The coefficient is 0.347. This positive coefficient implies that as income level increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p = 0.003$). Perceived Economic Benefit: The coefficient is 0.462. This positive coefficient indicates that as perceived economic benefit increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p < 0.001$). Security: The coefficient is 0.550. This positive coefficient suggests that as the perception of security associated with the electronic toll system increases, the adoption also increases. The coefficient is statistically significant ($p < 0.001$). Accessibility: The coefficient is 0.351. This positive coefficient implies that as the perceived accessibility of the electronic toll system increases, the adoption also increases. The coefficient is statistically significant ($p = 0.001$). Stakeholder Engagement and Communication: The study recommends among other, engagement with government agencies, road authorities, private sector partners, and local communities to ensure buy-in and address concerns, Investment in the necessary infrastructure, including toll plazas, gantries, sensors, and communication networks, to support the electronic tolling system, Design user-friendly interfaces and payment methods and continuously monitor the system's performance.

Keywords: Electronic Toll Collection (ETC), Automatic Toll Collection (ATC), Technology Acceptance Model (TAM) and Perceived Usefulness (PU), Perceived Ease of Use (PEOU).

INTRODUCTION

Domestic resource mobilization in the form of toll gates provide effective ways of financing long-run sustained growth and development. Bloch (2019) [1] argues along this line of thinking, highlighting that domestic resource mobilization in the form of toll gates enhances government revenue (public savings) and fiscal space; in this way, increasing the capacity and ability of governments to perform their functions effectively. Kidd and Crandall (2016) [2] view the shift to tolling collections as ways of boosting domestic mobilization of resources, strengthening national ownership of development policies, and reducing state vulnerability to reductions in revenue arising from trade reforms.

According to NRFA (2017), the strategic themes of service excellency and operational efficiency as contained in the Agency's strategic plan 2017 – 2021 remain key focus areas as the Agency leverage on new technologies such as the Wide Area Network, and Electronic Payment Systems. Specifically, the e- toll card will enhance payment systems at toll plazas in the country, secure the collected revenue and reduce intermitted congestion for the benefit of all road users.

It is clear from the literature reviewed that the electronic toll systems have a range of pros in comparison to traditional cash services. Electronic toll cards (ETC) are a more secure and transparent system that raises the levels of accountability on all toll revenues collected and are meant to eliminate the risks associated with cash handling. Electronic toll cards lower the operating costs, improves customer services, are convenient and time saving as they reduce congestion at Toll plazas, and reduce handling of cash which is susceptible to fraudulent activities (NRFA, Strategic Plan: 2017-2021).

Based on the evidence gathered about the many advantages that accumulated with the use of ETC, it is expected that its adoption should be rapid. However, this is not the case. On the contrary, its adoption is at a snail's pace. During the press briefing on 12th January 2021, the Chief Executive Officer for National Road Fund Agency (NRFA) bemoaned the low uptake of the electronic toll system in Zambia. (NRFA 2021). This is evident given that as of 31st December 2019, K908,590,000 was collected in toll revenues, out of which only K26,576,000 was collected through ETC and this accounted for only 3% of total toll revenue collected (NRFA, 2019). While K320 million was collected through ETC out of the K2.3 billion collected in the year 2021 as total revenue, this amounts to 13% of revenue collected through ETC. This percentage is way too low when contrasted with the target set by NRFA of 60% of the total revenue to be collected through the electronic road toll system. Further, statics indicate that in 2019, only 10,000 cards were in circulation. In 2020 and 2021, 14,261 and 16,727 cards were sold respectively. This indicates a decline of 13% in the sales of the e-toll cards.

LITERATURE REVIEW

Most systems which have implemented ETC require motorists to buy or rent the equipment. In addition to the cost of the system, the motorist is also required to pay a security deposit, keep a minimum balance in his account, and, in some cases pay a monthly fee for the ETC equipment. Some systems also require motorists to keep a credit card balance (Toll collection technology and best practice, 2018). One of the important characteristics that have influence on technology usage is lower cost [3]. In the literature, previous studies indicated that perceived cost influences adoption of online transactions. For instance, [4] suggested that lower cost in online transactions positively influence behavioural intention to use online purchasing. In another study, [5] proposed that cost is an important factor in customers' decision process on using mobile commerce. In this study, Cost will refer to the Costs incurred by the Users who are motorists in terms of perceived price of purchasing the Toll cards and the amount required as deposit. Several studies assume that if users of the technology perceive Cost of the technology to be low, users will adopt the technology. In the same vein, if users of technology perceive Cost of technology to be high, users will not adopt it. The study therefore, posit that: H1. Cost has a significant effect on the adoption of electronic toll system in Zambia. A research conducted by [6] extended the Technology acceptance model with social influence and investigated the moderation effect of income and concluded that income moderated the relationship between perceived usefulness and intention to use technology. In turkey a study was conducted, and the results showed that income level has a positive and significant effect on adoption of technology [7] Studies assume that persons with high disposable income tend to easily adopt technology and vice versa. In this study_Income shall mean the Income level of the motorist. The study therefore, posit that: H2. Income has a significant effect on the adoption of electronic toll system in Zambia.

Source of the Model of this Research

The research looked a lot of theories and models done by other researchers in line with the research topic in order to have an in-depth understanding and be able to develop a model that will address the research problem. The following theory was reviewed.

Technology Acceptance Model (TAM)

Several studies focusing on adoption of technology have their roots in Technology Acceptance Model (TAM) originally proposed by Davies in 1989. In TAM model, perceived usefulness, and ease of use, are the most important factors affecting the adoption and use of technology. The model assumes that if users of the technology perceive it to be useful, users will adopt the technology. In the same vein, if users of technology perceive technology to be easy to use, users will adopt it.

The model that is often used in adoption of information system, Technology Acceptance Model (TAM) was developed from TRA [8]. The goal of TAM is to provide an explanation of the determinants of computer acceptance that is in general capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified [9]. TAM claims that actual use is by behavioural intention and subsequently behavioural attention is determined by attitude or in the other words behavioural intentions are influenced directly by external variables through perceived ease of use (PEOU) and perceived usefulness (PU). Usage is determined by behavioural intention to use a system, which is jointly determined by a person's attitude towards using system and its perceived usefulness. This attitude is also jointly determined by both perceived ease of use and perceived usefulness. In addition, both perceived usefulness and perceived ease of use were influenced by external variables, see Figure 1.

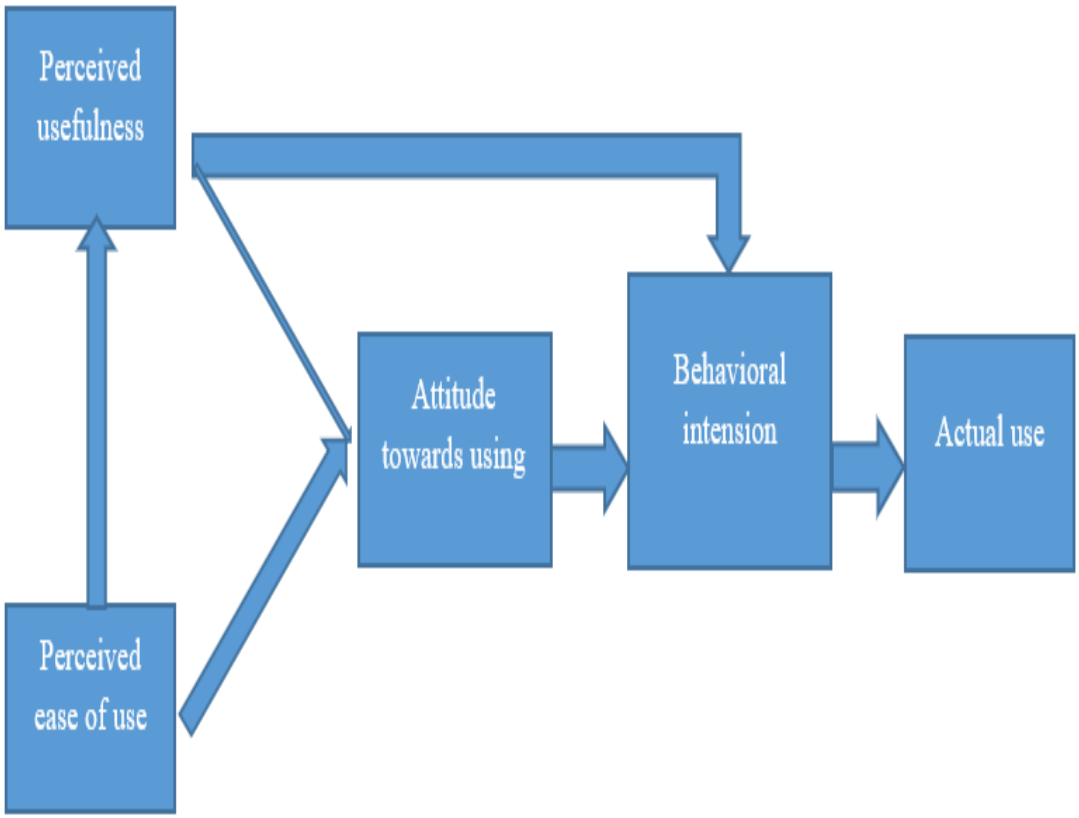

Figure 1:Technology Acceptance Model (TAM)**.**

Source: Davis (1989)

Conceptual Framework

A conceptual framework is a tool a researcher uses to guide their inquiry, it is a set of ideas used to structure the research and it offers a roadmap for the research [10]. Thus, it is the researcher's own point on the problem and direction of the research. As shown in Figure below, the independent variables include Cost, Income Level, Economic Benefit, Security and Accessibility. The dependent variable is adoption and use of electronic toll system.

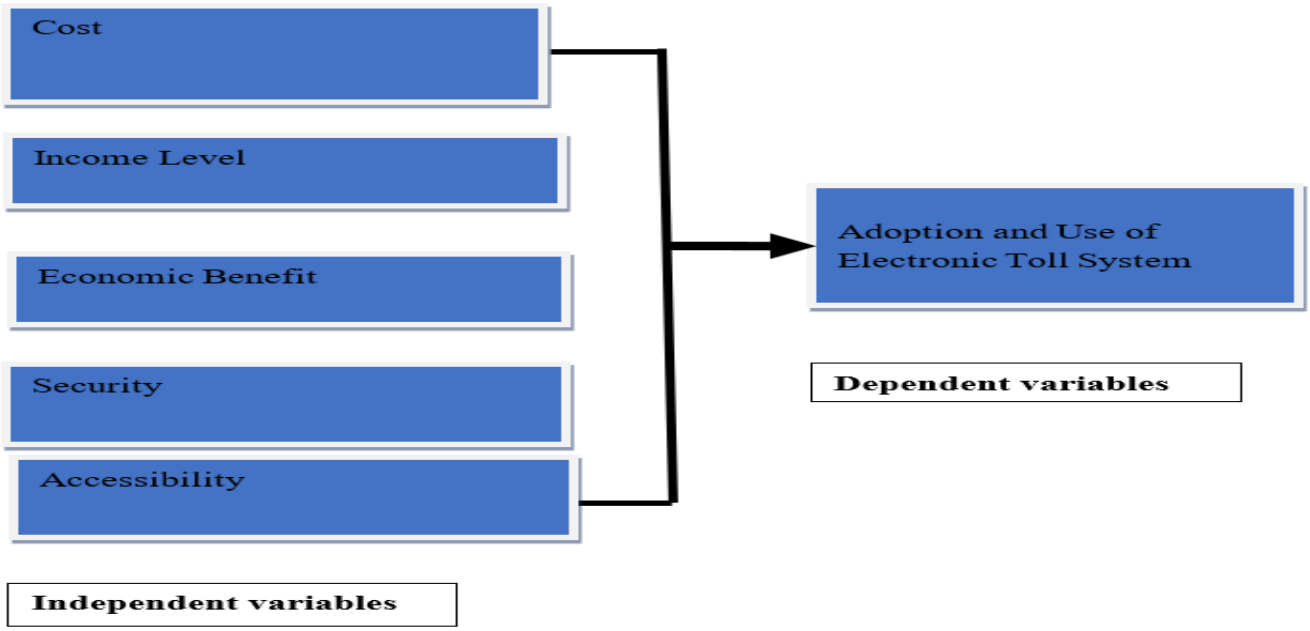

Figure 2: Conceptual Model

Source: Author, 2023

Proposed Hypotheses

Furthermore, the researcher developed the statements of hypothesis as follows:

Cost

H0: Cost has no influence on the adoption and use of electronic toll system.

H1: Cost has influence on the adoption and use of electronic toll system.

Income Level

H0: Income level has no influence on the adoption and use of electronic toll system.

H1: Income level has influence on the adoption and use of electronic toll system.

Economic Benefit

H0: Economic benefit has no influence on the adoption and use of electronic toll system.

H1: Economic benefit has influence on the adoption and use of electronic toll system.

Security

H0: Security has no influence on the adoption and use of electronic toll system.

H1: Security has influence on the adoption and use of electronic toll system.

Accessibility

H0: Accessibility has no influence on the adoption and use of electronic toll system.

H1: Accessibility has influence on the adoption and use of electronic toll system.

METHODOLOGY

The research design is intended to provide an appropriate framework for a study. A very significant decision in research design process is the choice to be made regarding research approach since it determines how relevant information for a study will be obtained; however, the research design process involves many interrelated decisions [11]. The research design employed in this study was descriptive in nature. Descriptive studies describe characteristics associated with the subject population. Descriptive design was chosen so as to collect in depth information about the population being studied. [12] describe population as the total collection of elements about which we wish to make inferences. [13] defines population as a set of all individuals that are relevant to a particular study. The target population for the study is **1360** frequent motorists accessing the Shimabala toll plaza in Kafue district and NRFA staff at the same toll plaza. Saunders, [14] argue that the larger the sample size the lower the likelihood of error in generalizing to the population. They also inform us that the choice of sample size is governed by the confidence you need to have in your data, the margin of error that you can tolerate, the type of analysis to be undertaken, and to a lesser extent, the size of the total population from which your sample is being drawn. Appropriate and adequate sample sizes influence the quality and accuracy of research. Sample size will be calculated by the following formula:

$$\frac{n_{0} = z^2 pq}{\frac{e^2}{1 + \left(\frac{Z^2 pq}{e^2 N}\right)}}$$

The sample size for the study consisted of **300** elements broken down as **290** motorists accessing the toll plaza and **10** NRFA staff (290+10). The formula used 95% as desired confidence level (Z=1.96), maximum heterogeneity assumed at 50% because the estimated proportions of an attribute present in the population is not known therefore P=0.5, q=1−P or 0.5, the margin of error allowed is at ± 5% (e =0.05) and N=1360 (target population). Primary and Secondary data will be collected in this study. Primary data can be collected by means of questionnaires, observation interviews and experimental research [15]. The main method to be used to collect primary data will be through the questionnaires. The chosen participants were given the closed ended questionnaires. The questionnaire were in five sections. The first section was about the attributes of the respondents and the rest of the sections was about the study variables. All the items of the questionnaires were measured using a Likert scale consisting of five scores from 1= “Strongly Disagree to 5 = “Strongly Agree”. Secondary data will be collected through e-resources such as journals, books and other appropriate sources.

FINDINGS AND DISCUSSIONS

Gender Distribution

Results show that 65% (65 out of 100) of the respondents were Male while 35% (35 out of 100) were Female.

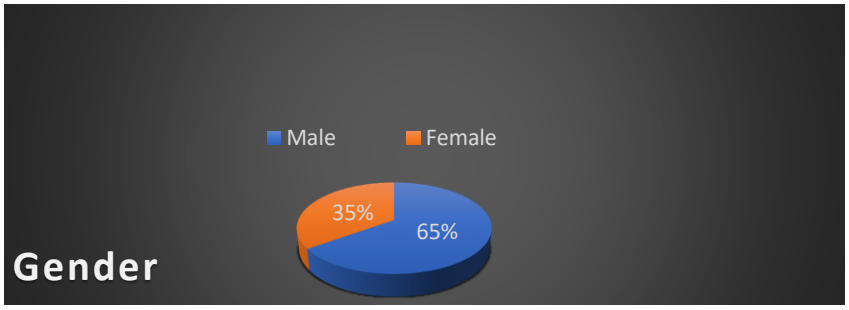

Figure 3:Gender of respondents

Age distribution

18-24 (12%): This age group comprises the youngest respondents. Younger individuals are often more tech-savvy and open to embracing new technologies. They might be more likely to adopt an electronic toll system

due to their familiarity with digital platforms and their willingness to experiment with new ways of doing things.

25-34 (24%): Similarly, individuals in this age range are likely to be comfortable with technology and might readily adopt an electronic toll system. Their higher representation suggests that a significant portion of the population in this survey falls within an age group that is generally receptive to digital innovations.

35-44 (45%): The largest age group among the respondents, this might represent the working-age population. Their high representation could indicate that this group is a crucial segment to target for the adoption of an electronic toll system. However, further analysis is needed to understand whether they might be resistant to changes or whether certain incentives would be needed to encourage adoption.

45-54 (10%): A smaller group, this might consist of individuals who are somewhat older and possibly less accustomed to rapid technological changes. However, it's important not to generalize, as many people in this age group are also comfortable with technology. Strategies to encourage adoption might need to consider their concerns or preferences.

Above 55 (9%): The smallest group, this might represent individuals who are less familiar with or resistant to adopting new technologies. However, this is not universally true for all individuals in this age group.

Some older adults are very tech-savvy, while others may need more support and education to adopt new systems.

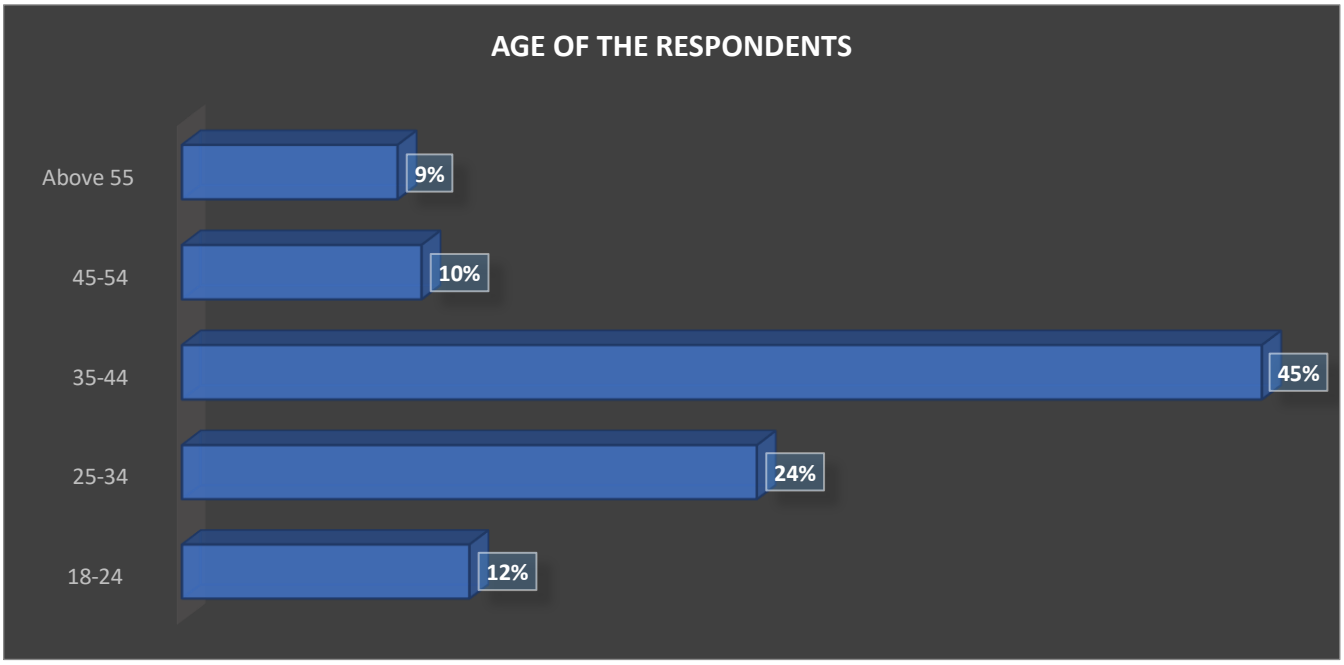

Figure 4:Age of Respondents

Education level of Respondents

This data shows the education level of the respondents. Primary Education (15%): People with a primary education might have limited exposure to technology and may be less familiar with electronic payment systems. They could potentially face challenges in understanding and using an electronic toll system. Factors influencing adoption might include accessibility, ease of use, and awareness campaigns to educate them about the benefits and usage of the system.

Secondary Education (22%): This group might have a moderate level of exposure to technology and could be more receptive to using an electronic toll system. Factors influencing adoption might include the convenience of electronic payments, reduction of waiting times, and the overall efficiency of the system.

College Education (35%): Individuals with a college education are more likely to be technologically savvy and open to adopting electronic payment systems. They might be more comfortable with digital transactions and could readily embrace the electronic toll system. Factors influencing adoption might include seamless integration with other digital services, cost-effectiveness, and ease of registration.

University Education (28%): People with a university education are likely to be highly familiar with technology and may have a strong inclination toward adopting electronic payment solutions. Factors influencing adoption might include advanced features like mobile app integration, loyalty programs, and environmental benefits. The figure below shows the education distribution:

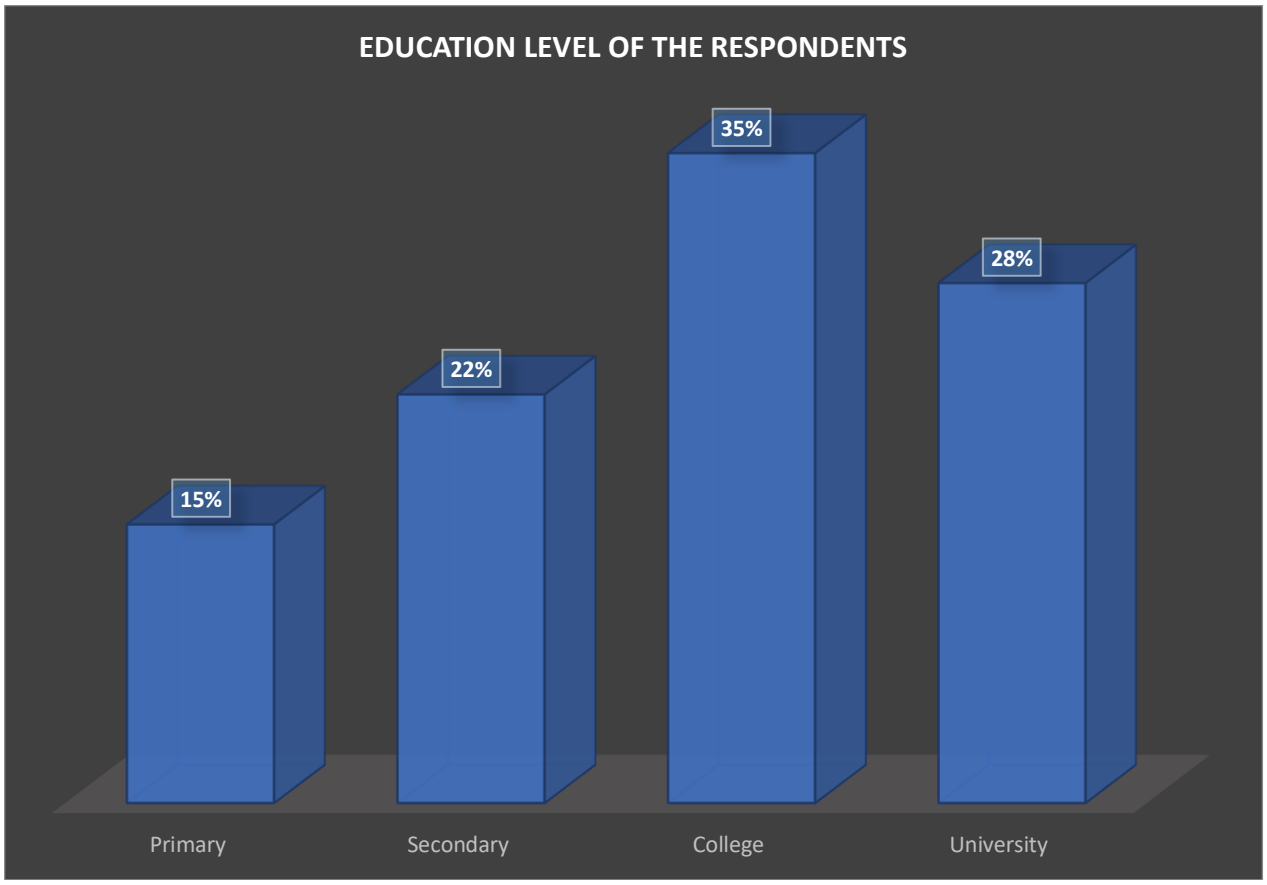

Figure 5:Respondents' Level of Education

How long the respondents have been paying toll fees

The results indicate the distribution of respondents based on the duration for which they have been paying toll fees in Zambia.

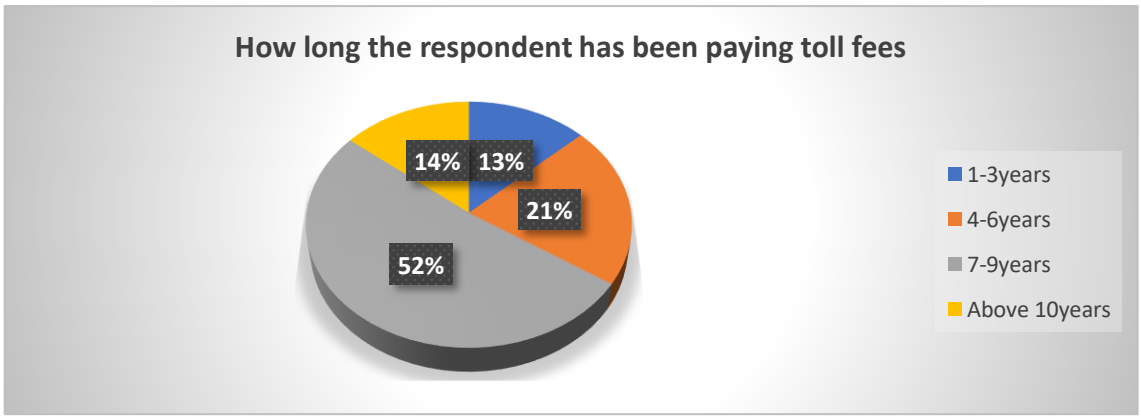

Figure 6: How long respondents have been paying Toll Fees

The data is presented in four categories. 1-3 years (13%): This group represents the smallest percentage of respondents and likely consists of relatively new toll fee payers. Their low representation might suggest that the adoption of an electronic toll system might not be strongly influenced by these individuals, as they may not have a well-established pattern of toll fee payment yet.

4-6 years (21%): This group represents a moderate percentage of respondents who have been paying toll fees for a few years. While not the majority, their presence suggests that a significant number of individuals have some experience with toll payments. Their opinions and experiences could contribute to discussions about the adoption of an electronic toll system.

7-9 years (51%): This group represents the majority of respondents and has been paying toll fees for a substantial period. Their significant representation suggests that this group is likely to have a strong influence on the adoption of an electronic toll system. They have a long history of toll fee payment and might be more receptive to changes that aim to streamline the toll payment process.

Above 10 years (14%): This group represents a smaller proportion of respondents who have been paying toll fees for over a decade. While not the largest group, their representation indicates that there are individuals with extensive experience in traditional toll fee payment methods. Their opinions and resistance to change might need to be considered when implementing an electronic toll system.

The Factors that influence the adoption of electronic toll system in Zambia

The respondents were requested to rate their level of agreement with the statements under the following factors that influence the adoption of electronic toll system in Zambia on the scale of 1-5 where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree. The table 5.2 below shows the results.

Table 1:The Factors that influence the adoption of electronic road toll system in Zambia

Statement	Mean	Std deviation	Skewness	Kurtosis
Cost of purchasing the electronic toll card has a significant influence on the adoption of the electronic toll system in Zambia	4.76	0.763	-1.115	0.782
Income level of the motorist has a significant influence on the adoption of the electronic toll system in Zambia.	4.01	0.566	0.671	0.760
Perceived economic benefit has a significant influence on the adoption of the electronic toll system in Zambia.	4.51	0.540	0.673	0.754
Security has a significant influence on the adoption of the electronic toll system in Zambia	4.43	1.420	-0.722	0.627
Accessibility has a significant influence on the adoption of the electronic toll system in Zambia.	4.42	0.726	0.618	0.727

These results are based on a survey or research where participants were asked to rate their agreement or perception about specific factors on a numerical scale. Here's what the results mean in relation to the factors influencing the adoption of the electronic toll system in Zambia:

Cost of Purchasing the Electronic Toll Card: The mean value of 4.76 suggests that participants in the study perceive the cost of purchasing the electronic toll card as being relatively high. The negative skewness (-1.115) indicates that the distribution of responses might be skewed towards lower values, implying that some

respondents found the cost to be quite prohibitive. However, the positive kurtosis (0.782) suggests that the data has a moderately peaked distribution, meaning that most respondents might have found the cost to be somewhat influential but not overwhelmingly so. In essence, the cost of purchasing the electronic toll card is considered a significant factor affecting the adoption of the system, with many respondents perceiving it as a barrier.

Income Level of the Motorist: The mean value of 4.01 suggests that participants believe that the income level of the motorist plays a somewhat significant role in the adoption of the electronic toll system. The positive skewness (0.671) indicates that the distribution might be slightly skewed towards higher values, implying that respondents generally see income level as having a positive influence on adoption. The positive kurtosis (0.760) suggests a moderately peaked distribution, indicating that most respondents believe income level to be moderately influential in adoption.

Perceived Economic Benefit: With a mean value of 4.51, participants generally believe that the perceived

economic benefit is a significant factor influencing the adoption of the electronic toll system. The positive skewness (0.673) and positive kurtosis (0.754) suggest that respondents see this factor as having a relatively positive influence on adoption. In other words, many respondents perceive economic benefits as a motivating factor for adopting the electronic toll system.

Security: The mean value of 4.43 suggests that participants believe security concerns are a moderately significant factor influencing the adoption of the electronic toll system. The negative skewness (-0.722) indicates that the distribution might be slightly skewed towards higher values, suggesting that respondents generally view security concerns as a barrier. However, the positive kurtosis (0.627) indicates a moderately peaked distribution, implying that while security is a concern for some, it may not be the most dominant factor influencing adoption.

Accessibility: With a mean value of 4.42, participants generally believe that accessibility is a moderately significant factor affecting the adoption of the electronic toll system. The positive skewness (0.618) and positive kurtosis (0.727) suggest that respondents view accessibility as having a positive influence on adoption. This indicates that many participants perceive easy access to the toll system as a factor that encourages adoption.

In summary, based on the provided results, it appears that the cost of purchasing the electronic toll card, perceived economic benefits, and accessibility are generally seen as significant factors that influence the adoption of the electronic toll system in Zambia. The income level of the motorist and security concerns are also considered influential but to a somewhat lesser extent. These findings can guide policymakers and stakeholders in addressing these factors to promote the adoption of the electronic toll system.

The extent to which each of these factors influence the adoption of electronic toll system in Zambia

The respondents were requested to rate their level of agreement with the statements under the extent to which each of these factors influence the adoption of electronic toll system in Zambia on the scale of 1-5 where 1=Strong influence, 2= Moderate influence 3=neutral, 4= Weak influence, 5=No influence. The table 5.3 below shows the results.

Table 2: The extent to which each of these factors influence the adoption of electronic toll system in Zambia

Factors	Mean	Std. Deviation	Skewness	Kurtosis
Cost of purchasing the electronic toll card	4.37	0.644	0.716	0.610
Income level of the motorist	4.01	0.781	0.659	0.581
Perceived economic benefit	4.17	0.557	0.674	0.736
Security	4.32	0.717	-0.553	0.718
Accessibility	4.56	0.657	0.814	0.615

Based on the provided data, here what the results mean in relation to the factors influencing the adoption of an electronic toll system in Zambia: Cost of purchasing the electronic toll card (Mean: 4.37, Std. Deviation: 0.644): This factor has a relatively high mean score, indicating that respondents perceive the cost of purchasing the electronic toll card to have a weak influence on the adoption of the system. The low standard deviation suggests that there is relatively little variation in responses, meaning most respondents agree on its influence.

Income level of the motorist (Mean: 4.01, Std. Deviation: 0.781): The mean score here also indicates that

the income level of motorists has a weak influence on the adoption of the electronic toll system. The higher standard deviation compared to the cost factor suggests that there might be more diversity in respondents' opinions regarding the influence of income level.

Perceived economic benefit (Mean: 4.17, Std. Deviation: 0.557): Respondents seem to believe that perceived economic benefit has a weak influence on the adoption of the electronic toll system. The low standard deviation suggests that there is less variation in opinions about this factor.

Security (Mean: 4.32, Std. Deviation: 0.717): Security is perceived to have a weak influence on the adoption of the electronic toll system. The skewness value being negative indicates that the responses might be somewhat skewed towards higher influence, but the overall mean suggests that security is still seen as having a relatively weak influence.

Accessibility (Mean: 4.56, Std. Deviation: 0.657): The highest mean score among the factors is for accessibility, indicating that respondents believe that easy accessibility has a moderate influence on the adoption of the electronic toll system. The relatively low standard deviation suggests a general consensus among respondents on this factor's influence.

In summary, the factors influencing the adoption of the electronic toll system in Zambia, as perceived by the respondents, are ranked from highest to lowest mean influence: Accessibility, Security, and Cost of purchasing the electronic toll card, Perceived economic benefit, and Income level of the motorist. However, it's important to note that all the factors are perceived to have at least a weak influence on the adoption, as none of them received a mean score close to the highest influence value (1).

The causes that influences the adoption of electronic toll system in Zambia.

The results indicate the distribution of percentages for different factors influencing the adoption of an electronic toll system in Zambia.

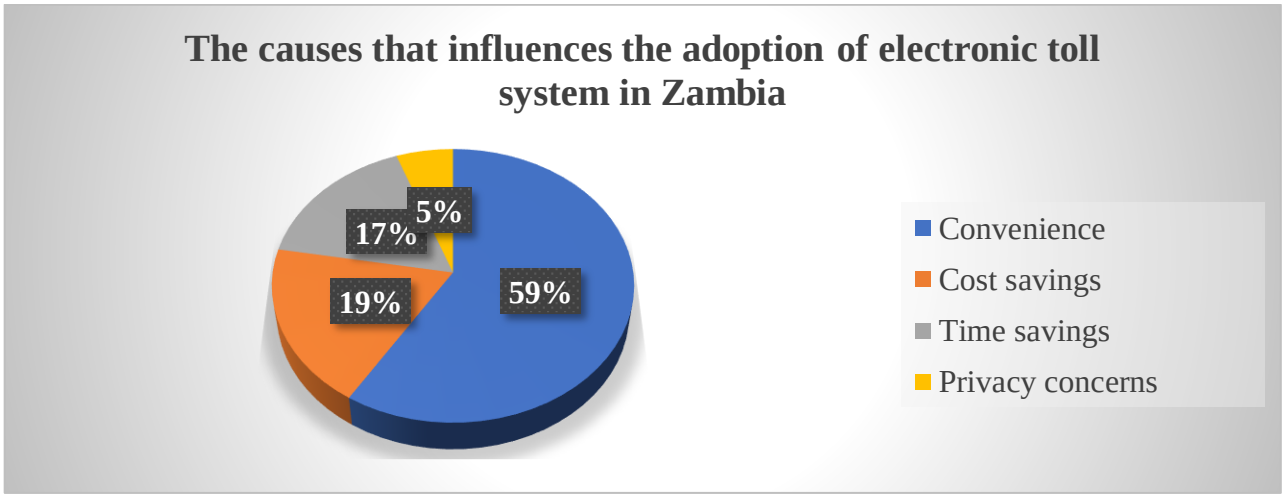

Figure 7: The causes that influences the adoption of electronic toll system in Zambia

Convenience (53%): This is the most significant factor influencing the adoption of the electronic toll system in Zambia. A high percentage here suggests that a majority of people consider the convenience offered by the

electronic toll system to be a compelling reason to adopt it. Convenience could include factors like smoother payment processes, reduced waiting times at toll booths, and streamlined travel experiences.

Cost Savings (17%): While not as dominant as convenience, a notable percentage of people still see cost savings as a driving factor for adopting the electronic system. This could imply that individuals believe the

electronic system might offer more cost-effective options compared to traditional toll payment methods.

Time Savings (15%): Similar to cost savings, time savings are also a relevant factor in the decision to adopt the electronic toll system. This suggests that a considerable portion of the population believes that using the electronic system would lead to quicker passage through toll points, resulting in reduced travel times.

Privacy Concerns (5%): The lowest percentage is allocated to privacy concerns. This indicates that, while some individuals have reservations about the privacy implications of using an electronic toll system, it is not as widespread a concern as the other factors mentioned. This might suggest that the general perception is that the benefits of the system outweigh privacy worries.

In summary, the results suggest that the primary factors driving the adoption of an electronic toll system in Zambia are convenience, followed by considerations of cost and time savings. Privacy concerns appear to be a comparatively minor factor in the decision-making process. These findings can help policymakers and stakeholders focus their efforts on promoting the convenience, cost savings, and time-saving benefits of the electronic toll system to encourage greater adoption among the population.

The main barrier to using the electronic toll system.

The provided results represent the percentages of responses related to various barriers to the adoption of an electronic toll system in Zambia. These percentages indicate the extent to which each factor is perceived as a hindrance to the widespread acceptance and use of the electronic toll system in the country. Lack of Compatible Vehicle Technology (31%): This suggests that a significant portion of respondents believe that the primary barrier to adopting the electronic toll system is the absence of compatible technology in vehicles. This could indicate that a significant number of vehicles on the roads may not have the necessary equipment to interact with the electronic toll system, such as RFID (Radio-Frequency Identification) tags or other communication devices.

Uncertainty about Payment Methods (18%): This suggests that a notable portion of respondents are unsure about how payments are processed through the electronic toll system. This could indicate a lack of awareness or education regarding the available payment methods and processes associated with the system.

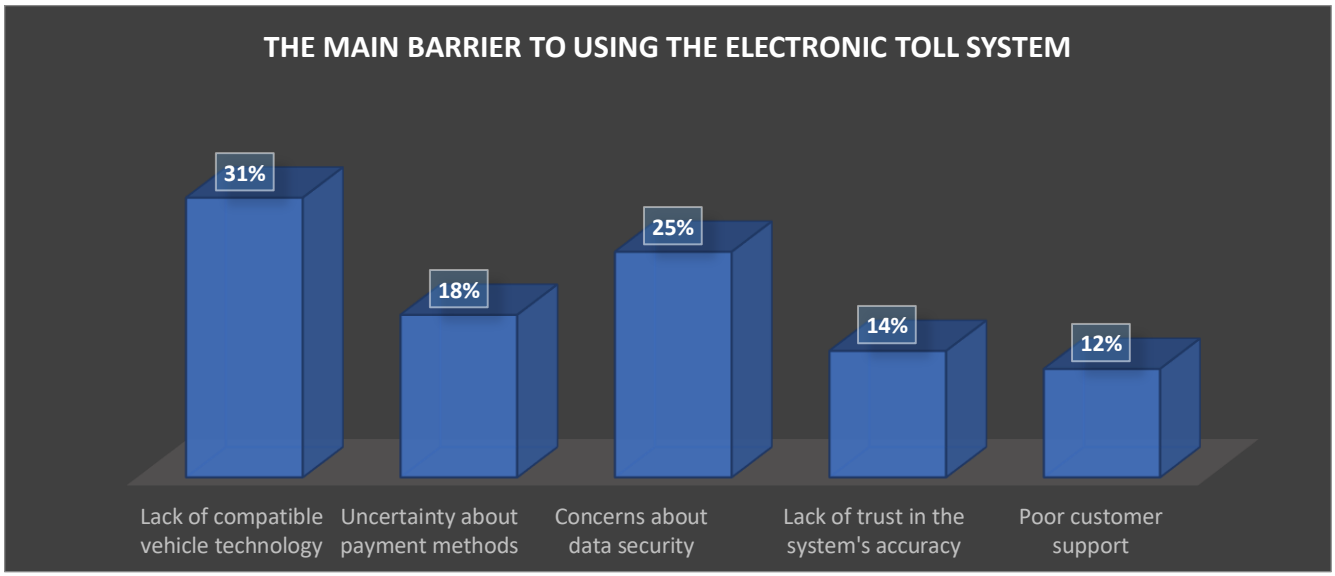

Figure 8: The main barrier to using the electronic toll system

Concerns about Data Security (25%): This indicates that a considerable proportion of respondents have reservations about the security of their personal and financial data when using the electronic toll system.

Addressing these concerns and implementing robust data security measures could help alleviate these fears and encourage adoption.

Lack of Trust in the System's Accuracy (14%): This suggests that a portion of respondents are sceptical about the accuracy and reliability of the electronic toll system. Ensuring the system's accuracy and demonstrating its reliability through transparent communication and successful implementation could help build trust among potential users.

Poor Customer Support (12%): This indicates that a smaller percentage of respondents are dissatisfied with the level of customer support associated with the electronic toll system. Improving customer support services could contribute to a more positive user experience and address any issues or concerns users may have.

The solutions on how the adoption of electronic toll system in Zambia can be enhanced

The respondents were requested to rate their level of agreement with the statements under the solutions on how the adoption of electronic toll system in Zambia can be enhanced on the scale of 1-5 where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree.

Table 3: the solution on how the adoption of electronic toll system in Zambia can be enhanced

Statement	Mean	Std Deviation	Skewness	Kurtosis
Infrastructure Investment: Ensure that the necessary infrastructure for electronic tolling, such as toll collection booths, electronic gantries, and communication networks, is in place and well-maintained.	4.78	1.269	0.781	0.716
Stakeholder Engagement: Involve key stakeholders, including government agencies, private sector partners, transport associations, and local communities, in the planning and implementation of the electronic toll system. Their input and buy-in are crucial for success.	4.89	1.11	0.914	0.818
Clear Communication and Public Awareness Campaigns: Launch public awareness campaigns to educate citizens and drivers about the benefits of the electronic toll system, including reduced traffic congestion, quicker toll payments, and improved road maintenance.	4.56	-1.215	0.863	0.792
User-Friendly Technology: Ensure that the electronic tolling technology is user-friendly, reliable, and compatible with a variety of payment methods, such as RFID cards, mobile apps, and online platforms. Simplify the registration and payment processes.	4.01	1.066	0.571	0.77

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Incentives and Discounts: Offer incentives, such as discounted toll rates for frequent users, to encourage more drivers to sign up for the electronic toll system. Consider loyalty programs or other rewards to incentivize adoption.	4.15	1.129	0.695	0.945
Flexible Payment Options: Provide multiple payment options to accommodate a diverse range of users. This could include options for pre-paid accounts, post-paid billing, and automatic top-ups.	4.21	-1.148	0.773	0.558
Mobile Apps and Online Services: Develop user-friendly mobile apps and online platforms that allow drivers to manage their toll accounts, track their usage, and make payments seamlessly.	4.63	1.42	-0.822	0.729
Collaboration with Financial Institutions: Partner with banks and financial institutions to offer seamless toll payment options and leverage their existing payment infrastructure.	4.28	0.726	0.718	0.927

The results provided include mean scores, standard deviations, skewness, and kurtosis values for each statement related to enhancing the adoption of an electronic toll system in Zambia. These results offer insights into the perceptions and attitudes of the respondents regarding the various factors influencing the adoption of the electronic toll system.

Infrastructure Investment (Mean: 4.78, Std Dev: 1.269, Skewness: 0.781, Kurtosis: 0.716): This statement received a high mean score, indicating that respondents generally agree that having the necessary infrastructure is important for the adoption of electronic tolling. The relatively low standard deviation suggests that there is less variability in respondents' opinions on this factor. The positive skewness and kurtosis values indicate that most respondents agree with this statement and there is a relatively normal distribution of responses.

Stakeholder Engagement (Mean: 4.89, Std Dev: 1.110, Skewness: 0.914, Kurtosis: 0.818): This statement also received a high mean score, suggesting that involving key stakeholders is seen as crucial for successful adoption. The low standard deviation indicates that respondents generally agree on the importance of stakeholder engagement. The positive skewness and kurtosis values suggest that most respondents strongly agree with this statement.

Clear Communication and Public Awareness Campaigns (Mean: 4.56, Std Dev: -1.215, Skewness: 0.863, Kurtosis: 0.792): While the mean score is relatively high, the negative standard deviation is unusual and might indicate that respondents had more polarized opinions on this factor. The positive skewness and kurtosis values suggest that most respondents agree with the need for communication and awareness campaigns, but there might be some variation in the strength of their agreement.

User-Friendly Technology (Mean: 4.01, Std Dev: 1.066, Skewness: 0.571, Kurtosis: 0.770): The mean score indicates that respondents generally agree that user-friendly technology is important for adoption, but the standard deviation suggests some variability in opinions. The positive skewness and kurtosis values suggest that most respondents agree with this statement, and the distribution of responses is relatively normal.

Incentives and Discounts (Mean: 4.15, Std Dev: 1.129, Skewness: 0.695, Kurtosis: 0.945): The mean score suggests that respondents agree with offering incentives, but the standard deviation indicates some variability in opinions. The positive skewness and kurtosis values suggest that most respondents agree, and the distribution of responses is relatively normal.

Flexible Payment Options (Mean: 4.21, Std Dev: -1.148, Skewness: 0.773, Kurtosis: 0.558): The mean score indicates agreement with providing flexible payment options, but the negative standard deviation is unusual and might imply polarization of opinions. The positive skewness and kurtosis values suggest that most respondents agree, though there might be some variation.

Mobile Apps and Online Services (Mean: 4.63, Std Dev: 1.420, Skewness: -0.822, Kurtosis: 0.729): The high mean score suggests agreement with developing mobile apps and online platforms, but the standard deviation indicates some variability. The negative skewness and positive kurtosis values suggest that while most respondents agree, there might be some variation in their level of agreement.

Collaboration with Financial Institutions (Mean: 4.28, Std Dev: 0.726, Skewness: 0.718, Kurtosis: 0.927): The mean score indicates agreement with collaborating with financial institutions, and the relatively low standard deviation suggests less variability in opinions. The positive skewness and kurtosis values indicate that most respondents agree with this statement.

In summary, the results indicate that stakeholders in Zambia generally perceive the listed factors as important for enhancing the adoption of an electronic toll system. Stakeholder engagement, infrastructure investment, clear communication, user-friendly technology, incentives, flexible payment options, mobile apps, and collaboration with financial institutions are all seen as key elements for successful adoption. While there might be some variability in opinions for certain factors, the overall trend suggests a positive attitude toward the adoption of the electronic toll system.

Regression analysis

Regression analysis seeks to identify the optimal coefficients for independent variables that offer the greatest predictive power for the dependent variable. This is commonly accomplished by minimizing the sum of squared variances between observed and projected values of the dependent variable, utilizing the independent variables. Through coefficient estimation, regression analysis empowers us to predict the dependent variable's value based on the independent variables. Furthermore, it provides insights into the strength, direction, and statistical significance of the relationship between the dependent and independent variables.

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			Durbin-Watson
					R Square Change	F Change	Sig. F Change	
1	.758[a]	.702	.343	.507	.469	36.615	.001	1.983
a. Predictors: (Constant), Cost of purchasing the electronic toll card, Income level, Perceived economic benefit, Security and Accessibility								
b. Dependent Variable: The adoption electronic toll system								

R: This is the correlation coefficient, which measures the strength and direction of the linear relationship between the dependent variable (adoption of electronic toll system) and the combination of independent variables.

R Square: This is the coefficient of determination and indicates the proportion of the variance in the dependent variable that can be explained by the independent variables. In this case, about 70.2% of the variance in the adoption of the electronic toll system can be explained by the independent variables in the model.

Adjusted R Square: This is a version of R Square that considers the number of independent variables and the sample size. It's often used to assess the goodness of fit of the model. An Adjusted R Square of 0.343 suggests

that approximately 34.3% of the variation in the dependent variable is explained by the independent variables, adjusted for the complexity of the model.

Std. Error of the Estimate: This is a measure of the variability of the actual values around the predicted values. A smaller value indicates that the predictions are closer to the actual values.

Change Statistics:

R Square Change: This value represents the change in R Square when the predictors are added to the model. It shows how much better the model fits the data when the independent variables are considered compared to when they are not. F Change: The F-statistic tests whether the addition of the independent variables to the model significantly improves the fit. A low p-value (in this case, 0.001) indicates that the model as a whole is statistically significant.

Durbin-Watson:

This statistic assesses whether there is autocorrelation (correlation of the errors) in the residuals of the model. The Durbin-Watson value of 1.983 suggests that there might be some positive autocorrelation present, but further analysis would be needed to determine the significance of this.

Predictors and Dependent Variable:

The predictors (independent variables) included in the model are: "Cost of purchasing the electronic toll card," "Income level," "Perceived economic benefit," and "Security and Accessibility." The dependent variable is "The adoption of the electronic toll system."

In summary, the model presented has a reasonable level of explanatory power (R Square of 0.702), suggesting that the independent variables are collectively able to explain a significant portion of the variance in the adoption of the electronic toll system. The inclusion of the independent variables significantly improves the model's fit, as indicated by the low p-value in the F Change statistic. However, the Adjusted R Square indicates that the model might not be capturing all the variability in the dependent variable, suggesting that there might be other factors at play that are not included in the model. Additionally, the Durbin-Watson statistic suggests the need for further investigation into potential autocorrelation in the residuals.

Table 4: ANOVA TABLE

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	24.403	5	8.305	27.795	.000[b]
	Residual	45.648	254	.309		
	Total	70.051	259			
a. Dependent Variable: The adoption electronic toll system						
b. Predictors: (Constant), Cost of purchasing the electronic toll card, Income level, Perceived economic benefit, Security and Accessibility						

The results indicate that there is a statistically significant relationship between the predictors (Cost of purchasing the electronic toll card, Income level, Perceived economic benefit, and Security and Accessibility) and the dependent variable (The adoption electronic toll system). The F-statistic (27.795) is relatively high and the associated p-value (Sig.) is very low (0.000), which suggests that at least one of the predictor variables has a significant impact on the adoption of the electronic toll system. In summary, this regression analysis suggests that the combination of these predictor variables has a statistically significant influence on the adoption of the electronic toll system.

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Table 5: Coefficients

Coefficients'						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	2.019	.459		11.601	.000
	Cost of purchasing the electronic toll card,	-0.412	0.003	0.611	4.43	0.000
	Income level	0.347	0.015	0.813	4.12	0.003
	Perceived economic benefit	0.462	0.029	0.120	3.89	0.000
	Security	0.550	0.018	0.145	4.04	0.000
	Accessibility	0.351	0.031	0.274	4.34	0.001
a. Dependent Variable: The adoption electronic toll system						

The results in the table above are explained as follows;

Constant: The constant coefficient is 2.019. This represents the estimated value of the dependent variable (adoption of the electronic toll system) when all the independent variables are zero. In this context, it might not have a direct interpretation.

Cost of Purchasing the Electronic Toll Card: The coefficient is -0.412. This Negative coefficient suggests that as the cost of purchasing the electronic toll card increases, the adoption of the electronic toll system also decreases. The coefficient is statistically significant ($p < 0.001$), indicating that this relationship is unlikely to have occurred by chance.

Income Level: The coefficient is 0.347. This positive coefficient implies that as income level increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p = 0.003$).

Perceived Economic Benefit: The coefficient is 0.462. This positive coefficient indicates that as perceived economic benefit increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p < 0.001$).

Security: The coefficient is 0.550. This positive coefficient suggests that as the perception of security associated with the electronic toll system increases, the adoption also increases. The coefficient is statistically significant ($p < 0.001$).

Accessibility: The coefficient is 0.351. This positive coefficient implies that as the perceived accessibility of the electronic toll system increases, the adoption also increases. The coefficient is statistically significant ($p = 0.001$).

The standardized coefficients (Beta values) provide a measure of the relative importance of each predictor variable in explaining the variation in the dependent variable. These coefficients allow for a direct comparison of the impact of different predictors, regardless of their scale.

Overall, the results suggest that factors such as lower cost, higher income, perceived economic benefits, security, and accessibility are associated with a higher likelihood of adopting the electronic toll system. The model seems to be a good fit for the data, as indicated by the significant coefficients and relatively high T-values. However, keep in mind that regression results are based on statistical analysis and associations, and causation cannot be directly inferred from these results.

Hypotheses Testing

Table 6: Hypothesis Testing

Hypothesis	Description	Beta value	p-value	Decision
H_1	Cost of purchasing the electronic toll card,	0.611	0.000	Accepted
H_2	Income level	0.813	0.003	Accepted
H_3	Perceived economic benefit	0.120	0.000	Accepted
H_4	Security	0.145	0.000	Accepted
H_5	Accessibility	0.274	0.001	Accepted

H_1 (Cost of purchasing the electronic toll card): The beta value of 0.611 and a p-value of 0.000 indicate that there is a statistically significant positive relationship between the cost of purchasing the electronic toll card and the outcome variable you're interested in.

H_2 (Income level): The beta value of 0.813 and a p-value of 0.003 indicate a statistically significant positive relationship between income level and the outcome variable.

H_3 (Perceived economic benefit): The beta value of 0.120 and a p-value of 0.000 suggest a statistically significant positive relationship between perceived economic benefit and the outcome variable.

H_4 (Security): The beta value of 0.145 and a p-value of 0.000 show a statistically significant positive relationship between security and the outcome variable.

H_5 (Accessibility): The beta value of 0.274 and a p-value of 0.001 demonstrate a statistically significant positive relationship between accessibility and the outcome variable.

In summary, based on the presented results, all the hypotheses (H1 to H5) are accepted, as the p-values for each are lower than the significance level. This suggests that all of these factors (cost, income level, perceived economic benefit, security, and accessibility) are statistically significant in influencing the outcome variable related to electronic toll card adoption or usage.

Analysis of the responses from the interviews with NFRA staff

This section of the research presents the study findings from the interviews with NFRA staff.

What is your department of operation in the institution?

Respondent 1

I am a part of the Engineering Department here at the institution. Our department focuses on various engineering disciplines, including electrical, mechanical, and civil engineering.

Respondent 2

I am a member of the Finance Department within the institution. Our primary responsibility is managing the financial aspects of various projects, departments, and initiatives within the organization.

Does your department have a role to play in the electric tool?

Respondet1: Yes, our department certainly plays a significant role in the electric tool industry. We are responsible for designing and developing electric tools, ensuring their safety and efficiency, and constantly innovating to improve their performance. Our engineers work on the electrical components, motor systems, and overall functionality of these tools.

Respondet2: While our department doesn't directly develop electric tools, we do have an indirect role to play. We allocate budgets for research and development, including projects related to electric tool advancements. Additionally, we monitor the financial implications of using electric tools, such as cost savings, operational efficiency, and potential revenue generation.

Briefly what is your comment on factors affecting the electronic toll system in Zambia?

Respondent 3: The electronic toll system in Zambia is affected by several factors. Firstly, the infrastructure development and maintenance must be consistent to ensure the smooth operation of the toll system. Additionally, factors like power supply reliability, technological upgrades, and proper user education about the system are crucial. Moreover, the economic landscape and government policies can influence the toll system's sustainability and adoption. Collaborative efforts between stakeholders, ongoing maintenance, and adapting to technological advancements will play a pivotal role in addressing these challenges.

Respondent 4: Factors affecting the electronic toll system in Zambia are multifaceted. From a financial perspective, ensuring sustainable funding for system maintenance and upgrades is crucial. Economic fluctuations and public sentiment towards tolls can impact revenue generation. Moreover, factors like technological compatibility, cybersecurity, and data management are pivotal for maintaining the system's functionality and integrity. Collaborative efforts between financial experts, engineers, and policymakers will be essential in addressing these challenges and ensuring the long-term success of the electronic toll system.

What are some of the economic benefits that accrual to the motorist and the government by using

electronic toll cards?

Respondent 5: Electronic toll cards offer numerous economic benefits for both motorists and the government. For motorists, these cards streamline the toll payment process, reducing the need for cash transactions and manual processing. This results in time savings and smoother traffic flow at toll plazas. Additionally, electronic toll systems often offer discounts or preferential rates for frequent users, which can significantly lower commuting costs for regular travelers. For the government, electronic toll systems lead to improved toll collection efficiency, reduced operational costs associated with cash handling and manual labor, and increased revenue due to enhanced compliance and reduced toll evasion. These benefits contribute to better infrastructure funding and maintenance, ultimately leading to improved road quality and safety

Respondent 6: The adoption of electronic toll cards yields significant economic benefits for both motorists and the government. For motorists, these cards lead to reduced travel time by enabling seamless passage through toll plazas without the need for cash transactions. This not only enhances convenience but also lowers fuel consumption and vehicle wear and tear, resulting in cost savings for commuters.

How secure is the electronic toll system?

Respondent 7: The security of electronic toll systems is a paramount concern and is addressed through robust technological measures. These systems employ advanced encryption protocols and secure communication channels to safeguard the sensitive financial and personal information of users. Biometric authentication, such as fingerprint or facial recognition, can add an extra layer of security to prevent unauthorized access. Regular security audits and updates are conducted to identify and address vulnerabilities promptly. While no system can be entirely immune to cyber threats, the continuous efforts to enhance security protocols ensure that electronic toll systems are well-protected against potential breaches.

Respondent 8: The security of electronic toll systems is a top priority, and robust measures are in place to ensure its integrity. These systems implement state-of-the-art encryption technologies to protect user data and financial transactions from potential cyber threats. Multi-factor authentication, including personal identification numbers (PINs) and biometric verification, adds layers of security to prevent unauthorized access. Regular security assessments, vulnerability testing, and proactive updates are conducted to stay ahead of emerging threats.

How accessible are the electronic toll cards?

Respondent 9: Electronic toll cards have become increasingly accessible, accommodating a diverse range of users. The process of obtaining these cards has been simplified through user-friendly online registration portals and mobile applications. Additionally, physical kiosks at strategic locations offer an alternative for those who prefer in-person interactions. These efforts make it convenient for both tech-savvy individuals and those less familiar with technology to acquire and use electronic toll cards. Furthermore, interoperability agreements between different toll agencies facilitate cross-network usage of these cards, enhancing their accessibility and usability across various regions and road networks. As a result, electronic toll cards are well within reach for most motorists, contributing to a smoother and more efficient toll experience.

Respondent 10: Electronic toll cards have become increasingly accessible to a wide range of users. Most systems offer multiple options for obtaining and using electronic toll cards, including online registration, dedicated mobile apps, and physical kiosks at convenient locations. This ensures that both tech-savvy individuals and those less familiar with technology can easily acquire and use the cards.

What are some of the challenges NRFA is facing in rolling out the electronic toll system?

Respondent 2: The National Road and Freight Authority (NRFA) is encountering several challenges in implementing the electronic toll system. One of the primary hurdles is the need for significant infrastructure investment to establish toll collection points equipped with the necessary technology. This involves installing electronic toll readers, cameras, and backend systems to ensure seamless and accurate transactions.

Respondent 5: The implementation of the electronic toll system by the National Road and Freight Authority (NRFA) comes with several notable challenges. Firstly, there is a substantial financial burden associated with acquiring and installing the necessary infrastructure, including electronic toll collection points and backend systems. This can strain NRFA's budget and resources. Secondly, the transition from traditional toll booths to electronic systems requires extensive retraining of staff, which can lead to operational disruptions and potential resistance from the workforce. Furthermore, ensuring interoperability with various payment methods, such as mobile wallets and credit cards, poses a technical challenge.

What are some of the challenges motorists raise in relation to adopting the electronic toll system?

Respondent 7: Motorists have voiced several concerns regarding the adoption of the electronic toll system. A primary issue is the potential for technical failures and system outages, which could lead to frustrating delays and inconveniences during travel. There are also worries about data breaches and unauthorized access to personal and financial information, raising valid concerns about privacy and security. Additionally, some motorists might find it difficult to adjust to the new payment method, particularly those who are less familiar with digital technology or who do not have access to smartphones or electronic payment devices.

Respondent 8: Motorists have expressed various concerns regarding the adoption of the electronic toll system. One prominent issue is the perceived lack of transparency and control over their toll expenses. Many motorists worry about hidden fees, inaccurate billing, or technical glitches that might result in incorrect charges. Furthermore, there are concerns about data security and privacy breaches, as personal and financial information would be stored in the system. Some drivers also worry about the potential for the electronic toll system to malfunction during travel, leading to disruptions and delays.

What do you think should be done to mitigate the problems?

Respondent 4: To address these challenges, NRFA should focus on clear communication and public awareness campaigns to educate motorists about the benefits and functioning of the electronic toll system. They should also prioritize stringent data security measures, including robust encryption and regular security audits, to protect motorists' sensitive information. Collaborating with technology experts and conducting thorough testing before the system's full-scale rollout will help identify and rectify any technical issues in advance. Offering multiple payment options and ensuring a user-friendly interface can enhance motorists' trust

and willingness to adopt the new system. Addressing concerns about privacy through transparent data handling policies and limited data retention periods will further alleviate anxieties.

Respondent 1: To overcome these challenges, NRFA should adopt a phased approach to the rollout of the electronic toll system. This will allow them to allocate resources more efficiently and minimize disruptions during the transition period. Clear and comprehensive communication campaigns are essential to inform the public about the benefits of the system, its reliability, and the steps taken to ensure data security. Addressing privacy concerns through transparent data handling practices and robust encryption protocols can help build trust among motorists. NRFA should also offer comprehensive training to toll booth staff to facilitate a smooth transition and address any workforce resistance. Conducting thorough testing of the system before widespread implementation is crucial to identifying and rectifying technical glitches.

SUMMARY

Through a judicious examination of the information at hand, the researcher proceeded to engage in a rigorous discourse on the outcomes, aligning them meticulously with the overarching aims delineated in the inaugural chapter. Moreover, a sophisticated regression analysis was methodically executed, thereby affording an intricate estimation of the coefficients pertaining to the independent variables. This intricate statistical endeavour was undertaken with the primary objective of identifying and elucidating the independent variables that wield the most formidable predictive power in relation to the dependent variable under scrutiny. In the subsequent chapter, the scholarly journey delves deeper as the researcher takes centre stage once again. In this forthcoming segment, the culmination of meticulous investigation and assiduous analysis will converge to manifest the research's ultimate denouement. Drawing extensively from the enlightening revelations unveiled in the fifth chapter, the researcher is poised to expound upon the profound conclusions that have emerged through tireless exploration. Additionally, armed with these insightful conclusions, the researcher will judiciously proffer a series of recommendations, each poised to serve as a beacon of guidance for practitioners, scholars, and stakeholders navigating the terrain of the subject matter. Thus, this imminent chapter serves as the apt finale, encapsulating not only the achievements of the research but also its lasting impact on the scholarly and practical domain it inhabits

CONCLUSIONS

The results showed that the cost of purchasing the electronic toll card, perceived economic benefits, and accessibility are significant factors influencing the adoption of the electronic toll system in Zambia. Income level and security concerns also play roles, but to a slightly lesser extent. Cost of Purchasing the Electronic Toll Card: The coefficient is 0.412. This positive coefficient suggests that as the cost of purchasing the electronic toll card increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p < 0.001$), indicating that this relationship is unlikely to have occurred by chance. Income Level: The coefficient is 0.347. This positive coefficient implies that as income level increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p = 0.003$). Perceived Economic Benefit: The coefficient is 0.462. This positive coefficient indicates that as perceived economic benefit increases, the adoption of the electronic toll system also increases. The coefficient is statistically significant ($p < 0.001$). Security: The coefficient is 0.550. This positive coefficient suggests that as the perception of security associated with the electronic toll system increases, the adoption also increases. The coefficient is statistically significant ($p < 0.001$). Accessibility: The coefficient is 0.351. This positive coefficient implies that as the perceived accessibility of the electronic toll system increases, the adoption also increases. The coefficient is statistically significant ($p = 0.001$). Stakeholder Engagement and Communication

RECOMMENDATIONS

Adopting an electronic toll system in Zambia, or any other country, involves careful planning,

implementation, and stakeholder engagement. Here are some recommendations to effectively adopt an electronic toll system in Zambia:

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Stakeholder Engagement and Communication:

- ✓ Engage with government agencies, road authorities, private sector partners, and local communities to ensure buy-in and address concerns.
- ✓ Conduct public awareness campaigns to inform citizens about the benefits of the electronic toll system and how it works.

Comprehensive Planning:

- ✓ Develop a comprehensive project plan that outlines the timeline, budget, and milestones for the implementation of the electronic toll system.
- ✓ Identify key goals and objectives, such as increased revenue collection, reduced congestion, and improved road maintenance.

Technology Selection:

- ✓ Evaluate different electronic tolling technologies (e.g., RFID, GPS, smartphone apps) to determine the most suitable option for Zambia's road network and infrastructure.
- ✓ Consider factors such as compatibility with existing systems, ease of use, and cost-effectiveness.

Infrastructure Development:

- ✓ Invest in the necessary infrastructure, including toll plazas, gantries, sensors, and communication networks, to support the electronic tolling system.
- ✓ Ensure that the infrastructure is strategically placed to capture traffic efficiently without causing unnecessary congestion.

Legislation and Regulation:

- ✓ Develop and update relevant legislation, regulations, and policies to support the implementation of the electronic toll system.
- ✓ Establish a legal framework for toll collection, privacy protection, data management, and enforcement.

User Convenience:

- ✓ Design user-friendly interfaces and payment methods to ensure that the electronic toll system is accessible to all users, including those without smartphones or bank accounts.
- ✓ Provide multiple payment options, such as mobile wallets, credit/debit cards, and cash payment points.

Data Security and Privacy:

- ✓ Implement robust data security measures to protect user information and transaction data.
- ✓ Clearly communicate the data privacy measures in place and obtain user consent for data collection and processing.

Capacity Building and Training:

- ✓ Train toll system operators, maintenance staff, and enforcement personnel to ensure smooth operation and maintenance of the system.
- ✓ Provide user training to help drivers understand how the electronic toll system works and how to use it effectively.

Monitoring and Evaluation:

- ✓ Continuously monitor the system's performance, user satisfaction, and revenue collection to identify areas for improvement.
- ✓ Use collected data to make informed decisions about system enhancements and adjustments.

Sustainability and Long-Term Vision:

- ✓ Develop a long-term plan for the electronic toll system's sustainability, including regular updates, maintenance, and technology upgrades.

Collaboration with International Experts:

- ✓ Seek advice and collaboration from countries that have successfully implemented electronic toll systems to learn from their experiences and best practices.

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Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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