ASSESSMENT OF THE ELECTRONIC SMART CARD PAYMENT SYSTEM AND THE SECURITY AND SAFETY OF PUBLIC TRANSPORT USERS IN LAGOS

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ABSTRACT

With the recent advancement in information technology, all activities have been said to be digitalized because the world is heading to a smart globe. This development led to the innovation of electronic payment (e-payment) systems in public transport. Thus, this study is aimed at assessing the effect of the e-payment system on the security of public transport users. To achieve this aim, the study reviewed the e-payment systems operational in both developing and developed countries, assessed the e-payment system in Lagos public transport, and analyzed how the e-payment system affects the security of transport users. Primary data was collected through the administration of 300 copies of well-structured questionnaire to BRT passengers in Lagos State using the convenience sampling technique. The data was analyzed via descriptive and inferential statistical tools. Most of the respondents believe that the cowry card provides robust protection against fraudulent or cyber-attacks, and that their details and vital information can be swiftly transferred to a new card in the event of loss or theft. The study recommends the integration of cowry card adoption across several modes of transport and increased publicity on the features and security of using cowry cards for transport fare payments.

Introduction

Transport is a crucial element of human existence, involving the movement of individuals, commodities, and services from one geographical area to another through a designated channel. Public transport plays a vital role in the overall welfare of a nation, as it serves as a crucial means of facilitating mobility and communication throughout various industries. According to Ali (2014), public transport is the act or means of transporting people or things in large numbers. It comprises mainly rail systems, light rail systems, tramways and monorails, bus systems, and sometimes, water transport. The choice of any or a combination of these public transport systems could be influenced by the population, size, and area of a city (Ali, 2014).

Ooi and Tan (2016) mentioned that migration in the urban centers is continuously increasing in contemporary society as electronic payment for

transaction in order to adopt cashless economy is being accepted. As a result of this development, electronic payment services have increasingly turned into daily activities in human life (Huang, Zhong, Davison, & Zhao, 2016), unlike previous traditional payment which was confined to either the physical exchange of notes or coins (Di Pietro, Guglielmetti Mugion, Mattia, Renzi, & Toni, 2015). The rapid growth in electronic payment technologies has created different payments opportunities for users today to explore various means of payments (Su, Wang, & Yan, 2018).

Electronic payment systems have become a popular method of exchanging quick data between two devices, readers, and other electronics tags (Ming- Yen, 2013). In some countries of the world, mobile payment has become an established payment mechanism like credit or debit cards. For instance, the volume of mobile payment transaction is expected to exceed credit card transaction volume by 30% in China (Wang, 2018). An average user of electronic payment in Lagos public transport known as the Bus Rapid Transit (BRT) finds it difficult to trust the security, usefulness, and ease of use of the card according to (Di Pietro et al., 2015) cited in (Alademomi et al., 2019). As a result of this, the efficiency and simplicity of electronic payment systems invariably predicts their behavior and attitude towards the technology according to (Baganzi & Lau, 2017).

Research on users' attitude to electronic payment system of BRT in Lagos is scanty therefore the study aims to fill this gap by examining the effects of electronic payment systems on users of public transport in Lagos.

2. Literature Review

Empirical Review

Bwigenge, Sensuse, Kautsarina and Suryono (2020) investigated passenger's acceptance of cashless payment system for public bus transportation system in Kigali City. The findings revealed that there is no significant connection between attitude and insecurity. Also, it is indicated that awareness, discomfort, and intention to use Cashless Payment System, Innovativeness, Optimism, Perceived ease of use and usefulness) are significant determinants of the use of cashless payment system among passengers. determinants of the use of cashless payment system among passengers.

Tinka and Behrens (2019) review cashless fare collection in Sub-Sahara African Paratransit. The study adopted a qualitative research approach and content analysis based on the review of past studies and contextual observation to conclude that cashless fare collection has been more successful amongst for-hire motorcycle-taxi services and cashless fare collection satisfy the interests of all minibus paratransit stakeholders' groups.

Omoruyi, Omoruyi, Okokpujie and Okokpujie (2018), conducted a study on electronic fare collection systems in public transit in Lagos. The study sampled commuters with questionnaires administered using a simple random sampling technique. The study also interviewed a representative of the Electronic Fare Collection System Technology Provider (e-Purse). Findings revealed commuter's adoption of Electronic Fare Collection System remains low due to amongst other factors a lack of know-how on the smart card usability.

Kuye, Sulaimon and Azeez (2017) investigated bus rapid transit and socioeconomic condition of bus

commuters in Lagos State. The study used multistage sampling technique and primary data via administration of questionnaire to collect data from the respondents, while descriptive and inferential statistics were used for data analysis. The findings showed that BRT services has reduced the cost of bus commuters and increased safety and security thereby increasing the socioeconomic condition of Lagosians. The study recommends the improvement of BRT services through the deployment of technology as it had been used in developed countries.

According to Ramos-de-Luna (2016), acceptance of electronic payment depends on the provision for self-service technology. In another study, Alademomi et al. (2019), noted that users of electronic payment prefer to have direct access to services without interaction with the provider of the technology. Liébana-Cabanillas and Marinkovic (2018) opined that younger individuals accept the use of electronic payment for payment of transportation fare. Zhang (2018) revealed that security, safety, risk, and belief of uncertainty are among the factors that determine acceptance of electronic card payment.

Kimaru (2016) evaluated the implementation of the cashless fare system in the Kenyan public transport system. The study used a quantitative research approach and primary data via a questionnaire. The descriptive statistics showed that users' participation, compatibility (interoperability) and training were the most critical factors that need to be addressed during the implementation of the cashless fare system.

2.1 Conceptual Review

Smart Cards

Smart cards were first introduced in the 1960s in Chicago, United States of America. Since then, they began to be implemented in transport systems across the world, mainly after the 1990s. The main objective of using smart cards in public transit systems is to collect revenue in an efficient way that benefits both the transport authorities and its passengers (Faro qi, Mesbah & Kim 2017). The card is simply used by tapping on and/or tapping off—the cards when boarding and alighting in a public vehicle. It is more efficient than paying cash or using paper tickets which reduces dwell time and helps to increase service speed. According to Blythe (2004), a smart card is essentially a credit-card-sized piece of plastic which has a microchip embedded in it. This chip is the smartness of the smart card and performs all the functions required by the card (storing data, processing data, writing data, etc.). Smart-card chips come in two broad varieties: memory-only chips, with storage space for data, and with a reasonable level of built-in security; and microprocessor chips which, in addition to memory, employ a processor controlled by a card operating system with the ability to process data onboard, as well as carrying small programs capable of local execution (Akintola, Eluyode & Oyedele, 2019).

Smart cards are being used in public transport around the world such as.

❖ America Washington uses "SmarTrip" for metro rail, bus and park lots, Passengers must tap out on leaving, if a one- or two-zone ride is taken and the appropriate value is restored. The same method is applied for parking.

❖ London uses "Osyer smart card" for trams and bus. Passengers can purchase an Oyster card on-line, and

the card will be dispatched by mail. But this takes a couple of days before it gets to the purchaser (Xu hao 2007).

❖ Hong Kong make use of "Octopus Card" for PT such as bus, rail, tram, and ferry. Octopus card is of two types, the regular octopus card for the people of Hong Kong and the tourist octopus card. According to xu hao (2007), tourist Octopus cards may be used only by tourists staying in Hong Kong for 14 or fewer days; users may be required to produce a passport showing their arrival date in Hong Kong.

❖ In Japan "Suica card" is used. Unlike other cards it is multifunctional as it is not limited to PT alone, it can also be used for shopping and parking lots.

❖ In Lagos, Nigeria "Cowry card" is being used for public transport particularly for bus services. According to the managing director of LAMATA Abimbola Akinajo (2021), the cowry card has been extended to other transport services such as water (LASWA) and rail transportation.

Lagos Public Transport and Electronic Fare Collection System

The Lagos BRT Electronic Fare Collection System first started operation in July 2013, however this was discontinued two years later after a disagreement between the Bus Operators, National Union of Road Transport Workers Bus Franchise Scheme (NURTW-BFS) and the technology providers (e-Purse) (Omoruyi et al, 2018). The technology providers attribute this to a breakdown in the relationship between them and the erstwhile bus operators. However, the Electronic Fare Collection System was reintroduced in November 2015 after the old bus operators were replaced and the right to use the BRT routes transferred to new bus operators. The new operators promptly reintroduced

the electronic fare collection system and approved vendors for paper tickets tied to smart card technology. The electronic fare collection system uses fewer smart cards with tap-to-pay devices. In the contact less smart card, the chip can be completely embedded within plastic, but is usually visible.

A small antenna is also installed in the contact less card, which makes smart card technology like radio frequency identification (RFID) technology (Pelletier, 2011). Smart cards usually do not contain passenger details and thus are limited in use to the payment transaction. This makes them susceptible to theft and other security concerns. The electronic fare collection system operates as an on-board fare collection system using the zonal fare structure. Electronic fare collection operators (e-Purse) noted that security and power supply concerns as the determining factor for its choice of an on-board fare collection system. Tap-to-pay devices are Liquid Crystal Display (LCD) - equipped, Personal Computer (PC)- Linked, Near Field Communication (NFC) Contact less Readers with USB as its host interface (Okokpujie, 2017). These devices are not insured and thus Technology operators incur losses when devices are damaged, stolen or destroyed.

Cowry Card as an Element of E-Ticketing

Cowry card is an e-ticketing system currently in use on the BRT route by the high-capacity Marcopolo buses in Lagos. One of the most important characteristics of this cowry card is that passengers are not required to pay for bus ride in cash; they become entitled to use these transport services by purchasing the cowry card (Kato, 2008). This system can generally be described as a cashless process.

Alfawaer, Awni and Al-Zoubi (2011) define an e-ticket as a paperless electronic

document used for ticketing travelers, mainly in the commercial airline industry. Sorooshian, Onn and Yeen (2013) further define e-ticketing as "a procedure of keeping record of sales, usage tracking and accounting for a passenger's transport with no requirement for a paper 'value document'. This definition clearly indicates that the e-ticket includes more than just a paperless document for the passenger: rather the e-ticket represents an extensive architecture within the organization that provides a wealth of information about the consumer.

Electronic Payment on the Security of Public Transport Users

Data security is also an issue of concern which impacts consumers' behavior and decision-making regarding electronic payment. The scope and extent of security issues related to e-ticketing is highlighted by Mut-Puigserver et al. (2012), that "the use of ET systems enables various privacy abuses both in real-time and retrospect since the anonymity of users is not always guaranteed and, therefore, users can be traced, and their profiles of usual movements can be created".

3. Methodology

This is an exploratory study which utilized descriptive research design. The population for this study is the regular commuters that make use of the Lagos BRT buses along various corridors. A primary source of data collection using the questionnaire instrument was adopted to investigate the opinions of the commuters regarding security on the use and adoption of cowry card as means of payment for public transport fare in BRT buses. The study analyzed about 300 copies of questionnaire which were administered to commuters of the Lagos BRT bus services across 14 corridors in Lagos State using the convenience sampling technique.

3.1 Study Area

Lagos State is the smallest in terms of land area among the Nigerian States with an area of 3,577sq.km of which 22% is water and it is arguably the most economically important state of the country, containing the nation's largest urban area and producing a significant portion of the country's GDP. The state is bounded in the north and east by Ogun state, in the west by the Republic of Benin and in the south by the Atlantic Ocean where it has a 180 km stretch of waterfront. It is however within easy reach of road, rail, and air transportation from various parts of the country. Lagos Metropolis is the most heavily motorized part of Nigeria, and almost all movement is made by road, while water and rail accounts for a very minute percentage.

4. Results and Discussions

Respondents' perception on the security of cowry card against fraud

Among the respondents, 1.7% expressed mild disagreement over the robustness of the anti-fraud security measures associated with the cowry card. Additionally, 37.8% of the participants exhibited a strong lack of confidence in the card's ability to effectively mitigate fraudulent activities. Conversely, most respondents, comprising 60.5%, expressed a belief in the strong anti-fraud security features of the cowry card. Based on the findings of this investigation, it was observed that commuters perceived electronic payment as a partially effective measure in addressing the issues of fraud and extortion encountered in their everyday operations.
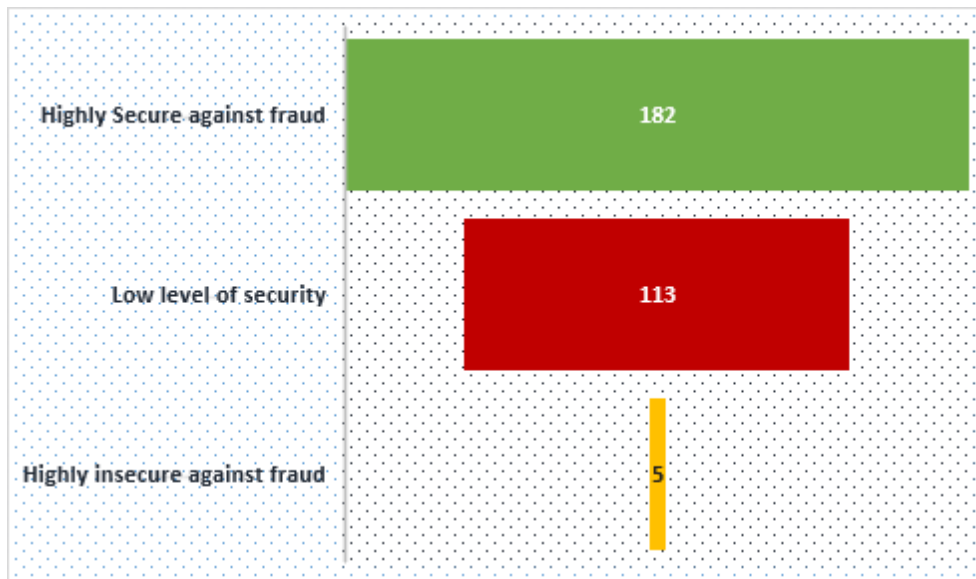
Figure 1: Security against fraud   **Source: Field Survey, 2022**

Respondents' perception on the ease of cowry card data and funds migration in case of lost or stolen cards

Figure 2 depicts the opinions of respondents concerning the transferability of funds from a lost or stolen card to a new card. In essence, 75.7% of respondents believed that the preloaded funds on the cowry card could be easily transferred to a new card if the original card was stolen or lost. According to this study's findings, most respondents assume that data transfer between cards is straightforward.

Fig 2: Perception of respondents on the ease of cowry card data and funds migration in case of missing or stolen cards.

Source: Field Survey, 2022

5. Recommendations

The study recommends further adoption of the electronic payment system on a larger and more robust scale (i.e., integrating two or three modes of transport into one payment system), increased education and publicity on the safety and features of the cards, and making the cowry card accessible to all.

6. Conclusion

The findings revealed that electronic payment technology has greatly improved the perception of adopters on the security of payments and the ease of information transfer in between cowry cards. Zhang (2018) observed that security of electronic payment platforms among other factors is critical to the adoption of the technology. The results of this study further confirm the importance of a secure payment platform with the majority, specifically 60.5% of the cowry card adapters among the respondents interviewed expressing confidence in the security of the cards.

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