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SOLUTIONS FOR THE USE OF SMART TECHNOLOGY IN TRANSPORTATION

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Abstract: *The focus of this study is the impacts of smart-technology motorcycle-taxi services in some parts of Nigeria. The purpose of the study is to evaluate the socio-economic impacts of the smart-technology transportation and logistics operators in the selected study areas in order to improve their service delivery. The study was motivated by the public complaints around the informal motorcycle-taxi arrangements in the study areas and the subsequent introduction of modern smart-technology assisted transportation models, with the intension to advance the public transportation in the areas under consideration. The target smart-technology companies under investigation are GOKADA, SafeBoda and KONGA. This work will analyze the opinions, preferences and demographic characteristics of five categories of the stakeholders involved in the smart-technology businesses under focus. The stakeholders are regular passengers, irregular/occasional passengers, regular order recipients, irregular order recipients, and bike drivers.*

The empirical data collection of this study consists of survey and interviews of participants with a profound understanding of the smart-technology transportation. A survey was conducted among two hundred and thirty end-users and operators of smart-technology motorcycle-taxi system in the two commercial cities of Lagos and Ibadan, Nigeria. The sharing proportions of questionnaires among the respondents in the study areas was informed by the preliminary information and recommendations of stakeholders, as follows; Ibadan (45%), Lagos (55%). The survey was conducted using structured and unstructured questionnaires. All the interviews were transcribed, analyzed, compared with other existing cases, presented through descriptive statistics and conclusions drawn using PEST and SWOT analyses. The results from this study will give an understanding of the activities and impacts of the three smart-technology based motorcycle-taxi companies in the selected study areas, towards the sustainable transportation and logistics services.

The results from this work show that the introduction of smart-technology motorcycle-taxi system has helped businesses grow in the study areas and should be given support by the government. Youth participation in the smart-technology transport system will boost the economy and provide jobs for the teaming youths. Women involvement and confidence in the new transport arrangement is a welcome development and is commendable. In view of the foregoing, more research work should be conducted on the activities of other smart transport companies for more positive impacts. The service providers are implored to extend their services to other high impact areas like health and accident related ones.

Keywords: *Smart technology, smart transportation, ICT applications; urban public transport; transport user preferences; travel behavior; sustainable city; transport ICTs.*

Introduction

Transportation constitutes one of the major features of the economic development of Nigeria. Over the years, scholars have debated on a number of issues related to the exact role of transportation in economic development such as the timing of the investment in transport infrastructure, how it works, the amount of transport investment needed for a specific level of development and many other aspects. The answers to these questions are not very easy to obtain because the demand for transportation is a "derived demand" while transport affects and is affected by many other sectors of the economy. While the debate on the role of transportation on economic development continues, some scholars emphasize that where a nation is lacking in the factors conducive to growth, no amount of transport investment can produce economic development. Fortunately, Nigeria is not lacking in resources and other factors conducive to growth. A wide range of transport facilities already exist in Nigeria and may range from primitive footpaths and dirt roads with human or animal haulage, super highways or expressways, railways, airways and lately to modern smart-technology based transportation arrangements (Onakala and Olajide, 2020). Today more than half of the population in the world lives in cities or urban areas (Sampaio et al. 2019). Therefore, logistics demand a well-integrated and well-functioning transportation solution. The fast growing population and urbanization requires new business models and innovative solutions for cities to be profitable, yet sustainable. To be sustainable and profitable one needs to allocate their resources the most efficient way. The new trends in logistics for cities are private smart transportation arrangements that aims to develop a more sustainable and economical solution. Together with the development of smart technology and the ubiquity individualism of smartphones, the shift to new transport model is trending (Sampaio et al. 2019).

Smart technology can be introduced even in cities, which are not fully digitalized; however, some enablers need to be in place. First, there is need for technology that allows for ICT to be in operation and for users to access it. With the development of the smartphone, the main access mode to ICTs was firmly established. Second, there must be a certain acceptance level among users. While the first condition can be now easily met with smart phones and internet connection, being an everyday feature of urban life, the second is not that obvious, especially regarding transport users. Research indicates that there seems to be a surprisingly large group of users who are not interested in any form of smart technology. There is as well a certain group of users who are not willing to switch to public transport regardless of what improvements are made. The choice is caused either by their preference of use of the private car or due to public transport quality being simply inadequate to them. Some of these users are inclined to use a private car due to laziness, medical purposes (Dobbs 2005), or simply comfort. This results in a tendency that cannot be met by even the most perfect public transport system (Steg et al. 2001). Smart technology can therefore also influence more rational use of car- based transport solutions (as seen in Bolt, Uber and others). The target groups of smart-technology based policies are those users who actually can be attracted to public transport by a better offer. Smart-technology can be a tool in making public transport sufficiently good to meet the demand of those end-users (Bak and Borkowski 2015). The economic potential of smart technology for transport providers is enormous. Technology should help to better manage transport networks and vehicle fleets. Meanwhile, in urban smart transport arrangements, the most direct positive effects on costs reduction yet to have been reported include: cargo transport (Mason et al. 2003) and fleet management (Button et al. 2001) but not passenger transport in the

real sense of it. Outside of the service provider, cost benefit analysis, from a societal point of view, benefits point to urban sustainability that considers the many positive effects due to smart transport system are numerous.

Relevance of the topic: The purpose of smart technology is to sustain and obtain services that improve the citizens' movement and socio-economic well-being through a combination of a developed transportation services and smart technology. Thus, this work is designed to make the motorcycle-taxi transportation in the selected study areas of Nigeria easier, more sustainable, and more impactful. The goal is to evaluate the socio-economic impacts and create an understanding of what could be expected of motorcycle-taxi with the aid of smart technology. It also aims to create an understanding of what could be done with the support of smart technology by sampling the opinions of the players and understand their preferences. This thesis will positively increase the understanding of the influences of smart technology in motorcycle-taxi in public transportation and discover what could be done, to improve the service delivery.

Practical problem: The emergence of informal commercial motorcycle operations, known as Okada in Nigeria, came as a big relief to the prevailing transportation and unemployment problems with other advantages such as curbing loss of economic man hour, lateness to work, and other challenges associated with traffic jam; nevertheless, the problems associated with its operations among other issues are enormous. Therefore, to guide against the recurrence of negativities of informal motorcycle-taxi sector, the evaluation of socio-economic impacts of smart-technology based transportation and logistics service provisions is necessary. This will go a long way at solving myriads of challenges associated with the informal transportation arrangements. This current study therefore aims at investigating the socio-economic performances of smart technology-based transport arrangements found in some Nigerian cities in order to fine-tune a way forward.

Object: solutions for the use of smart technologies in Nigeria's transportation system.

Aim. The aim of this work was to evaluate the socio-economic impacts of motorcycle-taxi services of (GOKADA, SAFEBODA and KONGA), operating in South-western Nigeria cities of Ibadan and Lagos.

Objectives. Specific objectives therefore include the following:

i. To perform a trend analysis of smart technology solutions and identify key issues;
ii. To analyze smart technology solutions from a theoretical point of view;
iii. To evaluate solutions for the use of smart technologies in logistics companies; and
iv. To suggest strategies for improving smart technologies in logistics service in Nigeria.

Research questions. The following questions will give a better insight into the problems this research project attempt to resolve:

1. What are the demographic characteristics and responses of smart-technology motorcycle-taxi stakeholders (end-users and bike drivers) and their socio-economic implications?
2. What are the socio-economic impacts of smart technology on motorcycle-taxi transport and logistics services on end-customers?
3. What are the socio-economic impacts of smart technology motorcycle-taxi services on motorcycle drivers?

Research Methods. This research task was approached in multiple stages as highlighted below:

1. **Desk research** -- This phase included documents review and conversations with some stakeholders in smart-technology based transport companies and those in informal transport and logistics services such as stakeholder and business owners in the transport sector, to figure out the approach to use and the categories of target**.**
2. **Quantitative research with motorcycle drivers/drivers and end-customers** -- The mainstream of this study focused on quantitative research with participating drivers and end-customers of each company. This was done through research collaborator/moderator, survey using open and close ended questionnaires administered to motorcycle taxi drivers, passengers and order individuals.

PEST and SWOT analysis – The responses gathered during the survey were analyzed and inferences drawn using PEST and SWOT analyses.

The Problems and Importance of Solutions for the Use of Smart Technologies in Nigeria Transportation System

Rapid economic growth and urbanization is leading to intolerable congestion in Lagos where residents already spend over four hours per day commuting (weetracker.com). This congestion threatens the country's economic progress, and is compounded by high rates of accidents, which are approaching a national health epidemic. Nigeria has one of the highest rates of road traffic accidents and fatalities in the world -- already the country's third-leading cause of overall death and the most common cause of disability (ncbi.nlm.nih.gov). These accidents also take a major toll on the economy. A 2010 study estimated that Nigeria loses over 80 billion Naira from road traffic accidents (Juillard *et al*. 2010). In this regard, calls for adoption of more coordinated transportation systems and adoption of smart technology are a timely intervention.

The urban transport problem in Nigerian cities manifests in the form of poorly constructed and maintained urban road network, road complementary facilities and ineffective transport management. Onokala (2001) discussed urbanization and urban transportation problems in Nigeria cities. Nigeria cities are dominated by paratransit or intermediate modes of transport. The most common types are small 14–18-seater buses, shared-fare taxis and motor cycles and tricycles which provide main, collector and feeder services between different parts of the city. Onokala (2000) discussed the implications of the adoption of small buses for "mass Transit" on the Transport Policy of Nigeria. After struggling with many ways of handling the urban transportation problem of Lagos State without making any progress, the Lagos State Government introduced the use of big buses for the Bus Rapid Transport (BRT) System in Lagos, Nigeria on 17th March, 2008 using Public Private Partnership (PPP). The government provided the major infrastructure while the private sector provided the buses. BRT was well received in Lagos, and LAMATA (2016) claims that thousands of Lagos resident queue up daily to make use of the buses to enjoy lower transport fares and to beat the gridlock in the city due to their use of dedicated lanes

The logistics network in Nigeria is seen as complex and difficult to grasp due to the challenges and peculiarities of the Nigerian environment. It has made many individuals and businesses opt to outsource the logistics arm of their operations while concentrating on their core strength. The crux for logistics is ensuring that products are delivered in the right quantities, to the correct location, in a cost-effective manner, at the right time. As easy as this may sound, statistics have shown that 67% of deliveries do not meet the above definition in Nigeria. This could be

attributed to the global evolution of the traditional logistics structure and management framework, which has had little or no impact in the Nigerian market (e.g. tracking and real-time reporting). It can also be argued that certain factors have hampered digitization in the supply chain. They include infrastructural issues, network challenges, poor regulation and ineffective digital solution in the Nigeria environment. Hence, the long-awaited disruption in the logistics and supply sector has not been able to revolutionalise the logistics industry in Nigeria.

According to a study carried out in 2019, the critical challenges for logistics operations in Nigeria include visibility, infrastructural decay, increasing customer demands dynamics, risk management, insecurity and cost optimisation. The competitiveness of logistics operations is determined by many different factors with attention to networks, knowledge management and environment. These components are either internal or external to the supply chain. They can be classified as belonging to the following realms of contributors to the functioning of the supply chain: Suppliers, Customers, Labour and Finance.

Nigeria businesses migrate goods and services across the entire nation; this is because each geopolitical zone specialises in a specific product due to their climate. Despite the importance of the logistics industry in the Nigerian economy, the focus on this sector is still insignificant. With the ever-growing demand, there is a limited number of large logistic companies that can meet this demand. In some cases, some industry does not have the right transportation infrastructure in place. A simple point in time will be the transportation of perishable goods from Maiduguri to Lagos, or Sokoto to Onitsha, on a regular truck as against a temperature-controlled truck.

Companies are faced by a great challenge of acting as efficiently as possible. Material flows and intra-logistics processes must be optimally coordinated with each other at all times. If there is a problem at one point, this impacts the entire value chain – and thus also competitiveness. Intelligent sensors and networked systems ensure efficient logistics processes. Data is collected and processed in real time. This then forms the basis for decisions in autonomous and controlled processes. The continuous traceability of goods and processes in combination with intelligent systems allows processes to be optimized independently.

Smart Transportation

Smart transportation is a term that is being used more and more frequently nowadays. Rosa M Arce writes that cities are in an revolution; like smartphones and smart TV we also want our cities and transport system to be smart. Smart cities and transportation are classified by 6 different topics; Government, Mobility, Environment, Economy, People and Living (Giffinger, 2007). They are reflecting on the fact that Smart transportation plays an bigger role in the urban growth than before, and that the utilization of an smart public transportation system can solve many issues. As well as H.K Liu are they on to the path that crowdsourcing can be the answer to innovation issues, as the development of the public transportation system to be sustainable through technology and engagement from the citizens. The focus in Smart mobility is to develop the infrastructure in cities through integrated ICT. This smart mobility could be a useful tool to make cities more sustainable and make the traffic run more smoothly through supporting logistics in congested cities (Cledou et al.2017)

Use of Smart Technology in Transportation and Logistics

While smart technology as an idea is an extension of an IT concept (Ketchum 2018), the term "ICT" is very frequently used together with the discussion of the smart city, green city, etc. (Thomopoulos et al.2015). Many empirical studies have been already conducted on the impact of ICT on social activity and travel patterns in different parts of the world, for example in the Netherlands (Technische Universiteit Eindhoven 2012), China (Yuan et al. 2012), and India (Lila and Anjaneyulu 2016). Additionally, some conceptual studies explored how ICT influences geographical accessibility (Van Wee et al. 2013 or Dijst 2004) and leisure activities (Mokhtarian et al. 2006). Moreover, research has been done on the conceptualization of interrelationship of ICT with transport behavior (Gössling 2017). This indicates that a high level of integration of ICT in an urban context is necessary to achieve sustainable development of the urbanized area. As the International Telecommunication Union put it "a smart sustainable city is a city that leverages ICT infrastructure in an adoptable, reliable, scalable, accessible, secure, safe, and resilient manner" (ITU 2014). The core element of this definition is the association between ICT and the sustainable mobility paradigm. ICTs can be perceived as a tool which makes public transport or non-motorized transport options more usable and more user-friendly (it concerns especially bike-sharing systems). In order to increase their use, the service should be designed in a way that accommodates the levels of service required by customers (Beirão and Cabral 2007). New technologies can offer answers to customer needs and allow users to use transport options more efficiently. For car user to consider public transport, a certain basic accessibility and reliability needs to be provided. ICTs can be helpful, for example, by providing access to direct on-line information reducing the risk of unforeseen delays and by providing new opportunities to procure means of transport, particularly in rural areas. Car users expect additional value from public transport. The habit-interrupting transport policy measures can succeed in encouraging car users to try public transport (PT) services initially while latter attributes connected to the individual perceptions, motivations, and contexts must be maintained (Redman et al. 2013). An important research question is can ICTs provide these attributes? A more environment-friendly urban transport means that at least part of the transport flows needs to be transferred into non-mechanized means of movement (e.g., biking and walking). Modern ICTs unlock these modes as well. Finally, most of the car traffic is made by single users. The average occupancy rate of a car is less than two (European Environment Agency 2015) and ICT solutions used in car-pooling systems may help to increase this rate. Since single occupancy car use is recognized as a major policy problem, the search for tools which might help to induce more car drivers to public transport is one of the more important issues in transport decision making as indicated by international institutions (Van Dender and Clever 2013; Transport & Environment 2018). Hence, the possibility to influence the modal structure of transport given by ICTs should not be overlooked.

The change in the modal structure of transport is universally recognized as a key objective of transport policy. On the international level it is visible for instance in the EU's commitment to reduce use of road transport as presented in the European Commission White Paper on transport (EC 2011). This problem of overuse of passenger cars is however mostly not in long distances but in short legged urban travels. Existing urban transport systems for decades seem to be persistently resistant to modal shift with dominating road transport prevailing (Khisty and Ayvalik 2003). The share of road-transport in transport activities has not been reduced during the past decade regardless

of the policies applied, for example pricing and taxation adjustments or infrastructure investments in railways (ECMT/OECD 2003). However, new ICT technologies could be perceived as disruptive technologies threatening major change (Kane and Whitehead 2017) and as such can enable what has not been achievable before.

While existing transport contribution is 25% of the total emissions, it is obvious that to achieve a stabilization of greenhouse gas emissions from transport, behavioral change brought about by policy is required (Chapman 2007). The expected profit of ICT use in urban areas is mainly visible through change in transport use patterns with resulting diminished emissions and congestion (Tafidis et al. 2017). While congestion costs could be sometimes considered beneficial in inducing change in behavior there are also considerable business costs caused by congestion (Weisbrod et al. 2003) which might be eliminated if ICTs effectively reduce car traffic. The success in re-orienting urban transport can only be achieved through persistent long term commitment to promoting environment friendly transport modes. So far this has been achievable only over long periods of time and only when external forces outside the remit of the city authorities exercised their power to enforce change. (Bratzel 1999). We argue the necessary time can be substantially reduced with ICT implementation. Moreover, it could be argued, ICTs might offer usability making them the preferred choice for users.

Some of the sustainable transport concepts were initially introduced over a 100 years ago (i.e. metro, transit oriented development plans date back to London or New York in the late 1800s) but surprisingly many ideas are relatively new developments. Hidalgo and Zeng (2013) composed a list of sustainability developments in cities around the world. Accordingly, low emissions zones were introduced in Tokyo in 2003, congestion pricing in Singapore in 1975, followed by vehicle quota systems in 1990. Bus rapid transit originated in Curitiba in 1974 and two-way car-sharing in 1987 in Lucerne and Zurich. Bike sharing is a very young idea introduced in Amsterdam in 1965 (and supplemented by ICT only in 1998 in Rennes). Smart ticketing originated in several cities (mainly Swiss) in the early 1990s. Those sustainable solutions could be brought to new levels of efficiency if overlaid with transport smart technologies.

Methodological approach for the empirical work

Methodology ahs to do with the specific procedure or means adopted in a research endeavour in order to identify, gather, process and refine data for a given task. On this note, the aim of this work is to evaluate the socio-economic impacts of motorcycle-taxi services of (**GOKADA, SAFEBODA and KONGA**), operating in South-western Nigeria cities of Ibadan and Lagos.

- **Research Design**

The study employed descriptive survey as the research design. The study is descriptive cognizant of the fact that it aims to assess independent variables of overall performances of the motorbike taxi system in the study areas of Lagos and Ibadan, of Southwest zone of Nigeria. In other words, this thesis adopted both quantitative, dynamic approach to achieve the research goal. This was conducted through a comprehensive study of the socio-economic impacts of three selected smart-technology motorcycle-taxi operators (Gokada, Safeboda, and Konga) on the end-customers and the operators. Face-to-face interview was conducted using structured and unstructured interview questions.

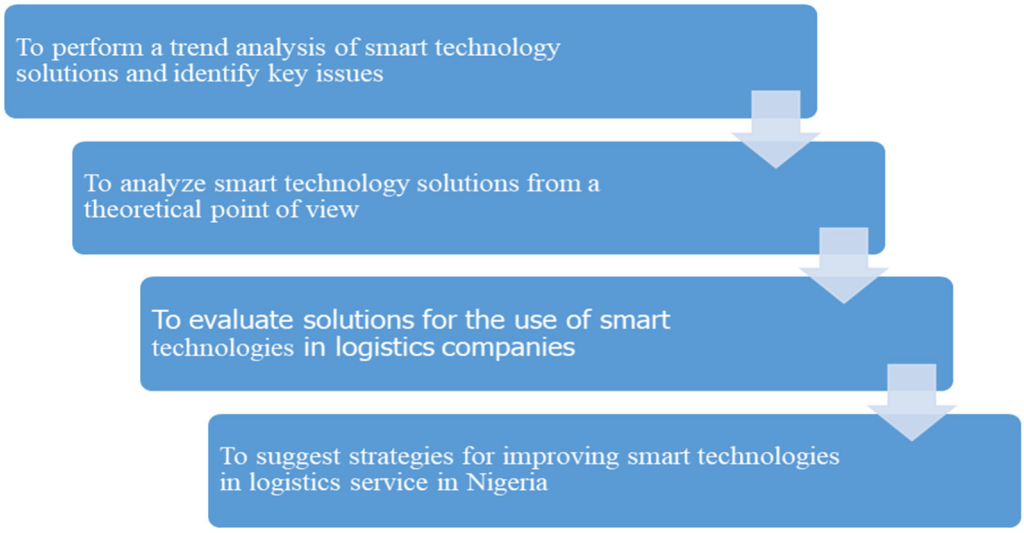

Figure 1. Logical sequence for empirical research for solutions for the use of smart technologies in transportation. *Source: Author 2021*

- **The Study Area/Population and Sample**

This study was done within the predominantly Yoruba states of Nigeria's Southwest Geo-political zone, comprising Lagos, Oyo and states. That is, the population of the work is composed of people in Lagos and Oyo states who patronize the service of smart transportation. The choice of the two states (Lagos and Oyo) resulted from their population and performance of smart-technology based transportation system. Lagos and Ibadan are two major commercial cities in the Southwest zone of Nigeria; therefore the choice of the two states as study area was appropriate based on the findings from the literature review. The zone, Yoruba or Southwestern Nigeria, is one of the six geopolitical zones of Nigeria. It has about 25 million people, a landmass of about 76852 km², and has control of about 60% of Nigeria's industrial capacity. Also, it is a national and intercontinental economic hub and home to two of the three largest cities in Nigeria; Ibadan and Lagos (AOAV and NWGAV, 2013).

- **Sample and Sampling Technique**

In all, at a total of 230 respondents, being users and operators of smart-technology based transportation and logistics system in the two states of Lagos and Oyo were sampled to answer the questionnaire for the empirical section of this research. Purposive random sampling technique was however adopted to sample respondents for this research on the strength that it allows the researcher to, through a research assistant to highlight people with definitive use of smart transportation.

- **Data Collection Technique**

The quantitative research method was accomplished by way of survey and questionnaire was adopted comprising both opened and closed ended questions as the research instrument (appendix 1). Two research assistants, one in Lagos another the other in Oyo, who have a clear picture of the areas worked on and well briefed about the goal of the research, were engaged to help in selecting

participants and to administer the questionnaire. For the interview, the respondents having been identified were connected with the researcher; interview was then conducted online, as scheduled.

In sharing the questionnaire, Ibadan 90 respondents (40%), Lagos 138 respondents (60%). The sharing proportions of questionnaires among the respondents in the study areas were informed by the preliminary information and recommendations of stakeholders. The questionnaire consists of both opened and closed ended questions. This is done to ensure that a full-orbed was elicited following the approach of Thomas (2001), Keith (2002), and Priscilla (2005). The first part of the questionnaire dealt with the pattern of preferences, by the stakeholders, in the smart transportation arrangement; the second part was comparison and opinions on existing and smart-technology based transportation arrangements; while the third was on the respondents' profile. After the pilot survey and ratification of questionnaire contents, they were administered and the completed questionnaires collected by hand. Observation of activities on the field was also conducted. At the long run, a total of 211 completed questionnaires were received, and sorted.

Two hundred of the completed questionnaires were found good for the study and were used for the analysis. The remaining 11 discarded on the ground that they are either uncompleted or mutilated questionnaires. The total completed questionnaires fell among the respondents in the quota proportions of 40%, 30%, 16%, 10% and 4% for regular passengers, regular order recipients, occasional passengers, occasional order recipients, and bike drivers, respectively. Due to the large population size, a sample size of 200, at 95% confidence level, ±5 confidence interval and 50% per cent level were used under *CRS* (2016). The non-probabilistic sampling techniques used during the data collection survey were judgment technique, convenience technique, and quota technique, respectively (Mugara, 2013). After data collection, they were edited and coded using SPSS statistical package (Daniel, 2014). They were then analyzed and presented using descriptive statistics.

- **Validity of the Instrument**

An instrument must be valid to yield accurate information and inform decision making. Validity concerns whether an instrument is measuring what is intended. Schmidt, (2001) stated that before an instrument can be recommended for application, its measurement properties of validity should be assessed, hence the validation of the questionnaire for this study was done in order to collect evidence to support its meaningfulness and usefulness. In achieving this, first after drafting the questionnaire, the researchers presented to it a scholar in the field of transport and logistics after it was vetted and corrected, the researcher tendered same to the supervisor; adjustments were then made where necessary.

- **Field Testing of the Instruments**

The field testing of the instrument was carried out to ensure appropriateness of its contents and understanding of the questions by the participants beforehand. The questionnaires were pilot-tested on twenty prospective respondents in Apete, Ibadan, Oyo State. Careful attention was however paid to it that those selected were not part of the main or final study. The questionnaires were administered on stakeholders without any time allocated to its completion. They were chosen for their daily activities in the smart-technology based transportation system. Also, their perceptions, information and daily experiences on the field are crucial in the present study.

- **Procedure for Data Analysis**

To analyse the closed ended questionnaire, for the quantitative empirical part of this study, data were analysed descriptively using simple percentage ably represented in tables. Consequently, analysis of qualitative data was done thematically attended with both data being attended with discussion and detail explanations. The thematic analysis for the opened questionnaire was done by identifying, analyzing and presenting the collected data. Deductive way of reasoning through reading, rereading, intuiting, analyzing and synthesizing of respondents' views were done.

For the closed ended questionnaire data, the summary of the whole data collection exercise followed the use of descriptive statistics of frequency counts and percentages for the demographic data. At the long run, a comparative study of the responses was conducted since it was found that perceptions of the respondents were based on geographical areas, experience and educational level. The responses were analysed using PEST and SWOT approach.

- **Ethical consideration**

Concerns for ethics in research include ensuring the willingness of research participants to participate as well as issues bordering on laws, rights and privacy of the respondent. It also borders on can have a trust in the researcher that he will not use the data more than as it was plotted to them. To this end, the researcher ensured that all participants were those that willingly participated and it was also plotted to them that data will only be used purely for academic purpose. Similarly, information from secondary sources were outlined and acknowledged by way of referencing.

- **Limitation of research**

No gainsaying the fact that there are always factors that inhibit the generalization of every research endeavours. Against this background the following are likely factors that may inhibit the generalisation of this work:

1. The fact that there is a go-between as epitomized by the research assistants could have created some lacuna in the process of administering the questionnaire;
2. It should be noted that the focal point of the work are just two states in Nigeria; Lagos and Oyo. Thus, if the research has been situated in other states of Nigeria, tendencies abound that different result might have emerged.
3. One other challenge was that it proved really difficult to get the needed respondents on time as many proved they were not interested in answering any questionnaire.
4. Moreover, the work was also demanding financially, as researcher had to engage research assistant to help gather data which involves transportation among other necessities.

All these put together is capable of limiting the level of generalization of the findings of this work.

Results and Discussion

Quantitative Analysis

- **Research Question 1**

What are the demographic characteristics of smart-technology stakeholders (end-users and bike drivers) and their economic implications?

- **Respondents' Demographic Characteristics of and their Effects**

This section explains the effects of smart technology motorbike services on the socio-economic well- being of all the stakeholders and the study areas in particular. It gives an idea of what could be expected as the influence of the smart services in the areas under consideration. Table 3.1 shows the respondents' demographic characteristics in the survey conducted on the evaluation of the performance of smart-technology based transport systems used in two Nigerian South-western states of Oyo and Lagos. From the Table, 51.0% of the entire sample population was male, and 49.0% were female. The dominant age categories of the respondents were 18-24 years and 25-34 years. However, 33% of the population was between 18 and 24 years, 30% between 25 and 34 years, 23% between 35 and 44 years, and 14% between 45 and 54 years of age. This finding implies that active users of smart-technology based transport model in the region were predominantly youth between the ages of 18-24, and 35-44 years.

Table 1: Demographic Characteristics of Respondents

Profile	Description	Regular Passenger	Irregular Passenger	Regular Order Recipient	Irregular Order Recipient	Bike Driver	**TOTAL (%)**
Gender	Male	22	8	8	4	9	**51**
	Female	30	2	12	4	1	**49**
Age	18-24	23	3	4	2	1	**33**
	25-34	15	3	8	2	2	**30**
	35-44	8	2	6	2	5	**23**
	45-54	6	2	2	2	2	**14**
Education	None	-	-	-	-	-	**-**
	Primary Education	-	-	-	-	-	**-**
	Secondary Education	7	2	5	1	4	**19**
	NCE/Diploma	10	3	4	2	3	**22**
	OND/HND/B.Sc	20	3	6	3	2	**34**
	Postgraduate Degree	15	2	5	2	1	**25**
Marital	Married	11	4	6	2	7	**30**
	Single	36	6	12	2	2	**58**
	Divorced	5	-	1	3	1	**10**
	Widowed	-	-	1	1	-	**2**
Weekly Patronage	< 1 time	-	-	-	-	-	**-**
	1-5 times	2	8	4	7	-	**21**
	6-10 times	20	2	6	1	-	**29**
	>10 times	30	-	10	-	10	**50**
Period of Interaction/ Patronage	< 1 month	4	5	3	1	2	**15**
	2-5 months	3	2	4	2	1	**12**
	6-10 months	15	2	10	2	3	**32**
	>10 months	30	1	3	3	4	**41**

This is a pointer to the fact that the transport model should be supported by the relevant authorities (Government) in order to provide more sustainable services and jobs for the teaming youth.

Also, the educational qualification of respondents indicated that about 34% of the entire population had formal education above high school (B.Sc), 25% had postgraduate education, 19% had secondary education, and 22% had NCE/Diploma. Equally, 29% of the respondents were married, 58% were single, 10% divorced, while 2% widowed. However, 21% of the respondents had up to 5-times weekly patronage of smart-technology based services, 29% employed the services between 6 and 10 times in a week, while 50% employed the smart services more than ten times in a week. Similarly, 15% of the respondents had just started interacting with the smart technology services in the last one month, 12% started between the last 2 - 5 months, 32% between 6 -10 months, and 41% had more than 10-month experience with the smart-technology services.

The entire findings show that the smart technology based transport model is being patronized mostly by educated youth of both gender, and should be given the required attention.

However, diverse opinions on informal (ETA) and smart-technology (MSSP) by the respondents were recorded during the survey, as shown in (Table 3.2). About 89% of the respondents agreed that MSSP is far better than the existing transport arrangement in the two study areas in terms of customer services, 3% was in disagreement, and 8% was indifferent. Also, 84% was of the opinions that MSSP had more robust billing arrangements that are a bit elitist, while 16% of them responded otherwise. Consequently, 53% of the respondents agreed that MSSP were generally better than the ETA, while 47% disagreed about the claim. Similarly, 60% of the respondents were in agreement with the fact that ETA were cheaper than the MSSP, while 40% were in disagreement with the notion.

Similarly, 63% of the respondents agreed that ETA were more available in the market than the MSSP, while about 37% of them disagreed. Whereas 54% of the respondents supported the continuous existence of MSSP in the study areas, while 46% of the respondents desired otherwise. Considering the level of attractiveness of the transport systems and their respective facilities, about 59% of the respondents were of the opinion that MSSP were more generally attractive in their carriage and facilities than the ETA, while 41% were in disagreement about the claim.

Concerning the service delivery, about 71% of the respondents agreed that MSSP service delivery was very good and should not be compared with the ETA, 23% thought otherwise, and 6% of the respondents was indifferent. Also, 89% of the respondents agreed that MSSP had diverse innovative services, while 8% thought contrary and 3% was indifferent about it. Generally, MSSP was rated higher and better in terms safety, welfare, innovative service delivery and welfare. Generally, the socio-economic benefits of the smart technology are discussed broadly under the successive sub-headings:

- **Elimination of Poverty and Provision of Employment**

Except Konga which is mainly on order deliveries, both SafeBoda and GOKADA set out to intensely improve the affordability, accessibility, and safety of motorcycle taxi transportation in study areas. The three companies invest greatly in training drivers and monitoring their performance to achieve these goals. These on-demand transportation options reduces trip complexity (allowing for door-to-door travel), extends end-customer opportunities (education, health, employment, social, family) into new geographies, and opens up the potential to work

longer or later hours via reduced perception of night travel risks. All of these are contributing to the social and economic opportunities of the study areas.

Table 2. Opinions on Modern Smart-Technology Services and Existing Transport Arrangement

S/N	Questions	Agreed (%)	Disagreed (%)	Indifferent (%)
1	ETA are better than MSSP in customer services?	3	89	8
2	ETA and MSSP have the same charges/rate?	16	84	-
3	MSSP are better than the ETA?	53	47	-
4	ETA are cheaper than MSSP?	60	40	-
5	ETA are more available than MSSP?	37	63	-
6	MSSP should be banned from operating in cities?	46	54	-
7	MSSP are more attractive than ETA?	59	41	-
8	MSSP has dominated the transport system in Southwest cities?	35	65	-
9	ETA and MSSP have the same service delivery?	23	71	6
10	MSSP has more innovative services?	89	8	3

Shorter travel times are particularly important for business and livelihood related activities since people can increase their deliveries and reduce their travel time, with end-customer respondents. indicating that GOKADA and SafeBoda services lower their daily transport costs by an average of 35%-50%. These models are also starting to unlock new economic opportunities that build off of ride-hailing -- i.e. food and product delivery can create new small shop and restaurant opportunities that simply never existed before.

- **Establishment of good Health and General Well being**

Road safety is a major development obstacle in most emerging economies, stressing public health budgets, removing productive members from the workforce. Accidents can impact household economics in many ways: the direct cost of emergency treatment and hospital costs, time away from productive work, as well as the indirect costs of the stress caused by a family member's injury. Poor people are likely at greater risk for such accidents because they tend to walk and a high proportion of road traffic accidents involve pedestrians. Limited and inefficient transportation options constrain movement in and around urban areas, making it difficult and

expensive for people to connect with employment, education, and training opportunities, as well as essential public services.

Road traffic accidents are also a major health issue, with over 1.25 million people killed each year from crashes, and another 20-50 million injured. More than 90 percent of road fatalities happen in low- and middle-income countries -- even though these countries are home to less than 50% of the world's working vehicles. By 2030, road accidents are projected to kill more people than HIV/AIDs, tuberculosis, and malaria combined. (1) Road traffic accidents predominantly impact the working age population, and have already become the single largest cause of death among 15-29 year olds. (2) The high costs of medical care and lost wages from accidents alone can impede a family's progress out of poverty. All the identified disadvantages of informal arrangement have therefore been taken care of by the operations of smart-technology aided services.

- **Equal Gender Participation**

Inefficient, limited, and unsafe mobility can significantly impact gender equality and participation by limiting women's empowerment and economic opportunities, and exposing them to security risks. The International Labour Organization findings show that "limited access to safe transport is the greatest obstacle to women's participation in the labor market in developing countries." Urban travel for women in emerging markets often requires long and unsafe walks, high cost trips in unsafe vehicles, and long waits between poorly connected transportation services. Particularly in urban areas, women and girls are often the targets of sexual assault and abuse in transportation, leading many to limit their daily transportation or avoid trips altogether. Women also generally have less money to spend on transportation, and are less able to change their schedules to accommodate more efficient transport modes or trips so face higher costs to poor mobility options. Furthermore, since women have greater responsibility for household maintenance, family health care, and children's education, any transportation delays and inefficiencies also reduce the time they have for economic opportunities.

This research found that GOKADA and SafeBoda are making major progress in reducing constraints to women's and girls' movement and gives them freedom of action to travel at their own convenience. Female end-customers felt that these services have eliminated their exposure to the type of violence and harassment they would otherwise face with public or informal transportation options. Well-trained drivers tend to follow the speed limit, listen and oblige when asked to slow down, and are generally more trusted by women clients. By significantly reducing these safety concerns, women and girls now feel more confident in pursuing economic and education ambitions. Both companies (GOKADA and SafeBoda) also deliver more direct and faster transportation options, which in most cases leads to a reduction in transport costs which women overwhelmingly use to the benefit of the family. By facilitating over 150,000trips per day, GOKADA and SafeBoda are enabling up to 75,000 women to more safely, efficiently, and cost effectively reach their jobs, access essential services for themselves and their families, and contribute to their independence and ability to pursue new productive opportunities.

- **Creation of Decent Work and Economic Growth**

Sustainable economic development will require not only significant job creation, but also a focus on ensuring employment opportunities are of high quality, offer fair incomes, and are available equally to women, men, and youth. Traditionally, being a motorcycle taxi driver has

meant long hours weaving in and out of congested urban environments, daily exposure to the risk of an accident, frequent run-ins with police and other authorities, and multiple safety issues related to transacting in cash. The society typically looks down on motorcycle taxi drivers, viewing them as uneducated and dangerous, and there are no systems in place to protect them from exploitation and harassment on a day-to-day basis. Most motorcycle drivers in the informal economy lack driving licenses, and have extremely limited access to training and educational opportunities that could improve their productivity and road safety.

Drivers participating in smart-technology's networks face a reality that is different in almost every way. First, the ride-hailing model formalizes gig economy activity for drivers, creating formal records and data on performance, income, and savings. These drivers receive training in road safety upon joining the companies, and can often access additional up-skilling opportunities throughout their journey with the companies to diversify their roles and further their personal development.

Real-time matching of supply and demand through the digital platform leads to improved income predictability and higher take-home incomes for most drivers, as well as contributing to their sense of job security. By providing access to insurance and financial services these companies also support the social protection of drivers and their families. As large population of drivers tend to be under 30 years of age, the companies under consideration are creating a channel for reducing the proportion of youth not in employment.

- **Research Question 2**

What is the socio-economic impact of smart-technology taxi services on end-customers?

- **Socio-Economic Impacts on End-Customers**

Safe and efficient urban transportation is a critical component of economic and social development, enabling people to access education and jobs, markets, essential services, and family. Unfortunately, significant barriers are slowing the transition to sustainable transportation, and serve to widen the movement opportunity gap between the rich and poor. People face limited work opportunities given the limited reach of public transportation and high costs of private vehicle ownership. Security risks and concerns over driver safety also cause women and girls to limit the times they travel, and leading them to forego opportunities altogether. Poorly managed intersections and congested streets make regular business related trips time consuming and expensive, causing businesses to miss deadlines.

This section however, presents a summary of qualitative research findings with current and former Konga, GOKADA and SafeBoda customers, and is also informed by additional conversations with local transport stakeholders (i.e. motorcycle mechanics and traffic police officers). Respondents were selected in conjunction with each company based on a few key criteria: gender, service usage level, and whether they were active or dormant.

- **Safer Transportation Arrangement**

End-customers interviewed were generally motivated to patronize the three smart companies for road safety, cost, and convenience, in that order. Given the high incidence of road traffic injuries and deaths in both Lagos and Ibadan, and the high proportion of accidents involving motorcycles, it's not surprising that safety is a top concern. Respondents were particularly drawn to these

services based on an understanding that approved drivers were trained and insured, wore helmets and had them available for customer use, and were incentivized to drive more safely. Over half of the respondents in each study area noted that the platform drivers would slow down and drive more carefully when asked, and most indicated that drivers in their experience almost always follow the traffic rules. While customer accident data before and after signing up for these services was not available for this study, the perceived improvement in safety emerged as an overwhelming benefit across both end-customer groups.

The core motorcycle-taxi software gives end-customers visibility into driver ratings and performance, and allows them to track driver location during both the pickup and the trip processes. Customers also expressed confidence and a keen sense of security through the additional data (driver name and ID, prior performance, location, etc.) that are available through the platform and smartphone app, as well as the ability to avoid using cash altogether if preferred.

- **More efficient Transport System**

SafeBoda and GOKADA services deliver time savings through more direct and faster transportation, and in many cases, a reduction in transport costs. This starts with reduced time and complexity in finding a ride, ensuring the driver knows your destination, and avoiding having to negotiate a price. All of these steps are done by the smartphone app. As motorcycle taxis can more easily navigate congested areas and travel on smaller and often dirt roads, most passengers described GOKADA and SafeBoda as much faster as compared to alternatives. Respondents also pointed to an increased ability to predict travel times as helping them in overall schedule and time management – reaching school classes, appointments, and jobs on time, reliably.

Shorter travel times are particularly important for business and livelihood-related activities since people can increase their deliveries and reduce their travel time (i.e., a photographer delivering orders in Lagos, a catering and food delivery business in Ibadan) and lower their daily transport costs by an average of 35%-50%. As these companies diversify into product / food deliveries and other related services this will likely create new entrepreneurial opportunities for restaurants and small shops that otherwise wouldn't have delivery options. Respondents described being able to complete additional business activities, and thus increase revenue from the time saved, which they were able to pump back into the business as working capital. These mobility enterprises are also beginning to extend access to new opportunities for end-customers.

While examples were limited, some respondents indicated that safer, on-demand transport from Konga, GOKADA and SafeBoda is making it easier to think about and explore new education and income generating opportunities in parts of the city that would otherwise be too expensive or unsafe to reach. The three companies extend people's reach beyond urban centers, so customers living in city outskirts and nearby rural areas can connect with urban markets since motorcycles can go beyond concrete roads and along village paths that trucks and cars cannot navigate.

- **Safety and Comfort for Women**

In addition to improved safety while on the road, the services have reduced overall transportation security risks for women and girls. Women and girls are frequently exposed to violence and harassment in transportation, whether it's walking, taking public transport, or riding in a private car or motorcycle taxi. Half of the female GOKADA respondents in Lagos reported being not just verbally insulted, but frequently physically abused while using okadas in the informal

market. Not a single respondent in either study area has experience with abuse of any kind under the service providers, and have not heard of others experiencing these issues. Most of them also describe the trained drivers as courteous and approachable. As women typically travel on a much lower budget compared to men, the lower cost of ride hailing services may also boost women's ability to take additional and longer trips. Most female respondents noted that they are now taking more trips and over longer distances as compared to their previous options.

In Nigeria, it's common for informal motorcycle taxis to make adjustments to their bike seat, extending the length and increasing the angle in order to create space to carry more than one passenger at a time. These changes also lead to an uncomfortable travel experience for women as the bike seat angle forces them to sit against the driver's back. Several GOKADA customers expressed appreciation that the company's bike seats are not adjusted, and allow for a comfortable amount of space between the passenger and driver.

Qualitative Analysis

This section presents findings from the open-ended questionnaire which is qualitative in nature. The analyses were done topically on respondents' opinions presented textually.

- **Research Question 3**

What is the socio-economic impact of smart-technology taxi services on motorcycle drivers/drivers?

- **Creation of Gracious and Inclusive Employment**

For the large population of young men operating independent motorcycle-taxi services, it is a largely cash-based income generating activity fraught with physical safety and financial risks. Operating exclusively in the informal economy, these individuals have little to no income security and predictability, do not qualify for or cannot access insurance services, and are a broken part, illness, or injury away from having no way to financially support themselves. Moreover, the informal motorcycle market in both Ibadan and Lagos has a reputation for being unprofessional, dangerous, and often chaotic.

The combinations of technologies and services offered by the companies have served to formalize the drivers' role, transforming the public's view of the occupation and creating social networks to support the drivers. They (drivers) stand out from the crowd of informal drivers, and operate with a renewed confidence in their own capabilities to navigate the roads safely. The three companies have invested heavily in developing a highly visible brand, intensive driver training for safety, and ongoing monitoring of performance to build trust in the local market, and make drivers feel confident being part of a formal entity. This brand association gives drivers a sense of dignity where society would otherwise look down on them as being uneducated, cheats, and thieves.

Drivers in both study areas also enjoy working with a network of fellow drivers from whom they can learn (often via WhatsApp groups), with many drivers in both study areas indicating that "making lifelong friends" is a primary benefit from participating in the service. As most younger drivers have recently relocated from semi-urban and rural to urban areas to work as motorcycle taxi drivers, this internal network can make this transition easier, creating opportunities for

mentorship and guidance from fellow drivers, and in some cases leading to the establishment of a formal motorcycle taxi cooperative.

- **Availability of More Sustainable and better work**

Respondents in both study areas spoke highly of their increased ability to control the direction of their lives, with lower daily stress through flexible working hours, a wider geographic reach for client acquisition, and less time spent tracking down new clients. Prior to joining the, drivers were highly dependent on customers who could be acquired in-person at a particular location (stage) where they are based. Under the informal model drivers would typically spend over half of the day waiting at their stage for potential customers, a time cost and location dependency that is largely eliminated with the platforms, which connect them with trips around the city. In Lagos, drivers have also been able to expand the geographies they serve as the company-financed motorcycles meet the engine speculations required to travel on national highways, which are often out of reach for informal okadas.

Findings in both studies showed that participating drivers take home ~25% more than similar taxi drivers in the informal market as they repay bike loans, and 50% more once they own their own bikes. This increase in take-home income and asset ownership can be transformational, enabling drivers and their families to eat more and better quality food, and providing capital to build a home for the drivers and their family members back in a rural village and reliably pay school fees for children. Most drivers use the new income to either improve their home or invest in income diversification, establishing small retail shops or mobile money agent businesses for a family member to run.

The three companies' software platforms create formal records and data on driver performance, earnings, and a transactions history as since they participate in in-house savings and credit schemes. The companies are leveraging this data to offer financial products internally, such as short-term loans and savings. The package of benefits and financial services serves as a gateway to greater financial inclusion and financial health**.** To start, these companies often facilitate the opening of bank and mobile money accounts for drivers, and support their registration for national identification and driving license documents.

SafeBoda recently launched an internal "cashless" wallet that enables both drivers and customers to electronically store value, pay for rides, purchase mobile airtime, send funds to other customers or drivers, and acquire goods and services from partners; all within the SafeBoda smartphone application. All SafeBoda drivers participating in this study were recently enrolled to the cashless option, with most seeing it as a savings tool where they can accumulate funds electronically and keep it away from the temptation to spend.

Conclusions and Recommendations

The socio-economic impacts of smart technology-based transportation and logistics companies of GOKADA, SafeBoda, and KONGA express, operating in Ibadan and Lagos cities of southwestern Nigeria have been evaluated with a view to improving their service delivery. Therefore, the following conclusions are drawn from the study.

In view of the first objective of work, which is to perform a trend analysis of smart technology solutions and identify key issues, the findings of this work, both theoretical and empirical, have

shown that the application of smart technology solutions in transportation has the potential of turning around the fortunes of Nigeria's SMEs for good as well as being a great source of IGR and adding to GDP. On this note, if all that is needed are put in place. After much of critical review it was discovered that, though the smart tech transportation system is full of potential in consideration of its numerous advantages, yet its current state in Nigeria is marred by some inhibiting factors as inadequate infrastructure, absence of robust internet facility among others.

Similarly, the study was able to examine and highlight and analyze smart technology solutions from a theoretical point of view conception vis-à-vis those factors that affect it.

Moreover, pursuant of its task to undertake a survey in order to evaluate solutions for the use of smart technologies in logistics companies, findings from both qualitative and quantitative empirical research of this study suggest that there are inhibitions to smart technologies in logistics companies and this in turns is having negative impacts on the operations in Nigeria.

And in view of the need to suggest strategies for improving smart technologies in logistics service in Nigeria, likely suggestions for improvement, in the logistics parlance generally and smart tech transportation particularly, were highlighted and discussed; such as good legislation, credit facility, data-driven policies, etc.

On a finally, in keeping with the standard best practices, PEST and SWOT analyses were done, and it was revealed that smart tech transportation in has a lot of potentials yet still fraught with many challenges. Factors as political, social, legislation, technological and economic are seeing as affecting Nigeria's smart tech transportation system with regards to PEST analysis. On the other hand, the SWOT revealed certain factors with regards to strengths, prevailing weaknesses, available opportunities and threats to smart tech transportation in Nigeria.

In view of the forgoing, deliberate efforts need to be injected into this sector of the economy. Thus, stakeholders as private corporations, the government, etc have undeniable roles to play in order to stem the current challenges in the smart tech transportation service in Nigeria towards an effective operation.

In view of the foregoing, more research work should be conducted on the activities of the transport system in order to improve its efficiency. The service providers are implored to extend their services to other high impact services like health and accident-related ones.

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