



UNIVERSITY *of*  
RWANDA

**ASSESSMENT OF CUSTOMERS' SATISFACTION FOR PUBLIC TRANSPORT  
SERVICES IN RWANDA**

**A CASE STUDY OF KIGALI CITY**

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By

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**Declaration**

I declare that this Dissertation contains my own work except where specifically acknowledged and it has been passed the anti-plagiarism system and found to be compliant and this is the approved final version of the Thesis:

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## **Dedication**

This project report is dedicated to

The Almighty God,

My beloved mother,

Brothers and Sisters,

My relatives and friends,

My classmates and colleagues,

For moral and financial support, we shared during my educational life, I greatly thank you!

Be blessed all.

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## **ABSTRACT**

Satisfaction is one of the key factors which influences customer loyalty. We assume that the satisfied customer will be willing to use the same service provider again. Kigali public transports system has undergone different reforms with aim to improve the public transports services provision and align the public transport services to demand as the city is growing very fast.

The aim of this study is to assess the user's satisfaction for public transport in the city of Kigali.

The study used customer satisfaction survey and collected data from 400 public transport users in total taken from 4 zones proportional to public transport users in the City of Kigali. To achieve the goal, two types of analysis are used., the method of factor analysis and the method Varimax were utilized to categorize variables according to their mutual relations and the model was validated using the structural equation modeling method.

Results of this study find that the satisfaction for public transport users is highly affected by Logistic parameters than Service. It was found that on average the increase in service by a value equals to one unit of its standard deviation satisfaction are expected to increase by a value equals to 0.34 units of its standard deviation holding all other relevant variables constant. In the same way, if logistic parameters increase by a value equals one unit of its standard deviation, satisfaction is expected to increase by 0.57 units of its standard deviations on average holding all other relevant variables constant.

The study concludes that although the satisfaction of users of public transports is mainly affected by the "logistic parameters in structure equation modelling but individual opinions expressed through attributes show that satisfied rates are very low comparing to those of very dissatisfied combined with dissatisfied. In this regard, Bus frequency and Service punctuality have higher rate of dissatisfaction and hence are critical for the public transport in terms of service provided.

**Keywords:** Customer satisfaction; public transport; logistic parameters, service and opinions.

## LIST OF SYMBOLS AND ACRONYMS

<b>AMOS</b>	Analysis of a Moment Structures
<b>CFI</b>	Comparative Fit Index
<b>GoR</b>	Government of Rwanda
<b>NFI</b>	Normed Fit index
<b>ONATRACOM</b>	National office for transport and Communication
<b>PTAs</b>	Public Transport Agreements
<b>RFTC</b>	Rwandan Federation of Transport Cooperatives
<b>RMSEA</b>	Root mean square error of approximation
<b>RTDA</b>	Rwanda Transport Development Authority
<b>RURA</b>	Rwanda Utilities regulatory Authority
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>TRB</b>	Transportation Research Board
<b>WBG</b>	World Bank Group

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## **CHAPTER ONE: INTRODUCTION**

This chapter introduces the historical background of the problem by clearly describing the Rwanda public transport evolution, reforms and services provision in all steps of development of the country. It explains then the major development paradigm and clearly set the scene by describing the public transport provision modes and distribution of role and responsibility in terms of regulation and policy.

### **1.1 Study background**

Worldwide, increase in using private vehicles for traveling is causing rapid motorization in many countries around the world. As result, most people highly depend on private motorized travel (Hiscock, 2002). According to Gabriela, 2007 this is due to the people love to drive.

An increase in use of private vehicles has raised number of problems including traffic congestion which in turn causes longer travel times for many people. In addition to congestion, private transportation is also affecting the safety of vulnerable road users as well as human environments and high consumption of non-renewable resource (Tolley, 2003). Recommendation from researchers and decision makers was that public transport would be alternative mode of transport as it prevents many problems caused by the increase in private car driving in many cities (Aßmann, 2005). In finding solution for sustainable transport, public transport should be a big concern. But to public transport must provide high quality services to fulfil large number customer's needs and attract for long (Anable, 2005). It is of great value to highlights the realization that leads to satisfaction and dissatisfaction of customers in public transport area to tailor public transport which is attractive and marketable. This study focuses on Kigali City as the number of private vehicles keep increasing.

For the past twenty years, the transport sector has been reformed several time mainly to cope with growing demands of transports services and the high demographic increase in Kigali city. The transport system in Kigali is centered primarily on the road network where the public transport was mainly dominated by public bus owned by the government (Byamukama, 2012). Recently the city of Kigali has acquired the total cost of contracting method to secure privately services provided by buses from 4 companies to serve four corridor as well as its central business district.

The point was that bus services was supposed to absolutely enhanced service coverage and vehicles quality, nevertheless services schedules, fares, and customer care failed to meet the performance principles of the contracts (GoR, 2018). Global experiences indicate that the success of procurement comes upon the participation of multiple providers in the bidding process, and separate roles played by diverse public institutions in planning, execution, and control (WBG, 2017).

Given that population in Kigali City is growing fast and the rapid economic development, traffic congestion and long commuting has started to emerge and this are part of the main challenges to deal with effectively for future development of the city. It is imperative to start planning and putting in place an integrated transport mechanism that would not only facilitate smooth transportation of people and goods within the city, but also have an effective infrastructure support (Mwizerwa & et al., 2017). That is why, ongoing reforms introduced since 2013, have seen more than 60 public transport providers allocated specific routes under a contract. Four companies won five-year tenders and the first generation contract has paved the way for the rest of the other generations to follow in public transport in the capital Kigali. Kigali's public transport decided to go cashless and then AC Group a private company introduced Tap and GO cards in 2017. Their job responsibilities include reducing passenger lines and waiting times at bus stations and terminals, as well as adhering to Rwanda Utilities Regulatory Authority tariffs (RURA, 2014). Operators are being asked to switch to a 60-seater bus fleet with speed governors, as the speed limit is 60km/h and passengers tend to stick to agreed-upon departure timetables. However, the services provision under franchise agreement still need improvement in customer satisfaction by focusing on waiting time that should range from 5 to 10 maximum short and truck routes respectively (GoR, Kigali development master plan 2050, 2020).

The contracting forms of franchise introduced, which can take many forms, as many different types of relationships between transportation authorities and transport operators are possible, the way authorities divide regulatory powers over public transportation, the way public transportation funding is organized, the type of regulatory regime, and so on.

The most common technique of ensuring that public service objectives are met is through public service contracts. Contracts have been used to alter the relationship between authorities and operators, either by replacing these providers with new ones or by holding them accountable for service quality' (Massami & et al., 2016).

## **1.2 Statement of the problem**

Public transport plays a critical role in stimulating economic development of any nation. Majority of the population of any country rely on public transport usage.(Niyonsenga, 2012).

Kigali public transport authority has introduced the contract framework organized around the franchise, and this kind of arrangement was supposed to improve the quality of services delivery and improve the adherence to public transport usages (RURA, 2014). However, despite this kind of arrangements, different challenges emerged within the signed framework, and among the serious reported issues is related to long commuting to people, low level of connectivity and customer's satisfaction due to poor services provision and operator's capacity to increase the transit to reach the residential zones (Rwabuhungu, 2015). In addition to this, the signed contract did not provide details on attributes and the way of evaluating them in order to know how services are perceived which could help both decision makers and operators to improve service delivery however aspect of customer's need seems to be ignored.

Therefore, the study on the assessment of satisfaction of customers in public transport service in the city of Kigali is essential, which will help both operators and the City of Kigali to know where to put much effort to improve service quality in public transport which may result in attracting people from private transport to public transport .

## **1.3 Objectives of the Study**

### **1.3.1 General Objective**

The main objective of the study is to assess customer's satisfaction in public transport service in the city of kigali.

### **1.3.2 Specific objectives**

- To evaluate customers' perception for public Transport Services through their opinions

- To identify the most sensitive attributes for customer satisfaction of public transport in the City of Kigali.
- To determine the relationship between public transport attributes and perception of customers in Kigali city.

### **1.3.3 Research questions**

- How do users' perceive public transport attributes in the city of Kigali?
- What are the most sensitive attributes for customer satisfaction of public transport in the City of Kigali?
- What is the relationship between public transport attributes in Kigali city and overall user satisfaction?

### **1.3.4 Significance of the study**

This study is very important to understand the level of customer's satisfaction that are using public transport to inform future policy measures and reforms of public transport. The current public transport arrangement recently adopted by Kigali city which is based on modern development approach for improving the role of private sector in economic development by allowed a restricted number of operators to provide public transport. Evaluating the level of satisfaction for public transport provision is very crucial for current and future decision making.

### **1.4 Scope of the Study**

This study analyses the level of customer's satisfaction provided by public transport service providers in city of Kigali to the outer surroundings location of Kigali City. Due to financial and time constraints, the scope of this study is limited only to public transport buses in Kigali on the main terminals. It is limited on Kigali city and assess the level of satisfaction for only public transport users.

### **1.5 Structure of the Thesis**

Chapter one provides a general introduction and over view about public transport sector in Rwanda and its major's development paradigm. It further includes the problem statement, objective of the study, significance and the scope of the study. Chapter two presents the literature review related

to public transport service provision and customer satisfaction about especially customers using public buses. Special attention were given to assessment of customer's satisfaction using service quality attributes and the literature review close with problem statement addressed by this particular study. Chapter three describes the methodology for this study, data collection tools and data interpretation methods that was used to arrive to the conclusion. Chapter four presents findings and discusses the results while chapter five presents the conclusions and recommendations for this study.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter describes the existing literature on public transport service and customer's satisfaction. Special attention is given to Rwanda implementation framework context considering available information for public transport service provision and customer's satisfaction. It reviews studies done in this area by other researchers from which the gaps or areas for improvement is identified.

### **2.2 Definition of Key terms:**

#### **Customer Satisfaction**

A customer can be defined as someone who buys goods and service regularly from seller and may be internal or external. Customers who are not members of the company producing products but influenced by the product are called external customers while those customers who are also members of company producing products are called internal customers (Cilliers & Nagel, 1990).

According to thomassen (2003), Customer satisfaction is the result from customer's assessment for service provided after comparing perceptions of delivered service with their prior expectations. According to Clark and Jonson (2005), both customer's perceptions and expectations for delivered service influence more their level of satisfaction of customers (Clark & Jonson, 2005).

Similarly, Kotler & Keller (2008) defined customer satisfaction as the customer's view of their experiences in relation to their expectations. They went on to say that performance that falls short of customers' expectations results in unsatisfied customers, whereas performance that meets expectations results in satisfied customers. Expectations being exceeded lead to a "very satisfied or even pleasantly surprised customer. Apart from customer satisfaction, different authors also discussed about service quality attributes.

#### **Service Quality Attributes**

Services are complex activities or group of activities which make the quality of services to be definitely of complex nature. Compared to quality of goods where various attributes which are tangible like shape, size, color, package, etc., can be checked properly service quality is more



difficult to measure because of intangible nature of service. From this, it is not easy to make an assessment about service quality before their purchase. (Parasuraman, Zeithaml, & Berry, 1985). However, various tangible attributes such as personnel of service providers, their equipment, and physical facilities can be considered as measures of quality assessment of service in the case of services purchasing procedures (Becky , 2009)

## **Public Transport**

Public transport refers to ‘established navigation system for different areas of the city using the public means available (Vukan, 2013). According to Becky , (2009) public transport operate on fixed routes as well as fixed schedule and are available and used by all people by paying a certain amount of money.

In his study (Becky , 2009) identified important public transport services quality attributes that can influence customer’s satisfaction. These include availability of bus stop , characteristics of route, frequency, reliability, furniture at bus stop, bus overcrowding, cleanliness, cost of travel, information, promotion, character of drivers, drivers character), personal security, personnel complains and the way of handling them, environmental protection as well as maintenance of bus stop).In public transport, there exist numerous and occasionally puzzling, goal that can influence consideration on public transport service patterns and levels (Holger & Sakamoto, 2012). High-quality public transport can be described as a public transport system that is able to compete with private car use and is reliable for majority of users. The public transportation service offered as a real option to the majority of potential users with access to a car (Traffic, 2010).

A well-structured and affective public transport should therefore adhere to three main guiding principles as described by Traffic (2010). (Traffic, 2010). First, it should be cost effective compared to private transport. Second it should provide service by meeting customer needs and contribute to social inclusion and lastly, public transport should improve the quality of service for their users.

### **2.3.1 Customer's Satisfaction for Public Transport System**

In transportation studies, the attractiveness of public transport is primarily considered by concentrating on the technical aspects of the public transport services the view of the customer is often neglected (Friman & et al., 2001). In economics and marketing, however, the management of consumer services is a topic that is widely studied. Smaller numbers of authors fill the gap between measuring the technical quality of public transport service provision and measuring the perception of passengers on public transport quality are among the few to take both these perspectives into consideration (Mwizerwa & et al., 2017). A problem with customer-based public transport policy is that the perception of non-public transport users on public transport service may be biased (Del Castillo & Benitez , 2013). Compared to bicycles and cars for example, the perception from these users would be that public transport homogenous and not taking into account their needs.. Better perception and evaluation of the quality as well as heterogeneity of the public transport system can be given by people familiar with public transport (Holger & Sakamoto, 2012).

Public transport services are provided by semi-public and private contractors. These operate in conditions of ownership. With such situations, public transport operators are not connected by competitive market conditions in fulfilling the needs of passengers (Larsen, 1990). Operators are liable to the focus on the needs of the public transport Agreement in place of the passengers needs. Yet, it belongs to customers interest, authorities and operators that public transport systems focus on needs for passengers (Agarwal, 2008). PTAs can improve customers' orientation of operators by negotiating quality-based payment schemes (Hensher & Houghton, 2004). The problems for Public Transport Agreement is the way their guiding mechanisms should be adapted to lead Public Transport in line with various user preferences and at the same time guarantee the best value for money' (Mouwen, 2015).

### **2.3.2 Public Transport Quality Services and Satisfaction**

Over last decade, evaluating transport user satisfaction by assessing quality service and identifying priorities of users great effort has been made .(TRB, 2004). Differentiating service quality and satisfaction is very important due to the fact that judgement can be made without experiencing service,while experience is required to judge satisfaction.Realization of the role of customer satisfaction should be considered by transport agencies, since it is somehow cheaper to retain

existing travelers rather than attracting new ones (Agarwal, 2008). Increasing the quality of public transportation system requires budget and budget available for this is limited. From this, there is a need for identifying priorities by agencies and authorities in order to raise global satisfaction of customers.

Relating quality and satisfaction, taking decisions on quality and satisfaction are multifaceted. In transport perspective, factors reflecting proper functioning of the public transport system should be identified (Agarwal, 2008).. According to Tyrinopoulos and Antoniou (2008) satisfaction in a public transport is the overall level of accomplishment of a customer's expectation, measured as the percentage of the expectations actually fulfilled”.

### **2.3.3 Public Transport in Kigali City**

The public transport in Kigali city is oriented entirely directed in public transport services. Kigali public transport arrangement based on franchise agreement is operated by four companies arranged in form of cooperatives companies that use different types of public transport vehicles. (RTDA, 2019). Regarding the capacity of total seats available, the four operators provide about 70% of the supply. In terms of total available seat capacity, the three individual operators account for 70% of the supply where large buses, medium buses and minibuses are mainly used. In addition to this, 3% of the passenger capacity and 13 % are provided by motorcycle taxis and taxi cabs respectively. (RTDA, 2019). From this, it can be said that public transport in Rwanda is dominated by public operators.

Contracts for the provision of public transport has been perceived as the best option between private public transport operators and Public institutions to ascertain motivation for operators to deliver a desirable service.

While the contract arrangement for public transport in Kigali city is binding for operators they may put much effort to fulfil the agreement conditions but the issue of principal agent behavior create a level of customer satisfaction given that the working arrangement between agent (operator) and the principal (State) cover up the customer's satisfaction as the last in not represented. This study then is being undertaken to assess the level of customer's satisfaction using the surveys question

## 2.4 Empirical framework

For determining aggregate customer's satisfaction on public transport, different methods are available. There are two types of these methods namely methods that make statistical hypothesis and methods that do not use statistical hypothesis on the data and both methods use a series of observations, measurements or scores. (Del Castillo & Benitez , 2013). Some of the methods with no statistical hypothesis include methods that use aggregation functions, models with fuzzy logic and neural network models. The Eboli and Mazzula (2009) developed a method for getting global indices by compiling these methods that do not use statistical methods. The methods founded on statistical hypotheses are also variable. The majority of them use the Structural Equations Method to calculate the global satisfaction index, as described in publications by Friman and Gärling (2001) and Friman, et al. (2001) in Sweden. Furthermore, Agarwal (2008) employed linear regression to evaluate customer satisfaction with public transportation in India. Ji and Gao (2010), on the other hand, utilized a multilevel logistic regression model in China for the same objective. The quality of public transportation systems has been directly observed in user surveys by gathering user feedback on various parts of the system. As a result, satisfaction surveys have shown to be a valid and stable means of assessing the perceived quality of public transportation systems by users (Del Castillo & Benitez , 2013).

Lot of surveys focused on assessment of different items where public transport users liked or dislike about bus network in the city as shown by (Stradling et al., 2007) who used 68 items for bus transit in Edinburgh. Fellesson and Friman (2008) conducted a study comparing customer perceptions of public transportation in nine European cities. The study's findings revealed that timely adequacy, service punctuality, reliability of service, information, bus stop design, safety, and personnel abilities were all important factors in public transportation customers' happiness.

In the literature different modelling approaches have been used in assessing public transport provision and customer's satisfaction such as basic statistics, Ordered Data structural equations model which seems to be effective given that data collection is easy through the survey (Pawlasová , 2015). The rating of customer 's satisfaction using the ordinal scales like five Likert-scale rating ranging from "very satisfied" to "very dissatisfied", are most used in measuring the

satisfaction of customers using a list of 15 travel attributes for public transport as have been identified and most contributing attributes to customers satisfaction (Pawlasová , 2015).

## 2.5 Conceptual Framework

The following figure contains attributes for public transport service quality in Kigali city. These attributes were identified based on similar studies conducted in this area and considering public transport system in Kigali City. Based on the study conducted by Redman et al (2013) and that conducted Pawlasová , (2015), attributes for public transport are defined based on the public transport system. For example Pawlasová , (2015) in czech Republic conducted a study similar to this study but attributes like Wheelchair space for disabled people, facility at station, Vehicle cleanliness and Staff behavior were identified as important attribute but they found to be not relevant in public transport in Kigali City.

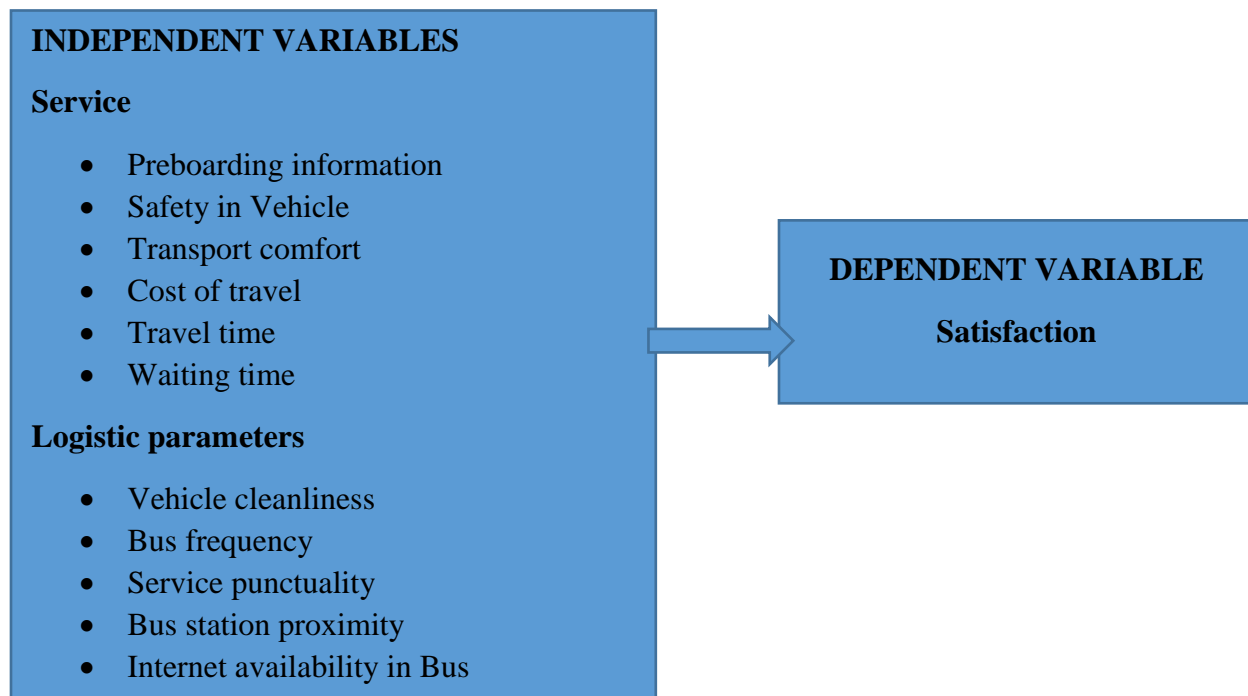


Figure 1: Conceptual framework

Source: Autor

Figure 1 presents variables used in this study and how they are related. The study used two independent variables which are Service and Logistic Parameters. The dependent variable is Overall satisfaction. Since all these variables can not be measured directly, each of them was measured using interrelated attributes as presented in the Figure. Variable Service was measured using six attributes which are Pre-boarding Information, Safety in vehicle, Transport Comfort, Cost of travel, Travel time and waiting time. On the other hand, Variable Logistic parameters was measured using 5 attributes which are Vehicle cleanliness, Bus frequency, Bus station proximity, service punctuality and internet availability. The variable Overall satisfaction was measured using a combination where two or three attributes having with logic flow were grouped together. In the same way Mokonyama, (2013) showed that public transport attributes are defined in terms of their relative impact on passenger satisfaction. Also the

## **2.6 Gap identified**

Different studies have been conducted in for assessing customer's satisfaction in public transport using different method like linear regression, multi level logistic regression, Structural Equation modelling and user surveys. The government of Rwanda, different measures were taken in order to improve service in public transport where contacts with private companies to ensure quality of public transport. Despite much effort of government of Rwanda in improving public transport service quality, there is no clear way of investigating satisfaction of customers on service provided.. This study investigates, public transport users' satisfaction , this study looks for identifying and assess the factors that affect public transport users satisfaction in the City of Kigali through user survey using Structural Equation Model (SEM) and Factor analysis.

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1 Introduction**

This study used a descriptive study design, in which information and data were gathered in the field and analyzed using descriptive tables, with the results relating to the relationship between public transportation attributes and customer satisfaction providing valuable insight that complements and expands the general truth gathered from the respondents.

This study's survey was designed as a cross sectional survey, with data and information collected once from the field (Kigali City) and from different respondents who use public transportation in Kigali

### **3.2 Target population and sample size**

A population, according to Sekaran, (2003) is the total group of people, events, or objects that the researcher wants to explore. All users that use Kigali's urban transportation on a daily basis make up our target population.

A target respondent is a person between the ages of 15 and 60, who lives in Kigali and, of course, in one of the four corridors, and has used public transportation before. The age range of 15 to 60 years old was chosen since people in this age group have a regular travel pattern and have most likely used public bus transportation as their mode of choice on a regular or frequent basis. Below age of 15 were considered the children even if they use public transport regularly to go to school and the question of their transport services may bring more subjectivity given their level of understanding of subject matter. People after age 60, are usually retired and their mobility may be reduced considerably. The total number of population was found from tap and go company where number of tap and go daily users were 104,622 (period considered, month and year). Table 1 containing the information about daily average tap and go for all lines in Kigali City presented below:

Table 1: Average daily TAP&GO in Kigali City

<b>Operator Name</b>	<b>TAP&amp;GO</b>	<b>Corresponding zone of activity</b>
KBS	22,000	Kabuga-Remera-Down Town Taxi Park
ROYAL	19,000	Nyanza-Nyabugogo- Down Town Taxi Park
RFTC	39,079	Kabuga-Nyabugogo- Down Town Taxi Park
CITY CENTER	24,543	Ruyenzi-Nyacyonga-Nyabugogo-Down Town Taxi Park
<b>TOTAL</b>	<b>104,622</b>	

**Source:** Provided by AC Group, January and 2020

### 3.3 Sample size

Zikmund (2013) defines sample size as the number of objects in the sample. All of the persons or cases chosen to participate in a study are referred to as a sample. The practice of selecting a limited number of respondents to represent the survey population is referred to as sampling. The population for this study was found based on daily average TAP&GO in Kigalicity for all public transport operators in Kigali City and the number was found to be 104,622. To find the sample needed for this study, Yamane (1967) formula with 0.05 significance level was used as follows:

$$n = \frac{N}{(1 + Ne^2)}$$

Where

$n$  is the sample size

$N$  is the population

$e$  is the margin error or sampling error (it could be 0.1, 0.05 or 0.01). In this study we used 0.05



$$n = \frac{N}{(1 + Ne^2)} = \frac{104622}{(1 + 104622 \times 0.05^2)}$$

$$= \frac{104622}{262.555} = 398.47 \approx 400$$

After calculating the total sample needed, the number of observations to be sampled in each zone was calculated proportional to the average number of daily TAP&Go for that operator. That is, multiplying the total sample size by average number of daily TAP&Go for that operator divided by the population size (104,622). The following table shows the sampled observations for each Operator.

Table 2: Distribution of sample by Operator

<b>Operator Name</b>	<b>TAP&amp;GO</b>	<b>Number of respondents</b>	<b>Corresponding zone of activity</b>
KBS	22,000	84	Kabuga-Remera-Down Town Taxi Park
ROYAL	19,000	73	Nyanza-Nyabugogo- Down Town Taxi Park
RFTC	39,079	149	Kabuga-Nyabugogo- Down Town Taxi Park
CITY CENTER	24,543	94	Ruyenzi-Nyacyonga-Nyabugogo-Down Town Taxi Park
<b>TOTAL</b>	<b>104,622</b>	<b>400</b>	

### 3.4 Data Collection Process

A four hundred (400) questionnaires were issued to different travelers using public transport in Kigali city during three consecutive days. To make sure that our sample were representative the number of respondents needed from each zone were given questionnaires purposively where as small conversation was conducted with respondent to be sure that the selected people has age

ranging from 15 to 60 years old, living in Kigali City and is a public transport user. Questions for this study were answered only by those people meeting these criterions.

All (400) questionnaires were completed and returned which made the response rate 100%. This is adequate response rate since response rate that exceeds 75% is adequate according to Mugenda (2003)

### **3.5 Validity and Reliability**

The data collection tools was translated in Kinyarwanda and then test on a small number of respondents from population. This helped in checking whether questions asked are accurate and meet the study objectives. In addition to this, validity and reliability of data was checked as well.

### **3.6 Data Analysis Procedure**

Responses obtained from respondents were entered in the template of questionnaire created using statistical software called SPSS. After data entry the data was cleaned to make them ready for analysis. After cleaning data, some descriptive statistics on attributes were produced still using SPS. The same software was used in factor analysis which helped in making components for correlated attributes. By using other software called SPSS Amos, the components formed using SPSS were used to obtain Structural Equation Model and estimate its parameters as well as other model diagnostic checking needed to validate the model.

### **3.7 Factor Analysis**

Factor analysis is method used for the purpose of reducing data. Its basic idea is that a set of variables is represented by a small number of variables known as factors. ..An example of variable that can have factors is happiness. For example, the variable happiness can have many constructs and a single variable cannot measure it. Factor analysis is appropriate for interval data, even if it can be applied to ordinal data such as Likert scale data. The condition for variables used in factor analysis is that they should have a linear relationship to each other. A scatter plot can be used to check that linear relationship. Again, there should be at least a moderate correction between variable, if not we will have the number of factors variables almost equals the number of variables. In this case, the use of factor analysis will be meaningless (Manly, 2005).

The algebraic form of the factor analysis model is shown below:

Let  $X_i$  presents the observable trait  $i$  and  $m$  be a vector of traits written as follows:

$$X = \begin{pmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ X_p \end{pmatrix}$$

This vector has mean equals the population mean and is assumed to be random. Considered random with mean equals the population mean. Considering that vector  $X$  was obtained from the following vector made of population mean as shown below

$$\mu = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \cdot \\ \cdot \\ \mu_p \end{pmatrix} \text{ Vector of traits}$$

Consider  $m$  unobservable common factors  $f_1, f_2, \dots, f_m$ . The  $i^{\text{th}}$  common factor is  $f_i$ .

In general,  $m$  is smaller  $p$ .

Common factors can also be expressed in vector form as follows:

$$F = \begin{pmatrix} f_1 \\ f_2 \\ \cdot \\ \cdot \\ f_m \end{pmatrix} : \text{Vector of common factors}$$

The factor model is a sequence of several regressions that forecast each of the observable variables  $X_i$  based on the values of the unobservable  $f_i$  common components.

$$\begin{aligned}
X_1 &= \mu_1 + l_{11}f_1 + l_{12}f_2 + l_{13}f_3 + \dots + l_{1m}f_m + e_1 \\
X_2 &= \mu_2 + l_{21}f_1 + l_{22}f_2 + l_{23}f_3 + \dots + l_{2m}f_m + e_2 \\
&\vdots \\
X_p &= \mu_p + l_{p1}f_1 + l_{p2}f_2 + l_{p3}f_3 + \dots + l_{pm}f_m + e_p
\end{aligned}$$

Where

- $\mu_i$   $i=1,2,\dots,p$  are the intercepts of the multiple regression models?
- $l_{ij}$   $i=1,2,\dots,p$   $j=1,2,\dots,m$  are coefficients also called the partial slopes from all these multiple regressions. They are called factor loadings. The  $l_{ij}$  is considered as the effect of the  $i^{th}$  variable on the  $j^{th}$  factor.
- $e_j$  is the error term.

The factor model can be thought of as a series of multiple regressions, predicting each of the observable variables  $X_i$  from the values of the unobservable common factors  $f_i$

$$\begin{aligned}
X_1 &= \mu_1 + l_{11}f_1 + l_{12}f_2 + l_{13}f_3 + \dots + l_{1m}f_m + e_1 \\
X_2 &= \mu_2 + l_{21}f_1 + l_{22}f_2 + l_{23}f_3 + \dots + l_{2m}f_m + e_2 \\
&\vdots \\
X_p &= \mu_p + l_{p1}f_1 + l_{p2}f_2 + l_{p3}f_3 + \dots + l_{pm}f_m + e_p
\end{aligned}$$

Where

The variable means  $\mu_1$  through  $\mu_p$  can be regarded as the intercept terms for the multiple regression models.

The regression coefficients  $l_{ij}$  (the partial slopes) for all of these multiple regressions are called factor loadings.  $l_{ij}$  is the  $i^{th}$  variable on the  $j^{th}$  factor. The  $e_j$  term is the error term.

The model can be reduced in matrix form as follows:

$$X = \mu + LF + E$$

Where  $F$  the column is vector of factor loadings and  $E$  is the column vector of error terms

To be able to obtain plausible result with factors analysis it is important to have a representative samples with enough observation from respondents (Malhotra & Birks, 2006). The variable should be measured on an interval or ratio in factor analysis, and there is a guideline that the number of respondents in the sample should be 4 to 5 times the number of variables used. The rule is followed in this study because there are 15 variables and 400 observations.

### 3.8 Structural Equation Model

Structural equation modeling can be defined as a technique used in multivariate when analysing structural relationship (Anderson & Gerbing, 1988). It combined both factor analysis and multiple regression. The method estimates multiple and interrelated dependencies in a single analysis, and this makes it to be preferred by many researchers. (Anderson & Gerbing, 1988). The independent variable used by this method is also known as exogenous variable while dependent variable is called endogenous variable. Even though Structural Equation Modelling has similarities with regression modelling, Structural Equation modelling is more advanced as it can show latent factors due to respondent subjectivity. The model is a combination of two models namely structural and measurement models (Armitage 1998).

**Structural model:** Represents the theory that explains how constructions (factors) interact with one other (factors). Structural equation modeling (SEM) is a type of causal modeling that tests the suggested causal links (Bentler & Chou, 1987).

**A measurement model** depicts the relationships between observable and latent variables. Only measured latent variables are correlated with observed variables. The variance of the latent variable explained by the observed variable can be determined using the measurement model (Bentler & Chou, 1987). The latent variable model (sometimes called the structural model) is presented mathematically as:

$$\eta_i = \alpha_n + B\eta_i + \Gamma\xi_i + \zeta_i$$

Where

$\eta_i$ : Vector of latent endogenous variables for unit  $i$ ,

$\alpha_n$ : Vector of intercept terms of the equations,

$B$ : Matrix of coefficients that provide the expected effects between endogenous variables themselves,

$\xi$ : Vector of exogenous variables,

$\Gamma$ : Matrix of coefficients providing the expected effect of exogenous variable to endogenous variable.

$\zeta$ : Vector of disturbances terms. The subscript  $i$  indexes the  $i^{\text{th}}$  observation in the sample. The assumption is that the expected value of  $\xi_i$  is zero and that the covariance of  $\xi_i$  and  $\zeta_i$  is zero. Also,  $(I-B)$  exists.

The measurement model links the latent to the observed responses (indicators). It has two equations:

$$y_i = \alpha_y + \Lambda_y \eta_i + \varepsilon_i \text{ and } x_i = \alpha_x + \Lambda_x \xi_i + \delta_i$$

Where  $y_i$ ,  $x_i$  represent vectors of endogenous and ( $\eta_i$ ) and exogenous ( $\xi_i$ ) respectively.  $\alpha_y$ ,  $\alpha_x$  represent vectors of intercepts while  $\Lambda_x$  and  $\Lambda_y$  represent factor loadings matrices or regression coefficients which give the impact of the latent  $\eta_i$  and  $\xi_i$  on  $y_i$  and  $x_i$  respectively.  $\varepsilon_i$  and  $\delta_i$  represent unique factors of  $y_i$  and  $x_i$  respectively. It is assumed that  $\varepsilon_i$  and  $\delta_i$  have mean zero and that the covariance matrices  $\sum_{\varepsilon\varepsilon}$  and  $\sum_{\delta\delta}$  for  $\varepsilon_i$  and  $\delta_i$  respectively are not correlated and also not correlated with matrix of endogenous variables ( $\eta_i$ ) and matrix of exogenous variables  $\xi_i$

Regarding interpretation, Murti (2016), Grace and Bollen (2005) provide a detailed discussion on how coefficients can be interpreted.

### 3.8.1 Validity of the proposed model

To validate the model proposed by this study, different indices were used including Comparative Fit Index (CFI), Normed Fit Index (NFI) and Root Mean Square Error of Approximation (RMSEA). These indices can be calculated using using chi-square values as well as the degrees of freedom of proposed model and null model. In presence of causal paths, all exogenous variables in the null model are correlated while the endogenous variables are uncorrelated with each other (Kenny, 2020).

The formula for the Comparative Fit Index (CFI) can be written as:

$$CFI = \frac{\chi_{Null}^2 - df_{Null} - \chi_{Proposed}^2 - df_{Proposed}}{\chi_{Null}^2 - df_{Null}}$$

Where  $\chi_{Null}^2$  and  $\chi_{Proposed}^2$  are the chi-square values for null and proposed model respectively while  $df_{Null}$  and  $df_{Proposed}$  are the degrees of freedom for null and proposed model respectively. The CFI ranges from 0 to 1. values is 0 to 1. If the model fits well the data, the CFI values should be greater than 0.90. The sample size used does not cause much variation of this index (Kenny, 2020).

Other index which is normed fit index (NFI) can be given by the following formula:

$$NFI = \frac{\chi_{Null\ model}^2 - \chi_{Proposed\ model}^2}{\chi_{Null\ model}^2}$$

In addition, NFI values vary from 0 to 1. The optimal model, on the other hand, has a value that is closer to 1. If the NFI value of the model is less than 0.9, it can be improved (Hooper, Coughlan & Mullen, 2008). The RMSEA (Root Mean Square Error of Approximation), on the other hand, is

determined using the following formula.  $RMSEA = \sqrt{\frac{\chi_{Proposed\ model}^2 - df_{Proposed\ model}}{df_{Proposed\ model} (N - 1)}} dN$

where  $\chi^2$ ,  $df$  and  $N$  are the chi-square, degrees of freedom, and the sample size respectively (Hair Joseph F, 2010).

The RMSEA index assumes values of 0.08 up to 0.10 and lower. According to Urbánek (2000), as the value for this index get smaller, the proposed model fit well the real data. Based on study conducted by Carlback and Wong (2018), a smaller value of RMSEA indicates that the model fits well the data. According to this work, a value of RMSEA less than 0.08 is considered good fit, while the value between 0.08 and 0.1 indicates adequate fit, and values greater than 0.01 are an indication of poor fit.

### **3.9 Ethical Considerations**

A consent form signed by respondents was provided using an authorisation letter obtained from University of Rwanda, allowing them to freely engage in the research. Before the distribution of surveys, respondents were given explanations about the study's goal, and the authorization letter was presented to the audience. The respondents' official written consent was attached to the questionnaires collected as documentation, and the respondents' confidentiality is ensured by informing them that the study is solely for academic purposes. The information submitted by responders is held in strict confidence.

### **3.10 Study limitations**

This study identified characteristics as well as methodological issues of critical considerations in the development and analysis of the services quality in public transport. The issues are related to complexity of services quality concepts in public transport and the number of attributes that several research judged important. But those attributes are contextual and evaluation in one context may differ to other therefore the result of comparing consumer expectations with actual service performance perception would be taken contextually and generalized to typical population. The second issue relates to number of Service Quality Attributes which is large therefore this study focused at only 15 attributes that are judged to contribute most on the customer's satisfaction. They were ranked depending of the respondents answers during the survey.



## CHAPTER FOUR: RESULTS AND DISCUSSION

### 4.1 RESULTS

This section presents the results from the analysis of data for this study. It provides the frequency and percentage of respondents regarding perception for each public transport attribute. Data were corrected from five zones in down town taxi park. Four hundred customers were consulted to give their opinions according to the provided questionnaires. Table below summarize participants perception to each and every attribute as per questionnaire.

Table 3: Distribution of perception level by attributes

Attribute	Very dissatisfied	Dissatisfied	Average	Satisfied	Very satisfied
	Count (%)	Count (%)	Count (%)	Count (%)	Count
Travel time	34 (8.5)	161 (40.2)	128 (32.0)	77 (19.2)	0 (0)
Easy entering/exit	46 (11.5)	156 (39)	128 (32)	70 (17.5)	0 (0)
Transport comfort	32 (8)	163 (40.8)	134 (33.5)	71 (17.8)	0 (0)
Waiting time	36 (9)	158 (39.5)	142 (35.5)	64 (16)	0 (0)
Cost of travel	34 (8.5)	149 (37.2)	142 (35.5)	75 (18.8)	0 (0)
Safety in vehicle	31 (7.8)	154 (38.5)	146 (36.5)	69 (17.2)	0 (0)
Internet availability in bus	8 (2)	184 (46)	160 (40)	48 (12)	0 (0)
Bus frequency	84 (21)	164 (41)	116 (29)	36 (9)	0 (0)
Service punctuality	28 (7)	205 (51.2)	129 (32.2)	38 (9.5)	0 (0)
Service continuity	44 (11)	144 (36)	148 (37)	64 (16)	0 (0)
Bus station proximity	44 (11)	156 (39)	141 (35.2)	59 (14.8)	0 (0)

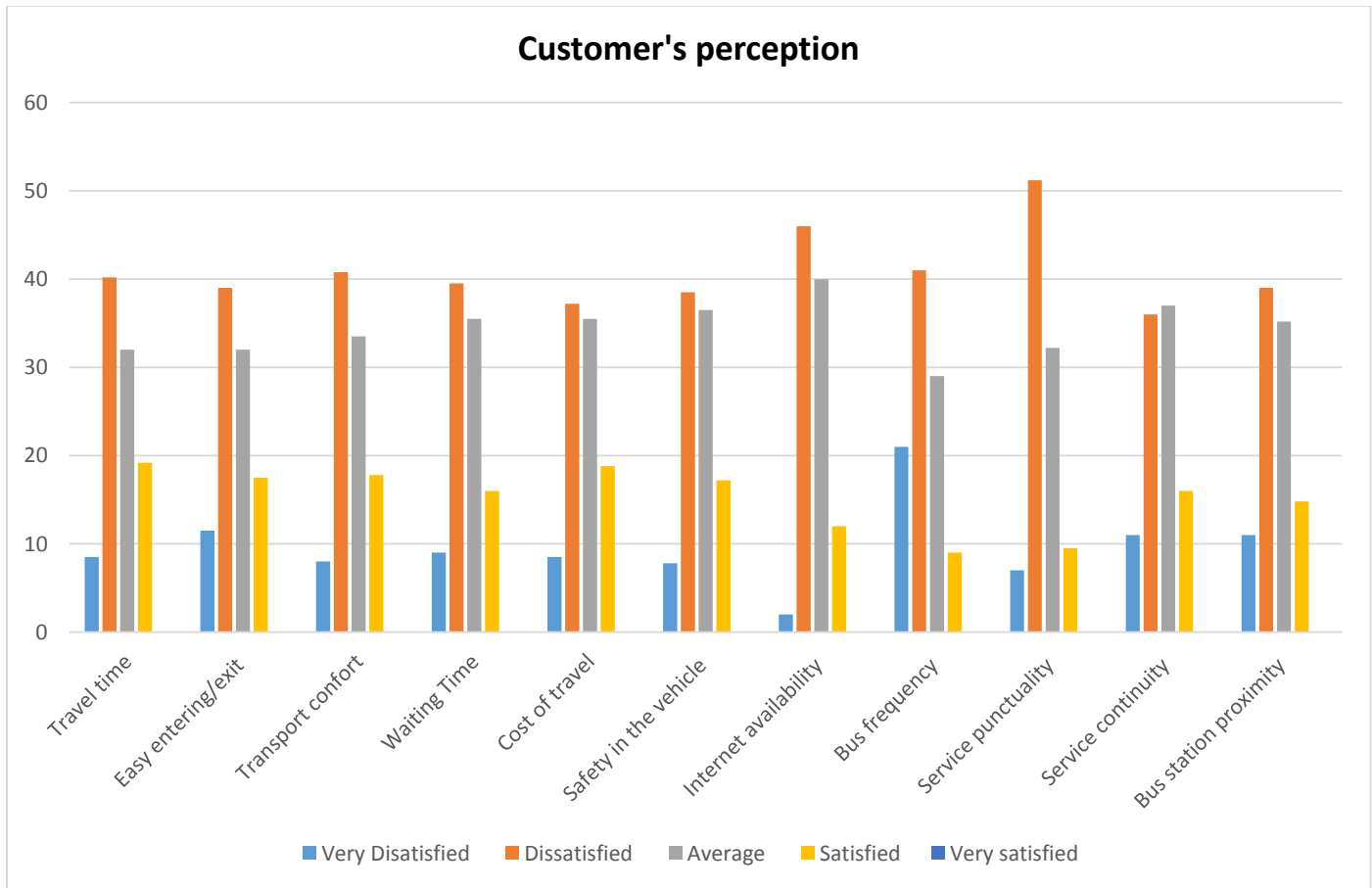
Overall satisfaction with: Cost of travel, Easy entering/exit, Safety in vehicle	31(7.8)	170 (42.5)	147 (36.8)	52 (13)	0 (0)
Overall satisfaction with: Waiting time, Travel time, Transport comfort	39 (9.8)	164(41)	140 (35)	57 (14.2)	0 (0)
Overall satisfaction with: Service continuity, Internet availability	33 (8.2)	163(40.8)	147 (36.8)	57 (14.2)	0 (0)
Overall satisfaction with: Bus station proximity, Bus frequency, Service punctuality	31 (7.8)	155(38.8)	149 (37.2)	65 (16.2)	0 (0)

#### 4.1.1 Customer's perceptions for public transport services in the City of Kigali

The perception of participants has been graded per attributes and has revealed customers perception on travel time is very dissatisfying to 34(8.5%), dissatisfied to 161(40.2%), Average satisfaction of 128(32%) and satisfaction of 77(19.2%), perception to easy entering/exit is very dissatisfying to 46 (11.5%), dissatisfied to 156(39%), Average satisfaction of 128(32%) and satisfaction of 70 (17.5%).Transport comfort is very dissatisfying to 32 (8%), dissatisfied to 163 (40.8%), Average satisfaction of 134(33.5%) and satisfaction of 71(17.8%).Waiting time is very dissatisfying to 36(9%), dissatisfied to 158 (39.5%), Average satisfaction of 142(35.5%) and satisfaction of 64(16%)Cost of travel is very dissatisfying to 34(8.5%), dissatisfied to, 149 (37.2%), Average satisfaction of 142(35.5%)and satisfaction of 75 (18.8)Safety in vehicle is very dissatisfying to 31 (7.8) , dissatisfied to 154 (38.5%) , Average satisfaction of 146 (36.5%) and satisfaction of 69 (17.2%) Internet availability in bus is very dissatisfying to 8 (2%), dissatisfied to 184 (46%) , Average satisfaction of 160 (40%) and satisfaction of 48 (12%)Bus frequency is very dissatisfying to 84 (21%) , dissatisfied to 164 (41%) , Average satisfaction of 116 (29%) and satisfaction of 36 (9%) Service punctuality is very dissatisfying to 28 (7%), dissatisfied to 205

(51.2%), Average satisfaction of 129 (32.2%) and satisfaction of 38 (9.5%). Service continuity punctuality is very dissatisfying to 44 (11%), dissatisfied to 144 (36%), Average satisfaction of 148 (37%) and satisfaction of 64 (16%) Bus station proximity is very dissatisfying to 44 (11%), dissatisfied to 156 (39%), Average satisfaction of 141 (35.2%) and satisfaction of 59 (14.8%).

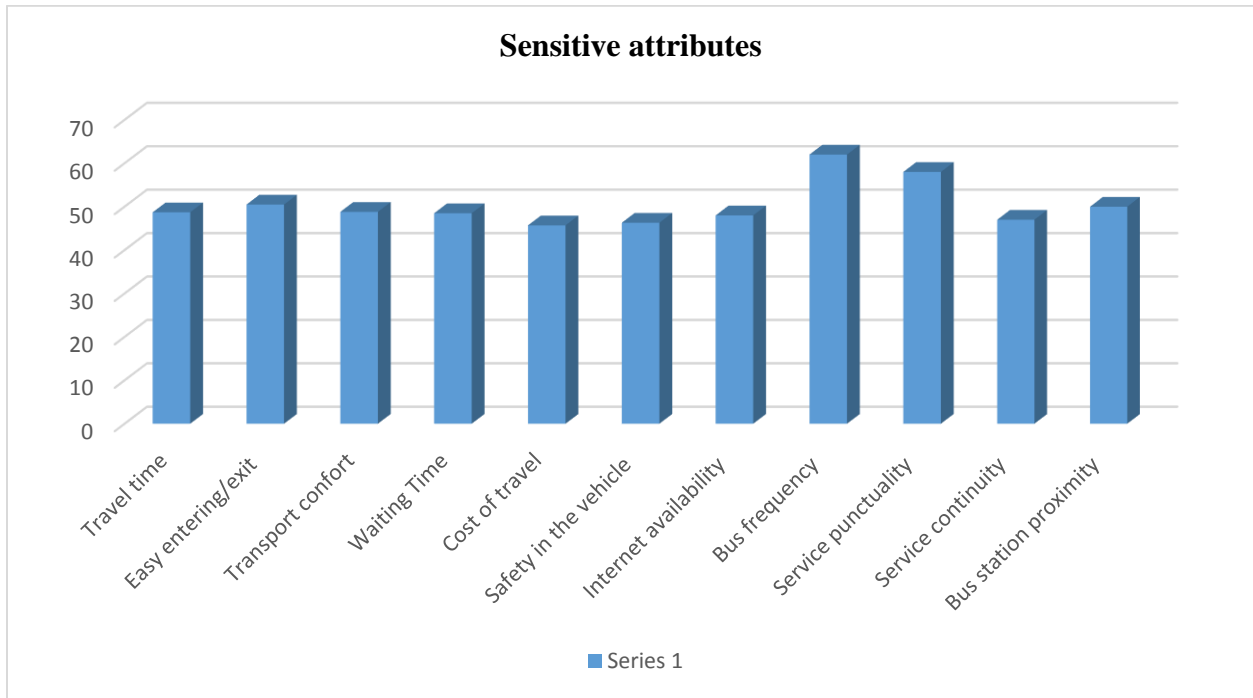
**Figure 2: customers perception on attribute's opinion.**



#### 4.1.2 Most sensitive attributes for customer satisfaction of public transport in the City of Kigali.

Among all defined attributes two of them ranked over 50% which are service punctuality 58.2% and bus frequency 62%.

**Figure 3: Attribute sensitive to the customers' perception**



**4.1.3 Results related to relationship between public transport attributes and customer's perception in the city of Kigali.**

**Factor analysis**

We must first determine whether factor analysis can be applied to our variables in order to categorize them according to their mutual relationships. The factor analysis was determined to be valid and successful in 89 percent of the cases, as evidenced by Kaiser-Meyer-Olkin and Bartlett's test below.

Table 4: Kaiser-Meyer-Olkin (KMO) and Bartlett's test

KMO test elements		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.89
Bartlett's Test of Sphericity	Approx. Chi-Square	6207.04
	df	105
	Sig.	0.00

The KMO value was 0.89 and Bartlett's test of sphericity significant with a p-value (Sig.) equals 0.00. The results indicate that the data set is adequately sampled and that factor analysis of the data is appropriate. On the other hand, the Bartlett's Test of Sphericity testing the null hypothesis that the correlation matrix is an identity matrix has a p-value (Sig.) equals 0.00 which is less than 0.05. This suggests the rejection of null hypothesis and accept the alternative hypothesis that the correlation matrix is not identity matrix which implies that factor analysis can be performed on the data. Actual communalities are shown in Tab 5, which are the mean ratios of the latent variable on the variance of the observable variable.

Table 5: Communalities

Attribute	Initial	Extraction
Travel time	1.00	0.82
Easy entering/exit	1.00	0.82
Transport comfort	1.00	0.86
Waiting time	1.00	0.85
Cost of travel	1.00	0.61
Safety in vehicle	1.00	0.83
Internet availability in bus	1.00	0.64
Bus frequency	1.00	0.68
Service punctuality	1.00	0.81
Service continuity	1.00	0.80
Bus station proximity	1.00	0.80
Overall satisfaction with: Cost of travel, Easy entering/exit, Safety in vehicle	1.00	0.89
Overall satisfaction with: Waiting time, Travel time, Transport comfort	1.00	0.88
Overall satisfaction with: Service continuity, Internet availability	1.00	0.87
Overall satisfaction with: Bus station proximity, Bus frequency, Service punctuality	1.00	0.89

Table 5 presents values for communalities which the proportion of variance of each attribute explained by the factors formed. According to Bryant (1995) the proportion of variance explained by factors for each attribute should be 0.5 or greater. That is the values in the column Extraction of Table 5 should be greater or equal to 0.5 for that attribute to be kept for further analysis. Based on this idea, all values in the table are greater than 0.5 which implies that no attribute can be removed from the analysis.

Table 6 presents the number of component (Factors) that should be formed from attributes. It also provides values for Eigen values for each component as well as the variance explained by each component. According to Bryant (1995) the number of components to be formed equals the number of components for which eigen value is greater or equal to 1. The percentage of total variance accounted by each components is obtained from Rotation Sums of Squared Loadings section in the column % of variance and are arranged in ascending order. The total variance explained by all components is the cumulative percentage of variance explained. Based on this information, Table 6 reveals that three components should be formed and account 80.6% percent of the total variance in the data which is a high percentage.

Table 6: Rotated Component Matrix

Attribute	Component		
	1	2	3
Transport comfort	0.91		
Waiting time	0.91		
Safety in vehicle	0.89		
Easy entering/exit	0.89		
Travel time	0.87		
Cost of travel	0.77		
Service continuity		0.88	
Bus station proximity		0.86	
Service punctuality		0.82	
Internet availability in bus		0.78	
Bus frequency		0.71	
Overall satisfaction with: Cost of travel, Easy entering/exit, Safety in vehicle			0.88
Overall satisfaction with: Waiting time, Travel time, Transport comfort			0.88
Overall satisfaction with: Bus station proximity, Bus frequency, Service punctuality			0.87
Overall satisfaction with: Service continuity, Internet availability			0.87

Table above shows the results for rotated components. The varimax rotation method has been used for the objective of distributing the factor loadings such that each attribute measures precisely one



factor. From the table, three factors are formed. As it can be seen in the table, Transport comfort, waiting time, Safety in vehicle, easy entering/exit, Travel time and cost of travel form one factor which is called Service as these attributes are related to service provided. In addition to this, Bus station proximity, Service punctuality, Internet availability in bus and bus frequency form other factor which is called Logistic parameters as these attributes are related to logistic parameters in public transport. Factor three is made of attributes formed from a combination of attributes for the purpose of getting overall satisfaction. These attributes form a factor called Satisfaction. Values presented in the table also called factor loadings which are all greater than 0.5, indicate that factors formed are correlated with attributes associated with it.

After performing factor analysis, there is other test called reliability analysis test that should be performed for each of the factors obtained using factor analysis to make sure that items in each component are correlated with the factor. To do this, Cronbach's Alpha was used and the factor with value greater than 0.7 is considered as reliable. The following are the results obtained.

Table 7: Reliability analysis

<b>Components</b>	<b>Reliability Statistics</b>	
<b>Service</b>	Cronbach's Alpha	N of Items
	0.95	6
<b>Logistic parameters</b>	Cronbach's Alpha	N of Items
	0.91.	5
<b>Overall customer satisfaction</b>	Cronbach's Alpha	N of Items
	0.96	4

Results from reliability analysis for obtained components revealed that all Cronbach's Alpha coefficient for all 3 components are greater than 0.7 and this indicate that the variables forming these components are consistent. This also proves that these components can be used to make Structural Equation Model (SEM).

### Structural Equation Model using formed Components

Three components obtained from factor analysis which are Service, Logistic and Satisfaction were used to make a Structural Equation Model. To do this, Service and Logistic were considered as independent variables also called exogenous variables and Satisfaction was considered as dependent variable also called endogenous variable. These exogenous and endogenous variables are also called latent variables. To make this model, SPSS Amos 26 software was used and Figure 2 below presents results obtained.

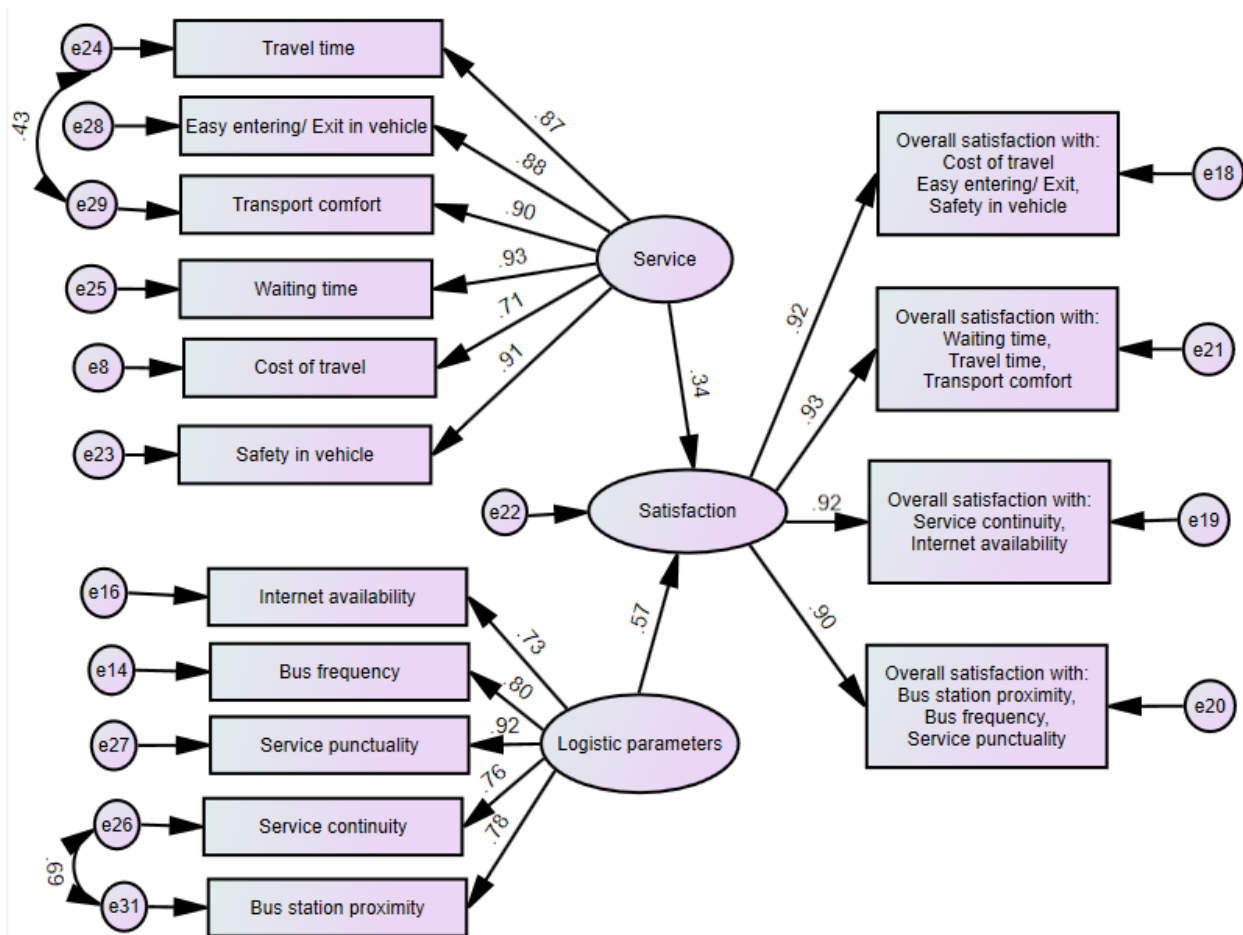


Figure 4: Structural Equation Model

From Figure 2, It is seen that there are arrows connecting latent variable (factor) and observed variable (attribute) to indicate relationship between observed variable and latent variable. The model presenting that relationship is referred to as measurement model. On the other hand, Figure 2 presents arrows connecting exogenous variables to endogenous variable which also present the relationship between latent variables. The model presenting this relationship is called structural model. Values presented on arrows pointing to observed variables are standardized regression coefficients indicating the covariance between observed variables (attributes) and latent variables in measurement model. Based on the output in Figure 2, the covariance between observed variables and latent variables are all greater than 0.7. According to Hair et al. (2016) standardized value greater than 0.7 indicate that there is a validated relationship between observed and latent variables in measurement model. Table 7 below presents the significance of standardized regression coefficients in measurement model at significance level equals 0.05 with the null hypothesis that the coefficient is not significant.

Table 8: Values of standardized regression coefficients in the measurement model.

<b>Latent variable</b>	<b>Observed variable</b>	<b>Standardized regression coefficients</b>	<b>p-value</b>
<b>Service</b>	Travel Time	0.86	0.00
	Easy entering /exit	0.88	0.00
	Transport comfort	0.90	0.00
	Waiting time	0.93	0.00
	Cost of travel	0.71	0.00
	Safety in Vehicle	0.91	0.00
<b>Logistic parameters</b>	Internet availability in Bus	0.73	0.00
	Bus frequency	0.8	0.00
	Service punctuality	0.92	0.00
	Service continuity	0.76	0.00
	Bus station proximity	0.77	0.00

Based on results presented in Table 7, all values in p-value column are 0.00 which is less than 0.05. This means that the null hypothesis that the coefficients are not significant is rejected, and all observed variables in the measurement model are statistically significant at the 0.05 significance level. The latent variable can be deemed to exist based on the table's results. The observed variables, particularly service punctuality and bus frequency, explain the logistic parameter. On the other hand, output also reveal the latent variable Service is best explained by its observed variables. However, cost of travel has lower effect on Service compared to others.

According to (Hair Joseph F, 2010), Standardized regression coefficients should take values equal or higher than 0.5 (optimally 0.7) if the relations between the variables are significant. From this, we can say that the measurement model is valid.

### **Validity of the structural model**

After confirmation of validity of measurement model, the validity of structural model also needs to be evaluated. In order to accomplish this, the structural model's significance of the link between latent endogenous (Satisfaction) and latent exogenous (Service and Logistic parameters) variables was investigated. The values of the standardized regression coefficients in the structural model are shown in Table 8 at a significance level of 0.05.

Table 9: Values of standardized regression coefficients in the structural model.

<b>Latent endogenous variable</b>	<b>Latent exogenous variable</b>	<b>Standardized regression coefficients</b>	<b>p-value</b>
<b>Satisfaction</b>	<b>Service</b>	0.34	0.00
	<b>Logistic parameters</b>	0.57	0.00

The structural model is valid since the association between the latent variables Service and Satisfaction, as well as the relationship between the latent variable Logistic parameters and Satisfaction, is statistically significant at the significance level of 0.05. Satisfaction is positively related to both logistic characteristics and service. However, the latent variable Logistic parameters is more essential in explaining Satisfaction than the variable Service since the actual value of its standardized regression coefficient is larger. This implies that satisfaction of customers in public transportation in Kigali City is positively related to both Service and Logistic parameters but Logistic parameters is highly correlated to Satisfaction compared to Service.

According to Murti (2016), Grace and Bollen (2005) coefficients on path coefficients are interpreted in terms of standard deviations. Using ideas from these authors, it can be said that on average the increase in service by a value equals to one unit of its standard deviation Satisfaction

is expected to increase by a value equals to 0.34 units of its standard deviation holding all other relevant variables constant. In the same way, if Logistic parameters increases by a value equals one unit of its standard deviation, satisfaction is expected to increase by 0.57 units of its standard deviations on average holding all other relevant variables constant.

### **Validation of the proposed model**

The suggested model was validated using the comparative fit index (CFI), normed fit index (NFI), and RMSEA. SPSS Amos 26 was used to calculate these coefficients. The CFI, NFI, and RMSEA indexes for the proposed model are given in the table below.

Table 10: Performance metrics indices for the estimated model.

<b>Model</b>	<b>CFI</b>	<b>NFI</b>	<b>RMSEA</b>
Default model	0.95	0.94	0.089

The estimated model's CFI is 0.95, which is higher than the previous model's CFI of 0.90. Furthermore, the NFI, which has a value of 0.94, is also higher than 0.90. The proposed model, according to the NFI, fits the real data 94% of the time. The RMSEA's real value of 0.09 is also acceptable. All of the utilized indexes confirmed that the proposed model is the best based on this information.

### **4.2 DISCUSSION**

The First objective was to evaluate user’s perception through their opinions for each of the identified attributes. To achieve this, we’ve summarized a descriptive analysis where the percentage of each attribute on opinions. Based on the result the study found that customer satisfaction ranges from very dissatisfied to satisfied. There is no attribute for which customers were very satisfied with it. Result from this descriptive analysis also showed that the rate of dissatisfied opinions lead comparing to others which is not a good approach for public transport in city of Kigali the needs of customer should be take into account by bringing a significant change. Both decisions marker and operators are challenged.

The second objective for this study is to identify attributes that are the most sensitive to customer and need to be improved by the decision maker and operators. To achieve this, we have combined

opinions of both very Dissatisfied and Dissatisfied against Dissatisfied one's of each attribute individually by ignoring average's opinion results shows that Bus Frequency lead with 62% followed by Service punctuality 58%, Easy Entering/exit 50% Transport comfort 48,8%, Travel time 48,70%, Waiting time 48.50%, service continuity 47% and Safety in the vehicle and cost of travel come to the last. In the rate of satisfaction's opinions are very low comparing with those of Very Dissatisfied combined with Dissatisfied according to customer perception. Which is critical for the public transport in terms of service provided. Budino (2009) presented descriptive statistics showing how customers are satisfied with public transport attributes in Indonesia and results revealed that a smaller number of respondents were very satisfied with public bus service out of 278 respondents who answered questions only 15.8% said that they are satisfied with the service. Furthermore, the study assessed the means associated with all service quality features and discovered that the mean was less than 3, indicating that customers were unsatisfied with service quality in public bus transportation. When compared to the findings of Budino (2009), it can be said that the findings of this study are consistent with those of Budino (2009), because few customers said they were satisfied with public transportation attributes, while a large number said they were dissatisfied, and no one claimed to be very satisfied. According to this, this study it can be said that the dissatisfaction for customers in public transport is not a particular issue in the city of Kigali but in other regions. Regarding most sensitive attributes, the study by D'Ovidio (2014) in Czech showed that taking a certain attribute as sensitive for public transport users in a given region depends on public transport system in that region. While, this study in the city of Kigali identified Bus frequency and Service punctuality as most sensitive attributes, the study by D'Ovidio (2014) identified station proximity, service continuity and frequency as most as most sensitive attributes for Czech public transport users. Apart from this study by D'Ovidio (2014), Pawlasová (2015) conducted other study on how customers are satisfied with public transport attributes in the same country. Results from his study identified transport speed, punctuality and comfort are the key determinants of satisfaction. Other study by Tubis (2015) in Poland identified Punctuality as one of the three most important and recognizable attributes of public transport in a city.

The third objective for this study was to determine the relationship between public transport attributes and perception of customers in Kigali city. For this purpose, structural equation model

with two exogenous variables namely service and Logistic parameters while endogenous variable was satisfaction. Results from this study revealed the component of Logistic parameters affect more customer satisfaction compared to that of service. Findings from this study are not surprising as similar results were found by Pawlasová (2015) in the study conducted in Czech while trying to study factors that influence satisfaction with public City transport using structural equation model. Similar to this study, he used two endogenous variables Logistic parameters and Service while endogenous variables was Satisfaction. Results from this study indicated that customer satisfaction for public transport in Czech are highly affected by logistic parameters. However, the level at which Logistic parameters affect satisfaction in Kigali is small compared the level at which Logistic parameters affect satisfaction in Czech. This can be seen when comparing standardized regression coefficients of these variables. While the standardized regression coefficient of logistic parameters for model of the city of Kigali is 0.57, the standardized regression coefficient for the model of Czech is 0.75. Based on these values, it can be said that customers in Kigali City appreciate logistic parameters for public transport compared to customers of public transport in Czech.



## **CHAPTER FIVE: CONCLUSION AND RECOMMENDATION**

### **5.1 Conclusion**

The study contributes to a modest but growing body of research on service quality and consumer satisfaction in developing countries. Our findings also suggest that the dimensions of logistic parameters have an impact on overall satisfaction. In practice, this means that improving logistic characteristics improves total public transportation consumer satisfaction. As a result, the service quality characteristics included in our study, as well as the three customer satisfaction metrics, should be monitored and improved on a regular basis. Although this study focuses on public transportation in Kigali City, the findings and recommendations in this article can be applied to improve service quality and, as a result, customer satisfaction in public transportation in other cities in Rwanda and other nations. This can be accomplished by implementing essential adjustments in service quality features in accordance with the city's or country's socioeconomic context. Considering the issue highlighted in problem statement and in light of the outputs of the analysis of this thesis one can say that there is gap and it need to be taken into consideration by decision makers because according to customer's perception attribute's opinions revealed that the rate of dissatisfaction on Bus frequency and service punctuality were the most sensitive than others if we look at the structure equation model revealed the same in explaining more the latent variable logistic parameters which implies that either there is not enough buses or traffic congestion may be taken into consideration to settle this issue.

### **5.2. Recommendation**

It is suggested to the decision makers of public transport service to improve services factors of transport such as service punctuality, cost of travel, waiting time and travel time to attract more passengers as users of public transport get more assurance in public transport in Kigali city. Once the public transport become reliable it will reduce considerably other mode of transport therefore reduction in congestion and traffic accidents. The city authority and public transport operators has to keep in mind that public transport users has to feel comfortable and well-informed during travelling.

It is suggested as well that “to make the service more reliable and convenient by increasing the frequency of the service and by reducing waiting time as well as overcrowding, increasing the number of buses is indispensable. Buses can be increased through encouraging other private operators to join the market sectors via tax incentives and other facilities to invest on similar conventional public transport services.

It is suggested on the side of decision makers build appropriate routes for buses, like Bus route transit and initiate Bus dedicate line during pick hours as alternative solution in order to avoid congection and reduce traffic jump such initiative would have a significant impact on service puntuality,waiting time and would also increase produtitivity of the country.

It is suggested to include a mechanism of evaluation by defining clearly attributes that fits with the reality of transport in the city of kigali in the contract in order to allow both opeators and regulator to know the perceptions of customers and improve service delivery.

It is suggested to elaborate a perfomance contract based the soonest possible because instead of renewing the current one it was extented while it validity was five years from 2013 up to 2018.

It is suggest to revised Policy of transport because in the context of current situation we are in privatization regime despite the fact that many studies still need to be done in terms of public transport in order to enable decision makers to opt for the convinient policy this study shown that there is a gap and the service delivery is not up to level hence either decision can proceed with deregulations ,nationalization,subsidization or to promote competition in order to allow new incumbents to the market because the rationale of regulator it’s public interest.

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## ANNEXES

### 1. Consent for Participation in Interview Research

Mr. Alain RUKORO BIZIGIRA of the University of Rwanda has invited me to engage in a research project (UR). I understand that the project's goal is to collect information about the university's academic activity. I'll be one of about 100 people who will be interviewed for this study.

- My participation in this project is unpaid. I am aware that there will be no monetary compensation for my participation. I have the right to withdraw and stop participating at any moment.
- I believe that the majority of the interviewees will find the discussion to be stimulating and thought-provoking. If, however, I am uneasy in any manner throughout the interview, I will tell you.
- My involvement in this project is unpaid. I understand that I will not be paid for my participation. I may withdraw and discontinue participation at any time without penalty.
- I understand that most interviewees in will find the discussion interesting and thought-provoking. If, however, I feel uncomfortable in any way during the interview session,
- I understand that the researcher will not identify me by name in any reports based on information received from this interview, and that my confidentiality as a participant in this study will be protected. The use of records and data in the future will be governed by standard data use standards that preserve individuals' and institutions' anonymity.
- I realize that the University administration has reviewed and authorized this research study. I have read and understand the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

I have been given a copy of this consent form.

My Signature Date

Name Signature of the Investigator



For further information, please contact: Mr. Alain RUKORO BIZIGIRA

On mobile phone (+250 788779327)

## 2. QUESTIONNAIRE

### Public Transportation Customer's Satisfaction Survey

The purpose of this Questionnaire is to assess the level of customer's satisfaction for the Kigali public bus transport using the 15 attributes identified as most contributing factors to customer's satisfaction. This survey does not collect any confidential/personal information details. This research is supported by the University Of Rwanda (UR) in partnership with Rwanda Utility Regulatory Authority (RURA) and is conducted by Mr. RUKORO BIZIGIRA Alain as requirement to fulfill the thesis of Master of Science in Regulatory Economic and Competition Policy. The data will be used for this research purposes only and it will never submitted to any other third parties whosoever.

Your contribution will be highly appreciated

### PART I GENERAL INFORMATION

1. Gender:                      Male                                       Female
2. Age:    15-25 Years                       26-35 Year                       36-45 Years   
                    45-55 Years                       56 Years and above
3. Occupation:    Student                       Full-time                       Part-time                       Job Seeker   
                                    Owner of business                       Retired                       Other (please specify) \_\_\_\_\_

4. How long it take you to get to the bus stop/ when going to work or coming home?

0-10 min     11-20 min     21-30 m     31-60   
 Above 1 hour

5. How long have you been using the Public Transport in Kigali City?

0-2 years     3-6 years     7-10 years   
 11- 15 years     over 15 years

**PART II ATTRIBUTES INFORMATION**

Below is a list of some travel attributes identified. In the column labeled satisfaction indicate on ordinal likerts scale from 1-5 your degree of satisfaction with the level of provision of the attribute by your most regularly used means of transport. 1 Very dissatisfied, 2 Dissatisfied, 3 Average, 4 Satisfied and 5 very satisfied.

QN.	Travel attributes	Satisfaction (1-5)
1.	Travel time	
2.	Easy entering/exit	
3.	Transport comfort	
4	waiting time	
5.	Cost of travel	
6.	Safety in Vehicle	
7.	Internet availability in bus	

8.	Bus frequency	
9.	Service punctuality	
10.	Service continuity	
11.	Bus station proximity	
12.	Overall satisfaction with: Cost of travel, Easy entering/exit, Safety in vehicle	
13.	Overall satisfaction with: Waiting time, Travel time, Transport comfort	
14	Overall satisfaction with: Service punctuality, Service continuity	
15.	Overall Satisfaction with: Bus station proximity, Bus frequency, Service punctuality	

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