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Walkability, Adaptability, Accessibility and Parking in Rapidly Growing Cities: The Case of Kigali City

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Abstract: Walking, accessibility, and parking spaces are the major pressing challenges today in rapidly growing cities in the global south. Despite the fact that automobiles in these cities increase daily, many cities still have not coped with these changes due to various factors, such as a lack of appropriate technology to react to this. Therefore, this study aims to examine how walkability, accessibility, and parking spaces are taken into consideration in rapidly growing cities, using Kigali City as a specific case. Primary data were collected through observations and interviews that were conducted through the use of structured questions addressed to one administrative official in charge of road and bridge construction and maintenance in the infrastructure management unit at the district level. Secondary data were gathered from existing literature similar to this study. Moreover, 75 city residents from three districts (i.e., 25 residents from each district) were chosen randomly. Findings have revealed that pedestrian walkways are used 24/7 by people going to work, hospitals, buying commodities, and playing various games. In addition, the study has shown that the CHIC building parking yard can accommodate more than 400 cars when fully utilized, and the parking price is 200 Frw (0.2 USD) per minute. This parking space had the option to go in and out on both sides of the parking lot. Regarding accessibility, there is Kanombe International Airport, which makes the city accessible to international travelers, and Bugesera International Airport, which is 25 km south-east of Kigali and under construction. Additionally, the lack of smart parking and protected walkways against car accidents on commuters were highlighted by 77% of the respondents as the major emerging challenges that hold back walkability and parking in Kigali City. In conclusion, transformation in Kigali City is taking place, and the city is trying to cope with emerging technologies by making the city accessible, walkable, and parking spaces available in front ofhigh-raised buildings as well as commercial areas. This goes hand in hand with the use of IOT and further emerging technologies to improve walkability in urban areas as well as adaptability, especially for rapidly developing cities like Kigali City.

***Keywords*:** walkability, adaptability, accessibility, parking, growing cities, Kigali City

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Nomenclature

Term	Description
24/7	24 hours a day, seven days a week, all the time
ANOVA	Analysis of variance
CBD	Central Business District
CHIC	Champion Investment Corporation
DRC	Democratic Republic of Congo
FERWAFA	Rwanda Football Federation
Frw	Rwandan francs
IOT	Internet of Things
KBC	Kigali Business Center
KIST	Kigali Institute of Science and Technology
NPD	Nyarutarama Property Developers
PHC	Population and Housing Census
RDB	Rwanda Development Board
UN	United Nations
UR	University of Rwanda
US	United States
USD	United States dollar
UTC	Union Trade Center
WHO	World Health Organization
Wi-Fi	Wireless Fidelity

1. Introduction

Different urban designers have used the idea of walkability in connection with accessibility, comfort, suitability, and proximity. Walkability is connected with suitability components such as street landscapes, street furniture, pedestrian walkways, crossing improvements, safe speeds, and street width [1]. Understanding the elements that make a high-quality pedestrian environment is necessary to improve the conditions for walking. Three fundamental components influence the quality of the pedestrian's environment and must be taken into consideration during the design of pedestrian infrastructure and transportation networks. Those features are such as (i) street design; (ii) building design and land use mix; and (iii) street network [2]. Walkability is "the extent to which the built environment supports and encourages walking by providing for pedestrians comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys through the network" [3]. According to Southworth [3], a walkable network comprises six important attributes: connectivity of the path network (both locally and in the larger urban setting); linkage with other modes (bus, streetcar, subway, and train); fine-grained and varied land use patterns (especially for local serving uses); safety (both from local traffic and social crime); quality of the path (including width, paving, landscaping, signage, and lighting); and path context (including street design, visual interest of the built environment, transparency, spatial definition, landscape, and overall exorability).

Historically, walking has been the major mode of transportation in urban areas. This was transformed with the rapid development and introduction of mass vehicles in the 1950s and the successive population increases in suburban areas around the main cities. As a result, increased car ownership accelerated urban sprawl in most urban centers, in which large strips of the urban population move to suburbs of their cities, which are made to have low-density housing and a

lifestyle that depends on private cars because of the trickle of daily destinations. Thus, urban and rural planning puts too much effort into creating places for vehicle transportation, specifically highways, and then forgets active transport such as biking and walking [4]. This implies that cities in developing countries make improvements in vehicular rights of way at the expense of pedestrians, resulting in a substantial decrease in the quality of public realms and walking environments [5]. The welfare of pedestrians is often neglected in planning for the fast flow of vehicles, and investments in facilities for pedestrians are comparatively low [6].

Furthermore, the increase in car ownership has led to increased traffic jams, congestion, noise, and air pollution. A traffic jam is a situation where many automobiles are moving on a road that has an unsatisfactory capacity to accommodate road users. For this condition, traffic flows spend much time waiting at the same position or go in a very low hurry with complications. Traffic congestion is mostly found in countries with an increase in the traffic rate of vehicles, which goes beyond the capability of road transportation services, including roads and parking areas that were in use during that time [7]. Physical activities are an important requirement for a healthy lifestyle, and walking is the most common type of physical activity. Since recreation exists among the practices of the built environment, physical activity, and public health, various researchers are encouraged to research urban planning and design, transportation, health, and urban economics [8].

Non-communicable diseases such as obesity, cardiovascular disease, and diabetes constitute a substantial number of the increasing health problems on the global scale, of which a high number is expected in low- and middle-income countries. The country of India, with a population of 1.2 billion and soon to become the most populous country, is facing a non-communicable disease epidemic. India has the largest number of diabetic people on the planet, with 33 million in 2015 and expected to reach 130 million by 2030. Hence, physical inactivity is a leading factor in the development of non-communicable diseases. The UN and WHO recommend the increase in physical activity as a key strategy to minimize global epidemics of non-communicable diseases [9]. Indians need relative approaches to improving the livability and quality of life in their cities [10].

Walking is one of the simplest and most inexpensive forms of physical activity. Walking is highly needed to maintain community health, as it can prevent various diseases such as diabetes and hypertension [11]. In the US, the public health community is working to inspire people to become more dynamic, with the major focus being to promote walking. As previously stated, this act is inexpensive and can be performed by anyone; once the conditions are met, it can be performed anywhere. Nowadays, in many communities, the conditions are not favorable for them to walk. Therefore, public health workers and agencies are advancing their sustenance to create many walkable and bicycle-friendly societies [12]. In many Asian cities, economic growth and rapid urbanization have caused urban transport crises. The exceptional increase in the number and use of private cars has led to various traffic jams, a high number of accidents, and greenhouse gas emissions. The answer is to increase road capacity to minimize traffic congestion. But international agreements recommend that this is a short-term response that will temporarily facilitate traffic movement but also escalate the increase in vehicle numbers, which will result in traffic overcrowding [13].

Accessibility matters in cities. In Europe, the US, and Latin America, the population in cities dedicates a considerable percentage of their walking hours to travel, specifically in big cities like Mexico City and New York. In poorer cities, for instance, poor households from time to time spend extensively minimal on housing and transportation, but they regularly do so by consuming extremely little by living and housing on lands with the uncertain legal status that are also exposed to natural disasters, for example, flooding or land sliding. All these poor communities are willing to pay a tremendously high non-monetary cost for accessibility [14]. Access to goods, people, services, and information is essential for the economic development of cities. The better and more efficient this accessibility, the better the economic benefits through economies of scale, networking advantages, and cluster effects [15].

Parking necessities in zoning regulations represent an understudied connection between mobility and urban form. Planning professionals normally consider parking simply as a supplement to a building. This bias extends to various academic considerations of travel. People stop thinking about the car in the parking lot because parking means we've arrived at our destination. It is the point at which the driver turns into a pedestrian [16].

Rwanda is a rapidly growing country, and many people are buying vehicles and others are traveling day by day for various purposes. This development had augmented the number of vehicles on Rwanda's roads, especially in urban areas, which caused traffic congestion. Therefore, this issue has negative effects on the economic development of the country and residents' well-being. It is essential to think about how this problem can be solved [7].

Walkability, adaptability, accessibility, and parking in cities are interlinked components because once communities become adaptable to the city, this will facilitate easy and secure walkability for them. All of these go hand in hand with city accessibility—where and how to enter the city—and from there, it is good to know the spaces for parking and how they are connected and work together with technological aspects used to make them user-friendly during parking. For this reason, bringing all of them together contributes not only to knowledge generation but also to future city development, especially in those that are growing rapidly. Therefore, the following are the research questions of this study:

a. How is the current situation of walkability, adaptability, accessibility, and parking in rapidly growing cities (Kigali City)?
b. What are the challenges rapidly growing cities, including Kigali City, face regarding walkability, adaptability, accessibility, and parking?
c. What are the recommendations for suitable and sustainable walking, adaptability, accessibility, and parking in rapidly growing cities?

2. Materials and methods

2.1 *Overview of the study area*

Rwanda is quite a small country, both by area and population. The total area of this country is equal to 26,338 km^2, with a population of 13 million. Rwanda is among the least urbanized countries, with an urbanization growthrate of 3.5%. In eastern Africa, Rwanda's urbanization level and population growth rate are slower. Currently, population projections demonstrate that only 18.4% of Rwandans live in cities, and this target is to reach 35% by 2024 [17]. Rwanda is bordered by Uganda in the north, Tanzania in the east, Burundi in the south, and the DRC in the west. The altitude extends between 900 m and 4,500 m above sea level. The upper Nile basins occupy 67% of Rwanda and drain out 90% of their surface waters, while the remaining 10% is drained to the Congo basin. Likewise, 8% is covered by natural forest and 10% is by marshlands made by cultivation activities, including peat bogs and lakes. Rwanda is a biodiversity hotspot with more types of animals, for instance, reptiles, birds, and amphibians, compared to other developing countries [18]. The annual rainfall varies from 700 mm up to 1,400 mm in the eastern and lower land of the West, from 1,200 mm to 1,400 mm in the central plateau, and from 1,300 mm to 2,000 mm in the high-altitude area by an average of 1,200 mm each year [19]. Figure 1 shows a study area map of Kigali City, which consists of three districts (Nyarugenge District, Gasabo District, and Kicukiro District).

2.2 *Data collection procedures and analysis*

Before the data collection process, questionnaires were developed. This was done in such a way that each respondent could easily give his or her opinion on the current situation of walkability, adaptability, accessibility, and parking in Kigali City. The data collection process took place in Kigali City for the selected 15 sidewalks, 10 parking spaces, and 75 households, including those of the Road and Bridge Construction and Maintenance Engineer in the Infrastructure Management Unit at Nyarugenge District level. Data collection was carried out by researchers with the help of field assistants. It began in November 2022 and continued until the end of December 2022 during normal working hours (in the morning or evening), depending on weather conditions if there is no rain, which may interfere with the data collection job by also considering officials' and researchers' availability to collect the data. In addition to this, there is also data that was taken from 10th March up to 20th March 2023, after receiving a reviewer's comment to strengthen the output.

The data collector walked around Kigali City to see how the walking environment is pedestrian-friendly, demonstrated photos for suitable analysis, and filled out a questionnaire in an appropriate location. Additionally, both primary and secondary data collection techniques were used to make this report accurate for future walkability, adaptability, accessibility and parking in the cities of developing countries. The data were analyzed using Microsoft Excel for quantitative data analysis as well as Microsoft Word for producing and summarizing this report. Several criteria were taken into account in choosing Nyarugenge District, comprising:

1. Nyarugenge District is among the districts the author is allowed to conduct research in.

2. As the case study is in Kigali City, Nyarugenge District is also one of the Kigali City districts, in addition to Gasabo District and Kicukiro District.
3. Similarly, the district is where the city center is located. This is a good room for the author to collect more data on the subject to strengthen and enrich the results.
4. Since the officials of both Kigali City and Nyarugenge District work in the same building, it is easier to schedule an interview with them.
5. Potential experts are located in Kigali City and more decisions are initiated there. This is another reason to collect the data in Nyarugenge because it guarantees that the collected data is perfect.
6. Nyarugenge District is very accessible and near the author's living place compared to Kicukiro and Gasabo District.

The questionnaire was designed based on the research objective of this study and the research questions to be answered. Finally, qualitative and quantitative approaches were also adopted to avoid biases that can happen when using a single approach. Figure A in the appendix shows an acceptance letter for data collection.

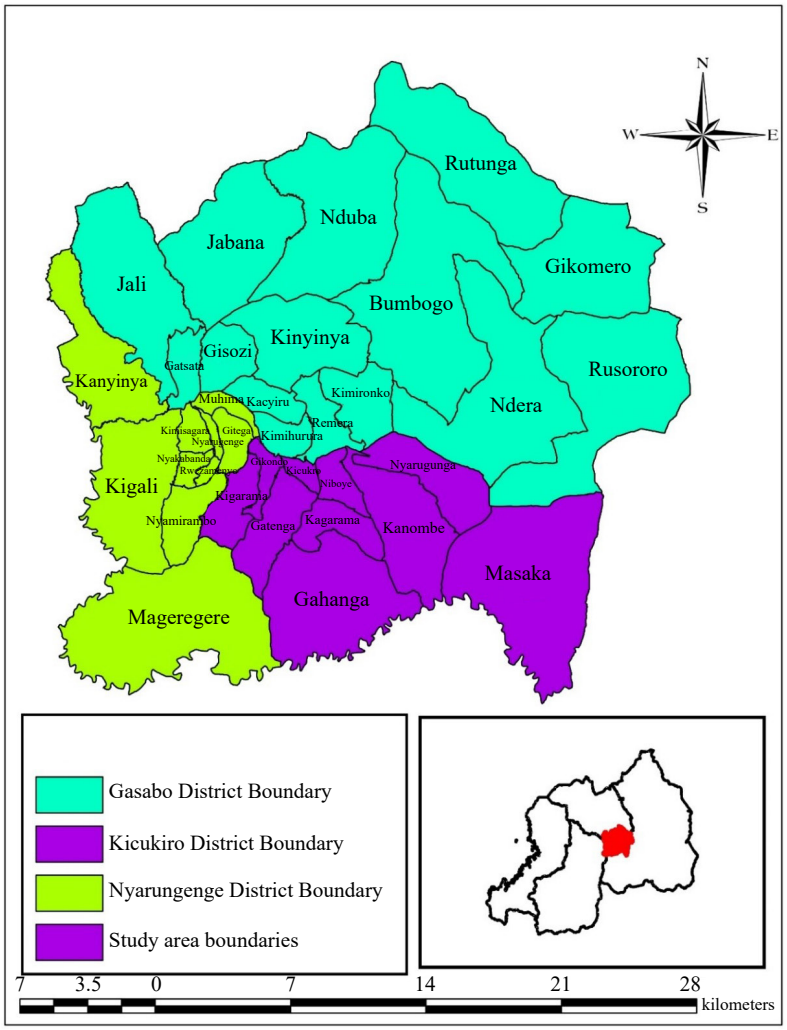

Figure 1. Map of Kigali City

3. Results

3.1 *Socio-demographic characteristics of the respondents*

This section explains the profiles of the respondents that were involved. Table 1 explains the population of Kigali City that participated in the interview and gave their opinion and input to this study when answering structured questions by researchers. According to the 5th Rwanda PHC [20], as of August 2022, the Rwandan population was 13,246,394. So far in 2022, the population in Nyarugenge District is equal to 374,319; in Kicukiro District it is 491,731; and in Gasabo District it is 879,505. Researchers decided to insert this population number to give a representation of the population in Kigali City living within its three districts. In addition to this, the above census is currently being conducted and this also reflects a population number different from the 2012 census. As the study is being done nearly after the census, it is preferable to avoid using the old population number completed in 2012 or to provide a brief on the new population number for future readers and planners. During this study, researchers conducted interviews with 75 city residents to capture their opinions on Kigali City's walkability, adaptability, accessibility, parking and areas for improvement as well. Also, one professional from Nyarugenge District in the Infrastructure Management Unit was consulted by the researcher to know more about technical aspects such as walkability, adaptability, accessibility, and parking in the Nyarunge District of Kigali City. Hence, the selection of respondents was not based on any discrimination or gender segregation. Therefore, both men and women road users participated in the discussion until researchers got information that could be used for the final output of this study. Respondents were also picked arbitrarily just based on their presence during researchers' data collection on the field in Kigali City. Table 1 shows the socio-demographic information of the respondents.

Table 1. Socio-demographic profile of the respondents

Districts		Nyarugenge		Gasabo		Kicukiro		Total
Variable	Description	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
Sex	Female	15	60	12	48	14	56	25
	Male	10	40	13	52	11	44	
Occupation	Business	4	16	5	20	6	24	25
	Student	3	12	2	8	3	12	
	Professional	10	4	12	48	11	44	
	Service	8	32	6	24	5	20	
Age	21 to 30	2	8	3	12	2	8	25
	31 to 40	10	40	9	36	12	48	
	41 to 50	9	36	10	40	8	32	
	51 to 60	3	12	2	8	3	12	
	> 60	1	4	1	4	1	4	
Education	Primary level	2	8	3	12	1	4	25
	Secondary level	11	44	9	36	13	52	
	University level	12	48	13	52	11	44	

3.2 *Walkability in Kigali City*

According to the respondents, it was reported that currently, walking in Kigali City is carried along the roads that are constructed to facilitate both vehicular and pedestrian movements, as shown in Figure 2. There are small paved roads for pedestrians as well as trees along the road to make the city green and provide fresh air for residents and visitors while moving safely in the city to buy or sell whatever they need. The building, constructed in clay bricks

with roof tiles on top and a white cross in front (Figure 2), is a Catholic church to receive Christians from all over the corners within Kigali City to come together for God's worship and Father from heaven, as well as the Saint Famille Hotel nearby the church, which looks similar to the church. Between the two roads, it can be seen that there are several street lights that give light during the night for drivers' smooth driving and safe walking for pedestrians. Retaining walls are also constructed to keep side roads from falling together with houses and multi-story buildings on the hillside. Before someone enters Kigali City, he or she must first face the roundabout, which directs drivers in different ways to Nyabugogo, UR (former KIST), and another road to enter the major city of Rwanda (Kigali City), or CBD.

Kigali City is pedestrian-friendly because it allows commuters to move around the city on their paved roads that are safer for walking without interfering with vehicles and bicycles that are also using the road. By considering the road shown in Figure 2, vehicles coming from or going to the city center are divided into two lanes to permit vehicles to go fast and overtake other vehicles without causing road accidents. In the middle, there is a space left where they can plant flowers and garden trees for the beauty of the city, as well as a place where street lighting is mounted to offer light in the darkness during the night. Sometimes during the summer, groundwater is installed to irrigate flowers. Similarly, on the right-hand side, two lanes are provided for vehicles to move safely and overtake when needed. Retaining walls are constructed with concrete blocks made by NPD COTRACO (a road construction company in Rwanda), which innovated those types of blocks and replaced them with stones that were used before for retaining wall construction. These concrete blocks are cheaper and not heavy enough for them to support the soil as well as the roadside and not fall onto the road and cause traffic jams or other costs associated with this action.

Figure 2. The recent situation of walkability in Kigali City

Furthermore, 89.3% of the 75 respondents interviewed said that a lack of protected walkways from incoming cars, motorcycles, and bicycles leads to road accidents. This is an issue to be taken into consideration, as vehicle drivers sometimes leave their driving lanes and knock pedestrians out of their way without knowing. It was highlighted by all respondents (100%) that road accidents are inevitable and might occur anytime, but people try their best to walk around as safely as they can. Meanwhile, traffic police are always around to monitor traffic movement and control cars that do have appropriate technical control, thereby minimizing road accidents that might happen instantly. Figure 3 demonstrates answers from Kigali City residents when asked about walkability in the city, especially about the quality

of walkability, city familiarity through walking, security during walking times, and walking-friendly technology. Familiarity ranked first with 90% because the majority of respondents are residents of Kigali City. Security came in second, with 89% of respondents indicating that they feel safe enough when walking in their communities. Some young people on the street may engage in minor security-related activities, but according to 97% of respondents, these incidents are extremely rare. Technology came last because the city is still developing other related technologies to help people walk safely and in healthy ways.

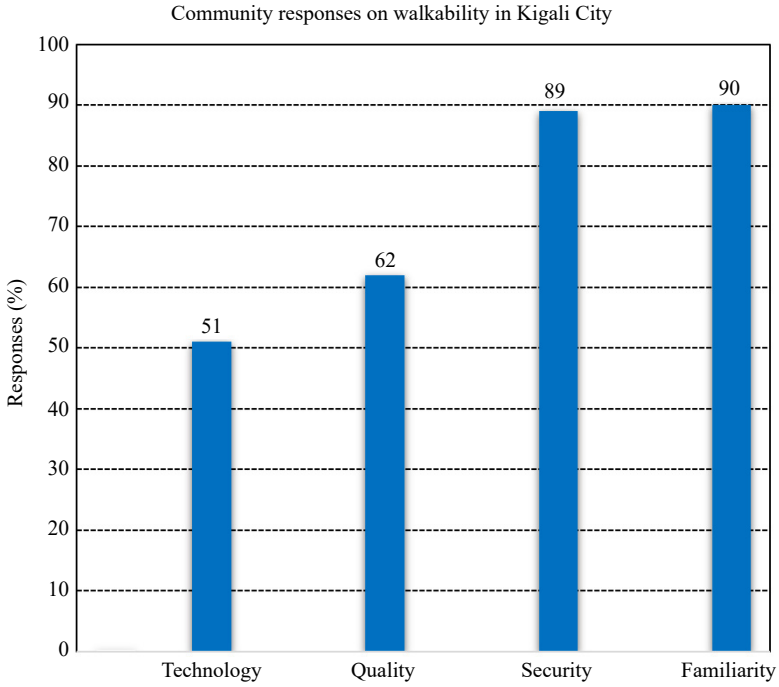

Figure 3. Walkability in Kigali City community understanding

3.3 *Adaptability in Kigali City, Rwanda*

Cities adaptability is necessary mostly for foreigners who come into the country for various purposes, including vacation, living, meetings, and conferences. Though those coming for official meetings and conferences are directed up to their designated hotels, where they stay and go for their event locations, those newcomers coming for leisure in the country need much more time to be adaptable in the city and other regions of the country. Apart from Google Maps, which can give directions to travelers and newcomers, Kigali City is among the first countries in Africa to have a good internet connection, which is available everywhere for tourists to properly search for their destinations. In Kigali City, there are many direction posts that can easily guide foreigners around the city. Also, due to the security, people can walk comfortably and drive 24/7 without any problem on the roads and sidewalks in the city. Visitors can use taxis (Yego cabs) or rent private cars, which can help them move around the country in a simple manner. Also, among those taxi drivers, most of them are educated and can help visitors reach their destinations by directing them accordingly. Figure 4 shows the big bus available in Kigali City, which plays a major role in transporting people, either foreigners or Rwandans. The top of these buses is open for visitors to observe clearly and take in the fresh air coming from trees planted along the roads in Kigali City. All of these are under the program "Visit Rwanda", which calls on foreigners from all over the world to visit the country of Rwanda. As noted by 70% of the respondents, adaptability in Kigali City is not difficult for visitors, as residents are helpful and can direct visitors to their destinations. This is simply because most people have language skills to communicate with foreigners coming into the country, either in English, French, Kinyarwanda, Swahili, etc. According to the Road and Bridge Construction and Maintenance Engineer [21], Kigali City

is transforming its existing transportation system into smart transport, where the community and visitors may be able to know which bus is coming and at what time it will arrive while they are in bus parks and bus stop areas by using their smartphones connected to the internet. This makes a significant contribution to adaptability, as visitors can use it to move around using common transportation at a low cost.

He added that the name of the bus in Figure 4 is the Kigali City sightseeing double-decker and was brought into reality in partnership with Kigali City Tour Ltd. and RDB. The bus is equipped with an air conditioner, charging ports for electronic devices, and Wi-Fi. Thus, local tourists, including Eastern Africans, pay 20 USD while international tourists are charged 40 USD for sightseeing and per itinerary. There is an itinerary of three schedules, respectively:

The morning itinerary includes routes along KBC - Kacyiru, Kacyiru Library - National Police, Kigali Genocide Memorial Site - Kinamba, Nyabugogo Bus Park - Kimisagara, Nyamirambo Stadium - Nyamirambo Onatracom, Camp Kigali - Serena Hotel, UTC - Kimihurura, and back to KBC.

The afternoon itinerary includes KBC - RDB, Nyarutarama Golf Club - Vision Estate in Gacuriro, Kibagabaga - Kimironko FERWAFA, Amahoro Stadium - Gishushu, and back to KBC.

The night itinerary involves KBC-RDB, Nyarutarama Golf Club - Vision Estate in Gacuriro, Kibagabaga - Kimironko, FERWAFA - Amahoro Stadium - Gishushu, and back to KBC.

This shows that the double-decker is going to boost the transportation industry, especially tourism by attracting local and international tourists.

Figure 4. Kigali City tour

Table 2 describes the regression analysis of the respondent's responses concerning adaptability in Kigali City, taking into consideration their age and location (Nyarugenge District, Kicukiro District, and Gasabo District) during the interview.

Table 2. Regression analysis results on community perspectives on adaptability in Kigali City

Regression statistics	
Multiple R	0.928668
R square	0.862423
Adjusted R square	0.752362
Standard error	15.06656
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	4	7114.993	1778.748	7.835849	0.022157
Residual	5	1135.007	227.0013		
Total	9	8250			

	Coefficients	Standard error	t stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-21.6159	16.76799	-1.28911	0.253773	-64.7193	21.48764	-64.71934944	21.48763882
Nyarugenge District	1.399322	3.073797	0.455242	0.668021	-6.50213	9.30077	-6.502126093	9.300769628
Kicukiro District	2.80767	3.93806	0.712958	0.507754	-7.31544	12.93078	-7.315435872	12.93077512
Gasabo District	-3.09634	3.757926	-0.82395	0.447475	-12.7564	6.563721	-12.75639259	6.563720812
Age	1.912933	0.492097	3.887305	0.011556	0.647956	3.17791	0.647956295	3.177909847

Note: df = degree of freedom; SS = sum of squares; MS = mean square error; F = F-statistic (ratio of two variances; explained and unexplained variances); t stat = ratio of the departure of the estimated value of a parameter from its hypothesized value to its standard error (hypothesis test static); and P-value = probability of observing the coefficient value or more extreme, if the null hypothesis is correct (probability value)

3.4 *Accessibility*

Accessibility in Kigali City is also something that was taken into consideration. Starting with someone coming from abroad to enter Kigali City or Rwanda. 97% of the respondents narrated that, firstly, you must use Kanombe International Airport for landing and city accessibility. But because the airport is a bit smaller, the country of Rwanda is constructing a new international airport that will be able to receive big and small airplanes with a large number of international travelers visiting Kigali City and other private missions in Rwanda. Construction for this airport is underway in Bugesera District, located not far from the city center (almost an hour and a half drive). Apart from that, all districts have bus parking for public transport where people can go and get buses to rural areas or to Kigali City. Private taxis are everywhere to provide transport services for people in need at any time. The Nyabugogo bus stop is there to receive cars from rural areas before people enter the CBD. It was said by Nyarugenge District Road and Bridge Construction and Maintenance Engineer [21] that there is a plan to construct other bus stops to add value to Nyabugogo bus parking as well as play the same role as Nyabugogo bus stops without forgetting the reduction in the number of buses that used to be in Nyabugogo Bus Park and the crowd of travelers. In addition to this, there are also ring roads to connect the city easily and smoothly, ensuring accessibility for all.

In the city center, there are public bus parking lots located in a place known as downtown. People from the city center or CBD to other neighboring destinations, for instance, Kimironko, Remera, Kacyiru, Nyabugogo, and Nyamirambo, come to this bus stop and then get buses to their homes and living places, as said by 89% of the respondents. You can see that there are small houses for travelers where they can sit during rainy and sunny seasons or when they are waiting for buses to come and pick them up. Cities and countries need to be accessible to everyone,

whether foreigners or residents. This is simply because once a country is easily accessible, it can also quickly boost its economic development. While people get access to places, they also want to visit commercial projects and tourist attractions, which are major driving factors for the country's development. 79% of the respondents replied that the idea of a small bus park at Nyabugogo to accommodate all the buses from the countrysides in the western, northern, southern and eastern parts of the country is among the emerging issues that the city needs to think about in the near future and make quick arrangements to respond to transportation problems in the city. Additionally, this bus park receives big buses from Uganda and Tanzania together with local buses, which do transportation jobs in the city as well as the countryside. Thus, this creates a large number that can't fit well into the existing Nyabugogo Bus Park. The population increase in relation to the number of vehicles as well as community infrastructure is another challenge to tackle as the city develops and transforms quickly. As depicted in Figure 5, there are only a few small roofs available in the bus parking lot in Kigali City, which causes people to suffer from rain while waiting for their buses.

Figure 5. Downtown in Kigali City, Rwanda

Additionally, Bugesera International Airport is considered one of the mega projects expected to transform Rwanda as a hub for investment, tourism, and other services in the region; its construction activities are also eco-friendly and constructed in Rilima Sector, Bugesera District, and Eastern Province. Concerning parking, it is planned that parking for 249 vehicles will be constructed for staff in the first phase. For regular passengers, there is a parking lot for 547 cars, 249 taxicabs and nine large buses in the first phase. It is expected to feature a 4,500-meter runway and have the capacity to accommodate at least 8.2 million people per year.

3.5 *Parking in Kigali City*

Parking is crucial, as it helps vehicles get a place to stay while they are not in use. Figure 6 shows one of the parking lots in Kigali City as a sample to demonstrate what other parking looks like in the city, and each building at this place had reserved parking spaces. Meanwhile, other building stories construct their parking on their ground floors or in their basements. Most of these parking lots receive different cars. As shown in Figure 6, small jeeps private taxis, as well as cars for business owners, often park in this parking space. Those small houses at the entrance gate play a role in monitoring and controlling vehicles in and out of the parking lot, where drivers pay parking fees as they park.

As described in Section 4, parking must be smart as more cities transform into smart cities, and these parking lots must evolve with the cities. Therefore, parking should give drivers a chance to know the parking situation before they come to park. Parking, on the other hand, can be a place that generates money for a country's economic development while also providing a space for vehicles to park in harmony, suitably, and securely. Discussion with the manager of this parking space indicated that when this parking is fully utilized, it can accommodate more than 400 cars, and car owners pay 200 Frw (0.2 USD) per minute when parked in it. Parking also has entrances on both sides (left and right sides), together with going-out options on both sides, which allow drivers to move the way they want, depending on the space available. 15 out of 25 city residents in Nyarugenge District interviewed mentioned that the parking below is safer at the time they park, and when they exit the parking, they do not lose any of their belongings in the car parked in CHIC parking. Cameras are also installed to monitor the parking yard for security reasons or for many other purposes to ensure efficient parking.

Figure 6. Parking yard in Kigali City, Rwanda

4. Discussion

The topic of walkability, adaptability, accessibility and parking in rapidly growing cities is not something new to urban planners and decision-makers. Walkability is still one of the most challenging issues confronting cities in developing countries. Most African countries still face this problem nowadays, to the extent that in some countries you cannot observe safer pedestrian roads and enough space for motorcycles and cars to park.

Rapidly growing cities should promote, accommodate, and manage walking spaces in their urban planning schemes so that people can walk easily and safely at any time. Paved surfaces need to be provided in such a way that people can move smoothly even during and after heavy rain. As discussed earlier, in Rwanda, pedestrian paths are paved and people can move around the city on a clean road surface. When a visitor comes to Rwanda he or she will find trees planted along the road just to protect walkers from the sun when going around all the corners of the city. Many people in Kigali City walk more than use public buses. This is because pedestrian walkways are used 24/7 by people going to work, churches, markets, buying commodities, and playing football and basketball games. Baobeid et al. [4] said that road safety perception influences the level of walkability and biking in the community, especially among the elderly and children. The existence of appropriate, well-designed walking and intersection facilities may encourage pedestrians to move. He added that five important attributes of the built environment needed for walkability include convenience,

connectivity, conspicuousness, conviviality, and comfortability.

Not only that, but one can also see athletes running here and there on pedestrian walkways and others refreshing their minds nearby. Between roads, there is a small space reserved for cars and pedestrians. There is another road for cycling purposes where people, either elder, younger people, or children, come to have fun with bicycles while enjoying going around Kigali City. As mentioned in the World Bank Group report [2], walking gives you basic mobility. It also provides essential first- and last-mile connectivity to community transport, and in addition, it brings entertainment and health benefits. The improvement of pedestrian conditions minimizes the demand for travel by vehicles and weakens numerous urban transport problems, including air pollution, traffic jams, personal security, and road accidents.

Furthermore, as the world is entering the fourth industrial revolution and cities are becoming smart, parking should be smart, allowing drivers to know whether there is space for parking in a particular area and what type of cars should park there. The cost per hour is another factor to know before someone or a driver brings his or her car into parking. In the pandemic era, parking must be smart to facilitate all pandemic protocols and regulations for drivers and people not affected by the pandemic in one way or another. By using smartphones and other platforms, drivers can monitor parking lots without going out of the car to check whether there is a parking place. Manville et al. [16] mentioned that it would be especially suitable to examine a building and its parking lot separately.

Cities accessibility is also important in helping travelers easily access the city. Airport location and accessibility must be simple for people to enter the country and the city in a manner that is not complicated or that can make someone feel lost. According to Duranton et al. [14], to reduce commuting costs, residents should preferably live as close as possible to work. Additional declines in development intensity and parcel size increase as someone goes away from the city center. Similar to adaptability, in rapidly growing cities in the developing world, visitors must adapt themselves to the city without asking too many questions when they want to know about a certain area. Direction signs and other open platforms should be implemented to make cities easier for foreigners to navigate without looking for a guide or other aid to reach a place. Their privacy and security matter.

5. Conclusion and recommendations

5.1 *Conclusion*

In conclusion, Kigali City is one of the African cities undergoing rapid development and transformation, and it is attempting to cope with the integration of emerging technologies in making the city accessible, walkable, and parking available in planned areas or in front of high-rise buildings and commercial places that do not interfere with traffic movement or cause traffic jams if vehicles are parked in inappropriate places.

5.2 *Recommendations*

By conducting this study and analyzing the results, the authors propose the following recommendations for easy and comfortable cities' walkability, adaptability, accessibility, and parking:

1. Smart parking is the first recommendation researchers highlight because it will improve the efficiency and effectiveness of city parking management.
2. Use of IOT and further emerging technologies to make walkability in urban areas smoother as well as adaptability and accessibility, especially for rapidly developing cities like Kigali City in Rwanda.
3. Protecting pedestrian walkways against car and motorcycle accidents with strong metal tubes or small reinforced concrete columns
4. Extension of the existing Nyabugogo Bus Park or construction of a new bus park to fit well with the increase in transportation buses to connect Kigali City with rural areas and the country's neighboring countries comprising Tanzania, Uganda, Congo, and Burundi is highly recommended.

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Conflict of interest

There is no conflict of interest in this study.

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Appendix

Republic of Rwanda
City of Kigali

Ref.n°. 17666/07.01.16/22

Kigali on 17 FEV 2022

Mr. David MIHIGO
Tel: (+25)0788808339
Email: mihigodavid7@gmail.com

Dear Sir,

Re: Your request for research paper/ dissertation data collection in Kigali City

Reference is made to your letter dated on 30th December 2021 requesting for research paper/ dissertation data collection in the City of Kigali on " **Emerging technologies, smart city like smart housing, smart transportation, urban agriculture, urban and regional planning and land management**";

We would like to inform you that your request is hereby granted. However, before starting data collection, you must first introduce you to the department of **Human Resource and Administration** to be guided.

Sincerely,

UMUJYI WA KIGALI

Joseph NIYONGABO
Director General of Corporate Services

Cc:
-City Manager of the City of Kigali
KIGALI

City of Kigali, P.O.Box 3527 Kigali, Hotline 3260, Email: info@kigalicity.gov.rw, Wbsite: www.kigalicity.gov.rw

Figure A. Acceptance letter for data collection