Research Article ISSN 2639-9512

Stem Cell & Regenerative Medicine

Retrofiting A Panacea to African Public Transport Terminals Toward the Global Pandemics Mitigation

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Received: 08 Jan 2026; **Accepted:** 21 Feb 2026; **Published:** 05 Mar 2026

Citation: Dukiya JJ. Retrofiting A Panacea to African Public Transport Terminals Toward the Global Pandemics Mitigation. Stem Cells Regen Med. 2026; 10(2): 1-9.

ABSTRACT

Public transport in Nigeria and some other African countries is synonymous to road transport system as the government policy seems to give more attention to it than other modes. The few available bus operations in the country are second-hand rickety vehicles that are fossil-fuel dependent with all its negative health implications that tend to catalyze SARS-CoV-2 otherwise known as COVID-19 infection that has ravaged the whole world at a pandemic scale. The spatial spread of the virus is mass transport related. This study therefore using direct observatory and internet-based review of literature method to examine the physical state of urban public transport infrastructure adaptation to the new challenges of COVID-19 and its variance. The study revealed that the use of vehicular and terminal retrofitting through IT based social-distancing before and after boarding, and the use of environmental friendly vehicles in line with the global crusade for smart city and green mobility is the panacea to the global epidemiology. African countries like Nigeria should therefore awake from their slumber and join the race toward green mobility and smart city to curtail the spread of epidemic viruses.

Keywords

Corona-virus, Epidemics, Public Transport, Retrofitting, Smart City, and Urban Mobility.

Introduction

Mobility and accessibility is essentially the hub of any community or nation as it determine the achievement of the socioeconomic goals. For example, global demand for passenger transport service is predicted to grow from 26 trillion passenger kilometers in 1990 to 103 trillion passenger kilometers in 2050 on average [1,2]. In fact, in some countries like Nigeria, about 80 percent of goods and services are transported on roads, 95 percent of workers commutes on roads by private automobiles and public buses; roads also bear the largest share of non-work and pleasure trips. Public transport refers to the means by which larger proportions of urban dwellers gain physical access to the goods, services, and activities they need for their livelihoods and well-being [3]. Public transportation therefore plays a very important role in both the developed and developing world cities.

Public transport (public transportation, public transit, or mass transit) is transport of passengers by group travel systems available for use by the general public, typically operating on a schedule established routes. These include city buses, trolleybuses, trams (or light rail) and passenger trains, rapid transit (metro/subway/underground, etc.) and ferries. Public transport between cities is dominated by airlines, coaches, and intercity rail. High-speed rail networks are being developed in many parts of the world. But the challenge is that how many of these systems are equipped with modern health related gargets to mitigate the spread of epidemic diseases.

For instances, as of 29 February 2020, COVID-19 has spread to 60 countries and territories, of which the World Health Organization (WHO) published the number of cumulative cases in 54 Member States all through one mobility or the other at the national and international level. This is not the first that humanity is forced to face or probably the last. The people infected by the COVID-19 in the world today [4] are over 7 million confirmed cases including 426,459 deaths and still counting of which, it is generally

believed that partial or total lockdown (stoppage of mobility) is the mitigation approach.

Usually, a resilient transportation system offers a diverse range of choices: where the train are out of service, there are easily-available substitutes like taking a bus. Resilient transportation can be fueled by multiple energy sources, for the same reason: the system should be able to run on renewable energy like electricity powered by the sun or the wind. Resilient transportation systems should be amenable to retrofitting in an effort to mitigate climate change challenges, reducing the likelihood of present and future disasters that may threaten transportation infrastructure and the commuters. The most resilient systems are seamlessly connected to one another-offering maximum mobility at every scale, and for every mile of the journey; and that is where China is far ahead of the United States in resilient transportation systems.

The conversion of buses to electric power will reduce particulate matter in the dirtiest and most populated regions of the world and provide health benefits to millions of people. For instance, more than 100,000 electric buses (one-fifth of the nation's total) are on China's roads today. At this adoption rate, China's entire bus fleet could be electric by 2025. Significantly, transportation systems represent a huge portion of public and private spending—to the tune of $1.2 to $1.4 trillion globally each year. The development of city bus systems can be significantly strengthened by learning from the implementation of innovative practices and challenges faced in other urban centres; and this can be done by evaluating the relative successes and challenges of city bus reforms initiated in those countries. Global initiatives and bus reforms in recent years reinforce the fact that city bus systems will continue to be the backbone of urban mobility.

Due to the rapid spread of COVID-19, unprecedented measures like general containment and restriction on the movement of city dwellers which also led to the restrictions on the use of public transport actually reveals the low level of resilience of local mobility systems in many cities of the developing countries. At a larger scale for instance, according to the International Air Transport Association (IATA), Air France-KLM and Qantas groups in Australia are facing financial blow. Qantas claimed that the corona-virus could reduce profits for the fiscal year ending June 30 to $66 million, with losses of around $30 million, while Air France-KLM estimated a profit loss of $216 million between February and April this year [5].

Structurally for instance, the major oil- and gas-producing states (the Gulf Cooperation Council member states, Iran, Iraq, Libya, Algeria), the pandemic's impact is revealing, once again, the dangers of being over reliance on hydrocarbons for economic growth, [6]. Global oil prices are currently oscillating between $20 and $30 a barrel that mean sustained low oil prices and a deep global recession is looming if not already here. Moreover, the tourism industry, a major part of several countries' economies (the United Arab Emirates, Saudi Arabia, Israel, Egypt, Turkey, Jordan, and more), has also nosedive substantially with severe impacts on employment and government revenues [7], The following guide are meant to aid transport officials on how to use recovery and reconstruction processes to promote transport infrastructure, assets, and services that can better withstand future shocks, as well as better meet the economic and social needs in communities where the transport network operates.

i. **Apply green and climate-smart solutions:** Identify opportunities to decrease the environmental footprint of the transport sector to combat climate change and pollution.
ii. **Innovate low-cost, high-impact solutions:** Intelligent transport systems, for example, enable users and operators to make safer, coordinated, and smart use of transport networks.
iii. **Build Back Better**: Recovery and reconstruction present an opportunity to address structural deficiencies in transport infrastructure and enhance resilience to future hazard impacts.

The mass transit (bus in particular) system in Nigeria is least to be desired comparatively as it still wholly depends on fossil fuel, inefficient in service delivery and operation, lack modern innovation and proper policy implementation, bedevil by inadequate infrastructure and poor technological adoption. The pandemic crises presents great challenges to public transport providers as the occupancy of vehicles during normal regular pre-COVID-19 could only be described miserable, and keeping social distance in post-COVID-19 is top priority. Although, the fare revenues have decreased dramatically during the lockdown phase, nevertheless the public transport companies must secure the health of their employees and their passengers alike while still running public transport efficiently as possible. This paper is therefore aimed at assessing the public transport infrastructure and the need for retrofitting to meet the modern system of global pandemic mitigation in Africa (Nigeria in particular), and this is to be achieve through the following objectives:

i. Examine the existing public transport system in the Africa (Nigeria),
ii. identify the vector role of mass transit in corona-virus as a global pandemic
iii. examine global best practices in public transport management in reducing the vector role,
iv. assess the country's mass transit operational system in relation the global best practices.

Relevant Literature

Generally, in humans, there are 7 spectrum of human corona-viruses (HCoVs) known to cause the common cold as well as more severe respiratory disease as illustrated in Figure 1. Out of these, human corona-viruses HCoV-229E, HCoV-NL63, HCoV-OC43 and HCoV-HKU1 are routinely responsible for mild respiratory illnesses like the common cold but can cause severe infections in immune compromised individuals. But three of them are known to have caused deadly outbreaks, which are: SARS-CoV, MERS-CoV, and the newly identified corona-viruses now known as SARS-CoV-2 [8]. Two outbreaks of new diseases in recent history were also caused by corona-viruses – SARS in 2003 that resulted in around 1,000 deaths and MERS in 2012 that resulted in 862

deaths [9,10]. Ebola is another virus found in 1976 that impacted seriously on the transport sector, and there has been a case of recombination in Zaire Ebola virus, described by Wittman et al., [11].

The public transport order-wise call mass transit more or less a disease vector across the world when not properly managed. The first Ebola incidence in Lagos Nigeria Port was through a passenger from Togo. Transport coaches and terminals are highly vulnerable to corona-virus host droplets in all its forms, hence the need for the air liners like Egyptian Airline to fumigate all their Aircraft and terminals during the lockdown periods.

Concept of Transport Infrastructure Retrofitting

Transport infrastructure retrofitting is the act of modifying, upgrading, and installing newly developed parts or devices into the existing infrastructure to meet new rising demands. The imperative to rebuild and retrofit urban transportation infrastructure is clear and pressing due to the continuous increase in demands on the available infrastructure, and the need for effective and efficient transportation facilities and services that are essential for economic, social, and environmental well-being of the nation. More so, science and technology are advancing rapidly, bringing in new concepts, materials, designs, and methods that—when properly evaluated and deployed—can assist in addressing many of the present day infrastructure challenges thereby bringing the gap between problems and solutions. [12], as illustrated in Figure 1.

The deploying of smart ticketing allows fleet managers to keep social distancing and keeping up with smart, ID-based Ticketing. Also the Crowd Management System 'MOBILEguide' initiated by INIT, predicts the number of free spaces in bus systems based on real-time and historical data and displays the least crowded bus by light signals, Jürgen [13]. In addition, this information can be fed into passenger information systems and displayed in real-time e.g. in apps DEPARTURESlivere, (see Figure 2).

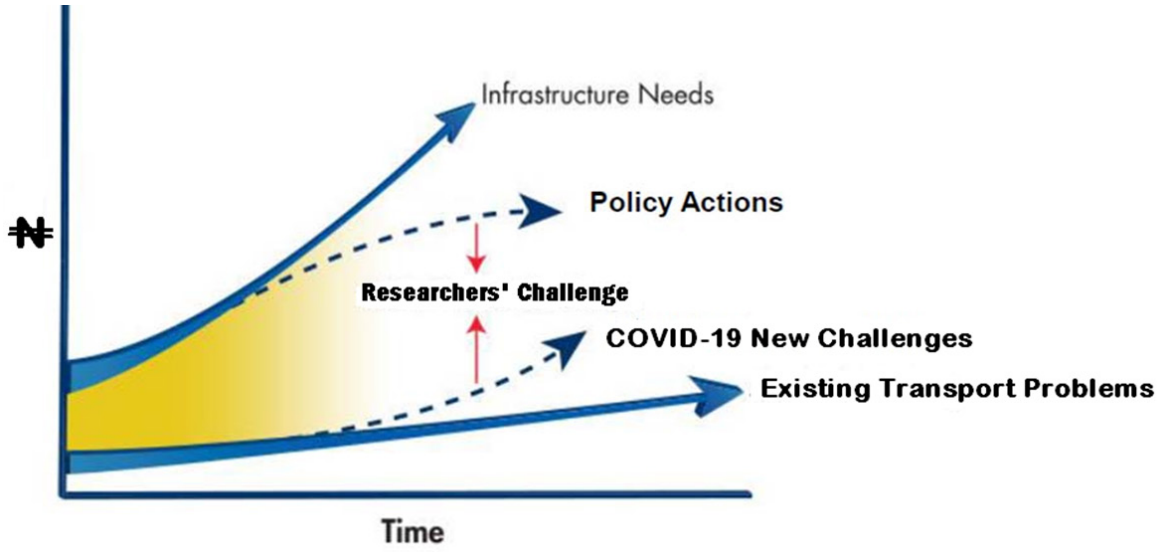

Figure 1: Transport infrastructure needs and gap bridging
Source: Adapted from Transportation Research Circular [12].

Figure 2: Overcrowding in bus services and the use of Mobile guide.
Source: Wang and James [14].

Infrastructure renovation can also take the form of adopting a 5-year overhaul cycle to return them to original standards. This then to extend the life of the fleets. For instance, the American Recovery and Reinvestment Act (ARRA), also known as the 'stimulus program', was adopted in February 2009.

Hybrid Buses and epidemic mitigation

Generally, corona-viruses thrive mostly in air polluted environment as experience in places like Italy. Transport have contributed substantially to global greenhouse gas (GHG) emissions, and is increasing dramatically by 2.1% per year. To reverse this trend, there is a global crusade for alternatives energy such as Solar, electric or hybrid electric vehicles. In Europe, Luxemburg and Italy in particular are forerunners in introducing this technology. BEVs (battery or blade electric vehicles), PHEVs (parallel hybrid electric vehicles) and CHEVs (complex hybrid electric vehicles) are present in many public transport systems, as in Beijing (China) and New York (USA) as revealed in Figure 3, cities need to introduce electric charging stations along these corridors.

ITS and the Urban Transport

Intelligent Transport Systems (ITS) can be generally defined as the application of advanced telecommunications, computing and sensor technologies to improve the safety, efficiency and sustainability of the transport system. It include a wide and growing suite of technologies and applications such as real-time traffic information systems, in-car navigation (telematics) systems, vehicle-to-infrastructure integration (VII), Vehicle-to-Vehicle integration (V2V), adaptive traffic signal control, ramp metering, electronic toll collection, congestion pricing, fee-based express, vehicle usage-based mileage fees, and vehicle collision avoidance technologies [15].

ITS technologies becomes relevant in the present day global pandemic and the ever reliance of the public on public transport, there are serious challenges of congestion and corona-viruses transmission in many countries of the world. Technology provides a rich variety of options to address existing and future automobile concerns, and ITS is at the forefront as displayed in Figure 4a.

Scheduling and Dispatching (S&D) software becomes veritable tool in addressing transport related COVID-19 challenges in modifying transit routes. Travellers now access information from differing locations such as home, work, transportation terminals, wayside areas, and on-board vehicles as illustrated in Figure 4b [16-20].

Public transport governance

Governmental policy on transport is paramount in general mobility and national development, and transport economics have

Figure 3: Guangzhou's BRT occupies the middle lanes of a road so they don't have to weave in and out of traffic to pick up passengers. Passenger boarding zones must be safe and well-designed as well. (Source: ITDP) and Seventh Framework Programme (FP7) of the European Commission.

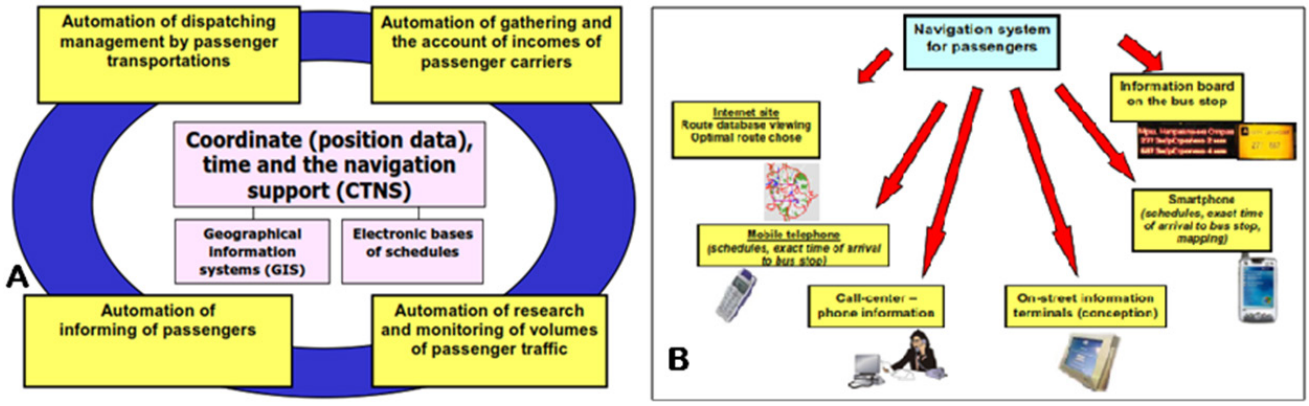

Figure 4a, b: Base technologies and Navigation system for passengers.
Source: After Dmitry B. Efimenko

established the relationships among transport, growth, income and governance. Transport governance therefore as social capital requires special attention for the enhancement of transport delivery and services [21]. The OECD defines transport governance as networks, together with shared norms, values and understandings that facilitate co-operation within and among groups [22]. Transport infrastructure management is unfortunately susceptible to corruption can account for as much as five to twenty percent of transaction costs [23,24].

Good transport governance therefore, must be inclusive fostering growth and enhanced contribution of civil society in promoting a more equitable distribution of transport infrastructure assets and services including their accessibility [25,26]. Transport governance can perhaps be viewed as "the single most important factor in eradicating isolation, deprivation, access problems of marginalised, peripheral and disadvantaged communities in developing countries [25,27]. For instance, in March 2011 the European Commission adopted the White Paper - Roadmap to a Single European Transport Area 2, which proposes that the transport sector will reduce GHG emission to about 20% below their 2008 level while still meeting up with the mobility demand, [28].

Methodology

The Study Area (Abuja)

Abuja, the capital city of Nigeria is located in the centre of the country, within the Federal Capital Territory (FCT). As a planned city, it officially became Nigeria's capital on 12 December 1991, replacing Lagos which is similar to Brazil building its capital Brasília. At the 2006 census, the city of Abuja had a population of 776,298 but as of 2020, it has population estimate of 3,278,000. Abuja a purpose built city in Nigeria, it is endowed with high intra-city road network of international standard in accordance to

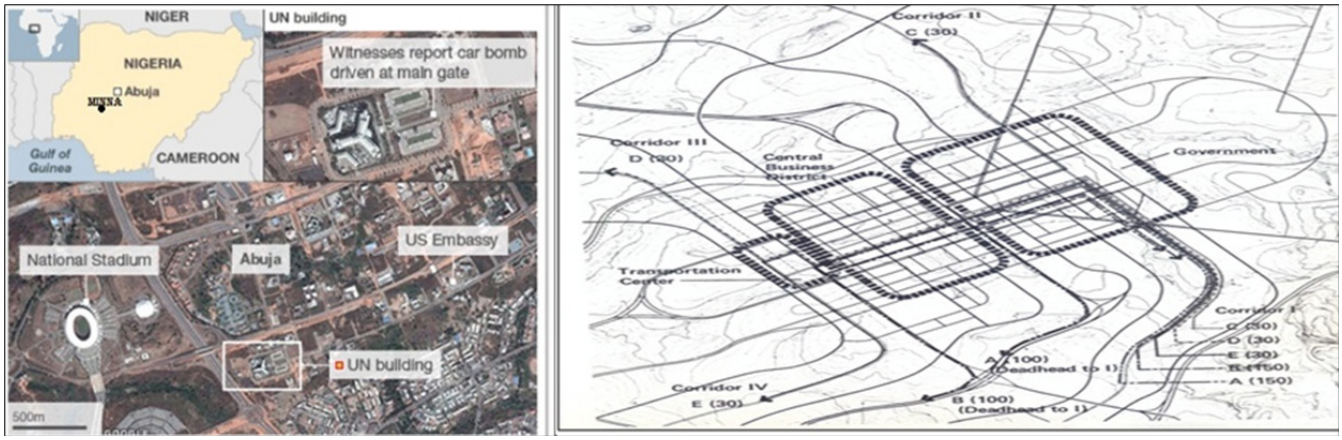

Figure 5: Central Area Bus Operation (Abuja Master Plan Extract).

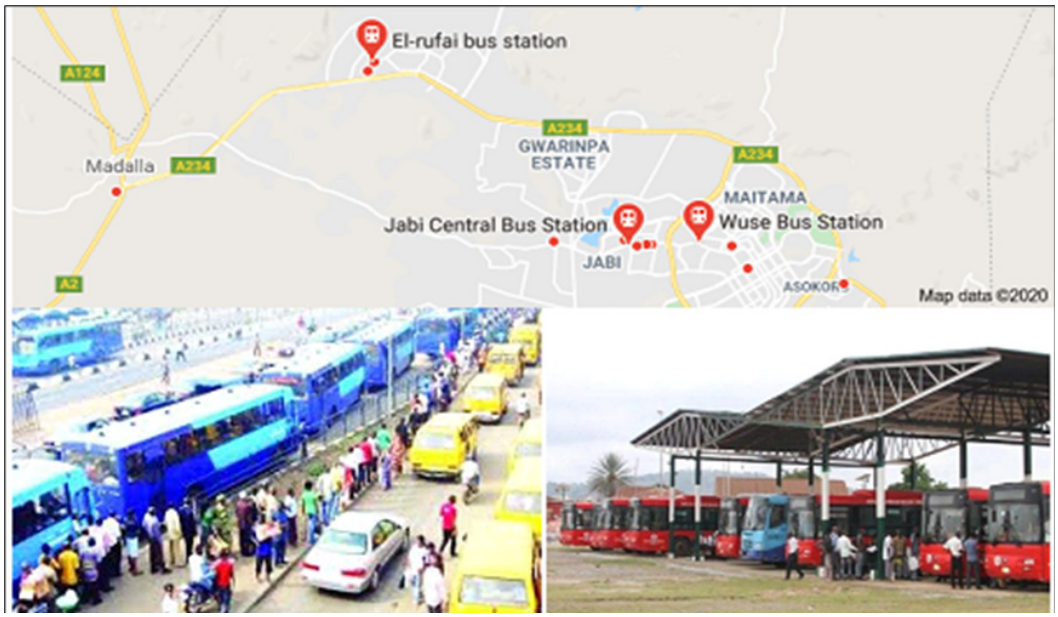

Figure 6: Bus terminals at Berger and Nyanya of Abuja, Nigeria.

the master plan preparation. The grade separated intersections are comparable to any of the developed countries of the world, see Figure 5 for some of such intersection within the city.

Data Collection and Processing

This study simply adopted the generic field observatory survey of the mass transit infrastructure facilities and their operational system. We also carried out detail review of relevant literature on global best practices in mitigating and adapting the public transport to the current global pandemic. Opinion survey and a simple framework for analysis were discussed, with exemplar case studies were provided to demonstrate the utility of such an approach in guiding better policy formation.

Observed Public transport operation in Nigeria

Private vehicle ownership in Nigeria seems to have skyrocketed, but for many people, especially low-income and welfare dependent families, public transportation is the only source of mobility. There is therefore the need for adequate, affordable and efficient public transportation in the city and the country at large. Following the growth in transport demand and the attending negative consequences; the Federal Government of Nigeria (FGN) in 1993 introduced National Transport Policy (NTP) that is aimed at achieving sustainability in the transport system.

When discussing bus terminal in Abuja, four terminals comes to mind which are: Berger, Area-1, Zuba and Nyanya. Berger terminal is very close to Wuse, the first popular terminal in phase one of Abuja Area-1 is another major terminal that host hundreds of both min and high capacity buses daily. It is not uncommon to hear drivers and conductors shouting "Area-1." all because many people get to Area-1 before connecting to their location.

Zuba is in the outskirt of Abuja as it service residents that lives in satellite towns like Lugbe, Gwagwalada, Dei Dei, Madalla and Suleja amongst others. Travellers going out of the capital city to neighbouring states like Niger, Kebbi, Kaduna and Kano also make use of the terminal. Dutse-Alhaji is the terminal that serves people living in places like Bwari, Kubwa and environs. The congestion here is much due to the popular weekly Dutse market situated beside it. **Nyanya terminal** is quite popular to both residents and non-residents because of its location at the border between Abuja and Nassarawa State. The terminal also serve vehicles going to Plateau, Bauchi, Kaduna, Nassarawa and other northern states.

The Nigeria's transport infrastructural facilities from every indication reveal that the NTP is yet to impact positively enough on the transport operations. More unfortunately, the outbreak of COVID-19 has compounded the existing glaring deficit in the transport infrastructure; the government has adopted the Public-Private-partnership (PPP) initiative to align with global trends in transportation infrastructure development. The existing terminal has not in any way support or being able to cope with the global pandemic, [29]. Figure 6 is a typical bus terminal scene in the Nigeria's Federal capital City (FCC) in comparison to the earlier discussed best practices.

The intrusion of COVID-19 pandemic in Nigeria with Abuja being one of the index cities after Lagos, the total lockdown policy to curtail the spread of the virus forces many operators to suspend their operation. The ban on intercity travel has also put an end to the activities of many carriers. The shutdown of these services has favored the development of clandestine passenger transport offers. For instance, trucks of goods have started offering passengers to hide in trailers in order to pass through police checkpoints, while many have leave the metropolis through non-motorized roads that are not controlled by the police. After the total lockdown, bus service demand is at its lowest ebb in which many drivers report that their wages have fallen on average by around 50% even though their personal expenses increased during the crisis, while crews are required to enforce the wearing of masks, disinfect their vehicle regularly and provide users with hydro-alcoholic gel or something to wash their hands, CODATU [30].

The challenging issue is the adaptation of those buses and their terminals to a more sustainable urban mass transit system that are none-epidemic-spread compliance.

Discussion

Nigeria does not manufacture vehicle even though there are some moribund assembly plants in the country and more so, the value system encourage private car ownership that is aggravated by the prevalence of public fund looting. Public transport is relegated to the background due to lack of inclusive governance, [31]. The few available public transport operators are bleeding financially due to lack of access to capital and therefore operate outdated second (tokunbo) vehicles that are not environmental friendly in the country.

The spate of global COVID-19 pandemic, global warming and climate change impacts across the world and the urban traffic gridlocks necessitated the crusade for Smart city in the form of green mobility and ITS technologies. Nigerian roads lack basic infrastructure that are amenable to automated vehicles for efficient service delivery and real time transport management. The existing public transport operating system is least desired as it is characterized with all forms of negativities even though the average income earner and the poor masses are captive to it.

The advancement in ICT and its adoption in the transport sector has metamorphose into the present day global village, smart city, smart mobility, smart economy, smart people, and smart government crusade of which no African city has attained and can attain in the nearest future going by the present pace of technological advancement and political system [32].

Global Initiatives and Best Practices for Adoption

Bus Terminal Design and Automation

Bus terminals facilities needed by transport operators and passengers at the beginning, within and at the end of a trip are often points of population agglomeration. In planning for terminals that will meet present and future needs of the society in term of health safety, the structural engineering, automated temperature sensors

and durable hand sanitizers must be installed at the entry and exit of both terminals and buses. Terminal Capacity enhancement is of major importance in planning for the increase in flow and throughput of buses, and to facilitate the throughput of buses, the design may incorporate two lanes for parking and an overtaking lane at each platform, [14]. Some BRT systems are expected to adopt prepaid smart card as best practice where card readers are install at terminals, see figure 7 for such standard design.

New Brunswick's anti idling policy

New Brunswick is moving forward with a new Intelligent Transportation Systems (ITS) strategic plan by building on Road Weather Information, Weigh in Motion and traveller information networks. A green vehicle and anti-idling policy for the government fleet is in place. As part of fleet efficiency, a hybrid school bus is being tested as well as the use of bio fuels in school buses, heavy equipment and light vehicles with the goal to evaluate optimal engine performance.

National Transport Master Plan (NATMAP) 2050

According to UN Habitat, the National Transport Master Plan (NATMAP) 2050 is a 45 years journey which started in 2005 and not an overnight event [33]. The UN Habitat Sustainable Transport for Africa 2050 is a major initiative that tends to engineer African countries to imbibe global practices. In Kigali for instance, in response to the present global corona-virus pandemic, the municipality public transport authority has put in place ground markings to guide bus users in the adherence to social distance as against the hitherto overcrowding and risk taking in hanging on buses in many African cities as revealed in Figure 8. Although, this can also be automated with the aided IT software where other required infrastructure are available.

Conclusion

Sustainable public transport system is a function of good transport governance in any nation as it tends to provide mobility to all at a relatively lower cost while still meeting eco-friendly developments. The seemingly continuous global corona-virus challenges on spatial interaction via all the transport modes calls for technological interventions in retrofitting the existing transport infrastructure that are almost impossible to replace due economic imbalances.

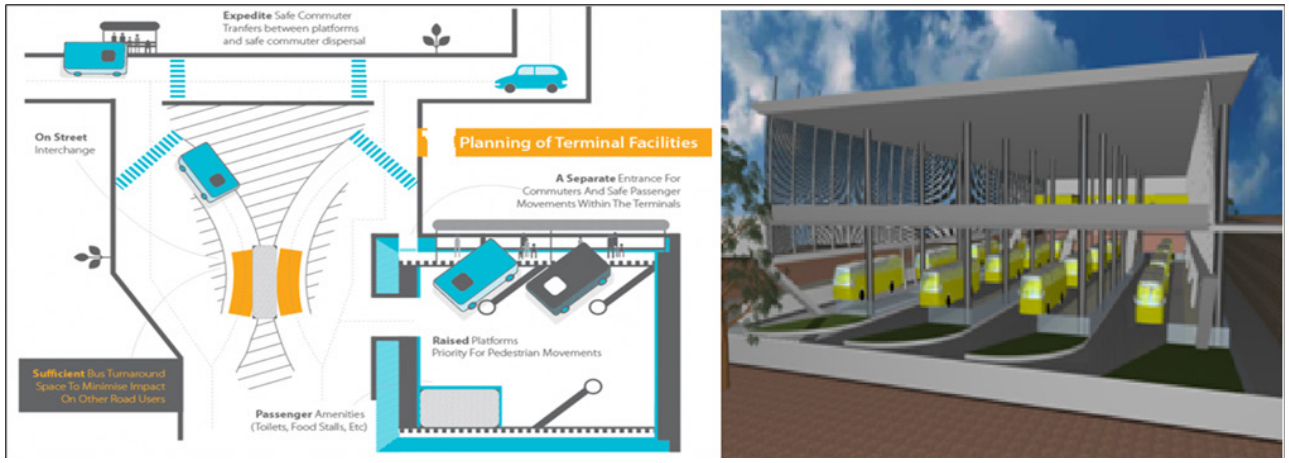

Figure 7: Bus terminal design and automation.
Source: Wang and James [14]. Solutions Factsheet 1.5

Figure 8: Ground marking in bus terminal for social distancing at Kigali.
Source: Municipality of Kigali; May 2020

Developing countries that are usually characterized with bloated population and low human capacity cannot but embrace retrofitting as panacea to the upgrading of their existing mass transit infrastructure to mitigate the corona-virus continuous challenges.

Recommendations

Based on the foregoing discussion, the following recommendations are given:

i. Past experiences globally and in Africa in particular reveals that epidemic outbreak of varied magnitude has come to stay with mankind (Malaria fever, HIV, Ebola, SARS, COVID-19, etc), the public transportation in Abuja and in other cities of the country must retrofit all the buses and the terminals with adequate modern technology software like to Automatic Passenger Counters (APC), Scheduling and Dispatching (S&D), and Signal Priority (SP).

ii. The government should as a matter of urgency invest into the public transport sector of the economy that will enhance modal split; while introducing transport policies that discriminate against private vehicles intermittently during the traffic peak hours.

iii. Smart city crusade should be seen by African countries and Nigeria in particular as a panacea to the major environmental challenges and not as a continental discriminator tool.

iv. Inclusive city planning particularly in the transport sector should be enhanced for a sustainable transport management system.

v. The Federal Government should commence the implementation of strategies that will metamorphous the country's transport system to less motorised and hybrid bus green mobility that will dovetail into the smart city system.

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