

Chinonso Uchenna UDOJI, Janusz SZPYTKO
AGH University of Science and Technology (Akademia Górniczo-Hutnicza)

THE CONCEPT OF A SUSTAINABLE URBAN TRANSPORT SYSTEM MODEL FOR DEVELOPING COUNTRIES ON THE EXAMPLE OF LAGOS

Koncepcja modelu zrównoważonego systemu transportu miejskiego dla krajów rozwijających na przykładzie Lagos

Abstract: *The subject of the article is the concept of a sustainable urban transport system model for developing countries on the example of Lagos in Nigeria. The city of Lagos is the largest and most populated city in Africa. Nowadays, the state of Lagos is facing many challenges, and the problem of urban transport is becoming more and more important due to the increase in the number of inhabitants and the size of the city. Significant problems were identified in the urban transport system in the Lagos state, and conceptual solutions were proposed taking into account the approach of sustainable development.*

Keywords: risk urban transport, sustainable development, safety in transportation

Streszczenie: *Przedmiotem artykułu jest koncepcja modelu zrównoważonego systemu transportu miejskiego dla krajów rozwijających na przykładzie Lagos w Nigerii. Miasto Lagos jest największym i najbardziej zaludnionym miastem w Afryce. Stan Lagos stoi obecnie przed wieloma wyzwaniami, a problem transportu miejskiego jest coraz bardziej istotny z uwagi na wzrost liczby mieszkańców i powierzchnię miasta. Zidentyfikowano istotne problemy w systemie transportu miejskiego w stanie Lagos i zaproponowano koncepcyjne rozwiązania uwzględniające podejście zrównoważonego rozwoju.*

Słowa kluczowe: transport miejski, zrównoważony rozwój, bezpieczeństwo transportu

1. Introduction

The origin of transport systems and devices goes back to the creation of man and all other living creatures because they all have the ability to move and they need to move to work efficiently [19]. This proves why transport systems and devices are part of the society [19]. This is why several researchers have put in so much work to end transport problems and improve the well-being of individuals in the society. Scientists have warned since the 1980s that strong policies are needed to limit the emissions of greenhouse gases. Various countries and international communities have devoted effort to cope with the situation but due to the constant increase in the population and urbanization that has led to constant carbon emissions, greenhouse gas emissions have increased. According to the Environmental Protection Agency [10], transportation contributes to 14% of global greenhouse gas emissions.

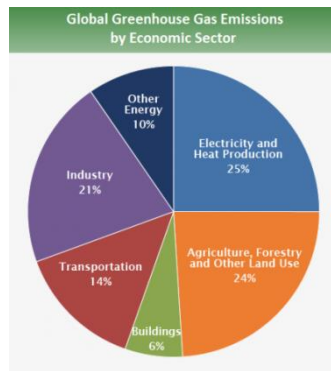


Fig. 1. Global greenhouse gas emissions by Economic Sector [10]

Greenhouse gas emissions primarily involves fossil fuels applied for road, rail, air, and marine transportation. Almost all (95%) of the world's transportation energy comes from petroleum-based fuels, mainly gasoline and diesel [10]. The population rise has caused a huge increase in road users especially in developing countries [19]. This has led to the overuse and deterioration of the existing low quality road systems and devices. Therefore, a sustainable transport system needs to be considered. Urban transport systems in most developing countries (especially in Africa) is road-based. Transportation systems in developing countries are confronted with several obstacles. We lack the quality road infrastructure: most of these countries do not have good road infrastructure. This means that every type of vehicle uses the same tracks. The lack of telecommunication infrastructure is another problem in these countries. The infrastructure in these areas does not allow an adequate deployment of communication between entities that constitute the road transport system. What is more, we also lack an effective road network monitoring system [15].

Objectives of the study. Identify the key causes of problems in the transportation sector. Identify if the transport engineering solutions, which are aimed to enable the urban

transport system concept in developing countries, will be useful to increase the urban transport availability in developing countries. Set up system model and a concept to solve the problem.

Novelty of this research

After the thorough review of several references, it was concluded that no author has published work on the following issues: the possibility of technology transfer of the working public transport system in Europe (Poland) to Nigeria, risk analysis of the existing transport system in Lagos in Nigeria and the possibility of renewable energy powered transport devices and petroleum as a substitute. This manuscript covers all of these helpful studies.

Current Situation

Nigeria, as the most populated country in Africa, has the largest road network in West Africa and the second largest in the Sub-Saharan Africa. It consists of 36 states and the state with the smallest land area (1,171 km²) is Lagos, which is located in south-west Nigeria and it is the most populous state in the country with over 21 million inhabitants [7]. Nigeria, especially its economic capital, Lagos, is currently facing enormous infrastructure challenges and there is a need to cope with the increasing demand for transport. This is especially acute as much of the existing road infrastructure in African cities is far from being appropriate for the actual transport demand. In addition, apart from a few remaining companies, almost all publicly owned and managed public transport enterprises in Africa ceased to exist during the 1990s, often as a consequence of structural adjustment policies required to comply with aid programmes associated with international agencies. Therefore, the public transport sector has suffered more than 15 years of negligence, and this, combined with escalating urban populations, has resulted in chaotic, unsustainable, time- and money-wasting transport systems in most African cities [8].



Fig. 2. A typical bus terminal in Lagos [8, 22]

There are seven major road public transport devices that ply various routes and cover various distances in Lagos;

1. Motorcycle (Okada)
2. Auto Rickshaw (Keke Maruwa)
3. Mini Bus (Korope)
4. Taxi
5. Medium Commercial Bus (Danfo. “Danfo” means “stands on its own” and refers to an integral construction medium bus)
6. Large Commercial Bus (Molue. “Molue” means “molded,” the vehicle with a truck chassis)
7. Bus Rapid Transit System (BRT)

S/N	ROAD TRANSPORT DEVICE	MAXIMUM NUMBER OF PASSENGERS	AVERAGE DISTANCE COVERED PER TRIP (KM)	OWNERSHIP
1	Motorcycle	2	2	Private
2	Auto Rickshaw	4	2	Private
3	Mini Bus	7	2	Private
4	Taxi	5	5	Private
5	Medium Commercial Bus (Danfo)	18	80	Private
6	Large Commercial Bus (Molue)	80	80	Private
7	Bus Rapid Transit System (BRT)	80	120	Government



Fig. 3. Motorcycle (Okada) [22]



Fig. 4. Auto Rickshaw (Keke Maruwa) [22]



Fig. 5. Taxi [22]



Fig. 6. Mini Bus (Korope) [22]



Fig. 7. Medium Commercial Bus (Danfo) [22]



Fig. 8. Large Commercial Bus (Molue) [22]



Fig. 9. Bus Rapid Transit System (BRT) [22]

All road transport vehicles in Lagos state do not have a permanent route except the Bus Rapid Transit System (BRT), which is owned by the government. The Bus Rapid transport system was introduced to Lagos state in March, 2008 and since then, it has been used by over 25% of all commuters. It plays a key role in the city's ongoing effort to reduce vehicle congestion [9]. Telematics has recently become a huge tool for an efficient transport systems in several parts of the world. Telematics for these BRT buses was introduced in Lagos in March, 2008.



Fig. 10. Telematics in Lagos, Nigeria [22]



Fig. 11. Lagos BRT bus route Source [11]

Telematics was introduced alongside with the BRT buses to aid the efficiency of the buses. This feature (telematics) could not work in Lagos state as a result of several factors, such as:

- I. Heavy traffic delay causing uncertainty of the arrival time of the buses
- II. Lack of the power supply in bus stations to power the telematics devices
- III. Lack of internet connection
- IV. Poor maintenance of the telematics devices
- V. Unavailability of transport devices due to technical failure of buses, etc.

It is obvious that the transport system in Lagos state, Nigeria is highly unreliable. The transport sector in Nigeria has several problems. In 2011, Oni listed several issues with the transport sector in Nigeria, such as:

- I. Inferior quality of networks,
- II. Shortages and malfunctioning of transport equipment and furniture
- III. Lack of executive capacity and technically-qualified personnel
- IV. Inadequate planning and coordination, and several others.
- V. Poor maintenance of transport devices and buses [16]

Road transport vehicles are one of the major causes of CO₂ emissions in Lagos. Reliability of transport systems is very important in every society. Therefore, solution to these problems is the main objective of this research paper.

2. Proposed solution

The transport sector in Lagos, Nigeria is currently facing several setbacks. When the government introduced the Bus Rapid Transit buses in 2008, there was a small improvement in the transport sector but due to the poor maintenance culture, most of the buses are not operational. Therefore, establishing a maintenance organization for the BRT buses should be encouraged. It will be a subsidiary of the existing Lagos State Transport Maintenance Agency (LASTMA). They will handle the repairs and maintenance of all transport devices, transport planning and coordination. Also, the introduction of articulated BRT buses is recommended, due to the fact that the number of the existing buses is often insufficient.

Lagos is constantly polluted with CO₂, thereby putting every inhabitant of the city at a health risk. All public transport vehicles in Lagos use fossil fuels as their energy source. The inception of hybrid-energy bus (use of 2 or more adoptable and distinctive energy sources) would go a long way in reducing the carbon footprint of the city. Solar-Petrol hybrid bus is the most suitable and adoptable solution for Lagos, because petrol and solar energy are readily available there.

Due to the factors like unavailability of electricity and internet, uncertainty of bus arrival time and several other factors, transport telematics systems cannot be installed in Lagos. Installing the proper bus stops with paper timetables showing bus routes as well as arrival and departure times is more feasible for this particular transport system and therefore, it should be encouraged.

Improving the road networks is very essential for a reliable and safe transport system. The bad road networks have led to several road accidents. In 2003, the Federal Government of Nigeria introduced the Federal Road Maintenance Agency (FERMA). The primary role of this agency is to maintain all roads in Nigeria. Despite the establishment of this agency, the roads in Lagos are still in perilous condition. The government and the Federal Road Maintenance Agency (FERMA) need to devote more effort to improve the road conditions in Nigeria, especially in Lagos.

3. Conclusion

Lagos is Africa's largest and the most populated city in Africa. Lagos is currently facing a lot of challenges and transportation, which is a never-ending problem due to the increasing population and the size of the city. Implementation of the above solutions will put an end to several problems in the Lagos state. The following can be achieved after the implementation of the following solutions:

1. Improvement of traffic in the Lagos state
2. Reduction of the fuel consumption
3. Increase in safety and security in the city
4. Reduction of unauthorized vehicle
5. Enhancement of traffic safety
6. Reduction of traffic pollution emission
7. Ensuring vehicles' maintenance
8. Improvement of the transportation system in the city

Improvement of traffic in the Lagos state

This seems really difficult but is still achievable. This can be achieved by the following measures:

- correction of distressed pavements
- construction of new roads and bridges to aid movement
- improvement of waterways to reduce the use of roads in the Lagos state.



Fig. 12. Current situation of some roads in Lagos State (Source: punchng.com)

Damaged roads constantly result in breakdowns of automobiles, thereby causing heavy uncontrollable traffic.

Improvement of the public transport system

The objective of improving the public transport system is to make the public transport a reliable, available, accessible and sustainable system. The following can be done to improve the efficiency of the public transport system.

- Getting rid of worn out public and inefficient vehicles like the Molue and Danfo buses and replacing it with efficient public automobiles will encourage more people to use the public transport systems rather than using their private cars, thereby reducing traffic on the roads.
- Introduction of hybrid buses into the public transport system. These buses will use solar and fossil fuels as their energy source, because they are readily available in the city. This will help to reduce the carbon footprint in the city.
- Introduction of articulated buses into the public transport system will increase the number of passengers. Considering the fact that Lagos is a very populous city, there are always more passengers awaiting different buses than the available buses. It results in passengers being constantly in a rush to get into the public buses. The need to introduce articulated buses is important as they are bigger and more sufficient than the normal BRT buses.

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