

# RETHINKING TRANSPORTATION: PLANNING AND BUILDING RESILIENT SYSTEMS TO MEET GLOBAL EXTERNALITIES

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## ABSTRACT

There is a need for the current transport systems and most commonly chosen modes of transport to change. This of course includes mostly shifting towards public transport. Implementing change in existing transport systems will result in the reduction of congestion in towns and cities, an increase in parking spaces and a reduction in the carbon footprint. The introduction of modern innovations like long-life pavements, clean and fuel-efficient vehicles, eco-flying and alternative fuels will facilitate in meeting global externalities.

## 1. INTRODUCTION

Social, economic and environmental developments are made possible by the driving force that is transportation. Unfortunately due to an increase in populations globally, current transport systems are causing adverse effects on externalities like air pollution and traffic congestion. This essay presents how transport systems can be redesigned for them to be sustainable.

## 2. DETERMINANTS OF CURRENT TRANSPORT SYSTEMS AND TRANSPORT MODE CHOICE

Transport systems can be defined as the combination of elements and their interactions, which results in demand for travel within a given area and the supply of transportation services to meet the demand (Cascetta, 2013). Transport systems are the backbone of passenger mobility, and this is why it is crucial for updating and rethinking these systems to better suit the ever-changing priority of global externalities. According to Rodrigue (2020) transport modes are the means supporting the mobility of passengers and freight.

Passenger flights and cars are the most commonly used modes of transport yet the least efficient forms of passenger transport and they produce the highest greenhouse gas emissions. Due to increasing populations, these modes of transport that play a crucial role in the current transport systems are now faced with challenges. The most vital transport challenges occur when urban transport systems cannot adequately satisfy the requirement of mobility which then affects social and economic development. Taking flights and individual car ownership continues to grow globally. This is common in urban areas and developing countries.

Travel mode choice is influenced by a range of elements which include socio-demographics, built environment and attitudes (Cheng et al., 2021). Most people prefer using cars in urban areas and taking flights for long distances for a variety of advantages like comfort, status, speed and convenience. However, in terms of socio-demographics

and urban transport, there have been several challenges that are emerging which include environmental impacts and energy consumption, high infrastructure costs, loss of public space and traffic congestion and parking difficulties.

When it comes to attitudes, there is a need for the general public to be educated on the transport systems that result in negative global externalities. For example, in rural areas of developing countries, not having a personal car may be deemed as a sign of being poor and people would rather purchase personal cars instead of using public transport systems or walking. However, this comes as a great task on the municipal governments in transport service delivery because the public transport systems that are currently available are discouraging. Challenges that are faced by public transport systems, especially in Africa include public delivery being slower than personal cars, low stage of comfort, no flexibility in timing and noise just to mention a few.

### **3. RESILIENCE AND SUSTAINABILITY OF TRANSPORT SYSTEMS**

Statista recently identified the African population as the largest growing population, with their statistical calculations showing that the African population would have caught up to the Asian population by 2100 (Saleh, 2022). It is pivotal for African governments to come up with more resilient systems that will be sustainable. In light of the upcoming 2030 deadline given by the United Nations (UN), greater effort has to be invested in transport systems to ensure that the Sustainable Development Goals (SDGs) are implemented and met. The Sustainable Development Goals are a global call to action to end poverty, protect the earth's environment and climate, and ensure that people everywhere can enjoy peace and prosperity (Sandhiyadevi, 2021). Five SDG goals are directly related to the transport sector, addressing road safety (SDG 3.6), energy efficiency (SDG 7.3), sustainable infrastructure (SDG 9.1), urban access (SDG 11.2), and fossil fuel subsidies (goal 12.c.1).

Furthermore, Rodrigue (2020) defined resilience for a transport system as the capability to recover from a disruption to an operational level similar to prior level of disruption in a timely manner. With continuous globalisation and urbanisation, there is a need to build resilient and efficient transport systems that reduce challenges to the economic, social and environmental sustainability of societies. These resilient systems will assist in combating negative global externalities associated with transport. Externalities can be generally defined as negative consequences that result from human activity either affecting Mother Nature, economic activities or resulting in social issues. These externalities include harm to the environment and to roads, accidents, traffic, and dependence on natural resources that are running out like oil and petrol. Emissions of greenhouse gases are the current externality issue with the highest priority and complexity to which transportation accounts for 24% of total emissions and this is expected to grow at a faster rate than any other sector (Wang & Ge, 2019).

In addition, the issues brought by the negative externalities have made it more than ever to shift towards more sustainable transport systems. Richardson (2005) explained a sustainable transport system as one in which fuel consumption, vehicle emissions, safety, congestion, and social and economic access are of such levels that they can be sustained into the future without causing great or irreparable harm to future generations of people all over the world. Sustainable transport can also be defined as any means of transportation that is 'green' and has low impact on the environment.

The objectives of sustainable transportation have been simplified into considerations of environmental, social, and economic integrity. Transportation systems have environmental

externalities. Transportation systems contribute to both deteriorating air quality and a changing climate through emissions from burning fossil fuels. Additionally, transportation contributes to air pollution, water pollution, and ecological disruption through a variety of direct and indirect interactions. Environmental change will have an impact on transportation networks as well. Increased frequency of weather extremes could disrupt infrastructure, affecting transportation networks as a whole. In some regions, roads may be subjected to more freeze-thaw cycles, while in others, direct heat damage to both road and rail systems may occur. The marine sector may be subjected to taking new shipping routes as sea ice melts. The aviation industry may have to deal with greater atmospheric turbulence and heat-related aircraft performance reduction (Banister et al., 2011).

In terms of transportation and society, mobility is one of the most fundamental characteristics of human activities. It meets the fundamental need of getting from one place to another, a need that is shared by both people and freight for various reasons. Mobility is a reliable sign of progress. With regards to the economy, access to a workforce, reaching suppliers, and customer service are all made possible by transportation. When transportation is improved, interactions with the workforce are more successful, and distribution costs typically go down as a result of the competitive advantages.

Resilient transport systems should also be able to combat global shocks. In terms of a pandemic like Covid-19, major improvements such as increased ventilation without recirculation and reduction of passenger density on public transport will reduce the spread of the virus. Developing countries especially in Africa will benefit from underground trains during wars. Underground trains provide cover and decrease the threats posed by bombings as the locomotive are not easily tracked.

#### **4. INNOVATIVE SOLUTIONS THAT WILL MEET GLOBAL EXTERNALITIES**

In order for transport systems to improve, designers need to rely on results obtained from research and previous transport systems. Appropriate policies and solutions must be created to maximize the benefits of transportation and reduce its drawbacks for transport systems to live up to their full potential. The following are solutions that can be planned or improved by appropriate authorities to reach the best forms of sustainable transport.

##### 4.1 Non-Motorised Transport

This form of transport comprises of walking, cycling and variants such as small-wheeled transport (skates, skateboards, push scooters and hand carts). Even though this is not a new form of transport it results in the production of zero emissions and pollutants. Urban areas should be designed in such a way that these modes of transport can be easy to use and more advantageous. Towns and cities need to ensure that walking and cycling networks connect with other transport networks (Cheng et al., 2021). This can be done by implementing new infrastructures:

- *Modernised pedestrian walkways and widened sidewalks:* These will make walking an attractive option. Footpaths need to be in good condition and well lit, with plants, benches, and street art to encourage users.
- *Raised, segregated and wider bike lanes:* These have proven to be far more effective at encouraging cycling through improving the major issue of safety.
- *Secure bike parking infrastructure:* Bike parking should be visible and prominent to ensure cyclists can find it, and to make bike theft more difficult.

- *Traffic light signalling that prioritises people travelling by foot or bike:* This allows people shorter waiting time to cross the road and helps cyclists to avoid red lights.

## 4.2 Public Transport and Modal Integration

Public transport has the greatest potential when it comes to meeting global externalities and this is because it contributes so many solutions to current transport problems. By getting a large number of people in one vehicle emissions per person will be reduced. Having fewer vehicles will also reduce the ever-growing issue of road rage. Public transport provides other advantages like improved accessibility, mobility, safety and is affordable (Rodrigue, 2020). To improve public transport from previous systems they must be made more attractive for passengers. This can be achieved by beating negative stereotypes about public transport through state-of-the-art facilities and deliverance.

### *4.2.1 Light Rail Transit (LRT), Trams and Bus Rapid Transit (BRT)*

These are the most efficient and sustainable ways to move large numbers of people across the urban areas. These systems provide lanes or tracks that are legally reserved for these modes of transport, resulting in minimum delay due to traffic. Integrated operations can be used to conduct studies and can help generate timetables that will best suit the demand generated in each area over a specific season. They can be funded through:

- Public finance.
- Public subsidy.
- Raised revenue.
- Private investment.

### *4.2.2 Public Transport Planning Can be Improved by Getting More Stakeholders Involved*

Planning, operating, and charging for physical travel in a whole-network, integrated way can also be done by making use of new technologies and apps. Transit agencies can make use of new technologies, such as smartphone applications, to make their services more fashionable and easier to use.

## 4.3 Long Life Pavements

The life span of pavements can be extended by the introduction of new materials like geosynthetics. Geosynthetics are still being introduced to various civil engineering projects like road construction. They are manufactured synthetic materials that have various properties classified as physical properties, mechanical properties, hydraulic properties, endurance (durability) properties and degradation properties. It is because of these properties that materials can perform functions like separation, filtration, reinforcement, stiffening, drainage, barrier, and protection which extend the life span of the pavement (Müller & Saathoff, 2015). They are cost effective and environmentally friendly and promote much more durable and sustainable infrastructures.

## 4.4 Clean and Fuel-Efficient Vehicles

Fuel-efficient vehicles require less fuel to operate compared with older vehicles. They save fuel costs and emit fewer greenhouse gases. Hybrid electric vehicles, plug-in hybrid electric vehicles, and all-electric vehicles use electricity to improve vehicle efficiency. These have the capability of fuel saving by using an electric motor in replacement of a combustion engine during multiple stages of driving (Cheng et al., 2021). Enforcing more

use and production of these vehicles will drastically drop the carbon footprint of transport systems.

#### 4.5 Eco-Flying

Flying goes to the bottom of the list in terms of environmentally friendly modes of transport. Flights produce large amounts of greenhouse gases. But recently, there has been an introduction of eco-flights which are airfares that have a lower impact on the environment. For example, since 2008 the Koninklijke Luchtvaart Maatschappij Royal Dutch Airlines's (KLM) climate action plan has ensured that the airline is more sustainable in the sky and on the ground. The company's Carbon Reduction Roadmap has a set goal of reducing its total carbon footprint by 15% in 2030 compared to its 2005 emission levels (Mi et al., 2017). Flights can also use new technologies to set more efficient flight paths and reduce delays.

#### 4.6 Alternative Fuels

Sustainable transportation options run on clean fuel, batteries, or both. Flexible-fuel and dual-fuel vehicles, as well as those equipped with cutting-edge technologies like fuel cells and hybrid power systems, can all run on alternative fuels. Alternative fuels aid in fuel conservation and emissions reduction. Modern automobile battery technology provides faster charging times and longer driving distances. As a result of continual research and development, their prices are decreasing. They include biodiesel, electricity, ethanol, hydrogen, natural gas and propane.

### **5. CONCLUSION**

The main outcomes of sustainable transport include environmental protection and improved public health through the reduction of greenhouse gas emissions and better air quality, increased energy efficiency and reduced traffic congestion due to the use of more efficient vehicles, better route planning, and the promotion of public transportation, cycling, and walking. Lastly, planning for resilient transport systems will enhance social equity and economic competitiveness since sustainable transport will reduce costs of transportation hence increasing productivity and improving the quality life of passengers.

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