

# RETHINKING TRANSPORTATION: PLANNING AND BUILDING RESILIENT SYSTEMS TO MEET GLOBAL EXTERNALITIES “RESILIENT RAIL INFRASTRUCTURE”

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## ABSTRACT

Rail infrastructure is an important element of the transportation network in Africa, and its importance has been growing over the years due to the increased demand for efficient transportation systems. With factors like climate change, rapid population growth, and urbanisation rate, it is inevitable that there will be shortages of infrastructure in the years to come hence the need for resilient infrastructure. However, rail infrastructure is susceptible to a range of hazards, including fire, which can cause significant damage and disruption. This essay will examine the issue of rail infrastructure resilience in Africa, with a particular focus on fire safety. Fire safety is a crucial aspect of rail infrastructure in Africa and investing in it, enhances resilience of rail infrastructure. There has been an increase in fire related incidents over the past years. This shows a careless treatment of fire safety of the railway infrastructure in Africa and calls for all stakeholders to work together and implement fire safety in rail infrastructure. The essay will begin by defining the concept of resilience and discussing the factors that contribute to rail infrastructure resilience. It will then examine the specific challenges and risks associated with fire safety in the context of rail infrastructure in Africa. Finally, the essay will explore some strategies and best practices for enhancing rail infrastructure resilience in Africa with respect to fire safety.

## 1. INTRODUCTION

Railway transportation is an essential component of many countries' and continents' transportation systems, allowing goods and people to be transported over long distances. For a modern economy to thrive, a functioning and efficient transport system is required to successfully supply the needed goods and services. With the ever-growing demand to have sustainable and resilient infrastructure due to factors such as climate change, terrorism, population, and industrial growth, it's imperative for Africa to invest in resilient infrastructure. Weather and climate cause about 90% of the disasters in Africa, and this is expected to worsen with time due to climate change (“Building Resilience in Africa”, n.d.). The transportation system is vital for the economy hence any disruption in the system caused by disasters may affect many activities, and sometimes prolonged disruptions have major impacts on administration and society. In addition to natural hazards, accidents and terrorist attacks often cause disruptions with enormous impacts. These accidents and attacks may cause fatal impacts to the safe operation of both the rail infrastructure and passenger services (Fabella & Szymczak, 2021). Railway transport is more vulnerable to disruptions than road transport because of its lower number of routes, limiting the alternative routing options (Mattsson & Jenelius, 2015). The main causes of disruptions of railway systems are manifold (accidents, damage to infrastructure, construction work, and natural disasters). When a disruption occurs on the railway system, usually the whole track is affected immediately because of the track-bound nature of the railway system. Due to

factors like climate change, and population increase, disruptions in the future are expected to occur frequently, last longer, and have a huge impact. In the context of these factors, rail operations and infrastructure must be resilient.

## **2. INFRASTRUCTURE RESILIENCE IN THE RAIL SECTOR**

According to the United Nations Office for Disaster Risk Reduction (UNISDR), Infrastructure Resilience is defined as:

*“The timely and efficient prevention, absorption, recovery, adaptation and transformation of national infrastructure’s essential structures and functions, which have been exposed to current and potential future hazards”* (United Nations Office for Disaster Risk Reduction, 2022).

In the context of transportation, resilience is defined in two ways. Firstly, resilience may be defined as the ability to continue to provide a service during disruptions (“CEN/CLC/WS 018 - Guidelines for the assessment of resilience of transport infrastructure to potentially disruptive events - CEN-CENELEC”, n.d.) and secondly, by evaluating the required time and resources to restore performance level after a disruption (Yang et al., 2022). The infrastructure that can withstand disasters and quickly recover from them is required. Several key factors contribute to the resilience of rail infrastructure. These include adequate investment in infrastructure (“Building Resilience in Africa”, n.d.), effective maintenance and repair programs (Rail Infrastructure in Africa, 2015), robust emergency response plans, strong regulatory frameworks (Blumenfeld et al., 2019), capacity building and training (“Rail infrastructure challenges abound”, n.d.).

## **3. THE AFRICAN CONTEXT OF RAIL INFRASTRUCTURE RESILIENCE**

The population of Africa is increasing rapidly. The population in 2016 had increased by approximately 50% from 1990 and is expected to grow to about 2.5 billion by 2050 (Walls et al., 2021). This increase in population has translated into rapid urbanisation which in turn will lead to shortages of transportation infrastructure to meet the increased demand (Walls et al., 2021). Approximately 70% of Africa’s urban cities are yet to be built, and with the evolving demographic growth and urbanisation rate, this is an opportunity for the private and public sectors to work together toward infrastructure resilience (“Building Resilience in Africa”, n.d.).

In recent years, African governments and international organisations have recognised the importance of building rail infrastructure resilience to support economic development and regional integration. There have been efforts to modernise and upgrade existing rail systems, as well as to build new rail lines to connect major cities and ports. Additionally, there is a growing emphasis on incorporating sustainability principles into rail infrastructure planning and design, which can help to mitigate the effects of climate change and other environmental risks (Blumenfeld et al., 2019). Despite these efforts, many challenges remain in building rail infrastructure resilience in Africa. These include limited funding and resources, political instability, inadequate regulatory frameworks, and a lack of skilled personnel (“Africa’s Rail Transport: 5 Major Challenges Faced”, n.d.).

While developed countries have made significant investments in railway infrastructure, developing countries continue to face numerous challenges in terms of railway transport infrastructure. One of the primary challenges facing rail infrastructure resilience in Africa is the lack of financial resources. Many countries on the continent have limited budgets and

must prioritise funding for other areas such as health and education (Walls et al., 2021). This limited funding can make it challenging to allocate the necessary resources for maintaining and upgrading rail infrastructure, which can impact its overall resilience. In addition to limited resources, many rail systems in Africa face challenges related to regular maintenance. Lack of maintenance can lead to the deterioration of infrastructure and equipment, making it more vulnerable to damage from natural disasters, accidents, and other events. Addressing these issues often requires significant investments of time and resources, which can be difficult to obtain in many African countries (*Rail Infrastructure in Africa*, 2015; “Africa’s Rail Transport: 5 Major Challenges Faced”, n.d.; Blumenfeld *et al.*, 2019). Another challenge is the inadequate regulatory framework and governance structure for rail transport. Many developing countries have poorly developed or poorly enforced legal and regulatory frameworks for rail transport, resulting in problems such as corruption, lack of accountability, and inadequate safety standards.

#### **4. FIRE SAFETY OF RAIL INFRASTRUCTURE FOR IMPROVING RESILIENCE**

Fire safety is among many factors overlooked, particularly in developing countries (Walls et al., 2021). Fire is a significant threat to rail infrastructure in Africa and can cause severe damage to rail tracks, trains, and other infrastructure. Fire safety can be described as planning and infrastructure design with the goal to reduce the risk of fire or reducing fire spread in the event of a fire outbreak. Fire safety consists of fire protection, preventive measures, safe work procedures, fire-resistant building materials, fire training, and regulation (“What is Fire Safety? - Public Health”, n.d.). Fire safety has many advantages, the most important of them is it reduces/minimises loss of property and lives in an event of a fire. Taking fire risk as a serious threat to the infrastructure and putting in preventive measures is the best way to minimize its risk (“The Importance of Fire Safety - Surrey Fire”, n.d.).

Developed countries have put in measures to enhance the resilience of their infrastructure to fire. Despite experiencing the same factors such as population growth and industrialization, the number of fire incidents in London has decreased by 64% in the last decade. The main cause of this reduction is the increased focus on fire safety (“The Importance of Fire Safety - Surrey Fire”, n.d.). However, in developing countries, fire disasters appear to be increasing. Some fire incidents might not be severe or have fatalities, but the disruptions caused by their occurrence might have severe impacts on the welfare of society (Walls et al., 2021).

Terrorist and arson attacks have also proved to be dangerous and expensive. A single attack on the carriages of a train station in Cape Town amounted to the loss of R61 million in infrastructure (Gous et al., 2022). In recent years, there have been several high-profile fires on rail systems in Africa, highlighting the vulnerability of rail infrastructure to fire.

Fire safety is a critical aspect of rail infrastructure resilience, particularly in Africa where many rail systems are aging and prone to failures. These factors contribute to the risk of fire in rail infrastructure (Reeves et al, 2019), including: poor maintenance and aging infrastructure, inadequate fire detection and suppression systems, limited access to firefighting resources and limited capacity for emergency response. Other challenges are unstable electricity and security system that sometimes increases the vulnerability to theft and arson attacks (“Africa’s Rail Transport: 5 Major Challenges Faced”, n.d.; “Rail infrastructure challenges abound”, n.d.).

## 5. RECOMMENDATIONS FOR IMPROVING FIRE-RELATED INFRASTRUCTURE RESILIENCE

Improving rail infrastructure resilience in the context of fire safety requires a comprehensive approach that includes preventive measures, preparedness, and response strategies. Some of the strategies for improving resilience in the context of fire safety by (Mattsson & Jenelius, 2015; Bešinović et al., 2022; Ferranti et al., 2022; Kaewunruen & Alawad, 2022; Yang et al., 2022) namely; risk assessment, fire prevention measures, emergency response planning, capacity building, and collaboration and partnerships.

## 6. CONCLUSIONS

Fire safety is a significant aspect of rail infrastructure resilience in Africa. Fire incidents can cause severe damage to railway infrastructure and disrupt the transportation of goods and people. However, adequate fire safety measures can significantly enhance the resilience of railway infrastructure, and there are already initiatives in place to address this issue. Effective maintenance, safety systems, public education, and response strategies are all critical in preventing and minimizing the impact of fire outbreaks in rail infrastructure. By focusing on these areas, it is possible to build more resilient rail systems that can better serve the needs of people across the continent.

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