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UNIVERSITY COLLEGE LONDON

MSc in Geospatial Science

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ABSTRACT

The cable car, with its superior ability to overcome terrain obstacles, environmentally friendly characteristics, and relatively low cost, has emerged as a new option for urban transportation solutions. However, current research on urban cable cars mainly focuses on Latin America and Europe, with comparatively few in-depth case studies in Asia and Africa. This study aims to assess whether cities in sub-Saharan Africa, represented by Freetown, can adopt cable cars as a sustainable urban transportation solution. The study aims to gain profound insights by analysing global urban cable car cases. It particularly focuses on the experience of Chongqing, as it shares a similar implementation context with the Freetown cable car project and has over 40 years of operational history with urban cable cars. Additionally, this research seeks to fill the gap in international literature regarding Chongqing's urban cable car system.

This study employs a mixed-method approach that combines a systematic literature review, semi-structured expert interviews, and content-thematic analysis. The aim is to qualitatively examine the challenges and solutions related to implementing cable cars as a sustainable urban transit option in Freetown and Chongqing. Additionally, the research investigates the impact of cable car projects on local communities.

The analysis shows that although Freetown's urban cable car project faces numerous challenges during implementation and integration, there are corresponding solutions found in global cable car cases. Additionally, most urban cable car projects exhibit positive impacts, improving transport efficiency and helping to eliminate regional inequalities, even bringing unexpected economic benefits to cities. These findings demonstrate the significant potential of cable cars as a sustainable urban transportation solution in sub-Saharan Africa.

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ABBREVIATIONS

CNKI: China National Knowledge Infrastructure
CPT: Cable Propelled Transit
LCCT: Lagos Cable Car Transit
SLR: Systematic Literature Review

SUM: Sustainable Urban Mobility

SUMT: Sustainable Urban Mobility Transit

1 INTRODUCTION

As global urbanization accelerates, cities face increasing sustainability challenges such as greenhouse gas emissions, traffic congestion, and noise pollution. Traditional car-oriented transport development often fails to meet the diverse needs of urban populations while exacerbating congestion and pollution (Rodrigue et al., 2020).In response, the concept of Sustainable Urban Mobility Transit (SUMT) has emerged as an important framework, advocating for transport systems that are not only efficient but also environmentally friendly and socially inclusive, aiming to meet urban mobility needs while minimizing negative environmental and social impacts (Banister, 2008). In this context, cable cars have gained recognition as a viable alternative public transport solution, especially in hills regions or densely populated urban areas where conventional infrastructure is impractical (Hass-Klau, 2004). While many studies focus on cable car systems in Europe and the Americas, research on their application in Asia and Africa remains scarce (Smith, 2022), showing that research on implementing cable car systems in urban environments is still at an early stage and existing gaps in studies of sub-Saharan Africa.

This study explores the feasibility of cable car systems as an option of Sustainable Urban Mobility (SUM), focusing on Freetown for a detailed case. With rapid economic growth and urbanisation, Freetown, as the capital of Sierra Leone, is facing the pressure from increasing demand on urban mobility. To address this issue, it is more socially and environmentally beneficial to develop SUMT than encourage private car-oriented transit mode. However, Freetown faces severe transport challenges, including limited public transport, traffic congestion, and poor accessibility (World Bank, 2018). Freetown's specific geographical features, such as its hilly landscape and dense population, create a compelling case for implementing cable cars as an innovative transport solution. These unique conditions highlight the potential benefits of this approach (Wang and Zhang, 2024).Chongqing is another selected study case laying in the southwest of the China. It has the first urban cable car system in China, which has been built in 1982 during the early stages of China's economic reform(Cai, 2013). Facing similar challenges to Freetown's current situation, Chongqing overcame tight budget, technical constraints, hilly terrain , and backward infrastructure and could give valuable experience for Freetown (Gu, 1983; Chen and Liu, 2012). Moreover, the long-term operational history of Chongqing's cable car, transitioning from public transport to a tourist attraction, offers valuable lessons for the long-term planning of Freetown's cable car and provides fresh insights into the currently limited research on long-term urban cable car management.

The significance of this study lies not only in academic exploration but also in filling an important gap in the literature on urban transportation, particularly concerning developing countries. While many studies focus on cable car systems in Europe and the Americas, research on their application in Asia and Africa remains scarce (Smith, 2022). The unique contribution of this research is its qualitative analysis of expert interviews and systematic literature review, examining the challenges and solutiuons encountered during the implementation of the cable car system in Chongqing, thereby offering insights and experiences for Freetown's cable car project. Moreover, t this research has far-reaching social implications. By proposing practical

recommendations based on global practices, this study aims to inform policymakers and stakeholders, ultimately promoting urban transport improvement and sustainable development in Sierra Leone.

The remaining structure of this thesis is as follows: Chapter 2 provides a literature review on sustainable urban mobility transit, urban cable car systems, and the current context of Freetown. Chapter 3 outlines the research methods, including research objectives, data collection methods, and data analysis techniques. Chapter 4 presents the results of the systematic literature review on the Chongqing cable car system, as well as the analysis of expert interviews from both Chongqing and Freetown. Chapter 5 discusses the research findings, comparing the two case studies and offering recommendations for Freetown's cable car project. Finally, Chapter 6 summarizes the key findings of this thesis and proposes directions for future research.

2 LITERATURE REVIEW

2.1. Sustainable Urban Mobility Transit (SUMT)

In recent years, sustainability has become a central focus in global policy-making, aiming to meet present needs without compromising the ability of future generations to do the same(Brundtland and World Commission on Environment and Development, 1987). The three core dimensions of sustainability—environmental, social, and economic—have attracted considerable attention as societies work to balance economic growth with environmental protection and resource conservation. Within this framework, sustainable mobility has taken on increasing importance due to the transport sector's significant role in greenhouse gas emissions, resource depletion, and urban pollution(Ackrill and Zhang, 2021).

The concept of sustainable mobility, originating in the early 1990s with the European Communities' 1992 Green Paper on '*The Impact of Transport on the Environment*', has become increasingly crucial in addressing growing environmental concerns(European Commission, 1992). This concept is integral to achieving several United Nations Sustainable Development Goals, including those related to climate action, sustainable cities, and health and well-being (United Nations, 2015). Sustainable mobility promotes reducing dependence on fossil fuels, encouraging clean energy alternatives, and supporting low-emission modes of transport such as walking, cycling, and public transit(Colglazier, 2015). It emphasizes not only cutting emissions but also improving accessibility, safety, and affordability, particularly in densely populated urban areas where transport is vital to economic and social life(Holden, Gilpin and Banister, 2019).

As cities continue to grow and urbanisation accelerates, the need for sustainable mobility in urban areas becomes increasingly pressing. Cities face unique challenges in managing transit needs while minimising environmental impact. One of the primary barriers is the deeply entrenched dependence on personal cars, which many cities struggle to overcome(Aravind, Mishra and Meservy, 2024). Additionally, public transport infrastructure is often underfunded and poorly integrated, making it less attractive to potential users(Oviedo *et al.*, 2022). Other challenges include the high cost of implementing sustainable mobility solutions, political resistance to change, and the need for long-term urban planning that aligns with sustainability goals(Papadakis *et al.*, 2024). These challenges are often exacerbated by rapid urbanization and population growth, particularly in developing countries.

To address these urban mobility challenges, the concept of Sustainable Urban Mobility Transit (SUMT) has emerged. SUMT represents a specific approach within the broader framework of sustainable urban mobility, focusing on public transport systems that are environmentally friendly, socially inclusive, and economically viable(Koroma *et al.*, 2021). It emphasises the development and implementation of transit solutions that not only reduce carbon emissions but also enhance urban livability and accessibility. Changing the mode of transport from personal cars to public transit modes is a key strategy in SUMT. This shift can help reduce the negative impacts of travel while still addressing the need for mobility. Public transit systems, including bus rapid transit (BRT) systems, light rail, metro systems, and innovative solutions like cable cars in cities with challenging topographies, when

properly designed and implemented, can significantly decrease per capita emissions, reduce congestion, and improve overall urban air quality(Papadakis *et al.*, 2024). Moreover, they can enhance social equity by providing affordable and accessible transport options for all segments of the population(Spadaro and Pirlone, 2021).

2.2. Cable Car System in Urban Context

2.2.1. Cable Cars as a Sustainable Urban Transit

Conventional urban public transport systems, typically designed based on population density and passenger demand, often rely on surface or underground modes like buses, subways, and light rail (Alshalalfah *et al.*, 2012). However, in cities with challenging geographical features such as hills, valleys, or bodies of water, traditional transport methods can be prohibitively expensive or inadequate. As a result, cities increasingly turn to innovative solutions like cable cars to meet residents' mobility needs. The concept of urban cable cars dates back to the late 19th century, with early systems in European cities such as Lyon, France, and Bolzano, Italy, initially built for tourism purposes (Tezak, Sever and Lep, 2016). These early systems laid the groundwork for cable cars to evolve into viable urban transport solutions. Over time, technological advancements have made cable cars more efficient, safe, and capable of carrying larger numbers of passengers(Alshalalfah, Shalaby and Dale, 2014).

Cable Propelled Transit (CPT) technology, commonly referred to as "cable car" systems, initially gained widespread use in tourist destinations and ski resorts, but over the past 20 years, it has increasingly become an emerging urban transport solution in a growing number of cities worldwide. These systems, which utilise steel cables for propulsion and efficiently transport both passengers and goods, can be broadly categorised into two main types: aerial systems and terrestrial systems. Aerial systems include Aerial Trams and Gondolas, while terrestrial systems comprise Funiculars and Cable Cars(Chu, 2012), as illustrated in Figure 1.It is noteworthy that in both casual conversation and academic discourse, the term “cable car” is often applied indiscriminately to all four of these technologies, despite their distinct characteristics.

For the purposes of this study, the term “cable car” specifically refers to Aerial CPT systems. It is worth noting that globally, implementations of this technology are referred to by various names, including “cable car”, “ropeway”, “cableway”, “aerial tram”, “gondola”, “Metrocable”, and “aerial cable”. For consistency and clarity, this study will employ the term “cable car” throughout to refer to this specific form of CPT. This standardization of terminology is adopted as the study focuses not on the specific technical implementations of cable car systems in individual cities, but rather on their broader impact and role in urban contexts.

Terrestrial systems Aaerial systems

a) Funiculars

b) Gondolas

c) Cable Rails

d) Aerial Trams

Fig 1. Four Types of CPT Technologies

Data Source: (a- c) Wikipedia；d) Aerial Trams: Sina website

2.2.2. Overview of Global Urban Cable Car Projects

The concept of using cable cars in urban settings dates back to the late 19th century, with early examples found in European cities such as Lyon, France, and Bolzano, Italy (Tezak, Sever and Lep, 2016). These early systems were primarily designed for tourism purposes, but they laid the foundation for the future development of cable cars as a means of urban transport. As technology advanced, cable car systems evolved to become more efficient, safe, and capable of transporting larger numbers of passengers(Alshalalfah, Shalaby and Dale, 2014).

In Europe, the Transbordador del Port in Barcelona, Spain, stands out as a pioneering example of urban cable cars. Opened in 1931, it initially served as a connection between the Expo'29 and its maritime section in the harbor area. Today, the Transbordador has become a symbol of Barcelona's harbor and a popular tourist attraction, marking one of the first instances of a ropeway carrying people instead of goods in an urban area(Nuessgen, 2015). Other notable European examples include the Cologne Cable Car in Germany, which has been an iconic feature of the city's transport network since 1957 (Carlet, 2016) and the Emirates Air Line in London,

which connects the Greenwich Peninsula and the Royal Docks as an important paratransit to transit network, serving as an important complementary mode of public transport(Flesser and Friedrich, 2022).

As urban cable cars gained popularity in Europe, they began to emerge as a viable transport solution in other parts of the world. In North America, urban cable cars have been implemented in a few cities. The Roosevelt Island Tramway in New York City, opened in 1976, was the first commuter aerial tramway in North America, connecting Roosevelt Island to Manhattan (Alshalalfah, Shalaby and Dale, 2014). The Portland Aerial Tram, opened in 2006, serves as a vital link between the South Waterfront district and the Oregon Health & Science University's Marquam Hill campus(Marks, 2010). These systems show the potential of cable cars to address specific transport challenges in American cities.

In Latin America, the Medellín Metrocable in Colombia marked a turning point in the history of urban cable cars. Opened in 2004, the system was designed to connect the city's marginalized hillside neighborhoods with the main public transport network, providing a much-needed lifeline for communities that had long been neglected (Brand and Davila, 2011). The success of the Metrocable in improving accessibility, reducing travel times, and promoting social inclusion inspired other cities in the region to follow suit. In Bolivia, the city of La Paz implemented the Mi Teleférico system, which has revolutionized transport in the city by offering a fast and efficient alternative to the congested road network(Garsous, Suárez-Alemán and Serebrisky, 2019). Similarly, in Caracas, Venezuela, the Metrocable has become an integral part of the city's transport network, connecting low-income neighborhoods with the metro system (Clement-Werny et al., 2011).

In Asia, the city of Chongqing in China has a long history of using cable cars as part of its urban transport system. The Jialing River Cableway, opened in 1982, was the first urban passenger cable car to cross a river in China, followed by the Yangtze River Cableway in 1987 (Gu, 1983; Wang and Shi, 1989). These cableways played a key role in enhancing urban mobility and overcoming the city's challenging terrain. However, as Chongqing's transportation infrastructure improved and travel options diversified, the role of cable cars in passenger transport gradually weakened, leading to financial losses starting in the early 2000s (Chen, 2019). It wasn't until 2006, when the film "Crazy Stone," which prominently featured Chongqing and its cable cars, became a hit across China, that the Yangtze River Cableway gained wider recognition and gradually evolved into a tourist attraction (Fan et al., 2009). In 2009, the Yangtze River Cableway was designated as a protected cultural relic by Chongqing Municipality (Yuan, 2018), and in 2013, it was officially transformed into a scenic spot (Chongqing Cableway Company, 2024). By 2023, the cableway’s annual passenger numbers had exceeded 5.2 million, with an annual revenue of over 100 million RMB, marking its transformation from a transport system into a unique cultural symbol of the city (Tencent News, 2024).

Fig 2. Map of Yangzi Revier Cable Car in Chongqing
Data Source: Open Street Map (https://www.openstreetmap.org)

Fig 3. Yangzi Revier Cable Car in Chongqing
Data Source: Own elaboration

There are two more notable urban cable car projects in Asia,one is located in Hong Kong and the other is in Singapore. Both of them applied Gondola to increase flexibility and passenger capacity. The Ngong Ping 360, opened in 2006, connects Tung Chung with the Ngong Ping area on Lantau Island, providing a scenic and efficient transport option for both residents and tourists(Doppelmayr, 2024). The Sentosa Island Gondola, originally opened in 1974 and recently upgraded, serves as a key transport link between Singapore's main island and the popular tourist destination of Sentosa (Henderson, 2015).

Urban cable cars have also made markable progress in Africa, especially in Algeria. In 2008, Constantine introduced its first new-generation cable car, connecting the

upper and lower parts of the city and drastically reducing travel times compared to bus services (Nuessgen, Bergerhoff and Perschon, 2015). This success led to the implementation of several more cable car systems in Algiers, Tlemcen, and Oran, all of which were fully integrated into the public transport network. Today, Algeria has 11 operational cable car systems, with another 12 in various stages of planning or construction. This make Algeria a leader in the implementation of urban cable cars in Africa.

Although we review many successful cable car cities, those cities that planned to implement the cable car as SUMT but eventually postponed or even abandoned it are also worth investigating. From their examples, we could figure out challenges that need to be paid great attention to in implementing the cable car system and the mistakes that can be avoided. For example, Lagos, Nigeria, called "the heart of Africa", is one of the largest cities in the world, with more than 21 million residents. In 2013, the Lagos government announced the launch of the Lagos Cable Car Transit (LCCT) project. This project aiming to alleviate urban congestion by connecting Lagos and Victoria Islands(Winter, Sesma and Funda, 2016). Despite signed necessary agreements with experienced cable car company in 2015 and received $20 million from the Clean Technology Fund in 2020 , the project has not entered the construction phase now(Goke, 2013; Climate Investment Funds, 2020). This shows the challenges of introducing new transport solutions in fast-growing urban areas. It also highlights the necessity of exploring the challenges faced during implementation and integration as potential solutions.

As cities around the world continue to explore innovative solutions to meet their transport needs, urban cable cars are playing an increasingly important role in sustainable urban mobility, from overcoming geographical barriers and reducing congestion to promoting social inclusion. The proposed cable car system in Freetown, Sierra Leone, aims to improve urban mobility and enhance accessibility for communities living in the city's hillside settlements (Canon Rubiano *et al.*, 2021). The Freetown project seeks to learn from the diverse experiences of cities in Europe, the Americas, Asia, and Africa, adapting these lessons to the local context to inform the planning, implementation, and integration of the cable car system.

2.3. Freetown

2.3.1. Socio-economic and Geographical Context of Freetown

Freetown, the capital of Sierra Leone, locates in Sub-Saharan Africa. It lies on the western coastal region of the country, covering an area of approximately 82 square kilometers(World Bank, 2018a). Freetown contains steep slopes and low-lying reclaimed land, with obvious urban height difference.(Macarthy, 2024). The confluence of geomorphological instability, the Atlantic Ocean to the west, and mountainous terrain to the east imposes natural constraints on urban expansion, particularly inhibiting growth towards the southern periphery of the city .

According to United Nations population statistics from 2018, Freetown's resident population exceeds 1.3 million, accounting for approximately 35% of Sierra Leone's urban population(United Nations, 2019). The population is projected to grow to 1.84 million by 2035(World Population Review, 2024). With rapid urbanisation, this

continuous population growth will place immense pressure on the city's infrastructure, transport systems, and service provision

Economically, Sierra Leone's per capita GDP in 2023 was approximately USD 634.74(World Bank, 2023), representing merely 38% of the average for Sub-Saharan Africa and 5% of the global per capita GDP(World Bank, 2023). Although Freetown, with 15% of the national population, contributes nearly one-third of the country's GDP, achieving a per capita GDP of USD 1,079 in 2020(Freetown City Council, 2023; Macarthy, 2024), the city remains in a state of extreme poverty compared to global standards. Moreover, the city's economic development is uneven, with a heavy reliance on the informal economy. Over 60% of the workforce engages in informal employment, particularly within the transport and construction sectors, thereby exacerbating challenges related to employment security and economic stability (Koroma *et al.*, 2021).

2.3.2. Current Urban Transport of Freetown

Freetown's urban mobility faces numerous challenges, primarily related to a lack of climate resilience, uneven development of the transport network, and the informal nature of the public transport system. These issues not only limit residents' daily mobility but also have a significant impact on the city's economic activities and social development.

Freetown frequently experiences primarily including seasonal rain-induced floods, landslides, and mudflows. The city has approximately 2,800 kilometres of unpaved roads, over 1,000 kilometres of which are often flooded or blocked during the rainy season, rendering them impassable. This not only severely impacts residents' mobility, safety, and convenience but also disrupts the daily functioning of the transport system, further hindering the development of the city's road network and public transport system (Arroyo Arroyo et al., 2020). Research further indicates that insufficient transport resilience has a detrimental effect on household incomes(d'Errico and Di Giuseppe, 2018). In Freetown, areas with inadequate road networks are often informal settlements where residents frequently face extreme weather events and struggle with limited access to essential services like water, sanitation, and healthcare, which restricts their participation in economic and social activities and worsens poverty.(Arroyo Arroyo and Espinet, 2018; Macarthy et al., 2022).

Freetown's transport system is inefficient in connecting various parts of the city. Despite international guidelines suggesting that 30% of urban land be dedicated to road infrastructure, only 5% of Freetown's land is currently used for this purpose, severely restricting traffic flow throughout the city (World Bank, 2019). Furthermore, the roads are generally in poor condition due to prolonged lack of maintenance. Particularly during peak hours, vehicle speeds in some central areas fall to as low as 3 kilometres per hour, even slower than walking (Oviedo et al., 2021).
The transport network in Freetown is inequitably developed. The northern region contains a more advanced network but experiences severe transportation congestion. Conversely, the southern region, marked by its hill topography and insufficient road infrastructure, encounters great transit issues. The disparity arises mainly from the diverse geography of the south and the high population density coupled with frequent economic activity in the north (Arroyo Arroyo et al., 2020). The Central Business District of Freetown sits in the north, where banks, government offices, and desirable employment opportunities are concentrated, drawing a large number of low-wage laborers, including street sellers and informal transit operators.

Also, the northern region has extensive educational and commercial resources, and its convenient living circumstances attract residents, leading to increasing population density and traffic flow, which worsens road congestion (Koroma et al., 2021; Oviedo et al., 2022). In contrast, the southern region's mountainous topography, coupled with frequent landslides and mudflows during the rainy season, makes the construction of transport infrastructure more challenging and expensive, resulting in the stagnant development of southern region's transport network.

Freetown's transport system faces significant challenges due to its high degree of informality. According to the World Bank (2018), government-operated large buses account for less than 15% of the urban passenger transport market. Due to the inadequate provision of formal public transport services, the majority of travel demand is met by informal modes, including 8-10 seater minibuses (poda-poda), shared taxis operating on fixed routes, three-wheelers (kekehs), and motorcycles (okadas) (SSL, 2015, 2017, as cited in Oviedo et al., 2022). These informal transport modes, while individually low in passenger capacity, are numerous. Drivers frequently make arbitrary stops at roadsides or weave through traffic, exacerbating the chaos and instability of the transport system. While these informal transport modes meet local residents' travel needs to some extent, the lack of unified management and regulations exacerbates urban traffic congestion, further reducing the operational efficiency of the formal public transport system. Large buses struggle to operate in congested traffic, prompting many residents to opt for more flexible informal transport modes, such as private motorcycles that can weave through traffic(World Bank, 2018b). This trend further deteriorates the urban traffic conditions, creating a vicious cycle.

2.3.3. Rationale for Selecting Freetown as a Cable Cars Case Study

In the context of rapid urbanisation, Sub-Saharan African cities like Freetown are at a critical juncture in deciding their future transport development patterns. These cities face a choice between adopting a private car-oriented development model or exploring a more sustainable and socially equitable transport transition pathway by drawing on the experiences of other cities(Teoh, Anciaes and Jones, 2020). While private car ownership in Freetown is relatively low, the city is gradually facing increasing pressure due to rising car ownership as the economy grows(Koroma et al., 2021).Without appropriate interventions, Freetown may follow in the footsteps of other rapidly developing cities, becoming reliant on a transport model dominated by private vehicles, which would exacerbate traffic congestion and environmental issues. However, if Freetown can capitalise on its current advantages by developing efficient public transport systems and sustainable infrastructure, it has the opportunity to forge a different path in urban mobility transition, avoiding the negative impacts of car-oriented transport and achieving a more eco-friendly and socially equitable urban transport system.

When considering the choice of public transport modes, Freetown's unique terrain and climate, transport requirements, technical and construction factors, and the government’s limited infrastructure budget make cable cars the most viable transport solution (Williams, Ito and Li, 2020). Table 1, which compares various transport modes, demonstrates that cable cars offer an efficient and cost-effective solution in such an environment.

	Issues	Bus Rapid Transit	Overground Light Rail	Waterborne Transport	Gondola - Cable Car
Transport Requirements	Passenger Carrying Capacity	Satisfactory	High (exceeds demand)	Satisfactory	Satisfactory
	Following travel demand desire line	Constrained	Constrained	Highly Constrained	Satisfactory
	Predictable Journey Times	Constrained	Good	Satisfactory	Good
	Serviceability - Operations and Maintenance	Satisfactory	Constrained	Satisfactory	Satisfactory
	Will complement current proposals for improvement in coastal bus corridor	Constrained	Constrained	Constrained	Possible
	Mass Transit solution can cost-effectively satisfy current and forecast demand	Constrained	Constrained	Constrained	Yes
Environmental Impact	Power Consumptions	Medium	High	Medium	Low
	Vehicle Emissions	High	Medium	Medium	Low
Technical & Construction Considerations	The destruction of existing buildings and the urban form during construction is kept to a minimum	High	High	Satisfactory	Satisfactory
	Proposed solution has the facility of extend network into hillside communities and to support city's tourism	Constrained	Constrained	Constrained	Very Satisfactory
Cost and Financing Requirements	A solution that can be operated and maintained using local labour or can cost effectively be delivered through a BOO/ DBFO type contract with requisite expertise to operate the system.	Possible	Possible	Possible	Possible
	Level of borrowing required to finance capital expenditure within the affordability threshold and customers' ability to pay the travel fare	Possible	Constrained	Possible	Possible

Table 1. Potential Mass Transit Options for Freetown
Data Source：(Williams, Ito and Li, 2020)

2.3.4. Proposed Cable Car Network for Freetown

The cable car system plan for Freetown primarily includes three main routes: the Eastern Route, the Western Route, and the Mountain Route, along with an extension of the Mountain Route(Freetown City Council, 2024). These routes are designed to significantly enhance the city's connectivity and accessibility.

- Eastern Route: As the core of the first phase of development, this route connects the eastern residential areas with the Central Business District (CBD). Future plans include extending the line to the eastern industrial zone of Wellington, strengthening the connection between the city's business district and industrial area.
- Western Route: This line primarily serves the commuting needs between the western residential areas and the CBD, effectively balancing the transportation development between the eastern and western parts of the city.
- Mountain Route: This route not only connects the Eastern and Western Routes, forming an integrated network, but is also planned to extend into the mountainous areas in the southern part of the city. This design significantly enhances the mobility of residents in areas with complex terrain, providing convenient transportation options for mountain dwellers.

Within this comprehensive plan, the Eastern Route Pilot has been selected as the initial implementation project. This segment begins at Ferry Junction Station and terminates at Central Bus Station, effectively meeting the peak travel demand from

the eastern residential areas to the CBD. Notably, this route is slated for future extension to the industrial centre of Wellington in the eastern part of the city. This expansion is expected to dramatically reduce peak travel times from the origin to the CBD, significantly decreasing the journey from the current 90 minutes to just 15 minutes, greatly improving commuting efficiency(Williams, Ito and Li, 2020).

The design of this cable car system reflects a deep consideration of Freetown's unique geographical environment and urban development needs, aiming to provide an efficient and sustainable public transport solution for the city.

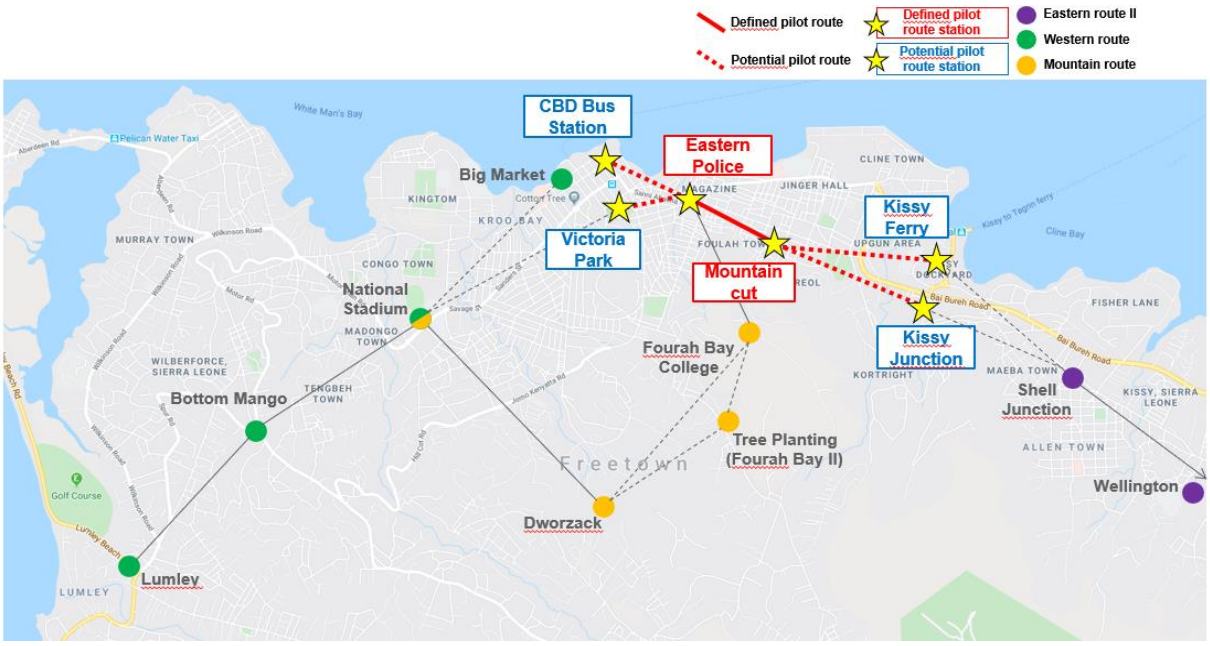

Fig 4. Freetown Cable Car Network Proposal
Data Source：(Freetown City Council, 2024)

2.4. Gap in the Literature Review

Through a comprehensive review of the literature, I found that current research on urban cable car systems is primarily concentrated in Europe and the Americas, with significantly less focus on Africa and Asia, and almost no studies in Oceania. This observation is supported by Flesser and Friedrich (2022). This study selects Chongqing and Freetown as key case cities specifically to address the research gap in Africa and Asia. Moreover, there is currently no English-language literature on the Chongqing cable car project, making this research highly original.

Continent	Relative Share	Origin of Research
North America	6.9% 57% PT and 43% Tourism	19%
South America	24.8% 68% PT and 32% Tourism	20%
Europe	28.7% 38% PT and 62% Tourism	43%
Africa	17.8% 63% PT and 37% Tourism	2%
Asia	21.8% 36% PT and 64% Tourism	15%
Australia	0.0% 0% PT and 0% Tourism	2%

Table 2. The global spread of urban aerial cable car systems and the origins of their research

Data Source: (Flesser and Friedrich, 2022)

Compared to conventional modes of public transport such as buses and metros, cable car projects are still relatively novel as mass transit systems(Alshalalfah, Shalaby and Dale, 2014) . There is a notable lack of long-term management records and studies on cable cars' evolving roles across different stages of transport development. While cable systems have gained attention for their unique advantages, research typically focuses on initial implementation and short-term effects, with a conspicuous absence of systematic exploration into their long-term positioning (Yañez-Pagans et al., 2019). Therefore, assessing the sustainability and long-term benefits of cable car systems amidst evolving transport demands and technological innovations remains a significant gap in current research. This study selects the cable car system in Chongqing, China, as a case study because the Yangtze River Cableway has been in operation since 1987, providing valuable insights for analysing the long-term performance of cable car systems.

Currently, limited research focusing on the policy impacts of cable car systems in similar urban contexts. A comprehensive analysis of existing literature reveals that current studies on urban cable cars predominantly focus on technical, design, and implementation aspects. In contrast, there is a notable scarcity of research on the policy support for urban cable car projects. This study aims to explore global experiences in integrating urban cable car systems with other transport modes and analyse relevant policy support cases. By doing so, it seeks to provide valuable insights for future applications of urban cable car systems.

3 METHODOLOGY

3.1. Research Objectives

This study aims to explore the potential of cable car systems as sustainable transport solutions in sub-Saharan African cities, with a particular focus on Freetown, Sierra Leone.The objectives of this study are threefold:

1. To explore the main challenges encountered in implementing and integrating cable car systems as urban transit and their corresponding solutions globally, with a particular emphasis on Chongqing's experience.
2. To evaluate the impacts of cable car systems on urban communities.
3. To propose recommendations for Freetown's cable car project, drawing on global lessons whilst considering local conditions.

The study will first conduct a comprehensive literature review to explore global experiences in implementing cable car systems as sustainable urban mobility solutions. The review will focus on three key areas: the implementation processes, integration with existing transport networks, and the impact on communities along the routes.
Considering the fact that current research on urban cable cars focuses on Europe and Latin America, and there is a lack of detailed cable car case studies on Asian cities, this study has chosen to focus on the cable car project in Chongqing. This choice not only fills the existing research gap, but also provides a similar experience for Freetown, as both cities have similar backgrounds on cable car implementation. For Chongqing, the research employs the method of systematic literature review (SLR) and collects the detailed data of Chongqing cable car system through expert interviews. This will help to make a deep qualitative analysis of its implementation, integration and impact.

For Freetown, the research will include a qualitative analysis of expert interviews. It will focus on the potential challenges and solutions faced during the implementation and integration of the cable car project. Additionally, a comparative analysis will explore the similarities and unique aspects of Freetown's project in relation to other cities around the world and adapted global lessons to local context, provide practical recommendations for implementing an urban cable car system in Freetown.

3.2. Data Collection Methods

3.2.1. Expert Interview

This study employed a combination of audio interviews and written responses through semi-structured expert interviews to analyse the challenges and solutions in implementing and integrating cable car systems into existing transport networks, and to evaluate the impacts of these projects. Semi-structured interviews were chosen for two main reasons: cable cars are a specialised technology and still relatively novel in public transport, with a limited number of experts in the target cities. This made large-scale surveys unsuitable. Semi-structured interviews offer greater flexibility, allowing for deeper exploration of topics and enabling the researcher to ask

spontaneous follow-up questions based on the responses (Kallio et al., 2016), which is essential for qualitative research to enhance data quality (Kakilla, 2021).

Experts were selected based on their extensive knowledge of sustainable urban transport, direct involvement in the respective cable car projects, and a minimum of 10 years' relevant experience. Given that Chongqing's cable car project has been operational since 1981, many of the original project experts were difficult to contact due to changes in contact information or their passing, particularly exacerbated by the COVID-19 pandemic. The few qualified experts still available were difficult to reach, and those who were willing to participate were restricted by company regulations, meaning the interviews had to be conducted in written form, which made the process particularly challenging. In Freetown, the limited number of experts available was due to the cable car project being in the early planning stages. Despite the small sample size, with two experts from Chongqing and two from Freetown, it is considered representative given the limited pool of qualified participants.

The interview guide (Appendix 1) covered three main topics: implementation challenges and solutions, integration challenges and solutions, and project impacts. Questions were adjusted as needed, with follow-ups to explore responses in depth. The Chongqing interviews were conducted in writing through two rounds of questions and answers. This two-round approach was crucial in compensating for the inability to ask immediate follow-up questions, ensuring a thorough exploration of the topics. The Freetown interviews were conducted via Microsoft Teams, lasting 45-60 minutes, and were anonymously recorded and transcribed anonymously. Due to company regulations, the responses from the Chongqing experts were jointly completed and approved by the company before being shared.

This research was conducted by researchers from University College London and was reviewed and approved by the UCL Research Ethics Committee. All necessary measures to minimise ethical risks to both participants and researchers were implemented. The experts interviewed in this study have been pseudonymised and referred to as E1-E4 to protect their identities：

- **E1**, Operations Department, Chinese State-Owned Enterprise, with over 10 years of experience in cable car systems. Expertise in lifecycle management of cable cars.
- **E2**, Manager, Chinese State-Owned Enterprise, with over 10 years of experience in cultural tourism planning. Played a key consulting role in the transformation of Chongqing's cable car system from public transportation to a tourism icon.
- **E3**, Project Manager, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), specializes in advising cities in developing countries on sustainable infrastructure projects with a focus on climate protection. Extensive experience in managing large-scale service packages and leading technical teams.
- **E4**, Chartered Engineer/Strategic Planner, with over 30 years of experience providing strategic support to city authorities and development corporations in urban planning policies, infrastructure projects, and climate resilience.

Specializes in integrated transport, land use management, carbon reduction strategies, and project recovery.

3.2.2. Systematic Literature Review

A Systematic Literature Review (SLR) is a rigorous and comprehensive research method designed to identify, evaluate, and synthesise all high-quality research evidence related to a specific research question(Liberati *et al.*, 2009; Barn, Barat and Clark, 2017). It follows a clear and structured process, ensuring a high level of replicability(Topp *et al.*, 2015). Due to these features, SLR is widely used in disciplines such as computer science, social sciences, and engineering.

This study primarily uses a Systematic Literature Review (SLR) to analyse Chinese literature and documents related to Chongqing's cable car system. The SLR is conducted using the CNKI database as the primary search platform. Due to the historical nature of the project, most early documents are stored in paper form at the Chongqing Archives. According to archive regulations, accessing these documents requires in-person applications with proper identification, and photography or scanning is not permitted. Given these constraints, this research primarily relies on publicly searchable electronic literature. Additionally, relevant public policy documents are only preserved in written form within company archives, which are inaccessible to researchers. Therefore, this study can only analyse based on the best available evidence currently accessible.

CNKI (China National Knowledge Infrastructure) is a comprehensive Chinese digital library platform offering access to academic journals, theses, conference papers, yearbooks, news reports, and other scholarly publications. Unlike Western databases, CNKI doesn't use peer review as an inclusion criterion. Instead, article quality is often assessed through citation counts, download numbers, and download-to-citation ratios(CNKI, 2024).

3.3. Data Analysis Method

Content-Thematic Analysis

Content-Thematic Analysis is a qualitative research method that combines elements of Content Analysis and Thematic Analysis. This hybrid approach allows researchers to systematically examine and interpret textual data while identifying recurring patterns and themes.

Content Analysis, as described by Krippendorff (2004), is a research technique for making replicable and valid inferences from texts to the contexts of their use. It involves systematically categorising and quantifying content within communication. This method allows for both quantitative and qualitative analysis of text data, focusing on the frequency of specific words, phrases, or concepts.

Thematic Analysis, on the other hand, is a method for identifying, analysing, and reporting themes within data(Braun and Clarke, 2006). It goes beyond simply counting words or phrases, focusing on identifying and describing both implicit and explicit ideas within the data. This approach is particularly useful for capturing the complexities of meaning within a textual data set.

When combined, Content-Thematic Analysis allows researchers to benefit from the systematic and quantifiable aspects of Content Analysis while also delving into the deeper, more interpretive elements characteristic of Thematic Analysis. This integrated approach enables a more comprehensive understanding of the data, providing both a broad overview of content patterns and a deep dive into underlying themes and meanings.

The process typically involves coding the data for specific content categories, then analysing these codes to identify overarching themes. This method is particularly useful when dealing with large datasets, as it allows for a structured approach to handling complex qualitative data while still maintaining the flexibility to explore emergent themes(Vaismoradi, Turunen and Bondas, 2013).

4 RESULTS

4.1. Systematic Literature Review of Cable Car System in Chongqing

A search was conducted on CNKI for all literature related to the Chongqing cableway, covering both simplified and traditional Chinese. The specific search query was as follows:

(Subject%= ('Chongqing Cableway' + 'Yangtze River Cableway' + 'Jialing River Cableway') or Title%= ('Chongqing Cableway' + 'Yangtze River Cableway' + 'Jialing River Cableway'))

Translate From:
（ 主题%=（'重庆索道'+'长江索道'+'嘉陵江索道'） or 主题%=（'重慶索道'+'長江索道'+'嘉陵江索道'） or 题名%=（'重庆索道'+'长江索道'+'嘉陵江索道'） or 题名%=（'重慶索道'+'長江索道'+'嘉陵江索道'））

After following the screening process outlined in Figure X, a total of 30 papers were included in the literature review on the Chongqing cableway system.

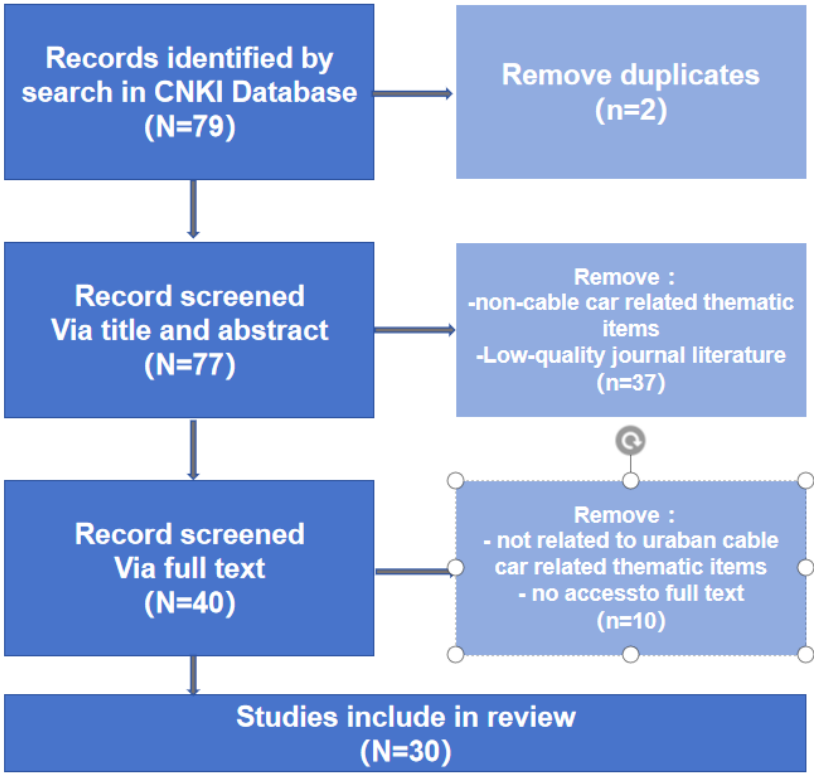

Fig 5. Flow diagram of systematic review on cable car in Chongqing
Data Source: Own elaboration

The analysis of this group of literature reveals several key points. The low citation rate and limited references suggest that the academic impact and citation value of this group of literature are relatively weak. However, the high download count may

indicate that certain content has garnered attention in specific areas. Therefore, while the attention is notable, the overall academic quality might be somewhat average.

Impact Factor Analysis	
Number of papers	30
Total references	11
Total citations	24
Total downloads	2511
Average references per	0.37
Average citations per	0.8
Average downloads per	83.7
Download to citation	0.01

Table 3. Impact Factor Analysis

Data Source: Own elaboration

In terms of publication time and volume, literature related to the Chongqing cableway mainly appears between 1984-1990 and from 2009 onwards. The period from 1984 to 1990 marks the construction phase and the first peak of the Chongqing cableway, resulting in a surge of publications focused on its technological innovations and planning advantages. In 2009, a significant shift occurred when the Chongqing government designated the cableway as a protected cultural relic, symbolising its gradual transformation from a public transport system to a tourist attraction. Following the rise of the internet and platforms like TikTok, the cableway experienced its second peak, attracting more academic studies. Research during this phase has largely focused on its tourism value and the story of its transformation.

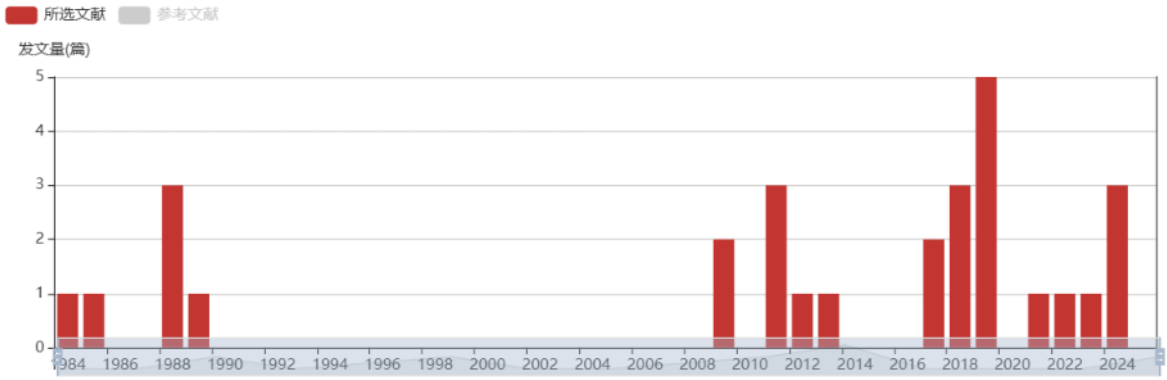

Fig 6. Trend Analysis of Literature (1984-2024)
Data Source: Own elaboration

4.2. Experts Interview Analysis

4.2.1. Chongqing

4.2.1.1. Challenges and Solutions in Implementation of Cable Car in Chongqing

The challenges and solutions faced during implementing Chongqing cable car project can be divided into two phases: the first phase involved designing and constructing the cable car, while the second phase encompassed the implementation of its repositioning strategy. In the early stages of the design and construction of the Chongqing cable car, the main challenges stemmed from limited funding and immature cable car technology. An expert noted, “Such a design had no precedent in the country at the time” (E2, 2024). Additionally, “there is a densely populated residential area approximately 200 metres long beneath the Yangtze River cable car, and the design must prevent the cabins from interfering with residents’ lives” (E2, 2024). Therefore, it was crucial to minimise the impact on the surrounding environment during the design process.

As the first urban cable car project in the country, “ensuring safe operation” (E1, 2024) became the primary principle during the operational phase. Despite being profitable for nearly 20 years after its opening, the cable car's transport function weakened with the increasing number of urban bridges, resulting in a decline in passenger numbers. By the early 2000s, the project faced ongoing losses and was even “at risk of being dismantled following the construction of the Dongshuimen Bridge” (E1, 2024). In response, both the enterprise and government adopted a transformation strategy, shifting the cable car’s role from a transport mode to a tourist attraction to ensure its ongoing development.

Theme	Implementation Challenges and Solutions					
Sub-Theme	Technical Difficulties	Weakening of Transport Function	Economic Difficulties	Transformation Decision	Safety Management	Environmental Impact
Code	· Barriers in independent research and manufacturing · Challenges in cable installation across the river	· Limited construction budget · Gradual decline in passenger transport function · Decrease in passenger numbers	· Continuous annual losses for the enterprise · Possibility of demolition	· Shift from transport tool to tourist attraction · Firm commitment to transformation	· Need for strict safety management measures	· Potential impact on surrounding environment

Table 4. Challenges and Solutions in Implementation of Cable Car in Chongqing

Data Source: Own elaboration

4.2.1.2. Challenges and Solutions in Integration of Cable Car in Chongqing

The challenges of integrating Chongqing's cable car system with other transport modes can be divided into two phases. In the initial design stage, the cable car was positioned as the primary means of crossing the river, necessitating its integration with other public transport systems. The implementation of through-ticketing was an

effective solution to this challenge. However, balancing economic benefits with social responsibility proved to be a significant hurdle (E1, 2024).

Subsequently, "with the successive completion of bridges such as the Yangtze River Bridge, the transport function of the passenger cable car gradually weakened" (E1, 2024). Although the cable car transitioned functionally into a tourist attraction, it retained some of its transport capabilities. To facilitate tourist travel (E2, 2024), and in the context of "major developments in municipal infrastructure", light rail stations, bus stops, and bike-sharing stations were designed around the cable car stations. Additionally, a differentiated pricing strategy was implemented for tourists and regular passengers. This approach aimed to ensure revenue whilst allowing local residents to continue using the cable car as a means of transport.

Theme	Transport Integration Challenges and Solutions		
Sub-Theme	Coordination with Other Transport Modes	Functional Transformation	Fare Adjustment
Code	· Coordination with bridge construction	· Transition from public transport to tourist attraction	· Balancing economic benefits and social responsibility
	· Challenges of diversified transport forms	· Retention of partial transport function	· Differentiated pricing strategy

Table 5. Challenges and Solutions in Integration of Cable Car in Chongqing

Data Source: Own elaboration

4.2.1.3. Impact of Cable Car Project in Chongqing

The cable car project has significantly influenced tourism development in Chognqing, transforming it into a popular tourist hotspot. As noted, "The convenience of the cable car has promoted the growth of urban tourism and boosted related industries" (E1,2024). Additionally, the cable car has become a prominent city landmark, serving as a cultural symbol and a representation of the city's identity, described as "the postcard of Chongqing, known for its beautiful landscapes and rich culture" (E2,2024).

Economically, the project has reversed previous financial losses, with visitor numbers exceeding three million in 2016, demonstrating its effectiveness in driving tourism revenue (E2,2024). Moreover, the cable car has fostered a unique urban culture by integrating Chongqing's distinct characteristics into the cable car transportation culture (E1,2024), enhancing its IP image (E2,2024). Finally, the construction of the cable car has also contributed to improvements in urban infrastructure, thereby facilitating better connectivity and services within the city

(E1,2024). Overall, the cable car project represents a multifaceted enhancement to both the cultural and economic landscape of the city.

Theme	Impact				
Sub-Theme	Tourism Development	City Image Enhancement	Economic Benefits	Cultural Value	Infrastructure Improvement
Code	· Becoming a tourist hotspot	· Becoming a city landmark	· Reversing the loss situation	· Formation of unique urban culture	· Promotion of urban infrastructure enhancement
	· Boosting city tourism	· Function as a city calling card	· Increase in visitor numbers	· Creation of IP image	

Table 6. Impact of Cable Car Project in Chongqing

Data Source: Own elaboration

4.2.2. Freetown

4.2.2.1. Potential Challenges and Solutions in Implementation

Topic		Infrastructure and Energy (11 mentions)	Financial and Business Model (12 mentions)	Development (5 mentions)	Political and Regulatory (4 mentions)	Social (7 mentions)
Sub-Theme	Code					
	Challenge	C1: Infrastructure industry and Technical capacity constraints	C3: Fare structure and inflation impact on usage	C5: Last mile problem	C7: Coordination between different levels of government	C8: Public acceptance
		C2: Operational risk	C4: Financing challenges	C6: Insufficient pedestrian space around stations		C9: Crossing over private properties
	Solution	S1: Solar energy supply and	S4: Reasonable fare structure design	S8: Establishing a comprehensive network to reduce congestion	S10: Establishing appropriate legal framework	S12: Providing safe and reliable service to attract passengers
		S2: Third-party verification	S5: Exploring international financial institution loans	S9: Forming a Special Purpose Vehicle (SPV)	S11: Establishing a transport authority	S13: Optimising cable car cabin design to protect privacy
		S3: Hiring experienced operators	S6: Consortium approach			
			S7: Securing support from potential financiers early on			

Table 7. Potential Challenges and Solutions in Implementation of Cable Car in Freetown

Data Source: Own elaboration

The implementation of the cable car system in Freetown faces multiple challenges across various subthemes. A key issue is the capacity constraints in the infrastructure industry, which can delay project delivery. One expert noted, *"Due to capacity constraints, it might take a bit longer to deliver all the infrastructure"*

(E3,2024). Additionally, operational risks, particularly related to power supply, are significant. An expert stated, *"Power supply has always been mentioned as a potential risk"* (E3,2024). Solutions involve promoting solar energy systems, with plans to rely on solar for 80% of power needs, and hiring experienced operators to enhance operational safety (E4,2024).

Financial sustainability also poses critical hurdles. Factors such as fare structures and inflation can influence usage. An expert highlighted, *"Fare structures, inflation, and ticket prices will impact the cable car system"* (E3,2024). To address this, a reasonable fare structure is essential, and exploring loans from international financial institutions could provide necessary funding (E4,2024).

Moreover, coordination among different government levels presents challenges for effective implementation. One expert mentioned, "*Bringing together different political parties is difficult*" (E4,2024). Establishing a legal framework and a dedicated transport authority to oversee the project is vital.

Finally, public acceptance is crucial for success. Concerns about safety and privacy have been raised, with one expert noting, *"People might be concerned if the government were to operate the cable car"* (E4). Ensuring a safe service and optimising cabin designs to protect privacy can help attract passengers.

Addressing these challenges through comprehensive planning and stakeholder engagement will be essential for the cable car system's implementation in Freetown.

4.2.2.2. Potential Challenges and Solutions in Integration

Topic		Regulatory and Policy Challenges (2 mentions)	Infrastructure and Service Limitations (5 mentions)	Business Model and Financing Issues (2 mentions)	Stakeholder Engagement and Coordination (2 mentions)	Long-term Integration Vision (4 mentions)
Code						
Sub-Theme	Challenge	C1: Regulation of Informal Transport	C2: Transport System Discrepancies C3: Suboptimal Transport Modes C4: Congestion Issues	C5: Business Model Constraints	C6: Stakeholder Identification	C7: Long-Term Integration Timeline
	Solution	S1: Stakeholder Engagement and Collaboration	S2: Phased Integration and Implementation S3: Expansion of Existing Services S4: Interchange and Connectivity Enhancement	S5: Public-Private Partnerships for Resource Sharing	S6: Comprehensive Planning for Integration	S7: Systematic Planning and Coordination

Table 8. Potential Challenges and Solutions in Integration of Cable Car in Freetown

Data Source: Own elaboration

The integration of cable car to transprt network in Freetown faces several challenges, primarily related to regulatory frameworks and infrastructure limitations. Experts identified the regulation of informal transport as a major hurdle, particularly

given the high unemployment rates in the region. One expert stated, *"Regulating informal transport is challenging due to the economic necessity for many"* (E3,2024). To address this, stakeholder engagement is crucial. Engaging different stakeholders, including private operators, can enhance project success and foster collaboration (E4,2024).

Infrastructure issues also complicate integration efforts. Existing transport systems often exhibit discrepancies that can negatively impact the efficiency of new solutions like cable cars. An expert noted, *"The various transport systems we have can hinder the effectiveness of cable car operations"* (E3,2024). A phased implementation strategy is recommended to gradually introduce the cable car system, allowing time for integration with current services (E4,2024).

Moreover, congestion is a persistent issue in transport corridors, limiting the expected reductions in traffic. Enhancing interchange and connectivity is vital; one expert suggested that *"designing stations as key nodes can significantly improve transport connectivity"* (E4,2024).

In terms of business models, challenges related to cost recovery complicate the integration of transport modes. Establishing public-private partnerships can help pool resources, facilitating smoother transitions (E4，2024). Finally, a comprehensive planning approach is necessary to identify critical linkages with existing transport networks, ensuring a cohesive integration process.

4.2.2.3. Impact of Cable Car Project in Freetown

Topic	Transportation System Impact (11 mentions)	Socio-Economic Impact (5 mentions)	Environmental Impact (1 mentions)	Transport Mode Transition (8 mentions)
Sub-Theme & Code	**Improved Transport Connectivity**	**Economic Development**	·Emission Reduction	**From Informal to Formal Transport**
	·Primary Mode of Transport	·Job Creation		·Current Informal Transport Situation
	·Connecting Different Transport Nodes	·Promoting Economic Growth		·Introduction of Formal Public Transport
	Improved Transport Efficiency	**Social Change**		**Multi-modal Integration**
	·Reduced Commute Time	·Positive Gentrification		·Integration with Existing Transport Modes
	·Increased Travel Speed	·Community Restructuring		·Long-term Integration Planning
				Phased Transition
				·Interim Transport Mix
				·Full Network Effect

Table 9.Potential Impact of Cable Car Project in Freetown

Data Source: Own elaboration

The Experts indicate that the cable car system in Freetown will significantly enhance the transportation landscape become a primary mode of transport, akin to a metro

system. One expert noted, *“I believe that once the full network of lines is completed, the situation may change”* (E3,2024), highlighting its potential to reshape urban mobility.

Improved connectivity will be crucial, with plans to link various transport nodes, including ferries and public buses. An expert explained, *“Once implemented, the cable car will connect to a network similar to those in Latin America, facilitating access to major transport hubs”* (E4,2024).

Additionally, the cable car promises to improve transport efficiency by reducing commute times. *“The cable car will cut travel time by half for the 3.6-kilometre distance it covers”* (E4,2024), while its speed of three metres per second will provide a safer and more convenient alternative to current informal transport modes, which suffer from severe congestion.

Beyond transport efficiency, the cable car's impact extends to economic development. Job creation is anticipated, as local staff will be trained to operate the system. Furthermore, the five stations are expected to serve 60,000 to 90,000 passengers daily, stimulating local economic growth and creating opportunities for local traders (E4,2024).

Overall, the cable car system represents a transformative shift in Freetown's transportation infrastructure, promising to enhance connectivity, efficiency, and economic opportunities for the community.

5 DISCUSSION AND LIMITATION

This chapter will focus on analysing the similarities and differences in the challenges encountered during the implementation and integration of the cable car projects in Chongqing and Freetown, as identified in the results of Chapter 4 through the SLR and thematic analysis. For the unique challenges faced by Freetown, broader references will be made to the global experiences discussed in the literature review in Chapter 2 to find appropriate solutions, along with recommendations for Freetown's cable car project team. In the third section of this chapter, the impacts of cable car projects on various cities will also be explored.

5.1. Challenges and Solutions in Implementation

When comparing the challenges faced by Chongqing and Freetown in implementing cable car projects, it is evident that both cities encounter constraints in technology and infrastructure. Specifically, Chongqing faced significant technological barriers during the construction of its cable car system, relying almost entirely on independent exploration for design, component manufacturing, and construction, lacking mature technical guidance and experiential references (Gu, 1984). Freetown's challenges, however, primarily focus on outdated infrastructure and relatively low construction efficiency (E3, 2024). To address these issues, Freetown could draw inspiration from Chongqing's solution by appropriately extending the construction period to ensure project quality.

Economic pressures are another common challenge for both cities. Chongqing in the early stages of China's economic reform and present-day Freetown have relatively low national incomes compared to global standards (Chen, 2019; World Bank, 2023). Although cable cars are a cost-effective transport solution compared with BRTs and metros, the required budget is still a significant expense. By developing its own technology, Chongqing reduced import costs and managed to complete its cable car project with a budget of less than 3 million RMB (approximately $ 420 thousand). Considering the inflation, this would be approximately equivalent to around 30 million RMB (approximately $ 4.2 million) today. Freetown could learn from Chongqing's experience in independent development or follow the expert's suggestion to explore loans from international financial institutions. Additionally, Freetown might consider adopting the 'consortium approach', a method commonly used in global cable car projects. This approach entails creating a consortium that includes construction companies, cable car equipment suppliers, and financial institutions to offer comprehensive solutions. It could integrate expertise and resources from various parties, ensuring professional involvement from project construction and equipment supply to financing. This would help facilitate smooth implementation and long-term operation. Successful examples of this approach can be found globally, such as New York's Roosevelt Island Tramway and Bogotá's TransMiCable system (Canon Rubiano et al., 2021). By adopting this approach, Freetown could ensure project quality while better distributing risks and enhancing project feasibility and sustainability.

Another common challenge in urban cable car projects' impletentaion globally is how to minimise interference with private properties along the route. Cable car lines

inevitably pass over some private residences, causing dual concerns of privacy invasion and property rights infringement. In Germany, for instance, airspace ownership above property belongs to the landlord, thus cable cars crossing private property are considered an infringement (Reichenbach and Puhe, 2018). Broader protests come from residents below the cable car routes, who feel their privacy rights are violated as their private spaces are visible from above (Flesser and Friedrich, 2022). To address this issue, both China and Freetown prioritise avoiding densely populated residential areas during the planning phase, followed by friendly negotiations with affected property owners, offering reasonable economic compensation.

Safety management remains a top priority for both Chongqing and Freetown's cable car projects. To ensure safe operations, it is crucial to employ experienced operators and establish clear, enforceable daily maintenance procedures.

Freetown faces unique challenges in three main aspects. Firstly, there is the issue of power supply. Experts suggest using solar power while also providing backup power sources for emergencies (E3, 2024). Secondly, Freetown's extreme weather conditions pose significant challenges to the construction and operation of the cable car. Thunderstorms, strong winds, and heavy rains during the rainy season could all affect normal operations. Although Freetown's experts did not elaborate on this issue in the interviews, and there is little experience to draw from similar projects in other global cities, Chongqing's experts mentioned that cable car operations are suspended during severe weather conditions for safety reasons. Therefore, Freetown's cable car operations team will need to closely monitor weather conditions and develop flexible response strategies. Lastly, due to differences in political systems, China's public transport systems are generally managed and operated uniformly by the government, while Freetown's current public transport is predominantly led by the private sector (Arroyo Arroyo et al., 2020), with plans for the cable car project to be operated by experienced private companies. This suggests potential regulatory gaps in the formulation and implementation of cable car-related management regulations, necessitating the establishment of an independent regulatory body as a third party to ensure effective policy implementation.

To conclude, the comparative analysis of Chongqing and Freetown's cable car projects highlights both shared and unique challenges in implementing this sustainable urban mobility solution. While Freetown can learn from global experiences, it must also adapt strategies to address its specific context, particularly in terms of financing, weather resilience, and regulatory frameworks. This case study demonstrates that cable cars, despite challenges, offer a promising sustainable transport option for cities with complex topographies like Freetown.

5.2. Challenges and Solutions in Integration

Chongqing and Freetown face two primary challenges in integrating cable cars with other transport modes. The first is coordination between cable cars and other transit options. The main difference between urban cable cars and scenic cable cars lies in the need to consider the integration of the cable car system with other public transportation. Because cable car routes are difficult to branch or turn, and they operate in the air, integrating them directly with other cable lines or transportation

modes can be challenging. Due to their inflexibility, it is essential to combine cable cars with more adaptable transport options, such as taxis or shared bicycles, to complete the “last mile” (E4,2024； Carlet, 2016). Moreover, as cable cars typically provide point-to-point transport in a linear service area, they need to connect with more extensive transit systems such as buses or metros to maximise their service coverage and overall benefits. For instance, in Medellín, precise behavioural surveys and time planning enable seamless integration between cable cars and the metro system, facilitating convenient transfers for passengers (Alshalalfah *et al.*, 2012). This comprehensive planning ensures that cable cars become an integral part of the urban transport system rather than an isolated mode. Chongqing adopted a different strategy, constructing light rail, metro, bus, and taxi stations within 200 metres of cable car stations, allowing passengers to choose their preferred transfer method. Freetown's cable car project could draw inspiration from both approaches: one ensuring seamless time integration, and the other offering passengers a rich variety of transfer options.

The second shared challenge is fare structure and pricing strategy. Operating revenue, social acceptability, and social responsibility are the main considerations in fare structuring, but balancing these three factors is not straightforward. Excessively low fares may lead to operational losses or delayed cost recovery, while high fares could reduce residents' willingness to use the system, affecting acceptability. Simultaneously, offering concessionary fares for special groups like students and the elderly can demonstrate corporate social responsibility(Xia, 2011; Martinez, Sanchez and Yanez-Pagans, 2024). Chongqing's cable car system experienced nearly a decade of losses in the early 21st century, largely due to a fare strategy that failed to reflect actual operational conditions (Jiang, 2019). As urban bridges were built and the bus system improved, the cable car's cross-river advantage gradually diminished. Without an integrated ticket policy, many people chose buses over the cable car to save money, despite its speed advantage (Wang and Zhang, 2024). In 2009, the government granted the cable car operating company independent pricing rights and incorporated the cable car into the city's public transport integrated ticket system (Ding, 2017). Subsequently, passengers only needed to pay once for transfers to other public transport within half an hour, restoring the cable car's popularity. In 2011, as the cable car transitioned towards becoming a tourist attraction, a dual fare system was introduced: local residents paid 2 yuan(0.28 dollar) during weekday peak hours, with students and the elderly riding for free, maintaining the cable car's role as a public transport tool; tourist fares were increased to 20 yuan(2.8 dollar) to ensure profitability (E2, 2024). Globally, cable car systems in cities like Caracas and Medellín have also implemented integrated ticket policies, which not only enhance the urban transport utility of cable cars but also effectively connect low-income areas near cable car stations with city centres, improving regional equity.

Freetown faces unique challenges in integrating its cable car system. Currently, Freetown's transport market is dominated by informal individual transport modes such as three-wheeler taxis (kekehs), motorcycles (okadas), and minibuses (Cavoli *et al.*, 2020). To fulfil its urban transport function, the cable car must integrate with these informal, more flexible transport modes (E3, 2024). However, the challenge lies in effectively coordinating these unregulated transport modes to handle 'last mile' transportation. Freetown's experts suggest establishing an efficient, dedicated

supervisory body (such as a transport authority) as a third party to coordinate the integration of formal and informal transport modes. Additionally, the ticketing systems of informal transport are difficult to uniformly plan, but Freetown's residents have already expressed dissatisfaction with high transport costs (Freetown City Council, 2023). If the cable car is implemented, fare structure and integration with informal transport ticketing will be crucial issues to address. Unaffordable fares could not only reduce residents' willingness to use the system but also potentially expose the cable car project to loss risks similar to those experienced in Chongqing's early stages.

5.3. Impact on Local Community

This section discusses the local impacts of the cable car project as a SUMT solution, considering aspects including transport efficiency, accessibility, equity, the environmental effects, economic benefits, residents' sense of pride, and long-term operational model shifting.

Firstly, one undoubted impact of urban cable car is that it have greatly improved the efficiency of transport along the routes and reduced the travel time. For example, the Chongqing cable car reduced the cross-river commute time, which would have taken 20-45 minutes, to 2 minutes (Wang, Shengsan and Shi, Fengqiang, 1989). Freetown's cable car feasibility report also predicted that during peak hours, travelling by cable car could cut journey times in half compared to travelling by bus (Williams, Ito and Li, 2020). Cable cars have also improved urban accessibility, particularly in areas with challenging geography such as hills regions, riverbanks, or sub-city. It provides a safe and efficient travel option for the residents among the route, and at the same time promotes the accessibility of these areas to the rest of the city, eliminating regional inequalities and increasing the sense of belonging and honour among the inhabitants.

Secondly, cable cars, as an eco-friendly and clean transport mode, have effectively reduced greenhouse gas emissions, leading to positive impact on cities' environment. However, as cable car routes almost inevitably cross over residential area, how to integrate them into the urban landscape while protecting residents' privacy an issue that requires careful consideration in project planning (Flesser and Friedrich, 2022).

Urban cable car projects typically generate positive economic and social impacts. For example, Mi Teleférico, the world's longest urban cable car system serving the La Paz-El Alto metropolitan area in Bolivia, has created thousands of jobs, stimulating the employment market in the surrounding urban areas (Martinez, Sanchez and Yanez-Pagans, 2024). Moreover, Medellín has gained global recognition as a 'cable car city' due to its innovative system, not only boosting tourism but also reducing local crime rates and enhancing community residents' sense of identity and pride (Vergel-Tovar, 2022).

From a long-term perspective, the impact of cable cars is dynamic, involving functional transitions and operational strategy adjustments. Taking Chongqing's cableway as an example, it initially improved urban transport efficiency and connectivity, generating economic benefits. However, as other public transport infrastructure developed, the cableway's usage and economic returns declined, even leading to the closure of one line. Subsequently, with government policy support and

operational strategy adjustments, the cableway gradually transformed into a city landmark and cultural symbol, regaining significant economic returns and driving tourism development in surrounding communities. Nevertheless, the excessive tourist influx has also brought some negative impacts to local residents' lives (Ding, 2017; Tu and Luo, 2021; Yang, 2023). A similar scenario unfolded with New York City's Roosevelt Island Tramway. It initially operated in 1976 and gained its popularity in 1989. Having undergone a brief closure for system upgrades in 2010, it continues to operate today as a prominent tourist attraction. Both the Roosevelt Island Tramway and Chongqing's cable car were initially designed for urban transport, underwent system role shifting, and have operated for extended periods, providing valuable references for Freetown's long-term cable car operation strategy.

5.4. Cautionary Insights for Freetown's Cable Car Project

In the preceding sections, we have systematically reviewed the challenges Freetown may face in implementing and integrating a cable car project, along with potential solutions. While most of Freetown's current challenges can be addressed using strategies derived from global case studies, it is important to note that the experiences and insights cited in this research primarily come from cities that have successfully implemented urban cable car systems. However, the experiences of cities that planned but failed to implement cable car projects, or those where implemented projects did not achieve the desired outcomes, have not been sufficiently emphasised in this study. Literature analysing these cases is also relatively limited. Therefore, this section will explore the possible reasons behind the 11-year delay in implementing Lagos' cable car project, based on available secondary data and literature. This analysis aims to provide a more comprehensive perspective on feasibility assessment for Freetown's cable car project investors and designers.

The Lagos urban cable car project was initiated in 2013, with a design comprising three lines and eight stations, intended to connect Lagos' central business district and link Lagos Island with both sides of the lagoon. With support from the African Development Bank and the Clean Technology Fund, the project had an initial budget of $294 million and was scheduled for completion in 2015 (Nuessgen, Bergerhoff and Perschon, 2015). However, the project has been repeatedly postponed due to management challenges, complex project structures, and power supply issues. Despite securing $20 million in funding from the Clean Technology Fund in 2020, there has been no further news of progress, and the project appears to have stalled again (Climate Investment Funds, 2020).

Lagos, as one of Africa's megacities, is the financial centre of West Africa and has been dubbed Africa's 'Silicon Valley'. Yet, despite its advantageous background and economic support, Lagos' urban cable car plan has failed to materialise over the past 11 years. Possible reasons for this phenomenon may include insufficient execution capacity of the local government or the existence of superior alternative transport solutions (such as BRT systems). The prolonged delay of the Lagos cable car plan highlights the complexities of implementing innovative transport solutions in rapidly developing urban environments.

For Freetown, with its relatively weaker economic and technological capabilities, this case serves as a reminder of the need for deeper consideration of the feasibility and implementability of urban cable car projects as Sustainable Urban Mobility Transit (SUMT) solutions. Freetown's decision-makers should thoroughly consider local specificities, including the political environment, economic conditions, technological capabilities, and social needs, to ensure that the cable car project can be successfully implemented and achieve its intended outcomes.

6 CONCLUSIONS

6.1. Reasoned Conclusion

As urbanisation accelerates, the demand for urban mobility continues to rise. In this context, exploring transport modes oriented towards Sustainable Urban Mobility Transit (SUMT) has become increasingly important. Such modes not only meet the growing travel needs of residents but also strike a balance between environmental protection and economic benefits. Cable car systems, with their unique advantages such as the ability to overcome geographical barriers, high carrying capacity, environmental friendliness, and relatively economical construction costs, have become a favoured new public transport option in many cities worldwide.

This study uses Freetown as a representative case to explore the feasibility of cable cars as a potential SUMT solution in sub-Saharan African cities. Through a systematic literature review (SLR) and expert interviews, the research qualitatively analyses the potential of Freetown's cable car plan as an effective SUMT solution from three dimensions: project implementation, integration with other urban transport modes, and impact on the city. Considering the similarity in implementation contexts, the study also conducts an in-depth comparative case analysis of Chongqing's cable car project, not only providing valuable experiential reference for Freetown but also filling a gap in long-term research on Asian urban cable car projects.

The research finds that implementing a cable car as an urban transit mode in Freetown is generally feasible, but faces numerous challenges. The main difficulties include inadequate infrastructure, low construction efficiency, limited project budget, difficulties in determining fare structures, and challenges in integrating with local informal transit modes. However, through analysing global cable car city cases, especially Chongqing's experience, corresponding solutions can be found for these challenges.

Regarding the issue of insufficient power supply, Freetown experts propose utilising the area's abundant solar resources as the main power source, supplemented by backup systems to ensure stable operation. To address the problem of low construction efficiency, lessons can be drawn from Chongqing's approach of extending the construction period or Medellín's practice of hiring experienced construction teams. To solve the limited budget dilemma, experts suggest exploring loans from international financial institutions or adopting a "consortium model", forming a joint venture including construction companies, equipment suppliers, and financial institutions to comprehensively address design, construction, operation, and financing issues.

In terms of integrating cable cars with other transport modes, the main challenge lies in the limited flexibility of cable car systems. Proposed solutions include using cable car stations as hubs to attract informal transit like tricycles and motorcycles to complete "last mile" transportation, while simultaneously developing other formal transit systems such as World Bank-funded bus lines to gradually improve the urban transport network. To address the difficulty in determining fare structures, experts recommend establishing a dedicated regulatory body (such as a transport authority) as a third party to oversee the entire transport market and gradually standardise transport modes.

Examining the experiences of global cable car cities reveals that cable car systems generally bring positive impacts. For instance, Chongqing's cable car not only improved transport efficiency and accessibility but also unexpectedly boosted the tourism economy, creating numerous job opportunities for the local community. Medellín's cable car system reduced crime rates and enhanced residents' sense of pride and cultural identity. Environmentally, cable cars utilise clean energy, effectively reducing carbon emissions. However, in terms of urban land use, while properties near cable car stations may appreciate in value, there might also be impacts on the urban skyline and potential privacy infringements for residents.

Although existing research primarily focuses on successful cases, it is crucial not to overlook cities that planned to implement cable cars as SUMT but ultimately postponed or cancelled their plans, such as Lagos in Nigeria. In-depth research into the reasons behind these abandonments is particularly important for cities considering cable car systems, as it can help them identify and avoid potentially insurmountable issues in advance.

6.2. Limitation

The field of cableways is relatively specialised and narrow in scope, and urban cableways are an even more emerging area of research. As a result, the number of experts in Chongqing and Freetown is limited. Given the practical challenges encountered during the interviews, the final number of interviewed experts was small. For instance, although the Chongqing experts initially expressed great interest in the research, company policies and other practical constraints meant that only two experts, both from the same company, were ultimately able to participate. The interviews were conducted in written form, with responses needing prior approval from the company. This led to both experts providing similar responses, focusing primarily on the positive aspects of the project, while glossing over challenges or difficulties, and the tone of their replies appeared somewhat formal. Therefore, future studies could aim to include a wider range of experts, including those from different organisations, academia, and government bodies. This would provide a more comprehensive and balanced perspective on urban cable car systems.

Due to the early construction date of the Chongqing cableway and the lack of computerisation at the time, many of the documents were stored in paper form and have not been well preserved. Most of the well-maintained paper records are held in the city archives, and early public policy documents are also only available in written form. For practical reasons, the researcher was unable to access these documents. Consequently, the analysis of Chongqing mainly relies on literature reviews, secondary data, and interview analysis, lacking support from primary documents. Future research could allocate more resources to accessing and analysing historical documents, including collaborating with local archives and relevant authorities to gain access to paper records and early policy documents. This would provide valuable insights into the early stages of cable car implementation and policy development.

This study has predominantly focused on cities that have implemented urban cable car systems. However, there is a notable gap in the analysis of cases where planned cable car projects have been consistently delayed or abandoned. Through an

extensive literature review, it has become apparent that this represents a significant lacuna in the current field of urban cable car research. Specifically, there is a dearth of studies investigating the underlying reasons why some cities, despite having plans for urban cable car systems, have failed to bring these projects to fruition. This gap in the literature presents a valuable opportunity for future research to explore the factors contributing to the stagnation or abandonment of urban cable car projects in various global contexts.

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APPENDIX

Appendix 1: Topic Guide

Online Semi-structured interview – Topic guide

Research question: Sustainable Urban Mobility Transitions in Sub-Saharan African Cities: A Case Study on Cable Car

Researchers:
Dr Clemence Cavoli (UCL Primary Researcher/Supervisor)
Rongchen Tang (UCL Geospatial Science Postgraduate)

Topic guide and research questions

1. **Description**
   a) Format

      - A set of questions sent before the interview
      - Online semi-structured interviews (audio and/or video recorded)
      - Follow-up questions are allowed

   b) Length: 45 minutes to 60 minutes
   c) Aim: To enhance understanding of urban sustainable mobility transitions within Sub-Saharan African cities by investigating the challenges and opportunities within implementing and integrating cable car systems. This study specifically focuses on analysing how cities such as Chongqing and Medellín have adopted cable car systems, aiming to apply these insights to the development of similar systems in cities like Freetown.

2. **Verbal consent**

Participants will be asked to answer the following questions:

   d) Please answer Yes or No. Would you like to participate in this interview?
   e) Please answer Yes or No. Do you agree for the interview to be audio/video recorded and kept anonymous, for the purpose of transcription only? The recording will be stored securely, deleted upon completion of the dissertation, and only seen by the researcher team. The transcription will be anonymised.

3. **Personal Information**
   a) Name
   b) email address
   c) occupation

4. **Background Information**

   Participants will be asked to briefly discuss their experience and perspective on the research topic.

5. Topic guide

1) Is the planned cable car system in Freetown intended to serve as a primary mode of transportation or as a supplement to the existing transport network? Based on this positioning, to what extent do you believe the cable car can be a sustainable urban mobility solution for Freetown?

2) What do you think/anticipate will likely be the greatest implementation challenges of the planned cable car in Freetown? Do you have any suggestions or solutions for overcoming these potential implementation challenges?

3) In cities where cable cars are established, buses are usually the most integrated form of public transport with cable car systems. Additionally, some cities have successfully integrated transport modes unique to their local context, such as Chongqing's light rail and Medellín's Metro.
   a) Considering the current transport situation and planning in Freetown, which public transport mode in Freetown is most in need of integration with the cable car system?
   b) What challenges might be faced during this integration process?

4) Cable car projects in cities such as Medellín and Chongqing have demonstrated the potential to enhance community pride, social cohesion, and local economic development. In Medellín, high-quality architecture associated with the cable car system has inspired a sense of belonging among residents. In Chongqing, the cable car has transformed nearby residential areas into popular tourist destinations, creating new economic opportunities for local businesses.However, they have also caused disturbances to the daily lives of local residents, such as increased tourist influx.
   a) Considering these global experiences,both positive and negative, how do you anticipate the cable car project in Freetown might influence the local community?
   b) What potential challenges or unintended consequences for the local community should be considered, and how might they be mitigated?

5) Do you have any further advice or recommendations regarding the cable car project in Freetown?

Appendix 2: Consent Form

CONSENT FORM FOR ADULTS IN RESEARCH STUDIES

Please complete this form after you have read the Information Sheet.
Title of Study: Sustainable Urban Mobility Transitions in Sub-Saharan African Cities: A Case Study on Cable Car
Department: Department of Civil, Environmental and Geomatic Engineering
Name and Contact Details of the Researcher(s): Rongchen Tang (ucesrt5@ucl.ac.uk)
Name and Contact Details of the Principal Researcher: Dr Clemence Cavoli (clemence.cavoli@ucl.ac.uk)

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

I confirm that I understand that by ticking/initialling each box below I am consenting to this element of the study. I understand that it will be assumed that unticked/initialled boxes means that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

		Tick Box
1.	*I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction and would like to take part in an individual interview.	
2.	* I understand that I will be able to withdraw my data up to 2 weeks after the interview.	
3.	* I consent to participate in the study. I understand that my personal information (name, email address, occupation) will be used for the purposes explained to me. I understand that according to data protection legislation, 'public task' will be the lawful basis for processing.	
4.	**Use of the information for this project only** * I understand that all personal information gathered in this study will be stored confidentially and securely during the research period and all data is expected to be uniformly deleted on December 31, 2025, after the project concludes. I agree that my comments are presented pseudonymised but give permission to connect my affiliation with my comments (but not the title of my position).	
5.	*I understand that my information may be subject to review by responsible individuals from the University for monitoring and audit purposes.	
6.	* I understand that my participation is voluntary and that I am free to withdraw within 2 weeks after the interview without giving a reason. If I decide to withdraw, any personal data I have provided up to that point will be deleted unless I agree otherwise.	
7.	I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.	
8.	I understand the direct/indirect benefits of participating.	
9.	I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researcher(s) undertaking this study.	
10.	I understand that I will not benefit financially from this study or from any possible outcome it may result in in the future.	
11.	I understand that the information I have submitted will be published as a Masters thesis and I wish to receive a copy of it. Yes/No	
12.	I understand that the pseudonymised results of this study may potentially be published in academic journals or presented at conferences in the future. However, any personal	

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	information will remain confidential and will not be disclosed.	
13.	I consent to my interview being audio recorded and understand that the recording and transcripts of the recording will be destroyed on 31 December, 2025 .	
14.	I am aware of who I should contact if I wish to lodge a complaint.	
15.	I voluntarily agree to take part in this study.	
16.	Use of information for this project and beyond I would be happy for the data I provide to be archived at a password-protected computer on UCL OneDrive password-protected account. The recordings and transcripts will be stored during the research period and will be deleted on December 31, 2025, after the project concludes. I understand that only the researcher and their supervisor will have access to my anonymised data.	
17.		

This study has been approved by the UCL Research Ethics Committee: Project ID number: 27713/001

_____	_____	_____
Name of participant	Date	Signature
_____	_____	_____
Name of witness (If applicable)	Date	Signature

Appendix 3: Participant Information Form

Participant Information Sheet For Experts in urban mobility transitions and/or cable car design or implementation

UCL Research Ethics Committee Approval ID Number: 27713/001

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

Title of Study: Sustainable Urban Mobility Transitions in Sub-Saharan African Cities: A Case Study on Cable Car
Department: Department of Civil, Environmental and Geomatic Engineering
Name and Contact Details of the Researcher(s): Rongchen Tang (rongchen.tang.23@ucl.ac.uk)
Name and Contact Details of the Principal Researcher: Dr Clemence Cavoli (clemence.cavoli@ucl.ac.uk)

1. **Invitation Paragraph**

   You are being invited to take part in this MSc dissertation project. Before you decide, it is important for you to understand why the research is being done and what participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is unclear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

2. **What is the project's purpose?**

   The purpose of the project is to explore the potential of cable car systems as a sustainable transport solution in sub-Saharan African cities, with a specific case study on Freetown, Sierra Leone. The study aims to conduct a comprehensive literature review to analyse global experiences in applying cable car systems, focusing on three key aspects: the implementation process, integration with existing transport networks, and the impact on communities along the route. The research will examine notable cases such as Chongqing and Medellín, while also investigating the specific challenges and potential impacts of the planned cable car project in Freetown. The ultimate goal is to provide practical recommendations for the effective implementation and integration of cable car systems as a sustainable urban mobility solution in the context of sub-Saharan Africa.

3. **Why have I been chosen?**

   You have been chosen to participate in this study because you are an expert in the field of sustainable urban mobility or have directly participated in cable car projects in Chongqing or Freetown. Your experience and insights are invaluable for understanding the implementation and impact of cable car systems in urban settings.

4. **Do I have to take part?**

   It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. You can withdraw within 2 weeks after the interview date without giving a reason by emailing me (rongchen.tang.23@ucl.ac.uk) or my supervisor (clemence.cavoli@ucl.ac.uk). If you

decide to withdraw you will be asked what you wish to happen to the data you have provided up that point.

5. What will happen to me if I take part?

You will be interviewed on various aspects of sustainable urban mobility, including sustainable urban transitions, the design and implementation of cable car systems, and the integration of these systems within public transport networks. The interview is expected to last approximately 60 minutes and will be conducted remotely in July and August 2024 using online platforms Microsoft Teams or Zoom. The interviews will be recorded and transcribed for analysis. A topic guide will be provided to you one week before the interview to help prepare for the discussion. During this process, personal information such as your name, email address, and occupation will be collected but will not appear in the final thesis; instead, it will be pseudonymised to ensure confidentiality.

6. Will I be recorded and how will the recorded media be used?

The audio recordings and transcriptions of your interview will be used solely for analysis in this dissertation project. However, for the purpose of this project, no other use will be made of the recordings without your written permission, and access to the original recordings or transcripts will be restricted to the project team members only. Additionally, all results derived from these interviews will be pseudonymised to ensure that individual participants cannot be identified in the dissertation or any potential future publications.

7. What are the possible disadvantages and risks of taking part?

While the potential risks to you in this interview are minimal, as the questions are designed to explore expertise and insights rather than personal or sensitive issues, and your interview will be pseudonymised in the research with no public dissemination of the thesis, there remains a risk. Given the limited number of experts in this field, it is conceivable that your identity could be deduced through the description of your profession and/or the verbatim quotations used in the interview. However, the researchers will ensure that the pseudonymisation process is rigorous to minimise these risks.

8. What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will have the opportunity to contribute to the development of sustainable urban mobility solutions in cities such as Freetown. Their insights can influence future policies and projects. Meanwhile, participants will gain access to the study's findings, which could provide valuable insights into sustainable transport systems and cable car integration, potentially benefiting your professional work.

9. What if something goes wrong?

If you wish to raise a complaint about the research interview process, you can contact the project supervisor, Dr. Clemence Cavoli based at the Centre for Transport Studies, clemence.cavoli@ucl.ac.uk.If you complaint has not been handled to your satisfaction, you can contact the Chair of the UCL Research Ethics Committee – ethics@ucl.ac.uk

10. Will my taking part in this project be kept confidential?

All the information (name, email address, occupation, transcription, audio) that we collect about you during the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications.
However, kindly note that as the number of people interviewed is small, and the number of specialists in this field is also limited, it may be possible that you are identified in a publication through a description of your profession and/or from a quote that you gave

during the interview. All data will stored on a password-protected computer on UCL OneDrive password-protected account. The recordings and transcripts will be stored during the research period and the expected deletion date for all data is December 31, 2025.

11. Limits to confidentiality

Confidentiality will be respected subject to legal constraints and professional guidelines.

12. What will happen to the results of the research project?

Once the data has been analysed, the results (anonymised) will be available in the research project. The results of the research may be published in academic journals or presented at academic conferences. Only pseudonymised results will be used in these outputs.The final dissertation will be shared with the participants via email.

13. Local Data Protection Privacy Notice

Notice:
The controller for this project will be University College London (UCL). The **UCL Data Protection Officer** provides oversight of UCL activities involving the processing of personal data, and can be contacted at data-protection@ucl.ac.uk

This 'local' privacy notice sets out the information that applies to this particular study. Further information on how UCL uses participant information can be found in our 'general' privacy notice:
For participants in research studies, click here.

The information that is required to be provided to participants under data protection legislation (GDPR and DPA 2018) is provided across both the 'local' and 'general' privacy notices.

The categories of personal data used will be as follows: Name, Email, Occupation

The lawful basis that would be used to process your personal data will be performance of a task in the public interest.

Your personal data will be processed until 31 December, 2025. The data you will provide will be anonymised in publications and will endeavour to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at data-protection@ucl.ac.uk.

The recipients of personal data are researcher and supervisor, no personal data will be transferred outside the EEA.

14. Contact for further information

If you wish to have further information, please contact Rongchen Tang rongchen.tang.23@ucl.ac.ukthe Project Supervisor Dr Clemence Cavoli clemence.cavoli@ucl.ac.uk.
Participants will be given a copy of the information sheet and, if appropriate, a signed consent form to keep and remember to thank the participants taking part in the project.

Thank you for reading this information sheet and for considering to take part in this research study.

Appendix 4: Thematic Analysis Processing in Novivo