HOW CAPITAL MANAGEMENT OF PUBLIC TRANSIT INFRASTRUCTURE AFFECTS INEQUITY IN A METROPOLIS

by

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ABSTRACT

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This is a hybrid study on inequity and public transit investment with a particular focus on wealth inequality. In the initial literature review, research suggested that income inequality and geographic location are correlated. Research also suggested that increasing investment in public transit affects the population's ability to switch jobs and opens more opportunities for housing choice. Therefore, increasing public transit in a fixed geographic location would theoretically decrease income inequality. Reducing income inequality is one of the easiest ways to reduce wealth inequity, an important task for the quality of life in a society. The research problem is optimizing public transit investments for longevity, health, speed, and cost for a metropolitan area.

This dissertation includes personal exploratory and comparative research from traveling to and within various cities in order to create a qualitative assessment. Data points gathered from various sources over the last 50 years are used to create a comprehensive analysis in order to describe whether a city or metropolitan planning organization should invest more in public transit infrastructure- and if so which modes to invest in.

This study has found that active transit is consistently underfunded when compared to automotive transit, which creates an access barrier for all citizens not just citizens with disabilities. Many suburban routes have zero sidewalks at all, which creates a massive safety issue and prevents people from using public transit further. Without full public support, investment in infrastructure declines over time. Furthermore, many modes need to be integrated as layers of a fully built-out system in order to fully provide the speed and flexibility needed. Some

cities that stand out as successes are Tokyo and Amsterdam. Some clear failures of policy are Kathmandu and Las Vegas.

Key Words: Public Transit, Infrastructure, Inequity, Capital Management

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CHAPTER I:
INTRODUCTION

1.1 Introduction

This research study covers capital management and public transit infrastructure implementation of various metropolitan areas across the planet. In the United States of America, there are both Metropolitan Planning Organizations (MPO) and Transportation Management Areas (TMA). Both of these planning organizations are critical in managing the planning portion of public transit infrastructure, and any planner working for them or policymaker could benefit from this paper. As part of the process of developing this paper, researcher Mr. Carr worked as an intern at an MPO and discovered some weaknesses in capital management. Mr. Carr also led a team of researchers in investigating transit on the ground.

Focusing on investing in multimodal public transit is increasingly important as society concentrates in highly densely populated centers. Individually funded transit is increasingly inefficient and creates multiple gaps for the median citizen. Many cities are already feeling the strain as their road networks reach a point where they simply cannot expand any further. Public bodies are now put in a position where they must rethink how people move, and that means looking at systems that can carry more travelers with less space, cost, and environmental impact. Unfortunately, most metropolitan areas must contend with large pre-existing road networks, small or restricted right-of-ways, and a sizable portion of the population owning private transit.

In order to best understand transit options and which would best serve

various communities, Mr. Carr and his team travelled in person to several cities

around the world. Additionally, they completed a literature review for every city visited and then cross-analyzed different modes of transit.

1.2 Research Problems

The research problems are “What are the most important modes of transit a public body should focus on first? What is the fastest per dollar mode of transit? What mode provides the greatest degree of flexibility? If we combine the factors of transit speed, cost, environmental impact, and construction rate- what modes are the most efficient? How can a metropolitan area reduce costs across all modes?” One useful way to approach these questions is through the idea of a transit hierarchy, which is a simple framework that ranks transportation modes by the order they should be funded, starting with walking and wheeling and moving upward toward higher (both in terms of economic and environmental impact) cost options. This hierarchy helps clarify why some investments create immediate benefits while others only make sense once the base layers are already strong. It also gives planners a clearer picture of how each mode depends on the one below it, which is important when resources are limited, and the city needs results that actually reach most residents.

1.3 Purpose of the Research

The primary purpose of this research is to assist public officials, transportation agencies, and urban planners in making more informed decisions about where and how to invest public capital in transportation infrastructure in order to maximize societal benefit. Capital resources for transportation are finite, and decisions regarding their allocation have long-term consequences for mobility, economic opportunity, land use patterns, and social equity. This research seeks to provide a clearer analytical framework for evaluating these decisions, particularly in the context of metropolitan areas facing increasing congestion, fiscal constraints, and growing disparities in access to transportation.

It is generally understood within transportation planning literature that investing in high-capacity, high-speed transit systems—such as heavy rail, light rail, and bus rapid transit—represents an efficient use of public funds when measured by passenger throughput and spatial efficiency. Despite this understanding, most metropolitan regions in the United States continue to allocate a disproportionate share of capital spending to road infrastructure. This persistent emphasis on roadway expansion often occurs even in dense urban environments where additional road capacity is physically constrained, economically inefficient,

or environmentally unsustainable.

Fixed-route public transit systems are capable of moving the largest number of people while consuming the least amount of urban space, a

characteristic that is especially critical in dense metropolitan areas where road widening or new highway construction is no longer a viable option. Beyond their operational efficiency, these systems also provide long-term structural stability to urban transportation networks. Once a core fixed-route network is established, complementary modes—such as local bus service, active transportation infrastructure, and emerging mobility options—can be organized around it, reinforcing the overall effectiveness and resilience of the system.

Additionally, as public engagement and participatory planning processes play an increasingly central role in transportation decision-making, there is a growing need for clear, accessible explanations of how different transit modes perform and why certain investments yield greater public benefit than others. This research aims to contribute to that understanding by providing an evidence-based breakdown of transit efficiency, capacity, and spatial impacts in a form that is intelligible not only to technical professionals but also to policymakers and the general public. In doing so, the study seeks to support more transparent, equitable, and outcomes-oriented capital investment decisions in metropolitan transportation systems.

1.4 Significance of the Study

This research is significant because it addresses a critical gap in public policy and urban transportation literature by examining the relationship between multimodal transit systems, access to wealth, and quality of life across a broad global context. While a substantial body of scholarship evaluates transportation outcomes within individual cities or through limited comparative analyses, relatively few studies adopt a transcontinental perspective capable of informing policy decisions beyond localized or national contexts. As a result, policymakers often rely on case-specific evidence that may not translate effectively across governance systems, funding structures, or cultural environments. By examining cities across five continents, this study contributes to a comparative foundation that supports more informed, transferable public policy frameworks for transportation investment and urban development.

The policy significance of this research is further strengthened by its emphasis on chronological proximity and methodological consistency. Many comparative studies rely heavily on secondary data collected across varying time periods, which can obscure policy impacts due to economic fluctuations, electoral cycles, or incremental infrastructure changes. In contrast, this study is grounded in

in-person observations and data collection conducted within a relatively narrow time frame, allowing for more equitable and contemporaneous comparisons. This approach enhances the credibility of policy-relevant findings by reducing temporal bias and enabling clearer evaluation of how different governance

models, funding priorities, and regulatory environments shape everyday mobility outcomes.

From a methodological standpoint, the study makes an important contribution to public policy research by foregrounding qualitative evidence, supplemented by quantitative indicators where appropriate. Public policy decisions in transportation are frequently driven by technical performance metrics—such as cost efficiency, ridership projections, or congestion reduction—while underemphasizing user experience, system legibility, and accessibility for diverse populations. By directly observing how individuals navigate transit systems, interpret wayfinding, and integrate multiple modes into daily routines, this research captures dimensions of policy effectiveness that are often overlooked yet central to equitable implementation. These insights provide policymakers with a more holistic understanding of how infrastructure investments translate into lived outcomes.

The scale and depth of the fieldwork further reinforce the study's significance. A research team of five individuals traveled approximately 100,000 miles over more than six months, investing roughly 9,000 combined person-hours in direct engagement with twenty-two cities worldwide. This sustained immersion enabled systematic observation of how policy choices manifest at the street level, revealing both common structural patterns and locally specific adaptations. Such extensive firsthand engagement is rare in transportation policy research and allows for a nuanced assessment of how institutional decisions interact with cultural norms, urban form, and socioeconomic conditions.

Finally, this research holds direct relevance for public officials, planners, and policymakers tasked with allocating limited capital resources in pursuit of broader social goals. By linking multimodal transit design and investment strategies to access to wealth and quality of life, the study provides evidence that transportation policy is not merely a technical or logistical concern but a central mechanism for shaping social equity and economic opportunity. The findings offer policymakers a grounded basis for evaluating trade-offs, justifying capital investments, and designing transportation systems that align infrastructure spending with long-term public value in metropolitan regions around the world.

1.5 Research Purpose and Questions

Globally, severe income inequality has persisted for at least half a century.

According to the World Inequality Lab, “While inequality has increased within most countries of the world, Over the past two decades, global inequalities between countries have declined” (World Inequality Lab, 2022). They continue to state that total income inequality between countries remains significant. One method of addressing income inequality is to address inequality geographically,

focusing on the metropolitan and rural areas as separate problems. This paper will focus on metropolitan areas as the primary problem due to the fact that this is where the majority of the global population lives and works.

Single user transit, such as cars disproportionally affects the air quality and overall health of lower income populations. Healthcare costs reduce the amount of wealth available, therefore increasing health and safety has a direct impact on wealth even if income remains the same. Additionally, if we assume that income remains the same, then removing the costs associated with private vehicle ownership is immediately beneficial.

Job opportunities are often not in the same neighborhoods as affordable housing, and affordable food may be in a third location. Being able to quickly transit to all necessary locations in an affordable manner has improved the lives of many citizens in metropolitan areas that will be covered. Multiple small changes that occur due to public transit investment cumulate into a much larger combined outcome. Furthermore, data suggests that this improvement is replicable even with a small revenue stream. Helping metropolitan planning committees identify which transit modes to fund first will be done by emulating cities with fast transit, low inequality internally, and environmentally friendly modes will be prioritized.

1.6 Research Hypotheses

What are the most important modes of transit a public body should focus on first? The initial hypothesis is that high speed/high density options such as the rail should be focused on first. What is the fastest per dollar mode of transit? Hypothesis is heavy rail. What mode provides the greatest degree of flexibility? Surface level rails such as trams hypothetically offer the most flexibility. If we combine the factors of transit speed, cost, environmental impact, and construction rate- what modes are the most efficient? My hypothesis is that active transport is the most efficient. How can a metropolitan area reduce costs across all modes? By effectively coordinating with all relevant agencies including non-transit related infrastructure that nonetheless occupies the same space.

The primary hypothesis of this research is that investing in active transportation reduces inequity in a given population. The secondary hypothesis is that generally speaking, the more modes a metropolitan area offers the more opportunities for class mobility to arise and a higher life expectancy. The tertiary

hypothesis is that after active transportation, the next most efficient mode is fixed route public transit best represented by the tram or similar.

CHAPTER II:
REVIEW OF LITERATURE

2.1 USA Broad Context

All major cities in the USA are impacted by federal decision making. This section will delineate some key Acts and historical points but is not intended to be exhaustive, it is simply to provide a background on American metropolitan projects. According to the Code of Federal Regulations: “an MPO shall be designated for each urbanized area with a population of more than 50,000 individuals” and “The FHWA and the FTA shall identify as a TMA each urbanized area with a population of over 200,000 individuals, as defined by the Bureau of the Census. The FHWA and the FTA shall also designate any urbanized area as a TMA on the request of the Governor and the MPO designated for that area” (Code of Federal Regulations, 2025). The MPO and TMA are critical planning organizations in American transit, they receive funding from Federal, State, and sometimes outside sources. Authorizations and Appropriations are passed by Congress and subsequently signed by the President.

The Federal Highway Act of 1950 amending and supplementing the Federal Aid Road Act of 1916, supplied a large $500,000,000 USD budget for various road infrastructure projects including roads specified for bus networks. (Federal-Aid Highway Act, 1950). This massive investment focused on road infrastructure benefited bus transit tremendously. Subsequently, this incentivized research and development into bus transit as one of the core modes of American public transit infrastructure.

Several important acts set the stage for transit infrastructure planning prior to 1975: CRA, NEPA, CAA, Rehabilitation, and ADA. The Civil Rights Act (CRA) of 1964 prevents discrimination based on a protected class. The National Environment Policy Act (NEPA) of 1969 requires environmental assessment. The Clean Air Act of 1970 (CAA) regulates all sources of air emissions. The Rehabilitation Act of 1973 prevents discrimination in employment and program services based on disability. The Age Discrimination Act (ADA) of 1975 prevents discrimination based on age. Collectively, these describe that public transit needs to provide service to everyone, and they must also account for environmental

factors that may come into play, especially with large industrial projects.

The MPO is integral to public transit infrastructure in the USA and has several core functions. The MPO must act as a public forum, prepare and maintain a Metropolitan Transit Plan (MTP), develop a Unified Working Program (UWP), identify and evaluate alternative transportation, develop a Transportation Improvement Plan (TIP), involve the public and develop a public participation plan, and assess air quality (DOT 2025).

In accordance with the federal requirement of public involvement, the MPO must understand the local cultural background. The MPO needs to identify and engage with the public. Proper planning also utilizes different techniques to safely involve the public in the decision-making process and generate, use, and evaluate feedback. True civic engagement is significantly more effort than just town halls but creates community engagement which is vital to long term projects.

Currently, the planning factors that are considered to be the most important are: economic vitality, safety, security, accessibility, mobility, environmental concerns, integration/ connectivity, efficient system management, preservation, resiliency/ reliability, travel and tourism. The only mode to meet a majority of these metrics is pedestrian travel. Sidewalks support all users at all capabilities for less cost than any other mode.

Large scale national research has been covered extensively in the United States showing that financial savings can be obtained via properly managing investments in public transit and reducing spending in infrastructure that supports individual transport. “Average US household expenditures as of 2022, of which transportation is the top expense behind housing” (Power, 2024). Housing is the number one expense in most environments, but the effect of housing on inequity is beyond the scope of this paper. “In addition, the research finds that through Electrification + Shift, the US can reduce public-sector expenditures on urban transport at local, state, and federal levels by a cumulative $2 trillion USD through 2050. This is only attainable, however, with policies and strategies that support large-scale vehicle electrification and a modal shift towards walking, cycling, and public transit” (Compact Cities Electrified, 2025). Looking forward, federal planning needs to overhaul the current spending paradigm and focus on supporting public transit projects over highways.

2.2 New York City

New York City is split into 5 Boroughs: the Bronx, Brooklyn, Manhattan, Queens, and Staten Island. These 5 counties were merged to deal with the massive influx of population and expanding metropolitan area in the late 1800’s. “The

planning area of the New York Metropolitan Transportation Council (NYMTC) encompasses New York City (the boroughs of Bronx, Brooklyn, Manhattan, Queens, and Staten Island), Long Island (Nassau and Suffolk counties), and the Lower Hudson Valley (Putnam, Rockland, and Westchester counties)" (NYMTC Plan, 2021). We will be looking at the 2021 transportation plan but for the purpose of this study we will focus on the 5 Boroughs. The 5 Boroughs are more comparable to metropolitan areas around the world.

The population of the New York City metropolitan area in 1975 was 15,880,000 and is 19,154,000 in 2025. (NYC Macrotrends, 2025) This is a pretty stable population growth which does make infrastructure planning easier.

"The Metropolitan Transportation Authority (MTA) operates subway and bus services throughout New York City. MTA New York City Transit (NYCT) operates 27 subway lines and 234 bus routes, including 20 enhanced bus service routes known as the Select Bus Service (SBS) and 73 express bus routes. Of the 472 subway stations, 122 currently comply with ADA accessibility standards. MTA Bus Company operates 44 local routes in the Bronx, Brooklyn, and Queens; 43 express bus routes between Manhattan and the Bronx, Brooklyn, or Queens; and 3 SBS routes in Queens. MTA Long Island Rail Road (LIRR) operates 11 commuter train lines from Penn Station, Atlantic Terminal, and Long Island City, Queens, to points east. MTA Metro-North Railroad (MNR) operates commuter rail from Grand Central Station to 6 train lines connecting to suburban New York and Connecticut. MTA LIRR and MNR have 108 and 60 accessible stations, respectively. MTA NYCT also operates a single railroad line on Staten Island. The New York City Department of Transportation (NYC DOT) provides public ferry service through the Staten Island Ferry" (N.Y.M.T.C. 2021).

Since 2004, real spending on highways has outpaced public transit spending on other modes. According to the NYC Independent Budget Office (IBO), a gap exists in the MTA Capital plan which may force the city to contribute more financially or risk losing services. (NYC IBO Gap in MTA, 2025) Interestingly, the MTA plans projects in 5-year time spans, the next plan starts in 2025. According to the IBO, only about half of the MTA's 68,400,000,000 USD budget had funding sources identified. If soft costs are not reduced in a meaningful way, services will have to be cut. Importantly, the city pays for MTA bus company, Access-a-ride paratransit, free schoolchildren fares, reduced fares for seniors and disabled riders, Commuter rail station maintenance within city limits, and the Staten Island Railway. The MTA is, by far, the largest provider of public transit in NYC.

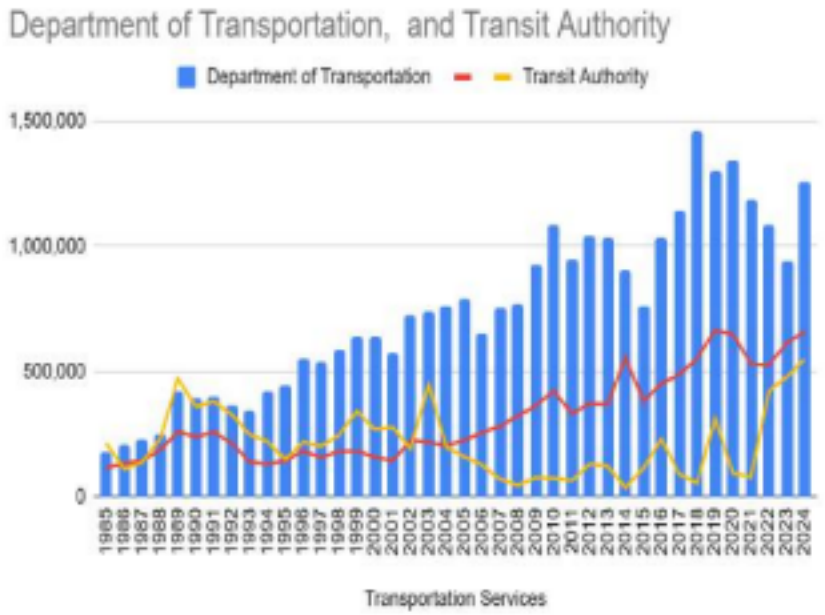

Figure 1: Public funding highway spending vs. public transit (Source: Carr 2024)

The second most important mode of public transit in NYC is the bus system. The Independent Budget Office of NYC has noted that buses are sometimes the only option for a rider, and yet the system suffers from slow speeds and traffic jams. (NYC IBO Speeding Up 2025) From 2019 to 2024 speeds have remained too slow for efficient use and this is largely due to a lack of designated and protected bus lanes, traffic congestion, and inadequate traffic enforcement. Increasing speed and reliability of bus systems improve public trust and therefore ridership. In the United States, user fare is a significant portion of public transit budgeting and any effect on ridership merits close investigation. Currently the fastest bus speed in NYC is in Staten Island, and the slowest is in Manhattan (13.9 mph vs. 6.3 mph) In NYC, this disparity in speed is largely due to a combination of traffic

management and density. Additionally, and importantly, for this study: IBO published an online interactive census-based map that shows that living within a 5-minute walk to a bus lane increases the median income of individuals.

2.3 Washington D.C.

"The National Capital Region Transportation Planning Board (TPB) is the designated Metropolitan Planning Organization (MPO) for the Washington

region…. The TPB's planning area, the National Capital Region, is home to approximately 5.7 million people. It includes the District of Columbia and 23 surrounding counties and cities in suburban Maryland and Northern Virginia" (MWCOG, 2022). The actual Washington D.C. metropolitan area had a population of 2,626,000 in 1975 and 5,600,000 in 2025 (Washington D.C. Macrotrends 2025). This is a large enough population spike to warrant significant increases in public transit spending.

By 1975, DC had already developed an extensive bus network and was getting ready to open its first rail line. (Historical Map, 2021) 50 years later, the rail is the most important transit infrastructure in the city center. "Metrorail provides safe, clean, reliable transit service for more than 600,000 customers a day throughout the Washington, DC area. The system is the second busiest in the United States, serving 98 stations in Virginia, Maryland, and the District of Columbia" (Metrorail, 2025).

In 1976, Washington D.C. opened the Rail system with an ATO (Automatic Train Operation) service capability. Over time, this function was cut due to not meeting standards but is currently being reinstated. (Metro and ATO, 2025) This will bring one layer of functionality on par with the majority of the developed rail systems around the world.

Currently, Washington D.C. has almost 1,500 miles of sidewalk in various conditions. (Pave DC, 2025) The Mayor and multiple community members identified issues in road and sidewalk conditions and laid out a well thought out plan to make significant changes. Pave DC delineates material condition, material type, past repairs, and planned construction segments. As of the writing of this dissertation, 362 miles of sidewalk repair and construction has been completed by Pave DC. Special consideration has been given to maintaining smoothness for ADA accessibility.

2.4 Chicago

Chicago is one of the leading examples of a developed public transit system in America. There is an aging legacy rail network that is still quite

functional, a bus system, and layers of subways and lifted rail. Additionally, there is a unique hub known as “The Loop” which allows for an easy way to switch transit lines. Importantly, for the last leg of any trip, there are sidewalks and bike lanes that cover the city. In 1975, the population of the Chicago metropolitan area was 7,160,000 and in 2025 is 9,042,000 (Chicago Macrotrends, 2025). This population growth is steady and well suited to marginal public transit investment increases.

The most important organizations managing public transit in the Chicago metropolitan area are the Chicago Transit Authority (CTA), the city itself, and

Metra. The CTA manages and operates the bus system, subway system, and some rail. Metra handles the responsibility of the intracity rail. The City of Chicago is directly responsible for the bike and pedestrian infrastructure (as well as roads) (Chicago HSTP, 2013). No single organization is solely responsible for public transit.

No discussion of transportation in Chicago can be fairly had without a short historical context. The transit lines used today can trace back to the old wagon trails and from there further back to Native American paths (Corliss, 1956). The westward expansion in the 1800s was explosive, including a population increase of ten times over 100 years from 1850 to 1950. However, much of the early population growth was centered around rivers, canals, and the great lakes. Once the rail was introduced, over time the population was allowed to grow inward into larger area spaces, much further from waterways. The invention of the railroad was absolutely critical to early Chicago success. Without it, Chicago would certainly be different.

Bicycle lanes have been developed extensively- especially over the last 25 years. One significant planning difficulty in Chicago is the usage of on-street parking, even so there is a solution on many streets. The city allows for a 5-foot-wide bike lane in order to give room for car door openings (Bike Lane Guide, 2025). The guide was developed for use in Chicago but has several useful metrics for any American city planner. Bike lanes are a high priority transit mode.

2.5 Rockford

Rockford, Illinois is a city that has historically struggled with redlining and discrimination. The metropolitan area developed its core during the height of the industrial era and the golden age of the automobile. This has led to a public perception that the city does not need to invest in public transit, which is far from the truth. Rockford does have great architecture from its heyday in the Art Deco to Midcentury period, but much of it is in disrepair. Due to the financial collapses related to manufacturing moving abroad, the city has struggled with maintaining

necessities for its population. In 1975, the population of Rockford was 205,000 and in 2025 is 336,000 (Rockford Macrotrends, 2025). Rockford had a massive population boom through the 50s and manufacturing through the 60s but during the late 70s and 80s the economic core of factory works abruptly left (America History, 2025). Today, Rockford primarily covers the healthcare and aeronautical industries. Any transportation strategy will have to consider the local airport and hospitals.

Currently, there are railroad tracks, a sidewalk system, bus system, and a few bike lanes. However, the execution today is extremely lacking and largely unusable by a significant portion of the population. The primary route of the bus

system covers the main spine but misses a significant section of the outer edges. Biking is highly restricted by parked cars in most neighborhood streets, and there are very few dedicated biking lanes with clear separation. Sidewalks are frequently cracked, missing, or angled severely. Additionally, many of the active transportation options are disjointed and have no overlap. This is typical of an American Midwestern city but when compared to similarly populated cities around the world- it is an underperformer.

According to the Coordinated Public Transit Human Services Transportation Plan (HSTP):

> "A lack of sidewalks presents a barrier to those looking to access public transit services safely and effectively. This barrier is even more prohibitive for individuals with mobility impairments, who may already find it challenging to reach fixed-route stops and other destinations…Households outside of Rockford Mass Transit District's (RMTD) service area must rely more on demand-response transit services to reach essential services, often making it far more difficult to actively participate in society" (HSTP, 2025).

Looking forward, Rockford has many projects already ongoing. There is a platform that will be built which will allow riders to use a train to connect to Chicago. Several studies are being conducted to allow people to access various services such as grocery shopping and healthcare without the need to own an automobile. Furthermore, there is an innovative approach to using the existing parking overflow in new ways such as adapting a large lot to use as a city market for small vendors. (R1 Planning, 2025)

2.6 Seattle

First intercity rail actually traces back to 1899. Prior to that, mini steamers and water-based vehicles were the primary mode of transit and transport (Crowley 2000). Early public transit was mired in coordination issues however and roads became the default mode of transit, as in most of the U.S.A. In 1975 the population of the Seattle metropolitan area was 1,663,000 and in 2025 is 3,581,000 (Seattle Macrotrends, 2025). This population increase supports a massive increase in public transit investment.

In 1979, there was a major push for a bus system update which did serve the public to a fairly successful degree. Series 872 King County Plan called for just under 100,000 new bus hours that only cost 2.5 million USD and included a

network of circulators and connectors (Division of Planning King County, Washington, 1979).

Currently, King County offers about 3.5 million service hours on fixed route bus service (King County Metro, 2025). With this being an annual number, the area still has a long way to go to meet the needs of its population. The largest current weakness identified by the metropolitan planning organization is timeliness. On time performance and frequency of service are both considered to be subpar by the local population.

The mode with the greatest increase in ridership is the vanpool, but the sounder rail line is in close second. 48% year over year increase vs. 43%. However, due to the significantly better performance in sustainability, the Sounder is the current most important mode of transit infrastructure for investment purposes.

2.7 Las Vegas

The desert city Las Vegas is an interesting American city with vast wealth and resources and yet underwhelming public transit infrastructure. There are a few buses, a monorail, and a few trams. Las Vegas, renowned for its vibrant tourism industry and bustling urban life, presents a unique case study in understanding the relationship between income inequality and public transit. The city, characterized by a significant service industry workforce, tourists, and a diverse resident population, experiences varied public transit needs and challenges. The analysis examines the relationship between Las Vegas's public transit system and the city's income inequality, with a focus on accessibility, service quality, and its effects on various income groups.

Las Vegas is a famous destination city for tourists across America and across the globe. The population of Las Vegas in 1975 was 325,000 and in 2025 is

3,000,000 (Las Vegas Macrotrends, 2025). If Las Vegas fixes its transit problem, and its income inequality problem is then solved; it may be a good example to other major cities across the US. Thomas Sanchez stated that income inequality across America, but especially in large metro areas is significant. Furthermore, he stated that public spending plays an outsized role even though the majority of travel is not by public transit. (EBSCO, 2001) Las Vegas is extremely dense near the Strip and is very walkable- until you leave the center and then there is a very low-density suburban sprawl with very little public infrastructure.

Las Vegas has been marked by significant income disparities, often influenced by its heavy reliance on the service and entertainment industries. These sectors are known for a wide range of incomes, from high-earning executives to lower-wage service workers (Brown & Bhattarai, 2018). According to Data USA, the income inequality in Las Vegas- as measured by the Gini coefficient is higher

than the national average, underscoring the socio-economic divides within the city. National average is noted as .478 compared to LAS Vegas [Southwest] .518 (Data USA, 2021). This is a massive problem and needs to be addressed. Public transit in Las Vegas, primarily managed by the Regional Transportation Commission of Southern Nevada [RTC], includes buses and a monorail system. While the RTC has made some efforts to expand and improve services, challenges remain in meeting the diverse needs of the population. Studies have shown that lower-income neighborhoods often have less access to efficient and reliable public transit, impacting residents' ability to access employment and essential services (Sanchez, Stolz, & Ma, 2003).

The limitations in public transit in Las Vegas disproportionately affect low-income residents, who are often dependent on public transportation for commuting to work and accessing basic services. The service industry workers, a significant portion of whom fall into the lower-income bracket, face challenges due to inconsistent and inadequate transit routes and schedules, especially during off-peak hours when many of them work (Glaeser, Kahn, & Rappaport, 2008). These transportation barriers can perpetuate income inequality, as they limit employment opportunities and access to resources that could facilitate upward economic mobility. Additionally, they can create a safety concern if a worker needs to travel at night and there is no public option. Improving public transit in Las Vegas can play a crucial role in addressing income inequality. Enhancing accessibility and reliability of transit services in underserved areas can provide more equitable access to job opportunities and essential services. Investments in public transit infrastructure and services, with a focus on inclusivity and equity, could mitigate some of the socio-economic disparities in the city (Litman, 2020).

2.8 Rio De Janeiro

The population of the Rio de Janeiro metropolitan area was 7,733,000 in 1975 and is 13,923,000 in 2025 (Rio de Janeiro Macrotrends, 2025). This growth represents a substantial and sustained increase over a fifty-year period, reflecting broader trends of urbanization and metropolitan expansion observed across much of the Global South. Such a dramatic rise in population has significant implications for transportation planning, particularly with respect to capacity, efficiency, and long-term capital investment. At this scale, Rio de Janeiro is well beyond the population density thresholds that typically support higher-capacity fixed-rail systems, including light rail and metro service, as primary mobility backbones rather than supplementary modes.

Despite this sustained growth, rail-based rapid transit infrastructure in Rio de Janeiro has developed relatively slowly when compared to other metropolitan regions of similar size and density. As noted in prior research, "Unlike most major

metropolitan cities, Rio de Janeiro was a bit behind in building a subway system. The Metro Rio, as it is called, was first opened in 1979. The system is still rather small with only 3 lines and 41 stations" (Rio, 2025). The delayed introduction of metro service meant that much of the city's urban expansion occurred in the absence of a robust, high-capacity rail network, reinforcing travel patterns and land use decisions centered on surface transportation.

As a result, Rio de Janeiro has historically prioritized bus-based transit solutions to accommodate growing travel demand. While bus systems offer flexibility and lower initial capital costs, they are inherently constrained by roadway capacity and are less effective at moving large volumes of passengers in highly dense urban environments. At population and density levels such as those currently observed in Rio de Janeiro, reliance on bus systems alone becomes increasingly inefficient, particularly when buses must operate in mixed traffic or compete with private vehicles for limited road space. This investment pattern highlights a structural mismatch between the scale of metropolitan growth and the capacity of the dominant transit modes employed.

2.9 Buenos Aires

The population of the Buenos Aires metropolitan area in 1975 was 9,143,000 and in 2025 is 15,752,000 (Buenos Aires Macrotrends, 2025). Buenos Aires has a significant income inequality problem. The average citizen and the urban elite of the North live very different lives (Council on Hemispheric Affairs 2014). Studies have found significant investments in bus routes; however, public spending on infrastructure has gone down significantly, and income inequality has gone up. Improving bus routes and train travel may not be enough to stave off

income inequality in this city, however, due to income inequality arising from real estate, education, food, and water access. This chapter explores the relationship between public transit and income inequality in Buenos Aires, considering how transit accessibility and infrastructure development affect various socio-economic groups within the city and aims to understand the role of public transit in either perpetuating or mitigating economic disparities.

In Buenos Aires, income inequality is a significant issue, with disparities evident between different neighborhoods and socio-economic classes. According to the World Bank (2019), Argentina has one of the highest levels of income inequality in Latin America, a region already known for its stark socio-economic divides. Buenos Aires, as the country's economic hub, epitomizes these disparities, with affluent neighborhoods contrasting sharply with impoverished favelas.

Public transportation in Buenos Aires, including buses [colectivos], subways [Subte], and trains, is extensive but faces challenges in terms of quality

and accessibility. While it offers a lifeline for the city’s lower-income residents, issues such as overcrowding, safety concerns, and reliability disproportionately affect these populations (Porta & Landoni, 2018). Moreover, the relatively higher costs of public transit can be a burden for low-income groups, making access to employment and essential services more challenging. That being said, there have been massive improvements recently such as: the main Boulevard of 20 lanes was reduced to 16 and the 4 lanes were dedicated to public transit options (Kamrowska-Zaluska, D. 2017). This was extremely successful in reducing transit times in both public and private options.

For many low-income residents in Buenos Aires, limited access to efficient public transit is a barrier to employment opportunities and social mobility. Areas with insufficient transit links often coincide with neighborhoods experiencing higher poverty rates. This lack of connectivity not only reinforces existing income disparities but also limits these communities' potential for economic growth (Jaitman, 2017).

Buenos Aires faces the challenge of modernizing and expanding its public transit system in a way that addresses the needs of its most disadvantaged residents. The allocation of resources for transit infrastructure needs to be strategically planned to ensure equitable access across the city. Future policies should focus on integrating transportation development with broader urban planning initiatives aimed at reducing socio-economic disparities.

2.10 Casablanca

The capital of Morocco is a port city with a rich history however the

metropolitan area is struggling with poverty. This problem is across Morocco but is declining in Casablanca. “While spatial differences in poverty also declined, there remain wide differences across communes” (Poverty, 2018). Casablanca has multiple tram lines and bus lines but lacks subway lines or proper train routes. With an increase in available transit- more work opportunities would open. According to RATP Dev. Casablanca, the transit operation is the leading public transit project in the entire continent (RATP, 2023). Casablanca, the largest city in Morocco, is a vibrant metropolis that serves as an economic and commercial hub. The population of Casablanca in 1975 was 1,793,000 and in 2025 is 4,012,000 (Casablanca Metrotrends, 2025). The city's public transit system is a critical component of its urban fabric, providing mobility to its diverse population. However, income inequality remains a prominent issue. This chapter explores the connection between income inequality and public transit in Casablanca, examining how transit accessibility and quality impact different socio-economic groups and potentially influence the city’s economic disparities.

Casablanca’s economic growth has been significant, yet not all residents have benefited equally. The city exhibits substantial income inequality, with a clear divide between affluent areas and impoverished neighborhoods. This disparity is reflected in varied living conditions, access to basic services, and employment opportunities (El Faiz, 2017). The World Bank (2018) indicates that while Morocco has made strides in poverty reduction, income inequality remains a pressing challenge.

The public transit system in Casablanca includes buses, a tramway system, and taxis. The tramway, introduced in 2012, represents a significant investment in improving urban mobility. However, the system’s reach and affordability have been subjects of debate. While it has enhanced transportation in certain areas, some peripheral and impoverished neighborhoods remain underserved (Cervero & Dai, 2020). This uneven access to reliable public transit exacerbates socio-economic inequalities by limiting mobility and access to employment for lower-income residents.

Limited access to efficient and affordable public transit in Casablanca disproportionately affects lower-income groups. These individuals often rely on public transportation for their daily commutes and access to essential services. The inadequacy of public transit options in certain areas hinders their ability to reach employment centers, educational institutions, and healthcare facilities, perpetuating a cycle of poverty and limiting socio-economic mobility (Poinsot, 2019).

Improving public transit in Casablanca can play a pivotal role in addressing income inequality. Enhanced accessibility, particularly in underserved areas,

would provide more equitable opportunities for all residents. Investments in extending transit routes, increasing frequency, and maintaining affordability are essential steps towards making the transit system a tool for socio-economic inclusion (Sclar, Lönnroth, & Wolmar, 2017). Expanding the nodality of the tram service would be an excellent first step in modernizing the system.

The development of an equitable public transit system in Casablanca faces several challenges, including financial constraints, urban planning issues, and the need for coordination among various stakeholders. Policymakers must consider the diverse needs of the city's population, ensuring that public transit development is part of a larger strategy to address income inequality. This approach requires a comprehensive understanding of the socio-economic landscape and targeted interventions that prioritize the most disadvantaged groups (United Nations, 2018).

2.11 Marrakesh

The metropolitan area of Marrakech had a population of 367,000 in 1975 and a population of 1,085,000 in 2025 (Marrakech Macrotrends, 2025). This represents a nearly three-fold increase over fifty years, indicating significant urban expansion and rising demand for efficient transportation systems. Marrakesh presents a particularly interesting transit situation in part because of its mixed modal environment. The train station in the city center is well connected to other cities in the region and is generally well designed, providing intercity rail access that supports regional mobility. Within the core of the city, especially the historic ‘old town’ area, built form and urban morphology create an environment with very pedestrian-friendly paths that are too narrow for most vehicles; these areas exhibit high walkability at least within the central districts.

However, despite these apparent strengths, there are several glaring issues that impact overall urban mobility and quality of transit infrastructure. Most importantly, the lack of separation between pedestrians and smaller motorized vehicles such as motorcycles and mopeds, which frequently share space with walkers on narrow streets. This lack of modal separation not only reduces the safety of pedestrian travel but also contributes to a chaotic travel environment where vulnerable road users must constantly navigate competing and fast-moving traffic. In addition to this, the city suffers from several pockets of infrastructure deterioration, including uneven paving, constrained sidewalks, and inconsistent maintenance of pedestrian routes outside the historic core.

These pedestrian infrastructure challenges in Marrakech reflect broader mobility issues documented in Moroccan cities, where walking remains one of the

most widely used modes of transport yet is consistently undermined by inadequate supporting infrastructure. Narrow, eroded, or discontinuous sidewalks, limited pedestrian crossings, and poor surface conditions reduce the safety, comfort, and efficiency of walking as a daily mode of travel. These deficiencies disproportionately affect vulnerable populations, including children, older adults, and individuals with disabilities, for whom unsafe or inaccessible pedestrian environments can significantly restrict mobility and access to essential services. (OECD, 2025) From a public policy perspective, this highlights a disconnect between the high reliance on walking and the relatively low level of capital investment dedicated to pedestrian infrastructure. Addressing these gaps would require not only physical upgrades but also stronger regulatory frameworks and enforcement mechanisms to prioritize pedestrian safety and clearly separate motorized and non-motorized modes. In the context of rapid metropolitan growth, the Marrakech case illustrates how insufficient attention to pedestrian policy can limit the effectiveness of otherwise walkable urban cores and constrain broader goals related to equity, accessibility, and quality of life.

2.12 Cairo

The Historic Capital of Egypt has a bustling subway system, an intricate network of corridors and alleys, and buses. The metropolitan area had a population of 6,450,000 in 1975 and has a population of 23,074,000 in 2025 (Cairo Macrotrends, 2025). This explosive demographic growth underscores the immense pressures placed on urban infrastructure, including transportation networks that must serve diverse socio-economic populations under conditions of rapid urbanization. The city's transit challenges exemplify many of the broader issues faced by megacities in the Global South, where both modal diversity and demand have surged without commensurate investments in capacity and coordination.

The subway system has more riders than NYC's but the rest of the transit infrastructure as a whole needs a lot of work. At a basic level, Cairo's metro network functions as the backbone of daily mobility for millions of residents. It remains a strong metro system in Africa, carrying extremely high volumes of passengers relative to its size, with estimates suggesting daily ridership in the millions and network extensions underway. However, the metro's relative success highlights the comparative underdevelopment of other transit modes. The main arteries of the city are consistently filled with cars, and traffic jams are regular occurrences that contribute to lost productivity and reduced quality of life across the metropolitan population (Mahdy, 2012). Persistent congestion in Cairo's road network has been estimated to impose economic costs equivalent to a sizable portion of the national GDP, as time lost in traffic, fuel consumption, and vehicle

wear contribute to reduced overall economic efficiency (World Bank, 2012).

Most tourists are encouraged to only travel by taxi due to safety concerns, which further reflects the underlying challenges of navigating Cairo's urban environment outside formally regulated transit systems. Despite having a major seaport and a large international airport, the internal movement infrastructure beyond the metro has struggled to keep pace with demographic and economic expansion. In addition to the core subway, Cairo has a diverse bus system and emerging initiatives aimed at enhancing high-capacity surface transit. The existing bus network, operated by the Cairo Transport Authority, is a critical component of daily commuting patterns, transporting millions of passengers each day across thousands of standard buses and minibuses. Yet even this network experiences strain from congestion and underinvestment, and informal para-transit services play a significant role in filling gaps in official coverage.

In recent years, international investment has begun to target gaps in both long-distance and urban transit connectivity. The World Bank is financing a 400 million USD railway connecting Cairo to Alexandria, a project intended to improve intercity rail reliability and service quality and contribute to broader regional mobility goals (Wyman, 2025). Such investments align with global development priorities that frame improved rail and transit infrastructure as

essential to equitable access to employment and economic opportunity. Moreover, major multilateral financing agreements—such as those by the European Investment Bank—have committed over a billion euros toward rehabilitating and expanding metro and tram systems in Cairo and Alexandria, illustrating international recognition of the need for enhanced public transport infrastructure in Egypt's urban cores.

However, despite these capital projects, systemic challenges persist. Traffic congestion remains severe and is compounded by insufficient integration between different transit modes, limited active mobility infrastructure, and relatively weak last-mile connectivity. Unlike cities that have invested heavily in multimodal integration, including cycling infrastructure and dedicated pedestrian spaces, Cairo's modal network remains relatively fragmented, which limits the ability of residents to shift seamlessly between buses, metro, and emerging systems such as the Light Rail Transit that links the city core with new administrative districts. The result is a transportation system that, while vital and heavily used, exhibits friction points that undermine overall efficiency and accessibility (Elkhateeb, 2017). Due to underfunding of public transit in favor of automobile subsidization, Cairo faces a similar infrastructure problem to the United States of America.

Cairo thus presents a multifaceted case for capital investment and public policy reform in metropolitan transit. Its metro system demonstrates the potential

impact of high-capacity rail in densely populated contexts, yet persistent congestion, modal disintegration, and uneven transit quality highlight the need for more comprehensive strategies that align infrastructure investment with long-term urban planning objectives. In this sense, Cairo's experience illustrates both the opportunities and limitations inherent in balancing rapid urban growth with sustainable, equitable transit development in a megacity setting.

2.13 Istanbul

Istanbul, straddling two continents, is a city of profound cultural and economic significance. The metropolitan area had a population of 3,600,000 in 1975 and a population of 16,237,000 in 2025 (Istanbul macrotrends, 2025). Its diverse socio-economic landscape is marked by notable income inequality, which is intricately linked to the city's public transit system. Currently, Istanbul is the most unequal city in Turkey (Hurriyet, 2018). In 2019, Istanbul served over a billion passengers (Statista 2021). Therefore, we can assume that inner core city transit is good, or at least currently functioning.

Istanbul, as Turkey's economic powerhouse, exhibits stark contrasts between wealth and poverty. Income inequality is evident across its sprawling neighborhoods, from affluent districts to densely populated, lower-income areas.

The Gini coefficient for Turkey, while showing some improvement, remains a concern, particularly in urban areas like Istanbul (World Bank, 2019). This economic disparity is often mirrored in access to services, including public transportation.

Istanbul's public transit system, encompassing buses, ferries, a metro, trams, and many buses, is expansive yet faces challenges in meeting the needs of its diverse population. While the system has undergone significant expansions, such as the Marmaray railway tunnel linking Europe and Asia, issues of accessibility and reliability persist. Areas with higher poverty rates often have less access to efficient and reliable public transit, exacerbating existing inequalities (Turan, 2017).

The limitations of Istanbul's public transit system disproportionately affect lower-income residents. Many depend on public transportation for access to employment, education, and healthcare. Inadequate transit in these areas not only reinforces the income divide but also hinders residents' ability to improve their socio-economic status. This situation is compounded by the relatively high cost of transportation compared to average incomes in these communities (Erdem & Şimşek, 2018).

Enhancing public transit in Istanbul could play a vital role in addressing income inequality. Improving accessibility, affordability, and coverage, especially

in underserved neighborhoods, would provide more equitable opportunities for all residents. Public transit improvements can facilitate better access to employment and essential services, contributing to socio-economic mobility and inclusion (Cervero, 2013). Developing an equitable public transit system in Istanbul is challenging, given the city's complex geography and rapid urbanization. Policymakers need to address these challenges with a focus on equity and inclusivity. Integrating transportation planning with broader urban development strategies is essential. This approach involves not only expanding and improving infrastructure but also ensuring affordability and accessibility for all segments of the population (Barter, 2018).

2.14 Athens

Athens, the capital of Greece, functions as a major regional transportation hub and is connected to nearby cities and international destinations through an airport, a seaport, and multiple train stations. This multimodal connectivity reflects Athens' long-standing role as both a national capital and a gateway between Europe and the eastern Mediterranean. The metropolitan population in 1975 was 2,738,000 and in 2025 is 3,155,000, indicating relatively modest population growth when compared to many other major global cities examined in this study (Athens Macrotrends, 2025). This slower rate of growth has allowed

Athens to focus less on rapid capacity expansion and more on system refinement, modernization, and integration within its existing urban fabric. An especially notable aspect of Athens' transportation infrastructure is the city's deliberate emphasis on preserving and showcasing historical artifacts within its transit system. During the construction and expansion of the subway network, extensive archaeological discoveries were made, and rather than removing these materials from public view, many stations were designed to incorporate them directly. As a result, large portions of the subway system function as informal museums, featuring curated exhibits of antiquities that are free and open to the public. This approach transforms everyday transit spaces into cultural environments, blending mobility infrastructure with heritage preservation. (Dmstephenson, Douglasjtimpe, Luciferasi, and Mbison, 2009). From a public policy perspective, this strategy has important implications for public engagement and social acceptance of large capital projects. By visibly integrating cultural preservation into modern infrastructure, Athens has increased public buy-in for transit investment and fostered a sense of shared ownership over the system. The subway does not function solely as a means of transportation, but also as a civic space that reinforces collective identity and community pride. This integration of culture and infrastructure illustrates how transportation policy can extend beyond efficiency

metrics to address social value, historical continuity, and public trust. In the context of metropolitan transit planning, Athens demonstrates how infrastructure investments that respect local identity can strengthen long-term political and public support for sustainable transportation systems.

2.15 Zagreb

Zagreb, as the capital city of Croatia, presents a unique urban landscape where public transit and income inequality intersect in complex ways. A moderately developed city with decent public transit and a growing income inequality problem, Zagreb is another interesting case. The population of the Zagreb metropolitan area in 1975 was 607,000 and in 2025 is 684,000 (Zagreb Macrotrends, 2025). According to contemporary researchers and modern historians, much of the inequality today can be traced back to the top 1% increasing in wealth dramatically- post communism (Nataša, 2018). In the 1970s' social welfare programs, including a small transit boost, helped decrease income inequality. Right now, the city has somewhat stabilized both in quality of life and income inequality. Currently, infrastructure is actively increasing in size and scope. (Igor, 2022) As the largest city in Croatia, Zagreb has a diverse socio-economic spectrum and faces challenges in providing equitable public transit to all its residents.

Zagreb, like many European cities, experiences varying degrees of income inequality. According to the Croatian Bureau of Statistics (2019), while Croatia has made significant strides in reducing poverty, disparities in income distribution remain evident, especially in urban areas like Zagreb. These disparities are often reflected in access to essential services, including public transportation. Zagreb's public transportation system, operated by Zagrebački Električni Tramvaj [ZET], consists of trams, buses, and a funicular. While the system is generally efficient and covers most of the city, issues such as aging infrastructure, connectivity, and service frequency, particularly in peripheral areas, pose challenges for equitable access (European Commission, 2020).

Lower-income residents in Zagreb often reside in areas where public transit options are limited. This lack of access to efficient transportation can significantly impact their ability to reach employment opportunities, educational institutions, and health services. The result is a perpetuation of income inequality, as these residents face more significant barriers to improving their socio-economic status (Tomeš, 2018).

2.16 Munich

Munich, the capital of Bavaria, Germany, is an excellently designed city that features a highly successful, multimodal public transit system, recognized for both its efficiency and coverage. The population of the Munich metropolitan area in 1975 was 1,296,000 and in 2025 is 1,591,000, reflecting modest but steady growth over the past fifty years (Munich Macrotrends, 2025). This controlled population increase has allowed the city to carefully plan and expand its transit infrastructure without the intense congestion pressures experienced in many other major European metropolitan areas. The careful urban planning combined with consistent investment in multimodal transit has contributed to Munich's reputation as a model for functional, well-integrated public transportation networks.

The city's rail system has historical roots in Cold War-era planning and as such exhibits a distinctive brutalist and midcentury architectural design, which is visible in many station structures and infrastructure components. The design approach reflects both the aesthetic and the functional priorities of the period, emphasizing durability, modularity, and efficiency in an era of rapid urban reconstruction and expansion. The train network in Munich is organized into two distinct systems: intercity and intracity trains, each with its own characteristics, operational speeds, and station densities (Nomad, 2025). The intercity trains provide faster, longer-distance travel with fewer stops, connecting Munich to regional and national destinations, while the intracity trains operate at higher station density and slower speeds to facilitate frequent local travel. This

dual-tiered rail system has significantly improved accessibility, reduced travel times, and enhanced rail ridership throughout the metropolitan area. The impact of these infrastructure decisions is evident in the city's high levels of rail utilization and overall transit efficiency. Massive improvements in rail ridership have resulted from the careful calibration of service frequency, route coverage, and integration with other modes such as buses and trams. The city's emphasis on multimodal connectivity enables residents to move seamlessly between transit types, creating a system in which public transportation is a viable alternative to private vehicle use for many daily trips. Despite these achievements, private motorized transport remains significantly higher than all other modes combined, reflecting both cultural preferences for automobile use and the high degree of vehicle ownership in the region.

Transport volume in Germany (in billion passenger kilometres)	2021[1]	2022[1]
Private motorised transport	804.3	874.3
Rail	56.2	93.3
Public road transport	44.4	56.2
Air travel (domestic in Germany)	2.1	4.1
Total	907.0	1.027.9

1 Provisional, partly estimated, figures rounded
Sources: Destatis, DB

Figure 2: Transport Volume in Germany (Source: Nomad, 2025)

This pattern highlights ongoing challenges in balancing multimodal transit planning with private transport demand, as well as the ability of policies that incentivize public transit use without compromising mobility for other segments of the population.

In addition, Munich's transit network demonstrates how mid-20th century infrastructure investments can continue to support sustainable urban mobility decades later. By maintaining and modernizing existing rail corridors, Munich has leveraged its historical planning decisions to deliver long-term value while minimizing disruption to urban form. The combination of historical foresight, rigorous planning, and multimodal integration positions Munich as an instructive example for other cities seeking to expand or retrofit their transit systems, illustrating the potential for early investments in rail infrastructure to generate enduring public benefits and shape urban mobility patterns effectively. Additionally, Munich public transit policy supports ongoing maintenance which is critical to longevity.

2.17 Barcelona

The population of the Barcelona metropolitan area was 3,679,000 in 1975 and is 5,733,000 in 2025, reflecting substantial long-term growth over a fifty-year period (Barcelona Macrotrends, 2025). This increase in population has placed sustained pressure on the city's transportation system, requiring deliberate policy interventions to manage travel demand while preserving urban livability. Unlike many metropolitan regions that have responded to growth through road expansion and increased automobile capacity, Barcelona has pursued a policy trajectory that emphasizes multimodal mobility, compact urban form, and reduced reliance on private vehicles. One such policy is establishing zones of complete ban of private vehicles. There are entire neighborhoods with a total exclusion of cars, only allowing emergency response vehicles.

As a result of these policy choices, Barcelona has one of the lowest rates of private automobile usage among large European cities. Approximately 16% of total journeys are made using private transit, a figure that underscores the effectiveness of the city's investment in public transportation and active mobility infrastructure (Autoritat del Transport, 2024). This relatively low share of private vehicle trips suggests that a majority of residents rely on alternatives such as metro, bus, tram, cycling, and walking for daily travel, reinforcing the role of public transit as the backbone of metropolitan mobility.

More importantly, according to the Autoritat del Transport, both public transit and active transit usage are increasing year over year, while private automobile use is in decline. This trend is particularly significant from a public policy perspective, as it indicates not only a successful modal shift but also the durability of transportation reforms over time. Rather than achieving a one-time reduction in car usage, Barcelona is sustaining behavioral change through consistent investment, regulatory measures, and urban design strategies that prioritize people over vehicles. These patterns suggest that coordinated land use and transportation policies can effectively influence travel behavior even in growing metropolitan regions.

Taken together, Barcelona's experience illustrates how long-term population growth does not necessarily require increased automobile dependence. Instead, the city demonstrates that strategic capital investment in public transit and active modes, combined with supportive policy frameworks, can accommodate metropolitan expansion while simultaneously reducing private vehicle use. This makes Barcelona a compelling case within the broader literature on sustainable urban mobility and offers transferable lessons for cities seeking to align transportation policy with environmental, equity, and quality-of-life objectives.

2.18 Amsterdam

Amsterdam, known for its extensive canal system, historic architecture, and vibrant culture, also presents a complex urban environment where public transit and income inequality intersect. As the capital city of the Netherlands, Amsterdam is marked by its diverse population and progressive urban planning policies. The metropolitan area of Amsterdam had a population of 978,000 in 1975 and has a population of 1,189,000 in 2025 (Amsterdam Macrotrends, 2025). Amsterdam is a city where the rich have benefited from the activities of the Dutch East India Trading Company. Therefore, there is a strong historical wealth inequality. Due to the last hundred years of political and social work, however, income inequality has actually been managed very well and is not far behind

Reykjavik (Madeline, 2021). Presently, public transit is quite good with extensive bike options and trams. In the future, train access will increase with the city investing in a rail network (City of Amsterdam, 2023).

Despite the Netherlands being known for its relatively equitable income distribution, Amsterdam faces its own challenges with income inequality. As reported by the Amsterdam City Council (2020), while the city has a high standard of living, there are noticeable disparities in income and living conditions among its residents. These disparities are particularly evident between the city center and the more peripheral neighborhoods.

Amsterdam's public transit system, operated by Gemeentelijk Vervoerbedrijf (GVB), is renowned for its efficiency and includes trams, buses, ferries, and a metro system. The city also emphasizes cycling and pedestrian-friendly infrastructure. Despite its overall effectiveness, there are concerns regarding the accessibility of public transit in economically disadvantaged areas, potentially exacerbating income inequality (Van Wee & Geurs, 2020).

Lower-income residents in Amsterdam, especially those living in the outskirts, often face challenges in accessing the more comprehensive public transit services available in the city center. This limited access can restrict their opportunities for employment, education, and social mobility. Consequently, the less efficient transit connections in these areas can perpetuate income inequality by hindering residents' ability to improve their socio-economic status (Kloosterman & Nijkamp, 2018).

Improving public transit accessibility in Amsterdam’s peripheral neighborhoods could significantly contribute to addressing income inequality. By enhancing the connectivity and affordability of public transit, the city can ensure more equitable access to opportunities for all residents. The Amsterdam Metropolitan Area is actively working on expanding and improving public transit infrastructure to better serve these communities (Amsterdam Transport Authority, 2021).

Developing a more inclusive public transit system in Amsterdam involves navigating challenges such as urban sprawl, funding limitations, and environmental sustainability. Policymakers must balance these challenges with the need to provide equitable transit access. This requires integrated urban planning that prioritizes public transit improvements in underserved areas and involves community stakeholders in the decision-making process (European Commission, 2019).

2.19 Reykjavik

Reykjavik, the capital and largest city of Iceland, stands as a unique case in examining the interplay between income inequality and public transit. Known for its high standard of living and strong social welfare policies, there is surprisingly little public transit. This chapter delves into how Reykjavik's public transit system relates to income inequality within the city, focusing on the accessibility and impact of transit services on different socio-economic groups. The metropolitan area had a population of 98,971 in 1974 (Demographic Yearbook UN, 1975) and in 2025 the population is estimated to be 216,940 (World Population Review, 2025). With a GINI coefficient of .26 (Statista 2023) Reykjavik is doing quite well, the city should be commended, and public transit is actively improving rapidly (Cowi, 2023). Again, according to Statista, income inequality is set to decrease or remain stable and according to Cowi public transit will remain accessible and increase in capacity. Further research will determine how Iceland was able to obtain such high equality.

For historical context, we need to look at two extremely important transit related topics. Firstly, the travel to and from the island was historically via ship and this island is very remote, for centuries the population was only minimally influenced by the exterior world. Secondly, World War 2 required updated logistics on the side of the Allies, which meant installing an airfield on the island. In the decades since, this airfield has turned into an international airport helping to connect Europe and North America.

While Iceland is often celebrated for its low levels of income inequality compared to other countries, disparities still exist, especially in urban areas like Reykjavik. According to Statistics Iceland (2020), there is a growing concern about income gaps, particularly among immigrants and lower-income groups. These disparities are reflected in varying access to essential services, including transportation. Globally, people are moving from rural areas to metropolitan areas in search of jobs and services- the same holds true in this city and if unaddressed the increase in population will make transit much more difficult.

Reykjavik's public transportation, primarily operated by Strætó bs, includes a network of buses that serve the city and surrounding areas. While the

system is reliable, there are challenges related to coverage and frequency, particularly in the suburbs and peripheral neighborhoods. This limitation can disproportionately affect lower-income residents who rely more on public transit (Transportation Research Board, 2021). The city core, however, has a dense representation of bus transit. There is an extensive sidewalk and bike path infrastructure that is very capable and supports the ethos of low-cost public transit first models.

The constraints of Reykjavik's public transit system can have a significant impact

on lower-income residents. Limited transit options in certain areas can hinder access to employment, education, and healthcare services, exacerbating income inequality. The cost of transportation, though relatively affordable, can also be a burden for those with limited financial resources (Jóhannesson, 2019).

Improving public transit in Reykjavik presents an opportunity to address aspects of income inequality. Enhanced transit accessibility, affordability, and service efficiency can provide more equitable access to opportunities across all socio-economic groups. The city has been making efforts to improve public transit, with plans for better connectivity and increased frequency of services (City of Reykjavik, 2020). Developing an equitable public transit system in Reykjavik involves addressing issues such as geographic constraints, funding limitations, and environmental sustainability. Effective urban planning and policymaking need to prioritize public transit improvements, especially in underserved areas. Moreover, involving community stakeholders in transit planning can ensure that the system meets the diverse needs of the city's residents (Nordic Council of Ministers, 2018).

2.20 Stockholm

The metropolitan area had a population of 1,015,000 in 1975 and has a population of 1,738,000 in 2025, reflecting steady and sustained growth over a fifty-year period (Stockholm Macrotrends, 2025). This population increase has required Stockholm to proactively manage transportation demand in a way that balances mobility, environmental sustainability, and quality of life. Rather than relying on large-scale road expansion to accommodate growth, Stockholm has pursued a long-term strategy centered on multimodal transit investment and regulatory measures designed to limit private automobile dependence in the urban core.

According to a white paper from Bombardier Transportation Metropolitan Planning Council (BTMPC), "Stockholm has an extensive multimodal transport system. The city boasts more than 1,900 buses and 1,000 trains, which transport more than 670 million people each year. A four-mile extension to the underground rail system is scheduled to begin construction in 2011, with the option for a

double track under consideration. The city's light rail system carries more than 40,000 passengers daily and will be expanded with a new east-west route to be built by 2013. Stockholm has five international airports; the downtown Stockholm Arlanda Airport station serves as the city's primary intermodal transit hub, with access to more than 172 destinations" (BTMPC, 2011). This extensive network demonstrates a deliberate commitment to providing high-capacity, reliable alternatives to private vehicle use across the metropolitan region.

The breadth of Stockholm's transit infrastructure enables efficient movement both within the city and across regional and international scales. This is despite significant geographic challenges of being located on an archipelago of several islands. High-frequency bus and rail services support daily commuting, while strong intermodal connectivity—particularly at Arlanda Airport—ensures seamless transitions between local, regional, and global transportation systems. These investments have positioned public transit as a competitive and convenient option for residents across income levels, reducing the necessity of automobile ownership for participation in urban economic and social life.

In parallel with these infrastructure investments, Stockholm has implemented strong policy measures aimed at managing travel behavior. The city has established cordon pricing and has begun restricting private automobile use, particularly in central areas where congestion and environmental impacts are most pronounced. These policies function not only as congestion management tools but also as revenue mechanisms that can be reinvested into transit infrastructure and public space improvements. Together, Stockholm's combination of robust multimodal transit investment and regulatory intervention illustrates how metropolitan regions can accommodate population growth while actively discouraging excessive private automobile use. This integrated approach makes Stockholm a leading example of transportation policy aligned with sustainability, equity, and long-term urban resilience.

2.21 Singapore

According to the Gini coefficient, Singapore is not that far off from the USA in income inequality. However, one author notes that the Gini coefficient is not the only useful way to measure inequality and that instead we should look at it from a holistic approach (Tjin, 2023). If we look at inequality from a 'felt' experience, then we see a more severe experience. As in many cases in America, "Travel by car is still much faster than by public transport, even in peak hours and even on some of the corridors served by MRT" (Barter, 2020). Enhancing multimodal transportation and reshaping societal perspectives on it could contribute to the enhancement of equality. Increasing efficiency in order to reduce costs in such a small City/country is essential to maintaining good social order in

the future. Singapore, a city-state known for its efficient urban planning and robust public transportation system, presents an interesting case study in the interplay between income inequality and public transit. Despite its high standard of living and well-developed infrastructure, Singapore grapples with income inequality, which has implications for its public transit system. The population of the metropolitan area was 2,260,000 in 1975 and is 6,157,000 in 2025 (Singapore

macrotrends, 2025). Singapore's rapid economic and population growth has led to significant wealth accumulation, but this prosperity has not been evenly distributed across all segments of its population. According to the Singapore Department of Statistics (2019), while the city-state has one of the highest per capita incomes in the world, it also faces widening income gaps. The Gini coefficient, a measure of income inequality, remains relatively high despite government efforts to address this issue through social welfare and redistribution policies.

Singapore's public transportation system is renowned for its efficiency, affordability, and extensive network, which includes Mass Rapid Transit (MRT), buses, and light rail transit. The Land Transport Authority (LTA) of Singapore has continuously worked to improve and expand public transit to meet the needs of a growing population. However, accessibility and affordability issues persist, especially for lower-income households located in peripheral areas (Barter, 2020). For lower-income residents in Singapore, the cost and accessibility of public transit can be significant barriers. Despite subsidies and concessions offered by the government, the cost of daily commutes can take up a considerable portion of their limited household budgets. Furthermore, residents in less central areas may face longer commute times and less frequent service, limiting their access to job opportunities and essential services (Pereira, 2018).

Improving public transit in Singapore is seen as a key strategy to address income inequality. Enhancing accessibility and reducing travel costs for lower-income groups can significantly improve their quality of life and economic opportunities. The Singaporean government has recognized this and has been investing in expanding public transit infrastructure and providing targeted subsidies to ensure equitable access to transportation services (Loo & Phang, 2020).

2.22 Kathmandu

Kathmandu, the capital city of Nepal, is experiencing rapid urbanization and socio-economic transformations. In 1975, the population was 180,000 and in 2025 the population is 1,673,000 (Kathmandu Macrotrends 2025). Amidst this growth, the city confronts significant challenges related to inequity, which are closely linked to its public transit system. This chapter examines the relationship

between factors of inequity that include income inequality, healthcare access, community engagement and public transit in Kathmandu, exploring how disparities in transit accessibility and infrastructure impact the city's diverse socio-economic groups. Most importantly, we will look at the recent political collapse catalyzed by student protests against the government due to corruption

and improper management of public funds.

When looking at Kathmandu, we need to contextualize it within the scope of Nepal as a country due to its status as the capital. Nepal has a rich history spanning hundreds of years but recently has suffered massive effects from British Imperial rule of India, a very recent industrialization process, several revolutions, rebellions, and general political instability. When advising on how to improve Kathmandu, we must acknowledge that a significant reason for poor quality of life experienced in the country is due to no fault of the government and citizens within but rather the actions of large empires. That being said, there are several actions that the current government needs to take responsibility for in order to best serve the needs of the public.

Citizens earn more in the city than they do in the countryside but, on average, significantly less than affluent wealthy families (Udaya, 2006). According to Dr. Udaya, even with the population moving from the countryside to the city of Kathmandu, there is still a larger increase in pay year-over-year than is found in the surrounding rural communities. This in turn is driving more people to move in hopes of increased quality of life. However, while their income may increase just by moving to the city, the consumption will also likely go up. This leads to stagnant wealth.

The most important factors contributing to inequity in wealth in Kathmandu are household size, discrimination, personal preparedness, intergenerational wealth transfer, and neighborhood location. It is well understood that increasing income positively affects wealth accumulation and decreasing consumption does the same. However, in Kathmandu and Nepal in general wealth inequality is higher than income inequality. Other papers point out the lack of a proper inheritance tax in order to partially explain this phenomenon, Additionally, wealth is largely accumulated via physical articles such as land and livestock. “Over 25 percent of the households, for example, reported consumption in excess of income and these households also included relatively high-income households” (Udaya, 2006).

Kathmandu’s public transportation consists primarily of private buses and carts, alongside a growing number of private vehicles. The public transit system is often criticized for its inefficiency, lack of reliability, and overcrowding. The inadequacy of this system disproportionately affects low-income residents who rely heavily on public transport for their daily commutes and access to services (Shrestha & Shrestha, 2020). The actual metropolitan area can accurately be

described as having little consistent public transit plan. For many low-income residents in Kathmandu, the challenges of the public transit system pose significant barriers to improving their socio-economic status. Limited access to reliable transportation affects their ability to secure stable employment and access

essential services such as healthcare and education. This situation perpetuates the cycle of poverty and limits opportunities for upward mobility (Dulal, 2017). Improving public transit in Kathmandu can be a significant step toward mitigating income inequality. Enhanced accessibility, reliability, and affordability of public transportation would provide more equitable access to economic opportunities and essential services, fostering socio-economic inclusion for all residents. Reducing the pollution caused by inefficient personally owned vehicles would also decrease the healthcare cost of many citizens, especially in the core neighborhoods with the highest density. There is a growing recognition of the need for comprehensive urban transport policies that prioritize the needs of lower-income groups (Pandey & Bardsley, 2019).

Developing an equitable public transit system in Kathmandu faces several challenges, including budget constraints, rapid urbanization, and the need for infrastructure improvements. Policymakers must address these issues with a focus on creating a more inclusive and sustainable urban transit system. This involves investing in infrastructure, enhancing the quality of service, and ensuring affordability for lower-income residents (Thapa & Murayama, 2020). When looking at transit in Kathmandu, the responsibility of the capitol extends to the rest of the metropolitan area which covers the majority of the Kathmandu Valley. Even though there are technically multiple cities in the region, the federal government has great capability in investing in transit in the whole region.

2.23 Tokyo

There is a significant difference between the income inequality levels of America and Japan and a significant difference between the public transit levels. This correlation has been shown repeatedly. Aizawa states that between 2009 and 2013 the GINI coefficient in America was about a third higher than in Japan (Aizawa, 2017). This is due to several factors, including societal factors but one in particular that this report seeks to explore is an increase in publicly available transit. Multimodal transit is important for any major city for multiple reasons. For one, having more options reduces the strain on any singular system. Additionally, having multiple modes allows diversification between speed, quality, safety, comfort, and availability. Furthermore, providing more options allows for freedom of choice.

As one of the world's most populous and economically significant cities, Tokyo provides a unique perspective on the relationship between public transit

and income inequality. The population has increased from 26,615,000 in 1975 to 37,063,000 in 2025 (Macro Trends, 2025). Unlike many other major urban centers, Tokyo is often lauded for its efficient and extensive public transportation

system. This chapter examines how Tokyo's public transit system influences, and is influenced by the city's income inequality, considering factors such as accessibility, service quality, and the socio-economic diversity of its users.

While Japan is often perceived as a relatively equitable society, income inequality has been a growing concern, particularly in urban areas like Tokyo. The Gini coefficient, an economic term describing the level of income inequality in a population, has been gradually rising in Japan, with Tokyo exhibiting one of the highest levels in the country (Tachibanaki, 2005). This growing division of class is often less visible due to the high overall standard of living and the cultural emphasis on social harmony. Additionally, the level of income inequality is not nearly as high as in some other countries in this study.

Public transit infrastructure cost is in many areas significantly cheaper than in the US. Many subway lines built in Tokyo cost ⅕ of equivalent lines in NYC (Behind Asia, 2025). The Tokyo strategy utilizes many cost saving measures such as utilitarian station design, repetition, in-house consultants, higher public ownership, and close integration with utilities. This means that any comparison with an American city is going to have a small caveat, however comparing Tokyo of 2025 with Tokyo of 1975 shows massive improvements in access to quality of life.

Tokyo's public transit system, known for its punctuality, safety, and coverage, plays a vital role in the city's daily life. The extensive network of trains, subways, and buses, managed by multiple private and public entities, offers remarkable accessibility across income levels (Hook & Replogle, 2002). However, issues such as crowdedness during peak hours and the high cost of living near central transit hubs can impact lower-income residents disproportionately.

Public transit in Tokyo has been a significant equalizer by providing high-quality, affordable transportation options across socio-economic groups. This accessibility enables lower-income individuals to access employment opportunities that might otherwise be out of reach, thereby potentially mitigating aspects of income inequality (Sorensen, 2002). Furthermore, the efficiency of the system reduces the need for private vehicle ownership, which can be a financial burden for lower-income households.

Despite its strengths, Tokyo's public transit system is not without its challenges. The cost of fares, while relatively affordable, can still be burdensome for the lowest income groups, particularly those living far from central Tokyo where public transit options are less frequent and less connected. Additionally, the

recent trends in urban development have raised concerns about gentrification around major transit hubs, potentially exacerbating income disparities.

2.24 Transit Oriented Development

The United States Federal Government has put out directives for MPOs and TMAs to use and develop Transit Oriented Development (TOD). TOD has become a central strategy in contemporary U.S. transportation and land use planning, particularly within the context of federal directives to metropolitan planning organizations (MPOs), transportation management areas (TMAs), and local governments. At its core, TOD seeks to leverage public investment in transit infrastructure by fostering compact, mixed-use development within walking distance of high-quality transit stations. This approach is intended to reduce automobile dependence, increase transit ridership, support economic development, and enhance livability in metropolitan regions.

The evolution of TOD policy in the United States reflects a gradual shift in federal transportation legislation toward greater integration between land use planning and transportation investment. Although early federal surface transportation laws largely emphasized highway construction in the mid-20th century, subsequent legislative acts began to incorporate more holistic planning principles. For example, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 established national policy encouraging more intermodal planning and required MPOs to incorporate environmental, energy conservation, and quality-of-life considerations into regional long-range transportation plans (U.S. Government Publishing Office, 1991). This legislative shift laid the groundwork for future federal engagement with TOD principles, even though TOD was not yet a fully articulated national strategy at that time.

Federal directives gained more explicit traction in subsequent statutes, including the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation Act (FAST Act). (FTA, 2015) Under these laws, the Federal Transit Administration (FTA) was authorized to make grants for comprehensive planning associated with new fixed guideway or core capacity improvement projects that seek land use enhancements and mixed-use development adjacent to transit stations. TOD planning grants under the FTA's Pilot Program for Transit-Oriented Development Planning illustrate this federal commitment. These grants provide financial support to communities for integrating land use and transportation planning, identifying infrastructure needs, and fostering multimodal connectivity that enhances pedestrian and bicycle access near transit.

The FTA's dedicated TOD program is a primary channel through which federal directives encourage local and regional adoption of TOD principles. In

Fiscal Year 2024, the FTA awarded approximately $10.5 million in competitive

grants to support TOD planning efforts in communities across ten states. These grants aim to help planning agencies, developers, and local governments coordinate development around transit stops with an explicit focus on affordable housing, economic development, and improved access to public transportation. Communities with proposals emphasizing affordable housing have been eligible for up to 100 percent federal support, demonstrating a policy preference for equitable outcomes in TOD planning (FTA, 2025).

In addition to planning grants, federal loan programs administered through the U.S. Department of Transportation's Build America Bureau, including the Transportation Infrastructure Finance and Innovation Act (TIFIA) and Railroad Rehabilitation and Improvement Financing (RRIF), explicitly recognize Transit Oriented Development as an eligible project category for credit assistance. This eligibility enables TOD projects to access low-cost, long-term financing that can support implementation phases, including construction of infrastructure and property development. By aligning federal credit programs with TOD priorities, the U.S. Department of Transportation signals that TOD is not only a planning concept but a fundable component of broader transportation investment portfolios.

Transit Oriented Development is most broadly defined as compact, mixed-use development located within approximately a half mile of high-capacity public transportation facilities. This development pattern typically includes residential units, employment centers, retail and service uses, and public amenities all organized around pedestrian-friendly environments that facilitate travel by foot, bicycle, or transit rather than by automobile. According to FTA and Federal Highway Administration descriptions, successful TOD encourages increased transit ridership, reduced vehicle miles traveled and congestion, improved air quality, and expanded mobility options for residents of all income levels (Federal Highway Administration, 2026).

Moreover, beyond transportation outcomes, TOD is associated with broader community objectives. It can stimulate neighborhood revitalization through increased economic activity, generate fiscal returns for local governments through expanded tax bases, and contribute to housing affordability by clustering development near transit that enables lower transportation costs for households. These public benefits are echoed in federal smart growth and environmental policies that emphasize efficient land use and reduced greenhouse gas emissions through coordinated land use and transportation planning (Environment Protection Agency, 2025).

While federal directives provide incentives and frameworks for TOD, implementation occurs principally at the regional and local levels. Metropolitan Planning Organizations (MPOs) and Transportation Management Areas (TMAs) are required under federal law to conduct comprehensive transportation planning

as a prerequisite for receiving federal funding. This planning must consider how transportation investments interact with land use patterns, including opportunities for transit-oriented development. MPOs often incorporate TOD principles into long-range transportation plans (LRTPs) and Transportation Improvement Programs (TIPs), aligning project selection with land use goals such as increased density, mixed use, and multimodal connectivity.

However, integrating TOD into local planning processes can present challenges. Local zoning codes, market conditions, and community perceptions about density and change may hinder TOD adoption without strong political leadership or community engagement. Federal guidance and funding help to mitigate these challenges by providing technical assistance, planning resources, and financial incentives, but the translation of federal TOD directives into built outcomes remains contingent on local capacity and stakeholder collaboration.

Equity has become an increasingly explicit concern within federal TOD programs. Federal planning grants and guidance increasingly emphasize affordable housing near transit and engagement with underrepresented communities to ensure that TOD benefits accrue to diverse populations rather than contributing to displacement or exclusion. This emphasis aligns with broader federal priorities around equitable access to jobs, services, and affordable transportation choices for low-income and transit-dependent households. Federal policy recognizes that without intentional planning for affordability and inclusion, TOD can inadvertently exacerbate disparities in access to opportunity rather than improve them.

In sum, Transit Oriented Development in the United States represents a significant shift in how federal transportation policy interfaces with land use planning. Directives to MPOs and TMAs, embodied through statutory authority for TOD planning grants and credit assistance programs, reflect a federal commitment to promoting compact, walkable development near transit. These policies aim not only to increase transit ridership and reduce automobile dependence, but also to foster sustainable, equitable communities with enhanced access to jobs, housing, and services. The continued evolution of federal TOD initiatives underscores the recognition that transportation infrastructure is most effective when integrated with intentional land use planning, economic development strategies, and community priorities, making TOD a critical component of contemporary metropolitan planning practice.

2.25 Summary

The literature reviewed in this study demonstrates that while public transit systems are a common feature of metropolitan areas worldwide, the composition, emphasis, and relative effectiveness of transit modalities vary substantially across

regions. Comparative urban and transportation scholarships consistently show that these variations are closely linked to outcomes related to social equity, economic access, and overall quality of life. Rather than a single optimal model, the literature suggests a hierarchy of modal effectiveness shaped by density, urban form, and long-term capital investment decisions.

A central theme across the literature is the strong association between active transportation modes, particularly walking and cycling, and lower levels of inequality in metropolitan regions. Cities that prioritize pedestrian infrastructure, protected cycling networks, and human-scale urban design tend to exhibit higher accessibility to jobs, services, and public space for a broader segment of the population. Scholars emphasize that active transit not only reduces transportation costs for households but also improves public health outcomes and fosters social cohesion. Importantly, the literature frames walking and cycling not as residual modes for those without access to automobiles, but as foundational components of equitable urban mobility systems.

Beyond active transit, rail-based systems emerge as the most consistently effective mode for high-capacity, high-speed urban travel in dense metropolitan contexts. Studies repeatedly identify rail transit—such as metros, subways, light rail, and commuter rail—as critical to reducing congestion, supporting economic agglomeration, and enabling reliable long-distance commuting. The literature highlights rail's spatial efficiency, long-term capacity, and ability to shape land use patterns, particularly when integrated with transit-oriented development. Cities with sustained investment in rail infrastructure are frequently cited as having more stable and resilient transit systems capable of adapting to population growth without proportional increases in automobile dependency.

In contrast, bus-based systems, including conventional buses and bus rapid transit (BRT), are generally characterized in the literature as compromise solutions. While buses offer flexibility and lower initial capital costs, scholars note that their performance is highly contingent on existing road infrastructure and traffic conditions. In cities where road networks are already fully developed and where dedicated lanes or signal priority can be implemented, buses and BRT can function effectively as interim or complementary modes. However, the literature cautions that reliance on bus systems alone in high-density environments often results in diminished efficiency, slower travel times, and increased competition with private vehicles, limiting their long-term effectiveness.

A recurring conclusion in the literature is that modal sequencing matters. When transportation systems are developed incrementally, starting with bus-based solutions and deferring rail investment, cities may lock themselves into less efficient patterns that are difficult to correct later. Conversely, when cities plan transit systems from the outset—or undertake major reinvestment—rail-based

modes are generally preferred as structural backbones, around which buses, active transit, and emerging mobility options can be organized. Trams, subways, and trains are frequently identified as the most effective foundational investments when cities have the opportunity to design systems without legacy constraints.

Overall, the literature underscores that transportation outcomes are not solely the result of technological choice, but of capital prioritization and policy intent. Metropolitan regions that emphasize active transit and rail infrastructure, supported by coordinated land use planning, consistently demonstrate lower inequality and higher quality of life. These findings reinforce the view that transit systems should be evaluated not only by operational efficiency, but by their capacity to provide inclusive, affordable, and dignified access to urban opportunities.

CHAPTER III:
METHODOLOGY

3.1 Overview of the Research Problems

What are the most important modes of transit a public body should focus on first?

What is the fastest per dollar mode of transit?

What mode provides the greatest degree of flexibility?

If we combine the factors of transit speed, cost, environmental impact, and construction rate- what modes are the most efficient?

How can a metropolitan area reduce costs across all modes?

3.2 Research Design

The research team for this study is composed of multiple individuals with six different but complementary backgrounds and varying levels of academic and professional experience, allowing for a multidisciplinary and collaborative approach to data collection and analysis. Mikel Carr serves as the Lead Researcher, Author, and Primary Photographer. Mr. Carr holds an MBA, BA, AA, and AFA, and has completed several years of training in economics, business, transit infrastructure, and digital photography. His role encompassed overall research direction, development of analytical frameworks, primary data synthesis, and visual documentation of transit systems and urban environments. His academic and professional training informed both the policy-oriented lens of the research and the structured evaluation of transit infrastructure across diverse metropolitan contexts.

Matthew Warwick is the Primary Research Assistant and contributed significantly to field observations and qualitative assessment. As an undergraduate studying inner urban education, Mr. Warwick brings a perspective rooted in social outcomes and lived experience within dense, walkable, and transit-oriented environments. His academic focus and personal interest in urban form informed observations related to accessibility, user experience, and the interaction between transit systems and everyday life. Brandi VonHaden served as the Secondary Research Assistant and Lead Editor. Ms. VonHaden is a published author with extensive experience editing academic papers and long-form research materials. Her role focused on ensuring clarity, coherence, and consistency across chapters, as well as refining analytical arguments to align with graduate-level academic standards. Beau VanFossen, Breanna VanFossen, and Deanna Carr acted as Tertiary Research Assistants and contributed to data collection through direct engagement in select metropolitan areas. These individuals assisted in visiting key cities, documenting transit conditions, and recording observational notes that

supplemented primary field research. While they possess some college education and international travel experience, their primary contribution was experiential, adding breadth to observational coverage and supporting triangulation of qualitative findings across multiple researchers.

The temporal scope of the study was deliberately structured to support both longitudinal historical analysis and rigorous contemporary comparison across metropolitan regions. Documented research from secondary sources spans the period from 1975 to 2025, capturing approximately fifty years of metropolitan growth, governance evolution, policy reform, and capital investment in transportation infrastructure. This period is particularly significant, as it

encompasses major global shifts in urban planning paradigms, including the rise of automobile-centric development, subsequent recognition of its social and environmental costs, and the gradual re-emergence of public transit, active transportation, and transit-oriented development as policy priorities. By selecting a fifty-year window, the study ensures that observed outcomes are not the result of short-term fluctuations but rather reflect sustained policy decisions and long-term infrastructure commitments.

This timeframe also allows for meaningful analysis of how changes in urban form, population density, and modal investment patterns interact over time. Major transit projects often require decades to plan, fund, construct, and fully integrate into metropolitan systems. A shorter historical window would risk understating the cumulative effects of capital allocation decisions, while a significantly longer window could introduce inconsistencies due to data availability or incomparable planning regimes. The 1975–2025 range therefore provides a balanced temporal lens through which structural transformation and policy continuity can be evaluated.

In contrast, direct in-person research was intentionally limited to the period between 2020 and 2025 in order to create a consistent and contemporaneous observational dataset. Restricting primary fieldwork to a relatively narrow timeframe minimizes temporal distortion that can arise when cities are observed at substantially different points in their development cycles. This approach allows for a more equitable comparison of how metropolitan transit systems currently function, rather than relying on observations separated by decades that may reflect outdated conditions or superseded policy environments. Observing multiple metropolitan areas within the same general period reduces the risk that findings are distorted by cyclical economic conditions, generational policy shifts, or outdated system configurations. This approach improves internal validity by ensuring that differences observed between cities are more likely attributable to structural and policy factors rather than to timing artifacts. It also accounts for recent global challenges, including economic volatility and public

health disruptions, ensuring that observations reflect present-day constraints and user experiences.

By combining a long-term historical review with tightly bound contemporary field research, the study achieves a balance between analytical depth and methodological comparability that would be difficult to obtain through either approach alone. This longitudinal perspective makes it possible to identify path dependency in infrastructure development, where early investment choices constrain or enable future mobility options, particularly marginalized populations.

This dual temporal structure also enhances the study's relevance to current

public policy debates. Policymakers often require evidence that both demonstrate long-term outcomes and reflect present operational realities. By anchoring conclusions in historical trends while validating them through direct observation of current conditions, the research produces findings that are both empirically grounded and immediately applicable. The methodology supports policy recommendations that are informed by proven long-term patterns but responsive to the lived experiences of today's transit users, thereby increasing the practical utility of the study for planners, transportation agencies, and public officials seeking to address inequity and improve quality of life through strategic transit investment.

The research design places explicit emphasis on active transportation infrastructure, including sidewalks, pedestrian networks, bicycle lanes, and shared-use paths, which are frequently underrepresented or treated as secondary considerations in traditional transit-focused analyses. In this study, active transportation is not viewed as an ancillary mode but rather as a core element of the urban mobility system. Active transit is treated as a foundational component of all trips, as nearly every journey—regardless of whether it ultimately relies on private automobiles, buses, or rail—requires walking or cycling at some stage. This perspective reflects a growing consensus in transportation planning literature that first- and last-mile conditions play a decisive role in determining the usability and equity of transit systems.

By foregrounding pedestrian and cycling infrastructure, the research acknowledges that deficiencies in these systems can significantly undermine the effectiveness of higher-capacity transit investments. Poor sidewalk conditions, fragmented bike networks, or unsafe street crossings disproportionately affect low-income residents, older adults, and individuals with disabilities, thereby reinforcing existing inequities even in cities with extensive rail or bus networks. As such, active transportation infrastructure was evaluated not only for its physical presence but also for its continuity, safety, and ease of use within the broader multimodal system.

Team members were instructed to visually assess all available modes of transit in each city visited, with structured attention to factors such as speed,

frequency, spatial coverage, legibility, and physical accessibility. Observations included how intuitively systems could be navigated by first-time users, the clarity of wayfinding and signage, and the degree to which different modes were integrated into a coherent network. Particular emphasis was placed on identifying barriers to access, including discontinuous or poorly maintained sidewalks, inadequate lighting, insufficient curb ramps, unsafe or unprotected crossings, and limited accommodations for individuals with mobility impairments or other disabilities. These qualitative assessments were recorded systematically to support

cross-city comparison and to contextualize quantitative measures of transit performance.

A variety of tools were employed to support data collection and contextual understanding, each contributing to the consistency, accuracy, and reliability of field observations. The primary field tool was a smartphone equipped with high-resolution photography capabilities, digital mapping applications, and language translation software. Photography was used to document infrastructure conditions, station design, street environments, and user interactions with transit systems, providing visual evidence to supplement written field notes. Google Maps was used extensively to assess route availability, modal integration, service frequency, estimated travel times, and spatial relationships between transit infrastructure and surrounding land uses. This allowed researchers to compare planned or advertised services with observed conditions on the ground.

Language translation applications, specifically DeepL and Google Translate, were used to navigate signage, ticketing instructions, and informational materials in non-English-speaking environments, as well as to facilitate informal communication when necessary. These tools helped minimize language barriers that might otherwise limit understanding of system functionality or user experience. Importantly, reliance on the same suite of digital tools across all study locations helped standardize observational methods, reducing variability introduced by differing local contexts. Collectively, these tools supported a user-centered evaluation of transit systems, emphasizing how infrastructure is experienced in practice rather than how it is described in policy or planning documents.

In addition to in-person observation, the research team conducted an extensive review of planning documents, transit maps, policy reports, and publicly available data. This documentary analysis provided critical context for understanding observed conditions, enabling cross-referencing between policy intent and real-world outcomes. While the use of digital tools and secondary sources may introduce minor contextual bias, their consistent application across all study locations helped standardize observation methods and enhance comparability. Together, these methodological choices support a qualitative

research design that emphasizes experiential validity, comparative insight, and policy relevance across a diverse set of global metropolitan regions.

3.3 Operationalization of Theoretical Constructs

The concept of wealth is central to this study's examination of long-term inequality. "Wealth, or net worth, is the value of assets owned by a family or an

individual (such as a home or a savings account) minus outstanding debt (such as a mortgage or student loan). It refers to an amount that has been accumulated over a lifetime or more (since it may be passed across generations)" (Schaeffer, 2021). Unlike income, which reflects short-term economic flow, wealth captures accumulated advantage and disadvantage over time. For the purposes of this study, wealth is operationalized at the individual level rather than the household or family level. This decision is driven by data availability and comparability, as most cross-national datasets related to equity, mortality, transit ridership, and access to services are reported on a per capita basis. Focusing on individuals allows for more consistent comparison across metropolitan regions and avoids distortions introduced by varying household structures in different cultural contexts.

The study also relies heavily on the concept of inequity, which is distinct from simple inequality. The Cambridge Dictionary defines inequity as "the quality of being unfair, or something that is not fair or equal" (Cambridge, 2024). This definition emphasizes normative judgment and structural unfairness rather than mere numerical differences. In transportation and urban policy analysis, inequity often manifests through uneven access to infrastructure, services, and opportunities that are shaped by historical investment decisions and governance structures. When combined with the concept of wealth, the term wealth inequity is used in this study to describe unjust imbalances in access to resources, mobility, and opportunity that correlate with an individual's accumulated net worth. Wealth inequity, as operationalized here, is therefore not simply a measure of economic disparity, but a reflection of how infrastructure systems either mitigate or reinforce long-standing social and economic divides.

Income is treated as a related but analytically distinct construct. According to Cornell University, income "is the value of what she [he] could consume in that year, while keeping her [his] wealth constant" (Cornell, 2024). This definition highlights income as a flow variable that reflects short-term economic capacity rather than long-term accumulation. In this study, income is used primarily to contextualize day-to-day affordability of transportation, such as transit fares, vehicle ownership costs, and commuting burdens. While income influences immediate travel behavior, it is wealth that more strongly shapes long-term

residential location, access to high-quality transit, and cumulative exposure to environmental and social benefits or harms.

Finally, public transportation is defined using a standardized institutional framework to ensure consistency across case studies. "Public Transportation (also called transit, public transit, or mass transit) is transportation by a conveyance that provides regular and continuing general or special transportation to the public, but

not including school buses, charter or sightseeing service" (APTA, 2019). This definition was selected because the primary cultural and professional background of the researchers for this dissertation is American, and because the APTA definition is widely used in policy, planning, and infrastructure evaluation contexts. While terminology and system classifications vary internationally, applying a consistent operational definition allows the study to compare functionally similar modes—such as buses, subways, trams, and commuter rail—across diverse metropolitan environments.

By clearly defining and operationalizing these theoretical constructs, the study establishes a shared analytical framework through which relationships between transit infrastructure, wealth inequity, and quality of life can be systematically examined. This clarity is essential for ensuring that qualitative observations and quantitative indicators are interpreted consistently across cities, regions, and policy contexts.

3.4 Population and Sample

The cities visited by the research team include New York City, Washington, D.C., Chicago, Rockford, Seattle, Las Vegas, Rio de Janeiro, Buenos Aires, Casablanca, Marrakesh, Cairo, Istanbul, Athens, Zagreb, Munich, Barcelona, Amsterdam, Reykjavik, Stockholm, Singapore, Kathmandu, and Tokyo. These cities were selected to represent a wide range of metropolitan sizes, economic contexts, governance structures, and transportation typologies across multiple continents. Collectively, they provide a diverse comparative sample encompassing both highly developed transit systems and cities where infrastructure is still rapidly evolving.

If a city is not discussed in detail in subsequent sections, it is due to a combination of limited time spent in that location and/or insufficient availability of comparable data necessary to support rigorous analysis. This limitation is particularly evident in the absence of a comprehensive regional case study from Oceania, Australia, and Southern Africa, where logistical constraints and data inconsistencies restricted the ability to conduct in-depth comparisons. While these regions are acknowledged as important areas for future research, they fall outside the practical scope of the present study.

It should also be noted that most cities examined exhibit gaps or inconsistencies in historical data, often resulting from political upheaval, rapid urbanization, or mismanaged record keeping. In such cases, the research team relied on triangulation from multiple sources and direct observation to mitigate data limitations. Despite these challenges, the team has collected and analyzed as

much reliable and comparable data as is reasonable given the scale, timeframe, and global scope of the study.

3.5 Data Collection Procedures

The study includes both a speed measurement of various modes of transit and a qualitative judgment of accessibility across different urban environments. Speed measurements were conducted using the Google Maps "look back" feature, which allows for retrospective analysis of completed trips. Multiple short trips within each city were averaged to account for variation in route type, congestion, and time of day, with final values rounded to the nearest tenth to ensure consistency and comparability across locations. This approach provides a practical approximation of real-world travel speeds as experienced by everyday users rather than relying solely on scheduled or theoretical performance metrics.

Judgments of accessibility were based on a series of binary assessments intended to standardize observations across cities. These assessments included whether sidewalks were free of major cracks, gaps, or bumps that would impede mobility; whether street crossings were clearly marked with crosswalks; and whether bicycle lanes provided any form of physical or visual protection from motorized traffic. While binary in nature, these criteria were selected to capture baseline accessibility conditions that significantly influence the usability of transit systems, particularly for individuals with mobility impairments, parents with strollers, or older adults.

Researchers conducted these assessments in person across multiple cities, directly observing sidewalks, bicycle infrastructure, train stations, metro lines, and other public transit features. This hands-on approach allowed the team to evaluate conditions as they are actually experienced by users, rather than as described in planning documents or promotional materials. Together, these measurements and observations support a grounded comparison of transit performance and accessibility across diverse metropolitan contexts.

3.5.1 Parameters

The study evaluates transportation systems using a defined and standardized set of parameters designed to ensure consistency, transparency, and comparability across all metropolitan regions examined. These parameters include dates, locations, mode speed, mode availability, mode cost, and mode type, each

of which captures a distinct dimension of urban mobility while collectively supporting a comprehensive assessment of transit performance and equity outcomes. Establishing these parameters in advance reduces subjective interpretation and strengthens the reliability of cross-city comparisons.

Dates were systematically recorded for all in-person observations, measured trips, and photographic documentation. Documenting the date of each observation allows the research to account for temporal context, including seasonal variation, weekday versus weekend travel patterns, and potential disruptions such as construction, special events, or service changes. This temporal specificity is particularly important in global comparative research, as transit performance can vary significantly depending on time of year or policy conditions in effect at the time of observation.

Locations refer to the specific neighborhoods, corridors, transit stops, stations, or intermodal hubs where data collection occurred. Recording locations ensures that observations are grounded in identifiable urban contexts and allows for meaningful comparison between similar spatial environments, such as central business districts, mixed-use neighborhoods, or peripheral residential areas. This spatial parameter also supports interpretation of how transit systems interact with land use, density, and urban form, which are critical factors in understanding accessibility and equity.

Mode speed was measured using retrospective trip data from the Google Maps “look back” feature, with multiple short trips averaged within each city to reduce the influence of anomalies such as temporary congestion or service delays. By focusing on actual travel experiences rather than scheduled speeds, this parameter provides insight into the functional efficiency of each mode as perceived by everyday users. Speed measurements were rounded to the nearest tenth to maintain consistency across cities and modes.

Mode availability captures both the presence and usability of each transportation option. This includes frequency of service, operating hours, geographic coverage, and ease of access from common origins and destinations. Availability is particularly relevant for equity analysis, as limited-service hours or incomplete network coverage can disproportionately affect lower-income residents and shift workers, even in cities with otherwise robust transit systems.

Mode cost reflects the direct out-of-pocket expenses incurred by users, such as single-ride fares, day passes, or subscription-based transit cards, as observed during the period of study. Costs were evaluated in relation to local wage levels, availability of reduced-fare programs, and the quality of service provided. This parameter supports analysis of affordability and helps identify whether transit systems function as inclusive public goods or as barriers to mobility.

Mode type categorizes transportation options into functional classes, including active transportation, bus-based systems, light rail, heavy rail, and other fixed-guideway modes. This classification enables comparative evaluation of how

different modal investments perform under varying density, economic, and governance conditions. It also supports broader policy analysis regarding the long-term implications of capital allocation decisions.

Together, these parameters form a structured and replicable framework for evaluating multimodal transportation systems across diverse global contexts. By integrating temporal, spatial, operational, and economic dimensions, the framework supports both qualitative observation and comparative analysis, strengthening the study's ability to inform public policy and infrastructure planning decisions.

3.5.2 Variables

These variables contextualize observations and help control for time-based variation that may influence transit performance, accessibility, and user experience. Temporal controls are particularly important in a comparative, multi-city study, as transportation systems are sensitive to seasonal demand shifts, service adjustments, and long-term policy cycles.

The primary temporal variable is 'year of observation' (numeric). The year in which data were collected or observed is recorded as a numeric variable to allow for longitudinal alignment with demographic, economic, and infrastructure data. This variable enables comparison between historical secondary data and contemporary in-person observations, and supports analysis of change over time, particularly when evaluating trends in ridership, investment, or modal shift.

The next variable is the month of observation (categorical). The month of observation is recorded as a categorical variable to account for seasonal variation in transit usage, service frequency, and active transportation conditions. Weather, tourism cycles, academic calendars, and holiday patterns can significantly affect travel behavior and system performance. Including a month as a categorical control helps distinguish structural characteristics of a transit system from short-term seasonal effects.

Spatial variables are used to define the urban context in which each transit observation occurs and to ensure that comparisons are made across comparable environments. The primary spatial identifiers are the city name and country, which establish the geopolitical and governance context of each observation. Land use context is documented as mixed-use, residential, commercial, or industrial to capture how surrounding development influences transit accessibility and performance. The presence or absence of an intermodal hub is also recorded

to identify locations where multiple modes converge, and transfer opportunities are concentrated.

From a policy perspective, these spatial variables enable analysis of how transit performance and accessibility vary by land use, density, and neighborhood context. They also support evaluation of spatial equity by identifying whether high-quality transit infrastructure is disproportionately concentrated in central or high-income areas.

Mode speed variables are used to capture the operational efficiency and competitiveness of each transportation mode. The primary performance metric is the average observed speed, recorded in kilometers or miles per hour, based on aggregated trip data. This measure reflects real-world user experience rather than theoretical or scheduled performance. Travel time per kilometer or mile is also calculated to provide a standardized basis for comparison across modes and cities.

The occurrence of delays is recorded as a binary variable indicating whether significant interruptions were observed during travel. In addition, perceived reliability is assessed qualitatively as high, medium, or low based on consistency of service and user experience. From a policy standpoint, these variables support direct comparison of modal efficiency and provide empirical justification for capital investment in higher-capacity, higher-speed systems where appropriate.

Mode availability variables reflect the degree to which transit options are usable and accessible rather than simply present. Service frequency is recorded in terms of headway, measured in minutes, to capture how often vehicles arrive during typical operating periods. Hours of operation are documented to identify whether modes provide all-day service or are limited to peak periods.

Network coverage is categorized as serving only the urban core, the full city, or the broader metropolitan region, allowing assessment of how well transit systems connect residents to employment and services. First-mile and last-mile connectivity are evaluated qualitatively as good, moderate, or poor based on the presence of sidewalks, bike facilities, and safe access routes. Barrier-free access is recorded as present, partially present, or absent to reflect accommodations for individuals with disabilities. Mode redundancy is also noted, indicating whether travelers have access to a single route or multiple overlapping options.

These variables are policy-relevant because they highlight service gaps that disproportionately affect low-income residents, shift workers, and transit-dependent populations, even in cities with otherwise extensive infrastructure.

Mode cost variables assess the affordability of transit and its implications for equity. The single-trip fare is recorded in local currency and adjusted to U.S. dollars to support cross-city comparison. Monthly pass costs are also documented to capture the financial burden on frequent users. Cost is further contextualized by

calculating the fare as a percentage of the local daily wage, providing insight into

relative affordability across different economic environments. The availability of reduced fares for students, seniors, or low-income riders is noted, as is the degree of fare integration across modes, categorized as full, partial, or absent. Penalty costs, such as transfer fees or re-entry charges, are also recorded, as these can create hidden barriers to multimodal travel. From a policy perspective, these variables enable evaluation of whether transit systems function as inclusive public services or impose regressive cost burdens on lower-income users.

Mode type variables classify the structural and technological characteristics of each transportation option. Each observed mode is categorized as walking, cycling, bus, bus rapid transit, tram, metro, commuter rail, etc... Right-of-way type is recorded as mixed traffic, dedicated, or fully grade-separated, as this distinction strongly influences speed, reliability, and capacity.

Energy sources are recorded as diesel, electric, or hybrid, reflecting environmental and operational considerations. Capital intensity is assessed qualitatively as low, medium, or high based on infrastructure requirements and investment levels. Finally, the permanence of infrastructure is categorized as temporary, semi-permanent, or fixed to capture long-term commitment and land use implications. Together, these structural variables support analysis of how different modal investments align with density, demand, and long-term policy objectives.

3.5.3 Reports

New York City

New York City presents one of the most multimodally complete urban transportation environments in the United States, both in terms of the number of available modes and the degree to which those modes are interdependent at daily scale. Within the five boroughs—Bronx, Brooklyn, Manhattan, Queens, and Staten Island—the transportation system functions as a layered network that includes walking, cycling, buses, trams, subways, ferries, private automobiles, commuter rail, and air travel, yielding nine distinct mode types available to travelers. This multimodal availability is reinforced by the breadth of the regional governance context; the New York Metropolitan Transportation Council planning area encompasses the city plus surrounding counties, but for comparative purposes the boroughs operate as a coherent metropolitan unit with transit characteristics comparable to other large global cities.

The city’s relatively stable metropolitan population growth over

the long term is also notable, as stable growth generally improves the predictability of capital planning and service scaling compared to rapidly expanding regions. In practice, the dominant daily modes during field visits were the subway, other rail services, and buses, which aligns with the operational reality that New York's fixed-route rail system provides the primary high-capacity backbone, while buses serve as the essential connective tissue for neighborhoods, late-night gaps, and corridors without direct subway access.

From a network design perspective, this layered structure is one of New York's principal strengths: it offers redundancy, multiple routing options, and the ability to complete trips using combinations of modes rather than a single corridor. This reduces the extent to which access to employment and services depends on a private vehicle, which is consequential in a city where space constraints and congestion make automobile-based mobility structurally inefficient for many trip purposes.

Navigation and system legibility were generally strong. Transit users benefit from a long-standing culture of public transport usage, extensive wayfinding norms, and a transit map language that is widely understood. In most stations and along routes, signage and mapping make the system usable for both residents and first-time riders, which is not a trivial achievement in a network of this scale. However, the user experience varies markedly by borough, corridor type, and station condition, and these variations are often most visible at the pedestrian interface—the point where riders transition from city streets into stations and stops. The subway may be fast and frequent, but it is only as accessible as the sidewalks, crossings, and station entries that lead to it.

The conditions observed in high-density areas such as Times Square illustrate the intensity of New York's street environment and how that intensity shapes multimodal performance. Traffic patterns changed significantly by time of day, season, and location, and the streetscape in tourist-heavy zones often displayed elevated noise levels, crowding, and visible sanitation strain. Heavy pedestrian flows moved rapidly in all directions, producing a "high-friction" environment where small obstructions—curb crowding, vendor placement, police barricades, delivery zones—can have outsized effects on safety and comfort. The cycling environment in these locations often reflected a similar tension between design intent and street reality, including instances where vending trucks or other curbside activity interfered with bike lane continuity, which effectively converts protected space back into mixed-traffic conflict points at precisely the locations where cycling safety requires the most clarity.

Although the overall transit system performed efficiently in terms of usability and the ability to complete trips without a private automobile, the visits repeatedly surfaced the same structural weakness: the pedestrian realm is frequently compromised by construction staging, scaffolding, and sidewalk detours that are persistent rather than episodic. This matters because pedestrian access is not a minor amenity in New York; it is the primary access mode to nearly every other mode. When sidewalks are narrowed, rerouted, or made uneven, the burden is not distributed equally. Detours with loose coverings, temporary ramps, uneven surfaces, or poorly maintained walkways create disproportionate barriers for people with mobility limitations, parents with strollers, elderly riders, and anyone using assistive devices. In equity terms, these conditions operate as a daily "access tax," increasing trip difficulty and risk for those least able to absorb it. These pedestrian-access challenges intersect directly with the city's accessibility profile. In a city where sidewalk disruptions are common and station accessibility is incomplete, the actual usability of transit for disabled riders depends on the continuity of an entire chain: sidewalk conditions, crossing safety, elevator availability, and the reliability of the connecting bus or rail segments. Breaks at any point in this chain undermine the practical equity of the system even when the network is extensive on paper.

Bus operations further illustrate how street management and enforcement shape transit effectiveness. New York's bus system is described in the dissertation as the second most important transit mode in the city, and it is sometimes the only option for riders in certain areas. Yet bus performance is constrained by traffic congestion, inconsistent lane protection, and enforcement limitations. When buses are slow, transit becomes a time burden that disproportionately falls on those with the least scheduling flexibility.

At the capital level, New York's transit advantage is also paired with material fiscal risk. New York's transit network is extensive and generally efficient for many trip types, but the repeated conflict between construction management and sidewalk continuity, combined with incomplete station accessibility and persistent bus-speed constraints, demonstrates how quickly daily usability can degrade for certain populations. The city's strengths—network depth, mode redundancy, and high-capacity rail—are substantial, but the observed weaknesses reaffirm that equitable transit performance depends on the reliability of the entire access chain, not only the existence of the system's backbone infrastructure.

Washington D.C.

The available modes of transportation are Mr. Warwick visited Washington, D.C., from December 20th through December 27th, 2024. Although it is the nation's capital, D.C. feels more European than American. This impression comes not only from its architecture, which is marked by a mix of neoclassical grandeur and imposing brutalism, especially evident in the vaulted design of its Metro stations but also from the quality of its urban mobility. The transit system is extensive and reliable, with Metro lines reaching deep into surrounding Virginia and Maryland suburbs and a dense network of Capital Bikeshare stations well beyond the city's core. The city's bus network is robust and integrated, functioning as a central part of the system rather than an afterthought. Walking and cycling are both highly viable modes of transport, thanks to well maintained and wide sidewalks, a growing network of protected bike lanes, and human-scaled street design. The average speed of transit was approximately 3.1 mph for walking, 11 mph for biking, 12 mph for private automobiles, and 13 mph for bus transit.

Official transportation data for Washington, DC show a multimodal system with significant transit usage and a measurable modal mix. According to the 2023 American Community Survey, within the District itself approximately 28.2 percent of workers drove alone as their primary commute method, 22.3 percent used public transit, about 10 percent walked, and around 3 percent biked, with nearly 30 percent working from home. WMATA's combined Metrorail and Metrobus system recorded roughly 264 million total passenger trips in fiscal year 2025 across rail and bus services, with Metrobus ridership increasing and Metro rail recovering to approximately 89 percent of its pre-pandemic volume. Metro's performance reporting indicates that about 88.9 percent of Metrorail trips arrive on time, while roughly 76.5 percent of Metrobus trips meet on-time criteria under current service guidelines. Street-level planning data further suggest that walking remains a dominant first/last-mile access mode at core stations, and the region continues to expand bike facilities and bike–transit integration efforts. These figures reflect a transportation environment in which transit plays a prominent role in daily mobility. Pedestrian travel is substantial, and active modes have a consistent, if smaller, share of overall trips in the urban core.

Chicago

Mr. Warwick visited the city of Chicago from June 7th through June 10th in 2024 as part of the broader field research effort. He arrived via Amtrak, entering the city through Chicago Union Station. Upon arrival, he was immediately struck by the architectural quality of the station, which prominently

features the Art Deco style. This architectural approach lends the station a sense of grandeur, monumentality, and civic importance, reinforcing its role not merely

as a transportation hub but as a symbolic gateway into the city. The scale of the interior spaces, combined with the decorative detailing typical of Art Deco, created a strong first impression and contributed positively to the overall user experience. Additionally, the station was well staffed, with numerous personnel available to provide directions, answer questions, and offer general travel advice, which improved navigability and reduced barriers for unfamiliar users.

After exiting Union Station, Mr. Warwick walked to the nearest Chicago Transit Authority (CTA) train station. From there, he traveled around the Loop in order to gain an initial understanding of the city's spatial organization, transit layout, and land-use patterns. This preliminary circuit highlighted Chicago's largely mixed-use character, with residential, commercial, and institutional functions often located in close proximity. However, it also revealed that different neighborhoods emphasize particular land uses more heavily than others. The Loop, as the city's historic and economic core, prioritizes commercial activity and employment uses, while the surrounding neighborhoods tend to emphasize mixed-density residential development, often combined with localized retail and services.

Mr. Carr conducted additional field observations through eight separate visits to Chicago between 2024 and 2025, allowing for repeated exposure to the city under varying conditions and at different times of day. These repeated visits helped establish average observed travel speeds across multiple modes of transportation. Walking speeds averaged approximately 2.4 miles per hour, while private automobile travel averaged 31.6 miles per hour. Bus travel averaged 21.3 miles per hour, and train travel averaged approximately 44 miles per hour. These figures reflect real-world conditions rather than theoretical maximum speeds and provide a comparative baseline for evaluating modal performance within the city.

All major transportation modes in Chicago are available on a 24-hour basis, though there is reduced public transit availability to certain neighborhoods during overnight hours, generally between 22:00 and 06:00. During this same period, ride-share services typically experience longer wait times, which can further limit late-night mobility options. Despite these constraints, the city is effectively covered by all major modes of transportation. A notable structural weakness, however, is that many routes begin and/or terminate in the city center. As a result, users traveling from one peripheral neighborhood to another often must transfer lines when crossing the city, which can increase travel time and complexity.

First- and last-mile connectivity in Chicago is generally strong, particularly within the urban core. The central areas feature high-quality sidewalks and a

pedestrian-friendly environment that supports walking as a viable daily mode of travel. In contrast, many outer neighborhoods experience declining sidewalk conditions, including aging infrastructure and reduced maintenance.

These areas also tend to have fewer protected bicycle lanes, which diminishes the safety and attractiveness of cycling as a transportation option. Additionally, numerous locations lack basic amenities such as benches, bicycle racks, and other supporting infrastructure that would otherwise encourage active transportation. Barrier-free access is present in parts of the city but remains incomplete, leading to the classification of accessibility as only partially achieved.

Walking is available at no monetary cost to users. Private automobile travel costs approximately 5 USD per mile, with the majority of trips measuring three miles or less. Public transit trips via bus, subway, or train generally cost only a few dollars per trip and typically cover distances of around ten miles. Reduced fares are available across all public transit modes for elderly individuals, children, students, veterans, and people with disabilities, which helps improve affordability and access for these populations.

Right-of-way conditions in Chicago are most often grade-separated, particularly for rail infrastructure, though mixed-traffic conditions do occur in certain contexts. One of the most common modal interactions observed is low-speed private automobile traffic operating alongside bicycle traffic. The majority of private automobiles and buses continue to rely on gasoline-powered engines, although there is a documented and ongoing shift toward electrification. Many subway lines and trains already operate using electric power, though older diesel-powered trains remain in service on some routes.

Chicago's capital intensity is exceptionally high, largely due to the engineering complexity involved in operating multiple layers of transportation infrastructure, including underground subways and elevated rail systems. These layered systems require substantial ongoing investment in maintenance, safety, and modernization. The overwhelming majority of the city's public transit infrastructure is fixed or semi-permanent in nature, reflecting long-term capital commitments and reinforcing the structural role of transit within the metropolitan transportation network.

Rockford

Mr. Carr resided in Rockford, Illinois throughout the year 2025 and conducted an extensive exploration of the metropolitan area using multiple modes of transportation, including travel on foot, by bicycle, and via the local bus system. This prolonged period of residence allowed for repeated observation of daily travel patterns, infrastructure conditions, and service availability across different times of day and days of the week. The primary modes of transportation

available within the city include walking, cycling, private automobile use, bus transit, and a limited-access streetcar system, which together form the existing mobility framework of the Rockford metropolitan area.

During his exploration of the city, Mr. Carr observed that usable walkability is present within the small downtown core, where blocks are relatively compact, and destinations are in closer proximity. However, even within this core area, pedestrian infrastructure does not meet standards necessary for full disability accessibility. Sidewalk conditions, curb treatments, and crossing infrastructure are insufficient to safely and comfortably accommodate users with mobility impairments. Once beyond the downtown core, the availability and quality of active transportation infrastructure decline rapidly. Sidewalks become intermittent or disappear entirely, and safe cycling facilities are largely absent.

As a result of these conditions, pedestrians are frequently forced into unsafe or inefficient travel behaviors. In many cases, individuals must take significantly longer routes than those available to motorized vehicles, creating substantial inefficiencies in travel time and effort. In other situations, pedestrians resort to walking through private yards, which introduces personal safety risks and potential conflicts with property owners. Alternatively, pedestrians may walk directly in the roadway, a practice that poses severe dangers to both vehicle operators and pedestrians. These conditions collectively undermine walking as a viable and safe mode of transportation for most residents.

Observed average travel speeds within Rockford vary significantly by mode. Walking occurs at an average speed of 2.2 miles per hour, private automobile travel averages 23.3 miles per hour, cycling averages 8.1 miles per hour, and bus transit averages approximately 8.7 miles per hour. Walking and cycling are free of direct monetary cost; however, due to missing sidewalks and absent bicycle lanes, both options are functionally inaccessible for a large portion of the population. Bus travel costs a few dollars per trip, with discounted fares available for students, elderly individuals, and people with disabilities. Veterans are able to ride for free upon presentation of a photo identification card, which itself costs 5 USD. Ride-share services typically cost approximately 3 USD per mile.

Walking, cycling, and ride-share services are theoretically available 24 hours per day, seven days per week. In practice, ride-share availability declines substantially during non-peak hours, reducing reliability. Bus service is generally limited to the hours between 05:00 and 18:00 and operates at relatively low frequency. Most routes provide service only once every thirty minutes, which significantly constrains usability. This low frequency is particularly problematic for time-sensitive activities, such as commuting to work or transporting perishable

goods. While the downtown core maintains a nearly adequate level of public transit service, the outer areas of the city are inadequately served both spatially and temporally. Additionally, there are very few amenities designed to encourage active transportation or even basic bus usage. Most bus stops consist solely of a sign, lacking shelters, seating, lighting, or real-time information.

The vast majority of Rockford operates under mixed-traffic conditions, with buses, private automobiles, bicycles, and pedestrians frequently sharing the same physical space. This lack of modal separation creates a substantial safety hazard for all users. The absence of protected rights-of-way increases the risk of collisions, discourages active transportation, and degrades the overall efficiency of the transportation system. Furthermore, nearly all non-active transportation modes rely on gasoline or diesel-powered vehicles, with electrification occurring at a very slow pace.

Rockford's overall capital intensity is assessed as moderate, reflecting the extensive presence of bridges, roads, highways, and inefficient transit rights-of-way throughout the metropolitan area. These infrastructure elements require ongoing maintenance while delivering limited mobility benefits. The most significant upcoming investment is a railroad connection intended to reattach Rockford to Chicago. This project represents a high capital intensity undertaking and will require careful integration into the existing urban fabric to maximize its effectiveness. At present, the majority of Rockford's public transit infrastructure remains temporary and flexible in nature, rather than fixed or permanent, which limits long-term system stability and performance.

Seattle

Mr. Carr resided in Bonney Lake, Washington from May 2020 through June 2024. During this period, he visited Seattle on numerous occasions and conducted repeated evaluations of the city's transportation system, with particular emphasis on walking, cycling, and the usability of active and public transit modes. These repeated site visits allowed for consistent observation of infrastructure performance under varying conditions, including different weather patterns, congestion levels, and times of day. Seattle functions as a regional economic and cultural hub, and its transportation system reflects long-term investment in multimodal mobility combined with ongoing large-scale capital projects.

Seattle has an extensive network of sidewalks and bicycle infrastructure that establishes a strong baseline for active transportation. While the coverage is broad, the system still requires refinement to achieve uniform performance across all neighborhoods. A map-based, overhead view of the city reveals clusters of highly interconnected bicycle lanes, often supplemented by smaller bicycle paths

that allow users to cut across corners, easements, and secondary corridors. These fine-grained connections significantly reduce travel distance and improve route efficiency, particularly within denser urban areas, and demonstrate a deliberate planning emphasis on active mobility rather than purely vehicular circulation. The city also contains two iconic streetcar routes that operate as fixed-route surface transit. Although these routes are not currently interconnected,

their linkage would substantially improve network legibility and usability. Even in their existing, separate configuration, the streetcars provide functional and symbolic transit value, serving both daily local trips and tourist-oriented travel. In addition to surface-level transit, Seattle is amid a large-scale light rail expansion project. This system has recently experienced major improvements in service quality, coverage, and reliability, reinforcing rail transit as a central structural element of the metropolitan transportation network.

Observed average travel speeds in Seattle illustrate the competitiveness of active transportation relative to private automobiles. Walking averages approximately 2.8 miles per hour, cycling averages 9 miles per hour, bus transit averages 7 miles per hour, and private automobile travel averages approximately 11 miles per hour. Walking and cycling are free of direct monetary cost, and sidewalks are present throughout the majority of the city. Protected bicycle lanes cover enough of the urban area that cycling achieves an average speed nearly equivalent to private automobile travel. This near parity between cycling and automobile speeds is notable within an American context and reflects the effectiveness of Seattle's protected cycling infrastructure.

While some sidewalks exhibit cracking or surface degradation, the majority are in good condition, and the city clearly prioritizes sidewalk maintenance and repair. This emphasis supports walking as a reliable and safe mode of transportation. All major transit modes in Seattle are available 24 hours per day. The metro system provides a designated "night owl service" operating from midnight to 05:00, though this service offers limited geographic coverage during overnight hours.

Bus trips typically cost a few dollars per ride, while walking and cycling remain free. Ride-share services generally cost approximately 5 USD per mile. The majority of Seattle's transit modes operate within grade-separated rights-of-way, particularly rail infrastructure and portions of the cycling network. This separation enhances safety, reliability, and operating speed. In addition, Seattle provides numerous amenities designed to encourage active transportation, including bicycle racks, signage, and supporting streetscape features.

Among the American cities evaluated in this study, Seattle has the most comprehensively supported cycling transit network. The continuity, protection, and density of its bicycle infrastructure exceed those observed in Chicago and

Rockford, contributing to higher cycling speeds and greater usability. Seattle's transit system is also highly capital-intensive. This is partially due to the inclusion of elevated rail infrastructure and partially due to the city's geographic constraints, including steep topography and frequent rainfall. These environmental conditions increase construction complexity and long-term maintenance costs but also necessitate durable, high-quality infrastructure to ensure reliable operation.

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Las Vegas

Mr. Carr surveyed random individuals and personally experienced public transit in Las Vegas from January 5th to January 8th, 2024. During this period, he evaluated pedestrian conditions, transit availability, and overall system usability within the metropolitan area. His observations identified some usable sidewalks along the geographic region colloquially known as "The Strip," though the public transit system serving this corridor was minimal relative to the intensity of pedestrian activity. While the Strip functions as the primary economic and social spine of the city, its transportation infrastructure does not scale proportionally with demand. Beyond this core area, the quality and continuity of pedestrian and transit infrastructure decline sharply, particularly within the surrounding suburban landscape.

Observed travel speeds further illustrate the performance limitations of the Las Vegas transportation system. The average walking speed recorded was 1.2 miles per hour, reflecting congestion, long block lengths, and frequent interruptions. Public transit speed averaged approximately 3 miles per hour, indicating slow service and limited effectiveness. Private automobile travel averaged 12 miles per hour, making it the fastest available mode despite congestion. These figures underscore the city's structural reliance on private vehicles and highlight the inefficiency of both public and active transportation options in their current form.

During her visit to the Las Vegas Strip from January 5th to January 18th, 2024, Ms. VonHaden conducted a detailed examination of transportation and pedestrian infrastructure with a specific focus on accessibility. One of her primary observations concerned the monorail system, which she found to operate at a sluggish pace. She noted that it took approximately fifteen minutes to traverse just a few city blocks, limiting its effectiveness as a rapid transportation option for both tourists and residents in an environment characterized by high activity levels and time-sensitive travel.

Ms. VonHaden also provided important insights into pedestrian mobility along the Strip, acknowledging that while sidewalks were designed with protective measures for pedestrians, "the crossing times at intersections were surprisingly brief." This condition raises concerns regarding pedestrian safety,

particularly for visitors unfamiliar with the area, individuals with mobility impairments, and elderly users. In contrast to more complex infrastructure deficiencies, this issue represents a relatively simple and quick intervention opportunity for local government through signal timing and pedestrian-priority adjustments.

In her evaluation of disability accommodations, Ms. VonHaden identified a notable absence of designated resting areas along pedestrian routes outside of

commercial establishments. Given the nonstop activity and heavy pedestrian volumes characteristic of the Strip at all hours, the lack of publicly accessible rest areas represents a significant omission in streetscape design. This absence may disproportionately affect individuals with disabilities, elderly pedestrians, and others who require periodic rest when navigating long outdoor corridors. Las Vegas exhibits an upper medium level of capital management intensity, largely attributable to inefficient right-of-way management rather than a lack of overall investment.

Taken together, the Las Vegas case reveals a transportation system that prioritizes movement through space primarily via private automobile use while underperforming pedestrian comfort, public transit efficiency, and accessibility support. The findings point to clear opportunities for improvement through relatively low-cost interventions, such as pedestrian signal adjustments and streetscape amenities, alongside more substantial reforms to transit speed and right-of-way allocation. Additionally, due to its desert location, Las Vegas faces a significant sustainability challenge. If the city does not address its massive emissions problem, the resulting environmental pressures are likely to translate into substantial long-term economic costs.

Rio De Janeiro

This city has extensive and complex multimodal public transit infrastructure. One of its most notable and visually distinctive elements is the cable car network that connects several of the surrounding mountaintop communities, which also functions as a significant tourist attraction. Beyond the cable car system, the existing transportation network includes subways, buses, bike lanes, and sidewalks, collectively offering a wide range of modal options. From a systems perspective, most of the network is relatively well connected, operates with reasonable reliability, and generally runs on time when measured against comparable metropolitan regions.

Despite this breadth of infrastructure, safety concerns significantly undermine overall system usability. Many subway lines operate without adequate protection and traverse gang-controlled neighborhoods known as “Favellas,” which substantially increases the risk of violent encounters. These safety

conditions materially affect user behavior and modal choice. While surveying the area, lead researcher Mr. Carr sustained a penetrating injury inflicted by an individual wielding a knife, underscoring the severity of these risks. In addition to this firsthand experience, a local city resident explicitly advised against subway use in certain areas, recommending buses instead. The resident stated, “it is not safe for any tourists to use the subway in the suburbs of Rio.” (Interview 2024) These concerns are particularly acute after sunset, when perceived and actual risks increase further.

Observed average travel speeds reflect moderate system performance across modes. Walking averages approximately 2.9 miles per hour; bus transit averages 7.5 miles per hour, and private automobile travel averages approximately 23 miles per hour. Rio de Janeiro offers 24/7 transit availability across all modes, which in theory provides strong temporal coverage. However, safety concerns effectively reduce usable service windows for many riders, particularly tourists and vulnerable populations. Sidewalk conditions are generally usable in many areas but remain inconsistently accessible for wheeled users, limiting mobility for individuals with disabilities or those relying on assistive devices.

Rio de Janeiro exhibits a high level of capital intensity in its transportation system, reflecting substantial investment in fixed infrastructure such as subways and cable cars. However, the results indicate that capital expenditure alone does not guarantee equitable or effective mobility outcomes. In the case of Rio de Janeiro, safety conditions function as a primary limiting factor, constraining the practical usability of otherwise robust transit infrastructure. As a result, the city demonstrates that system performance must be evaluated not only on connectivity, speed, and availability, but also on personal security and perceived safety, which are essential determinants of real-world transit use.

Buenos Aires

Mr. Carr spent the period from January 9th to January 16th in Buenos Aires conducting field observations and firsthand evaluations of the city’s public transportation system. During this time, he encountered a robust subway and bus network that was generally reliable, legible, and relatively safe for everyday use. The system functioned effectively as a means of moving large numbers of people across the metropolitan area, though its performance and accessibility were unevenly distributed. Transit quality was notably higher in certain parts of the city, particularly within more affluent neighborhoods, resulting in a system that, while extensive, remained somewhat localized in its highest-performing segments.

The most efficient and comfortable transit experiences were consistently observed in wealthier areas of the city. These neighborhoods benefited from

superior sidewalk conditions, a higher density of bus stops, and more continuous bicycle infrastructure. As a result, residents in these areas enjoyed greater mobility, shorter travel times, and more reliable access to employment, education, and services. Conversely, lower-income and peripheral neighborhoods exhibited reduced transit quality, fewer amenities, and less consistent service coverage. This spatial disparity reinforces existing socio-economic advantages by providing greater mobility to populations that already possess more resources, while limiting opportunities for those living farther from the urban core.

Observed average travel speeds further illustrate how mobility varies by mode within the city. Walking averaged approximately 1.5 miles per hour, reflecting congestion, narrow sidewalks, and frequent interruptions. Motorcycle travel averaged approximately 15 miles per hour, making it the fastest observed mode. Private automobile travel averaged approximately 11 miles per hour, while public transit averaged approximately 12 miles per hour. These figures suggest that public transit in Buenos Aires is competitive with private automobile use in terms of speed, particularly within the core areas of the city where service frequency and connectivity are strongest.

Improving public transit in Buenos Aires could represent a significant step toward mitigating income inequality. Enhanced accessibility, increased service frequency, and improved infrastructure quality in underserved areas would provide more equitable access to employment opportunities, education, healthcare, and other essential services. Such improvements would directly support socio-economic inclusion by reducing travel time burdens and expanding opportunity sets for residents in peripheral neighborhoods. Investments in public transit—particularly those focused on extending high-quality service beyond the urban core—could help bridge the gap between the city's diverse socio-economic groups (Cervero & Murakami, 2009).

The public transit system in Buenos Aires functions as more than a transportation network; it also reflects the underlying structure of income inequality within the city. The existing core-centric model bears strong similarities to Chicago, where transit infrastructure is heavily concentrated around central business districts and radiates outward with diminishing intensity. While this model supports high efficiency in central areas, it can exacerbate inequities when peripheral communities lack comparable access. Addressing these socio-economic divides requires a comprehensive approach that prioritizes transit accessibility and service quality for all residents, particularly those in lower-income neighborhoods.

Public transit in Buenos Aires has the potential to serve as a powerful tool for socio-economic inclusion and equality, but realizing this potential requires targeted investments and deliberate policy interventions. These efforts must explicitly prioritize equity and accessibility rather than solely focusing on

ridership or central-area performance. Buenos Aires exhibits a high capital outlay in its transportation system, reflecting significant public investment despite ongoing economic challenges. Overall, the city merits recognition for continuing to invest in public infrastructure while contending with the long-term impacts of colonial history and contemporary economic pressures. Despite these challenges, the transit system remained highly usable during the study period, even for a visitor unfamiliar with the local language, underscoring both its functional strength and its importance as a public good.

Casablanca

After traveling in Casablanca from January 19th to January 28th, Mr. Carr conducted direct observations and evaluations of the city's public transportation system and pedestrian environment. During this period, he identified several significant and systemic public transit issues that limit overall mobility and equity. While the city does possess rail infrastructure, the existing train stations are relatively few in number and, despite being well designed and visually appealing, fail to provide comprehensive geographic coverage across the metropolitan area. As a result, large portions of the city remain disconnected from high-capacity transit, forcing residents to rely on less efficient or informal modes of transportation.

In addition to limited rail coverage, the spatial distribution of bus stops presents a major barrier to effective transit use. In many areas, bus stops are located far apart, creating substantial gaps in service. These gaps are compounded by the absence of functional sidewalk infrastructure between stops, making it difficult or unsafe for pedestrians to access transit on foot. This fragmented configuration results in isolated islands of relatively good transit service separated by long stretches of poor or nonexistent public transportation access. Such discontinuities significantly reduce the practical usability of the system, particularly for residents without access to private vehicles.

The consequences of this fragmented network are most visible in low-income neighborhoods. In several areas, public transit service was so limited that residents relied on informal and unsafe travel arrangements, including sharing three people on a single older motorcycle. This reliance on informal transport underscores the inadequacy of formal transit options and highlights the direct relationship between infrastructure deficits and mobility insecurity. These conditions disproportionately affect low-income populations, reinforcing existing social and economic inequalities by limiting access to employment, education, and essential services.

The observed average travel speeds further reflect the constrained performance of Casablanca's transportation system. Walking averaged approximately 2.1 miles per hour; private automobile travel averaged

approximately 22 miles per hour, and heavy rail averaged approximately 23 miles per hour. While rail travel offers competitive speeds relative to private automobiles, its limited geographic reach significantly restricts its overall impact. Casablanca does not provide 24/7 transit services, further reducing temporal accessibility and limiting mobility options during early morning and late evening hours.

From an infrastructure perspective, there is a clear and pressing need for improvements across multiple modes. Sidewalk construction and repair are necessary to support safe pedestrian access to existing transit services. Expanded

bicycle infrastructure could provide a low-cost, flexible mobility option, particularly in areas where fixed-route transit is unlikely to be extended in the short term. Additionally, increasing the number of bus stops or expanding tram service would help reduce service gaps and improve spatial equity across the city.

Casablanca exhibits an upper medium level of capital outlay in its transportation system, indicating a moderate degree of public investment that has not yet translated into comprehensive or equitable mobility outcomes. The results suggest that more strategic allocation of capital—particularly toward first- and last-mile infrastructure and service coverage—could significantly improve system performance. Overall, Casablanca demonstrates how partial investment in high-quality infrastructure, when not accompanied by network continuity and pedestrian access, can limit the effectiveness of public transit and perpetuate socio-economic disparities within a rapidly growing metropolitan area.

Istanbul

Istanbul represents a notable outlier among the cities examined in this study, as it maintains an extensive public transit system while simultaneously exhibiting very high levels of income inequality. This apparent contradiction suggests the presence of several confounding variables that complicate the relationship between transit investment and equitable outcomes. One such variable is limited effective connectivity between inner-city employment centers and surrounding rural or peripheral areas. As individuals move closer to the urban core to access higher-paying jobs, they are often forced into significantly more expensive housing markets, which can offset the economic benefits of improved mobility and contribute to persistent inequality.

From January 28th to February 3rd, Mr. Carr explored Istanbul through direct observation and use of multiple transportation modes. The city is characterized by aging infrastructure, including cobblestone roads and tram systems that date back several decades. While such infrastructure might be perceived as outdated in other contexts, it is not inherently problematic in Istanbul's case. The historic tram system, in particular, remains highly functional and serves a large and

diverse population of tourists, students, and residents on a daily basis. The central areas of the city were observed to be highly walkable, with portions of historic neighborhoods intentionally restricted from private automobile use. These pedestrian-priority zones enhance the urban experience, reduce traffic conflicts, and support active transportation within the city center.

Ms. VonHaden also traveled to Istanbul during the same timeframe, and her experiences largely mirrored those of Mr. Carr. One aspect of her visit that stood out was the logistical challenge associated with accessing the public transportation system upon arrival. The hotel where she stayed was located more than a 20-minute Uber ride from the nearest location offering the "Istanbul Kart,"

the city's public transit payment card. This initial barrier highlighted an accessibility issue for visitors, particularly those unfamiliar with the city or arriving late at night. Despite this inconvenience, Ms. VonHaden found the Istanbul Kart to be an exceptionally economical option for navigating the expansive metropolitan area, offering substantial cost savings relative to alternative transportation modes.

A particularly distinguishing feature of the Istanbul Kart is its ability to be used by multiple individuals sequentially, allowing one card to serve several users traveling together. This feature differentiates it from similar systems, such as the transit card used in Tokyo, and proved to be a significant advantage for group travel. The ability to share a single card reduced friction in the transit experience, simplified payment logistics, and enhanced the overall value of the system for both residents and visitors.

In her observations of Istanbul's pedestrian environment, Ms. VonHaden noted the widespread presence of sidewalks throughout much of the city, which supports walking as a viable mode of travel in many areas. However, she also identified substantial variability in sidewalk quality. Some sidewalks exhibited significant wear, uneven surfaces, or damage, which could impede pedestrian movement and reduce accessibility, particularly for individuals with mobility challenges. Additionally, several smaller streets lacked sidewalks entirely, forcing pedestrians to share space with vehicles and diminishing the overall walkability of these areas.

Observed average travel speeds provide further insight into system performance across modes. Walking averaged approximately 1.8 miles per hour; monorail travel averaged approximately 4 miles per hour; other public transit modes averaged approximately 12 miles per hour, and personal automobile travel averaged approximately 14 miles per hour. These figures indicate that public transit is generally competitive with private automobile use in terms of speed, particularly within the urban core. However, disparities in infrastructure quality and access across neighborhoods limit the system's ability to function as an

equalizing force citywide.

Overall, Istanbul's transportation system demonstrates several notable strengths, including extensive modal availability, cost-effective fare structures, and strong pedestrian environments in central areas. At the same time, uneven infrastructure maintenance, access barriers to transit services, and broader structural factors related to housing and regional connectivity constrain the system's impact on income inequality. These findings suggest that while public transit in Istanbul is robust and widely used, addressing inequity will require coordinated interventions that extend beyond transit provision alone, integrating transportation planning with housing policy, regional connectivity, and targeted accessibility improvements.

Athens

From February 3rd to February 10th, Mr. Carr and Mrs. VonHaden visited Athens, Greece and conducted detailed investigations into the material conditions and operational characteristics of the city's public transit fabric. Their fieldwork focused on assessing the quality, connectivity, and usability of the transportation system across multiple modes, as well as understanding how historic preservation and urban form influence contemporary mobility. Athens presents a dense and historically layered urban environment, which has significantly shaped the evolution and current configuration of its transportation infrastructure.

Athens offers a wide range of transportation modes, including sidewalks, narrow streets with sidewalks on both sides, subways, buses, and light rail. The pedestrian environment is a defining feature of the city, particularly in central areas where compact block structures and mixed-use development support walking as a primary mode of travel. Narrow streets with sidewalks on both sides create a tight urban fabric that facilitates short trips on foot and encourages active transportation, even in areas with high tourist activity.

Observed average travel speeds reflect the relative performance of Athens' transportation modes. Walking averages approximately 3.1 miles per hour, making it a highly competitive mode within the urban core. Bus travel averages approximately 7 miles per hour, while private automobile travel averages approximately 21 miles per hour. These figures indicate that while private automobiles remain the fastest option in terms of raw speed, walking performs efficiently in many contexts due to proximity of destinations and the pedestrian-friendly nature of central neighborhoods. While walking is free, most bus and rail options are only 1 US dollar per short trip.

Athens exhibits a high level of capital outlay in its transportation system, driven in part by the need to preserve and integrate historic and archaeological assets. Transit construction and maintenance often require extensive coordination with preservation authorities, as major infrastructure projects frequently uncover or

interact with historically significant materials. This emphasis on preservation increases both costs and project timelines but also results in transit spaces that serve cultural and educational functions in addition to their transportation role.

Despite the breadth of available modes and the strong pedestrian environment, the most significant weakness observed in Athens' transit system is route efficiency. Many bus and train routes are significantly longer in physical distance than equivalent private automobile routes. This discrepancy increases travel time for public transit users and reduces the competitiveness of transit for certain trips, particularly those involving cross-city travel rather than movement within the urban core. Indirect routing is often a consequence of historic street layouts, constrained rights-of-way, and the need to avoid sensitive archaeological areas.

Overall, Athens demonstrates how historic preservation and urban form can both support and constrain modern public transit systems. While the city offers a highly walkable environment and a diverse set of transit modes, the physical inefficiencies of route alignment present challenges for system performance. These findings highlight the importance of balancing cultural preservation with functional connectivity to ensure that public transit remains a viable and attractive option for residents and visitors alike.

Zagreb

Mr. Carr traveled through Zagreb from February 25th to February 28th, 2024, during which time he conducted direct observations of the city's public transportation system and pedestrian environment. His fieldwork included walking extensively through the city center, regularly using the tram system, and observing bus operations across multiple corridors. These observations allowed for an assessment of both the formal structure of transit services and the informal practices that shape how residents actually interact with the system.

One of the most striking findings during this visit was the widespread local practice of not paying fares for trams operating within the city center. Residents regularly boarded trams without paying and openly acknowledged this behavior when asked. While this practice was unexpected, it has important implications for equity. The de facto fare-free nature of central tram service significantly benefits lower-income residents by reducing transportation costs and lowering barriers to access employment, education, and essential services. Although unconventional from a regulatory perspective, this informal system appears to function as an implicit social policy that increases mobility for economically vulnerable populations.

The tram system itself was observed to be frequent, reliable, and well-integrated into daily life. High service frequency makes trams particularly useful for

commuting to work and other time-sensitive trips, reinforcing their role as the backbone of urban mobility in Zagreb. In addition to tram service, the city center features accessible bike lanes and inclusive sidewalk infrastructure, supporting active transportation and facilitating seamless movement between modes. The pedestrian environment in the core areas is generally well maintained and legible, allowing walking to function as a viable primary mode for short trips.

Observed average travel speeds provide further insight into modal performance. Walking averaged approximately 2 miles per hour; local public transit averaged approximately 6 miles per hour, and continental public transit averaged approximately 31 miles per hour. These figures highlight the efficiency of long-distance rail connections while illustrating the comparatively slower pace of local transit, which nonetheless remains practical due to high frequency and short trip distances within the city.

Improving public transit in Zagreb could play an instrumental role in addressing income inequality. Enhancements in accessibility, reliability, and affordability of transit services would expand access to employment opportunities, education, and social services across the metropolitan area. The city of Zagreb has recognized the importance of these improvements and has begun working toward modernizing its public transit system, with a stated focus on expanding services and upgrading infrastructure (ZET, 2021). These efforts indicate institutional awareness of transit's role in supporting inclusive economic development.

Developing a fully inclusive public transit system in Zagreb is not without challenges. Constraints related to funding, urban planning limitations, and shifting demographic patterns continue to shape the city's transportation landscape. Future efforts will need to integrate public transit development with broader strategies aimed at reducing income inequality. This includes prioritizing investment in underserved areas, ensuring affordability, and accounting for the diverse mobility needs of residents in transit planning and policy decisions (UN-Habitat, 2019).

The temporal scope of this study spans several decades, but one particular year carries disproportionate significance for Zagreb's demographic and economic trajectory. In 1991, Croatia declared independence from Yugoslavia, followed by an internal war that led to population decline in the capital city (Grgurinovic, 2021). Although more than 30 years have passed, the effects of this period remain visible in urban form, economic structure, and social dynamics. These historical conditions continue to influence contemporary transit investment patterns and equity outcomes, underscoring the importance of contextualizing current transportation systems within their broader political and historical frameworks.

Munich

The observed average speeds across transportation modes in Munich

reflect a highly efficient and well-integrated transit system. Walking averaged approximately 3 miles per hour; private automobile travel averaged approximately 8 miles per hour, local public transit averaged approximately 18 miles per hour, and long-range public transit averaged approximately 32 miles per hour. These figures indicate that public transit—particularly rail-based services—is highly competitive with, and in many cases superior to, private automobile use in terms of speed and reliability, especially for longer-distance trips.

Munich maintains working sidewalks throughout most of the city core, supporting walking as a viable and safe mode of daily travel. The pedestrian environment is generally continuous, legible, and well maintained, allowing residents and visitors to navigate the city efficiently on foot. In addition to sidewalks, Munich offers a substantial network of bicycle lanes that further

enhance active transportation options. While these bike lanes are useful and widely utilized, many would benefit from stronger physical separation from motorized traffic. Improved separation would increase safety, comfort, and perceived security for cyclists, particularly less experienced riders and vulnerable users.

Accessibility is a notable strength of Munich's transportation infrastructure. The city presents relatively few barriers to use for people with disabilities, and the majority of the urban area is accessible to users with mobility impairments. Features such as smooth walking surfaces, curb treatments, and consistent transit access points contribute to this inclusivity. Munich also incorporates a significant number of grade-separated pedestrian paths, including underpasses and overpasses, which reduce conflicts between pedestrians and vehicles and improve overall safety and efficiency within the transportation network.

From a capital management perspective, Munich represents a high capital outlay city. This classification is largely attributable to sustained investment in multiple types of rail infrastructure, including local, regional, and long-range services, as well as the extensive networking required to integrate these systems seamlessly. Rather than relying on a single dominant mode, Munich has pursued a layered and redundant transit strategy that emphasizes reliability, coverage, and long-term system resilience. While this approach requires substantial upfront and ongoing investment, the resulting system delivers high performance, accessibility, and user confidence, illustrating the long-term benefits of coordinated, multimodal capital planning.

Barcelona

Mr. Warwick visited Barcelona from February 6th to 8th and again from

February 12th to 15th, during which time he engaged extensively with the city's public transportation and cycling infrastructure. He utilized the public bike-share system, buses, the metro, trams, and a high-speed train to Madrid. Having previously visited Amsterdam and several other Dutch cities, Mr. Warwick was struck by how comparably effective and enjoyable cycling was in Barcelona. The city offered a diverse array of cycling infrastructure: on some streets, dedicated bike lanes ran alongside vehicular traffic, while on others, protected lanes were positioned in the center of the road, shaded by overhanging trees. These features contributed to a sense of safety and comfort he did not expect to find outside the Netherlands.

Mr. Warwick found the metro system particularly impressive. It was clean, punctual, intuitively designed, and well-integrated across the city. He noted that it was accessible not only in terms of physical mobility—accommodating elderly and disabled passengers—but also in terms of user experience. Its frequency and

coverage, in his view, rivaled the best systems he had encountered. One cultural distinction he observed was the behavior of fellow passengers: unlike in many North American transit systems, there was a noticeable absence of eating, loud music, or confrontational behavior. This contributed to his impression that public transit in Spain is widely respected and used across social classes, rather than being stigmatized as a service for those without access to a private vehicle. Walking in Barcelona also stood out to Mr. Warwick. The narrow, human-scaled streets, vibrant storefront signage, and mixed-use density made it feel, in his words, as though "everything [he] needed was always within reach." Taken together, these qualities like a well-integrated public transit, dignified cycling options, and walkable urban design created an environment that supported not just mobility, but a high quality of life.

According to official data published by Transports Metropolitans de Barcelona (TMB) and the Barcelona municipal mobility authority, the city's public transportation system is both extensive and heavily utilized. The metro network comprises approximately 125.4 kilometers of track and 165 stations, providing full grade separation and electric operation throughout the system. The surface bus network spans roughly 813 kilometers, includes 103 routes and 2,628 stops, and operates at an officially reported average daytime speed of approximately 7.2 mph, with peak-hour speeds averaging around 6.8 mph. Walking speed was around 3.8 mph, and cycling was around 9 mph. Walking accounts for roughly 42 percent of all daily trips within the city, reflecting Barcelona's dense, mixed-use urban form and high pedestrian accessibility. Cycling and other personal mobility vehicles account for approximately 4 percent of trips, supported by a public bicycle-share system with more than 200 stations and over 2,200 bicycles. Public transit fares are comparatively low, with single

trips costing approximately €2.50 and reduced fares available for students, elderly individuals, and people with disabilities.

As of 2026, fares have been updated to €2.90, which is a significant increase but is still fairly affordable (TMB 2026). While metro services do not operate continuously overnight, citywide mobility is maintained through an extensive night bus network and 24-hour bicycle-share availability. Together, these data indicate a transportation system characterized by high coverage, strong multimodal integration, and a substantial reliance on sustainable travel modes.

Amsterdam

Amsterdam was selected as a primary case study and benchmark example of excellent multimodal public transit performance. Mr. Carr explored the city center extensively and observed a transportation environment that demonstrates a high degree of intentional coordination across modes. The city offers clean and well-maintained sidewalks, an expansive and continuous network of bicycle

lanes, subways, regional and intercity trains, tram lines, car-free zones, and an urban culture that actively supports and normalizes walking and cycling as primary modes of transportation. Rather than treating active transportation as supplemental, Amsterdam integrates walking and biking into the core structure of daily mobility.

The pedestrian environment in Amsterdam is notably consistent and legible. Sidewalks are well kept, unobstructed, and designed to accommodate high pedestrian volumes without compromising comfort or safety. Car-free and car-restricted zones further enhance walkability by reducing conflicts with motorized traffic and prioritizing people over vehicles in dense urban areas. These zones contribute to a calm and predictable street environment that supports both residents and visitors, making walking a practical and enjoyable mode for short and medium-distance trips.

Breanna Branam joined the research effort for this city and provided additional observations regarding the scale and effectiveness of Amsterdam's bicycle infrastructure. She specifically noted the extraordinary regularity with which residents use bicycles, regardless of weather conditions. Locals bike consistently in rain or shine, a behavior that is strongly reinforced by the built environment and supporting infrastructure. The widespread availability of secure bicycle locking locations, the presence of bike lanes on both sides of many streets, and the clarity of right-of-way assignments collectively create a system that feels safe, intuitive, and reliable. Beyond physical infrastructure, there exists a deeply ingrained cultural expectation that cycling is a normal, respected, and efficient way to travel.

Amsterdam eased expectations in several key areas. The tram system, in

particular, operates at ground level in many areas, similar to the tram systems observed in cities such as Zagreb. This ground-access configuration drastically improves accessibility for users with mobility limitations, individuals pushing strollers, and travelers with luggage. The seamless integration of trams with sidewalks and cycling infrastructure allows for efficient transfers between modes without the need for stairs, elevators, or complex station navigation.

Observed average travel speeds further illustrate the effectiveness of Amsterdam's multimodal system. Walking averaged approximately 1.8 miles per hour, private automobile travel averaged approximately 10 miles per hour, local public transit averaged approximately 31 miles per hour, and long-range public transit averaged approximately 43 miles per hour. These figures demonstrate a clear hierarchy in which public transit—particularly rail-based services—outperforms private automobile use in both speed and reliability. The relatively low average automobile speed reflects traffic calming measures, modal prioritization policies, and constrained car access in central areas, all of which discourage private vehicle use without eliminating it entirely.

Amsterdam's performance illustrates the cumulative benefits of multimodal access. High-speed public transit provides efficient regional and long-distance connectivity, while dense tram, cycling, and pedestrian networks support fine-grained local movement. Rather than competing with one another, modes reinforce each other, resulting in a system where users can select the most appropriate option for each trip. This flexibility reduces dependence on any single mode and enhances overall system resilience.

From a capital management perspective, Amsterdam is classified as a high capital outlay city. This status reflects sustained, long-term investment across multiple transportation modes, including rail, tram, cycling, and pedestrian infrastructure. Importantly, capital investment in Amsterdam is not concentrated solely on megaprojects but is distributed across continuous maintenance, incremental upgrades, and network expansion. The result is a transportation system that delivers exceptional performance, accessibility, and equity outcomes, serving as a leading example of how coordinated capital management can produce durable, inclusive, and highly efficient urban mobility. Anticipated to perform well given its international reputation, yet it exceeds even those high standards.

Reykjavik

Public transit in Reykjavik is primarily oriented toward serving tourists and schoolchildren, rather than functioning as the dominant mobility option for the general adult population. Most adult Icelanders rely on walking or private automobiles to traverse the city, reflecting both the compact urban form and long-standing travel habits. Pedestrian protections are present on most streets and

alleys, contributing to a consistently safe and legible walking environment throughout much of the city. Assistant researcher Mr. VanFossen explored Reykjavik extensively from February 10th to February 15th, allowing for a comprehensive assessment of pedestrian conditions, social dynamics, and transportation practices.

Reykjavik was described as “very walkable” by Mr. VanFossen, who explored almost the entire city during the observation period. Despite the absence of hostile architecture, he encountered only one individual panhandling, a notable observation given the visibility of poverty in many other global cities. Out of a national population of approximately 310,000 people, only 1,200 individuals experience primary homelessness. This extremely low level of homelessness provides important context for understanding the city’s transportation and public space environment, as public infrastructure is not burdened by crisis-level social displacement.

Much of Reykjavik’s pedestrian infrastructure reflects a strong emphasis on durability and local material use. Most walkways and some roads are paved with basalt stones, a locally available material that has been used for generations.