Guideway Transit and Intermodalism: Function and Effectiveness: Case Study, Paris, France

Lehman Center for Transportation Research (LCTR)

CUTR

Follow this and additional works at: https://scholarcommons.usf.edu/cutr_reports

Scholar Commons Citation
Lehman Center for Transportation Research (LCTR) and CUTR, "Guideway Transit and Intermodalism: Function and Effectiveness: Case Study, Paris, France" (1995). CUTR Research Reports. 70.
https://scholarcommons.usf.edu/cutr_reports/70

This Technical Report is brought to you for free and open access by the CUTR Publications at Scholar Commons. It has been accepted for inclusion in CUTR Research Reports by an authorized administrator of Scholar Commons. For more information, please contact scholarcommons@usf.edu.
Guideway Transit and Intermodalism: Function and Effectiveness

Case Study

Paris, France

Lehman Center for Transportation Research (LCTR)
College of Engineering and Design, Florida International University
University Park, Miami, FL 33199
(305) 348-3055, Fax (305) 348-4057
Email: shen@eng.fiu.edu
Director: L. David Shen, Ph.D., P.E.

Draft, June 1995

Project Manager
Jian Huang

Project Staff
Allison C. Smith    Maggie Xu

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, Federal Transit Administration, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof and does not endorse any vendors or products mentioned in the report.
PREFACE

Over the past few decades more than a dozen U.S. cities have implemented new public guideway transit systems and moreover, virtually every major urban area has or is considering increasing public transportation infrastructure investments. The country's dramatic suburbanization and socio-economic trends have placed new challenges on public transportation. Various guideway investments are among the solutions that local communities have considered in meeting the changing transportation needs of their communities. The result has been growing guideway transit ridership and an increase in the importance of guideway in the overall transportation system. Guideway transit is perceived as the public transit investment that provides an excellent opportunity to compete with auto travel, influence land use, motivate public and business financial support and address air quality and environmental goals. This report does not advocate guideway solutions nor discourage careful consideration of non-guideway transportation investments, but provides a knowledge base to support those involved in guideway planning and implementation.

With the development of numerous systems over the past few years, a great deal of experience and knowledge has been gained about all aspects of using guideway to meet transportation and other local goals. Much of this knowledge resides with local planning agency staffs and is of great value to urban areas if the most relevant information can be captured and communicated to the ever growing and changing group of professionals that are involved in guideway project planning and decisionmaking.

This report is one of several that are being produced as part of a study funded by the Federal Transit Administration on intermodalism and guideway effectiveness. This multiyear effort is being conducted by the Lehman Center for Transportation Research at Florida International University and the Center for Urban Transportation Research at the University of South Florida. The broadly-defined research project, a response to a U.S. congressional authorization, focuses on the examination of factors that influence the effectiveness and efficiency of guideway transit systems and passenger intermodal transportation. The work program is driven by eight primary research tasks, each of which is being addressed through a variety of research methodologies. The overall objective is to assemble existing and new information and interpret and communicate that information in a manner that supports the planning and decisionmaking efforts of public transportation planners. Knowledge gained in this project will provide useful information for the many communities and transportation professionals that are planning or considering guideway transit.
Guideway Transit and Intermodalism: Function and Effectiveness

as a key component in their transportation system. In addition, many of the issues and much of the information will have application for all public transportation planning.

The products of this research effort in 1995 include technical reports, case studies, and data books.
# TABLE OF CONTENTS

Foreword ........................................................................ 1

Paris Case Study ............................................................. 2

1. Introduction ............................................................. 2

2. Paris's Public Transit Systems ........................................ 3
   2.1 Overview ............................................................ 3
   2.2 Organization and Operating Structures .................... 3
   2.3 Multimodal Guideway Transit Systems ..................... 5
      2.3.1 Paris Metro .................................................... 5
      2.3.2 Express Regional Metro (RER) ......................... 8
      2.3.3 Suburban Rail System .................................... 10
      2.3.4 Light Rail System ......................................... 10
      2.3.5 Automated People Mover System ..................... 12
      2.3.6 Funicular ...................................................... 12
   2.4 Summary of Guideway Transit Systems' Characteristics ........................................ 12
   2.5 Intermodal Transfers ........................................... 12
   2.6 Fare Collection and Integration .............................. 12
   2.7 Guideway Transit Ridership .................................. 18
   2.8 Operation's Funding .......................................... 18
   2.9 Development Plan .............................................. 20

3. Contributors to the Success of Paris's Transit System ........ 20

4. Findings .................................................................. 20

References .................................................................... 22
LIST OF TABLES

TABLE 1 Major Construction Activities for Paris's Metro .................................. 8
TABLE 2 Characteristics of Guideway Transit Systems in Paris ............................ 13
TABLE 3 Fare Systems and Integration between Transit Modes ........................... 17
LIST OF FIGURES

FIGURE 1 Paris's Guideway Transit Map ........................................ 4
FIGURE 2 Organizational and Operating Structures for Paris's Transit System ........ 5
FIGURE 3 Paris Metro Train at a Station ....................................... 6
FIGURE 4 Paris Metro Rubber-Tired MP 89 Train ................................. 6
FIGURE 5 An Entrance/Exit to the Paris Metro System .............................. 7
FIGURE 6 A Paris Metro Station .................................................. 7
FIGURE 7 Paris's Express Regional Metro (RER) System Map ....................... 9
FIGURE 8 RER Train at the Charles De Gaulle Airport Station ....................... 9
FIGURE 9 An RER Central Platform Station ..................................... 10
FIGURE 10 SNCF's Latest Design for its 25 KV 50 Hz overhead Suburban Rail Lines .... 11
FIGURE 11 RATP Light Rail/Bus Interchange at Boligny (Jane's 1994) ................. 11
FIGURE 12 Intermodal Transfers between Different Transit Modes .................... 14
FIGURE 13 A Multimodal Transportation Center in Paris .......................... 14
FIGURE 14 A Direction Sign in a Multimodal Transportation Center ................. 15
FIGURE 15 Entrance Gate at Stations of Paris Metro and Regional Metro ........... 16
FIGURE 16 Ticket Vending Machine ............................................. 16
FIGURE 17 Ridership Statistics for Paris's Transit Modes .......................... 18
FIGURE 18 Operations' Funding for Metro, RER, LRT, APM and Bus Services ........ 19
FIGURE 19 Operations' Funding for SNCF's Suburban Heavy Rail Services .......... 19
FOREWORD

This report is one in a series of case studies examining guideway transit and intermodalism. These case studies are one component in a broadly defined research project that examines factors that have resulted in implementing successful guideway transit systems and how intermodalism can enhance the role of public transportation. These two goals are interrelated through the consideration of guideway transit where it is present as a core transportation element in cities and metropolitan areas.

The use of case studies as a research tool was chosen because individual urbanized areas and transit systems have faced unique problems and sets of circumstances in the process of implementing fixed guideway service. Exogenous variables, including those such as the political environment that are difficult to quantify, have exerted significant influence on the development of public transportation services and intermodal connections. Therefore, case studies permit the careful identification of influential factors in particular situations. The information from multiple case studies can then be used to construct an overall paradigm regarding the implementation of guideway systems and intermodal connections. In addition, the case studies will support the development of refined hypotheses and the testing of other hypotheses that result from other research tasks undertaken as part of this research.

Each case study in this series focuses on an urbanized area. The criterion for selecting the case study areas has been the presence of one or more elements of guideway transit including commuter rail, heavy or rapid rail, light rail, cable cars, monorails, automated people movers, suspended cableway, and busways. Each study reviews intermodalism and emphasizes how those various modes fit together as a system, recognizing that the facilities where transfers from one mode to another take place are critical components.

To provide examples of lessons learned that may benefit others and also to provide the base data and preliminary analysis for the broader project, technology, policy, and planning are emphasized in the case studies. Each case study begins with an overview of the guideway transit components in the region, followed by a discussion of intermodalism. Planning history that has led to the present is examined. Each case study concentrates on issues the author feels are most relevant to communicate to practitioners beyond the local region.
PARIS CASE STUDY

1. Introduction

Paris is the national capital and biggest economic and industrial city of France. As France’s most populous city, it has a population of 11 million in a metropolitan area of 805 square miles. With an urban population of 2 million in the 41 square-mile urban area or 53,389 persons per square mile, Paris has the highest density among advanced industrialized cities, and the fourth highest density among 105 world cities.

Paris occupies a depression hollowed out by the Seine River. The region has a temperate regional climate. The weather can be vary greatly especially in winter and spring, when the wind can be sharp and cold. The annual average temperature is 53°F; the July average is about 67°F, and the January average is about 38°F. The temperature drops below freezing about 35 days a year, and snow falls on an average of 15 days.

Paris has been one of most renowned cities in the world. It is appreciated for the opportunities it offers for business and commerce, study, culture, and entertainment. Its ideal crossroads location has enabled Paris to thrive for more than 2,000 years. Paris is the leading center of population, finance, and commerce in France. Even if large French firms have their manufacturing plants in the provinces, nearly all keep their headquarters in Paris, conveniently close to the major banks and key ministries. Since World War II, most industrial growth has been in the provinces; but Paris still contains nearly a quarter of French industry. As a financial center, Paris is the base for many large international concerns in commerce and banking, and despite some pockets of poverty it is a very wealthy city. After industry and commerce, the main activity is government administration, which employs nearly 700,000 people.

Such huge urban concentrations as in Paris would have created considerable traffic problems. However, this is not the situation in Paris, which may be attributed mainly to the planning of a network of public transportation, the quality of the rolling stock, the structure of the network operations and its management efficiency. Furthermore, this success can be attributed to government support. Government policy has encouraged the development of public transportation and established a dedicated employee tax for operating support. Legislation introduced in 1982 provided for employers to become liable for paying part of the cost of commuters’ season tickets. In 1991, the
employers' payroll tax was raised from 2.2% to 2.4%. The cost of the Metro is subsidized by the government; the passengers pay only about half of the actual cost.

2. Paris's Public Transit Systems

2.1 Overview

Paris, France has a century-long history in its mass transit. It has four guideway transit modes in service including rapid rail transit (RRT), light rail transit (LRT), commuter rail (CR) and automated people mover (APM) systems. A comprehensive and successful urban transit network has been established after Parisians' century-long efforts to meet their and visitors' mobile needs.

The public transport systems in Paris operated by a body that is largely state-controlled, have been superbly modernized and extended since the early 1970s. Trains on the 15 principal lines of the metropolitan subway system (Metro) are fast and frequent. In addition to these, the regional cross-city metro (RER), an express subway system, extends far into the suburbs, and at some points its lines have been integrated with the mainline railway network. A 9 km light rail line opened in 1992 between St-Denis and Bobigny in the northeast provides a connection between three metro lines. Orly airport and Antony station on RER Line B is connected by a 7.3 km automated people mover, which was opened in 1991. The city's bus system has also been modernized and serves as feeders to all other guideway public transit systems. Figure 1 shows the metro and express regional metro systems, which are the backbone for Paris's public transit network.

2.2 Organization and Operating Structures

The Syndicat des Transports (STP), consisting of government and local authorities has overall responsibility for policy and coordination of urban and suburban transportation provisions in the greater Paris. Under its overall control, Regie Autonome des Transports Parisians (RATP) or Paris Transport Authority in English operates metro, two lines of the express regional metro (RER), light rail, automated people mover, funicular and bus services. STP also supervises the services supplied by French National Railways (SNCF) including the remaining two lines of RER services and extensive suburban commuter rail services to a distance of about 85 km from the city center. Some suburban bus lines operated by private firms represented by an association (APTR - Association Professionnelle des Transporteurs Routiers), which is integrated under STP too. The organizational and operating structure is shown diagrammatically in Figure 2.
FIGURE 1 Paris's Guideway Transit Map
2.3 Multimodal Guideway Transit Systems

2.3.1 Paris Metro

The metro systems with a century-long history of development are often recognized as one of the most efficient, innovative transit systems in the world. As far back as 1855, the concept of a metropolitan railway was first presented by two prominent Parisians. However, it took about half a century to break ground for the Paris Metro. In 1898, construction of Line 1 began with the cut-and-cover method. Line 1, aligned through the heart of Paris, east to west on the right bank of the Seine River, was completed in an incredible 17 months (Clark 1995). The major construction activities for the Metro are listed in Table 1. A system map of the Paris Metro is shown in Figure 1. Figures 3 shows a Metro train at a station. Figure 4 shows the rubber-tired MP89 train. The Metro system, which extends to every corner of the city and out to the suburbs, are fast, efficient and extraordinarily convenient. No matter where you are in the city, one is never more than 500 yards away from a Metro station (Clark 1995). Figure 5 shows an entrance/exit for the Metro, which is easily recognizable with its big distinguishing sign. A splendid metro station is shown in Figure 6, depicting the beauty in the system.
FIGURE 3 Paris Metro Train at a Station

FIGURE 4 Paris Metro Rubber-Tired MP 89 Train
FIGURE 5 An Entrance/Exit to the Paris Metro System

FIGURE 6 A Paris Metro Station


**TABLE 1 Major Construction Activities for Paris's Metro**

- Line 1 construction began in 1898, through the heart of Paris, east to west on the right bank of the Seine River.
- Line 2, completed in 1903, circled the northern portion of the city.
- Line 3, which runs in between Lines 1 and 2, was completed in 1905.
- Line 5 was completed in 1906, running from the left bank to the right bank in the eastern portion of the city.
- Line 6 was brought to completion in 1909, circling the south of the city.
- Line 4 was finally completed in 1910, cutting north to south directly through the heart of the city and under the river.
- By 1925, the Metro consisted of 11 lines, covering every corner of the city.
- Lines 7, 8 and 9 were extended in the 1930s to the suburbs.
- Two new lines, 11 and 14, were built.
- By 1937 the Metro extended beyond the city limits to the suburbs at seven points.
- Line 13 was opened in 1953 with the first rubber-tired wheel trains.
- In the 1970s, six Metro lines were again extended. The RER was also opened, consisting of four lines that stretched out from the city and deep into the suburbs.

Source: (Clark 1995)

2.3.2 Express Regional Metro (RER)

In the 1970s, RATP and SNCF opened an entirely new system called the express regional metro (RER). The RER, consisting of four lines that stretched out from the city and deep into the suburbs, was designed to service the greater Paris area and the new satellite cities. Figure 7 shows the express regional metro system map (RER). RATP shares the responsibility of RER's operations with SNCF. Figure 8 exhibits a RER train at the Charles De Gaulle Airport Station. Figure 9 shows a central platform station for the RER system.
FIGURE 7 Paris's Express Regional Metro (RER) System Map

FIGURE 8 RER Train at the Charles De Gaulle Airport Station
2.3.3 Suburban Rail System

Suburban rail or commuter rail services are supplied by the French National Railway (SNCF). There are 37 suburban lines with a total route length of 1263 km. All the suburban lines have been electrified with 25 KV ac or 1.5 KV dc overhead supplies. The trains are usually comprised of six or eight cars and hauled by electric locomotives. Many of the cars are double-deck cars. SNCF is aiming for 100% double-deck operations by 2005 (Jane's 1994). Figure 10 shows SNCF's latest design for its 25 KV 50 Hz overhead lines on classic routes.

2.3.4 Light Rail System

A 9 km light rail line, which opened in 1992 between St-Denis and Bobigny in the northeast provides connections between three Metro lines. Figure 10 shows a light rail car. The second light rail route was announced in 1991 and is under construction. It will take over SNCF's last third-rail suburban line from Puteaux to Issy-Plaine. Extensions are being built at each end to create a 13 km route from La Defense to Boulevard Victor.
FIGURE 10  SNCF's Latest Design for its 25 KV 50 Hz overhead Suburban Rail Lines

FIGURE 11  RATP Light Rail/Bus Interchange at Boligny (Jane's 1994)
2.3.5 Automated People Mover System

In 1991, a 7.3 km automated people mover opened connecting Orly Airport and Antony station on RER Line B. The APM system was built with VAL technology. To relieve RER's Line A, a new fully-automated metro line is under construction from Tolbiac to Gare de lyon, Gare du Nord and St Lazare. The Est-Quest Liaison Express (Eole) comprising a link from the Nord and Est stations to St Lazare is also under construction. This would run through between the eastern and western suburban networks.

2.3.6 Funicular

In 1901, the 102m Funiculaire de Montmartre was built as a water balance system and electrified in 1935. It has an incline of 36%. After refurbishment, it reopened in 1991 with new cars and has a capacity of 2,000 passengers/hour in each direction (Jane's 1994).

2.4 Summary of Guideway Transit Systems' Characteristics

Characteristics of Paris's guideway transit systems are summarized in Table 2. It can be seen from this table that the Paris Metro and RER form the backbone of the guideway public transit network.

2.5 Intermodal Transfers

Intermodal transfers within the Paris transit systems are shown diagrammatically in Figure 12. Figure 13 shows passenger movement inside a multimodal transportation center. Figure 14 shows a direction sign for transferring passengers. There are several multimodal transportation centers in Paris, which enable passengers to make quick, efficient and safe transfers between modes.

2.6 Fare Collection and Integration

The greater Paris area divided into seven zones. A monthly pass, called Carte Orange, is good for unlimited trips within valid zones on metro, buses, RER, and suburban SNCF lines. Carte Integrale,
### TABLE 2 Characteristics of Guideway Transit Systems in Paris

<table>
<thead>
<tr>
<th>Item</th>
<th>Metro (RRT)</th>
<th>RER (RRT/CR)</th>
<th>Suburban SNCF (CR)</th>
<th>LRT</th>
<th>APM</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of lines</td>
<td>15</td>
<td>4</td>
<td>37</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No. of Stations</td>
<td>370</td>
<td>162</td>
<td>382</td>
<td>21</td>
<td>N.A.</td>
</tr>
<tr>
<td>Route Length (km)</td>
<td>201.4</td>
<td>363 (urban)</td>
<td>1263</td>
<td>9.1</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1263 (suburban)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train Consist</td>
<td>8</td>
<td>8</td>
<td>6-8</td>
<td>1</td>
<td>N.A.</td>
</tr>
<tr>
<td>Rolling Stock (Cars)</td>
<td>3481</td>
<td>948 (RATP)</td>
<td>3505</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3505 (articulated)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrification</td>
<td>750 V dc, third rail</td>
<td>1.5 KV dc/25 KV 50 Hz, overhead</td>
<td>25KV ac/1.5KV dc, overhead</td>
<td>750 V dc, third rail</td>
<td></td>
</tr>
<tr>
<td>Service Frequency</td>
<td>1 min 35 s to 3 min 50 s</td>
<td>N.A.</td>
<td>Peak 30 min off-peak 1 hr</td>
<td>Peak 5 min off-peak 8 min</td>
<td>4 min</td>
</tr>
</tbody>
</table>
**Guideway Transit and Intermodalism: Function and Effectiveness**

**FIGURE 12** Intermodal Transfers between Different Transit Modes

**FIGURE 13** A Multimodal Transportation Center in Paris

Buses serve as feeders to all guideway transit modes
an annual pass, and Carte Orange are valid on SNCF, RATP and private bus services; other combined passes available include 'Formula 1' - one day travel on all modes, SNCF-RER-RATP or Metro/RATP. More than 50% of passengers use the zonal Carte Integrale (annual pass) or Carte Orange (monthly pass); the remainder use graduated -fare tickets (15%), weekly workers' passes or student passes.

The fare collection structure is summarized in Table 3. Figure 15 shows an entrance gate the for the Paris Metro and RER systems. In Figure 16 is a ticket vending machine on the Metro system.
FIGURE 15 Entrance Gate at Stations of Paris Metro and Regional Metro

FIGURE 16 Ticket Vending Machine
### TABLE 3 Fare Systems and Integration between Transit Modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Metro (RRT), RER</th>
<th>Suburban SNCF (CR)</th>
<th>LRT</th>
<th>APM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ticket</strong></td>
<td>seven zones</td>
<td>Annual pass (Carte Integrale)</td>
<td>Daily ticket</td>
<td>Daily ticket</td>
</tr>
<tr>
<td></td>
<td>monthly pass (Carte Orange)</td>
<td>Monthly pass (Carte Orange)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weekly pass</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graduated-fare ticket</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined pass</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fare Collection</strong></td>
<td>Vending machines</td>
<td>Vending machines</td>
<td>Vending machines</td>
<td>N.A.</td>
</tr>
<tr>
<td></td>
<td>Entrance Gates</td>
<td>Automatic turnstiles</td>
<td>on-board validators</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exit Gates</td>
<td>roving inspectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>roving inspectors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ticket Validity</strong></td>
<td>Metro, RER, suburban</td>
<td>Annual or monthly pass valid on RATP and private buses</td>
<td>Stand alone</td>
<td>Stand alone</td>
</tr>
<tr>
<td></td>
<td>SNCF lines, Buses</td>
<td>Combined pass valid on specific modes, e.g., SNCF-RER/RATP or Metro/RATP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.7 Guideway Transit Ridership

The Metro's annual passenger trips dropped somewhat in 1991 (1,199 million), compared with 1,228 million in the previous year. In 1992, however, the ridership had a small bounce up to 1,201 million. Today, the Metro itself carries 5 million passengers daily. In 1991, the Regional metro (RER) had a small increase in annual ridership with 361 million from 359 million in 1990. Ridership statistics are shown in Figure 17.

![Annual Ridership](image)

**FIGURE 17** Ridership Statistics for Paris's Transit Modes

2.8 Operation's Funding

The government of Paris subsidizes the operating costs for transit systems. A breakdown of the specific shares of funding sources is shown in Figures 18 and 19.
FIGURE 18 Operations' Funding for Metro, RER, LRT, APM and Bus Services

FIGURE 19 Operations' Funding for SNCF's Suburban Heavy Rail Services
2.9 Development Plan

Paris's guideway transit systems have been developed to maximize intermodalism. The second LRT line and the second APM are under construction.

Extensions for existing lines are planning, for instance, the extension of the first LRT line. Automated train operation for all RRT lines are planned to implement in the long-term future.

3. Contributors to the Success of Paris's Transit System

Contributors to the success of Paris' transit system can be summarized as follows:

- A well planned and developed guideway transit network
- High quality and large quantity of rolling stock
- Convenient transfers between different modes
- High efficiency of operational management
- Strong support from government, such as a dedicated employee tax (2.4%) for operating support and employers being liable by legislature to pay partial costs of commuters' season tickets

4. Findings

Based on this study, findings are listed as follows:

1. Paris's transit systems have formed a well planned and developed network. Intermodal guideway transit is the backbone of this network. The public transit network in Paris supplies convenient and quality services. With two million residents in urban area and 11 million in metropolitan area, the Metro's ridership of five million passengers daily is considered very successful.

2. It is difficult for public transit systems to be self supportive from farebox recovery rates and therefore should be subsidized by the government because public transit serves many purposes. Passengers of public transit leave highways and give more space for the passenger cars to reduce delays and accidents. Also transit riders produce much less pollutant...
3. A highly efficient authoritative organizational and operating structures are essential for the successful implementation of intermodal guideway transit systems. The success of Paris' intermodal transit system is greatly attributed to the Paris Board of Transport (STP) and its three transport authorities or representatives.

4. The fare collection structure for Paris intermodal guideway system can be further improved. LRT and APM service should be integrated with Metro and Regional Metro and suburban commuter rail service. This will attract more passengers to this public transit network and provide more convenient transfers between modes.
REFERENCES


