PPP FOR CITIES CASE STUDY

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A Descriptive Comparison of the Tram Systems of: Barcelona, Bordeaux, Dublin and Manchester

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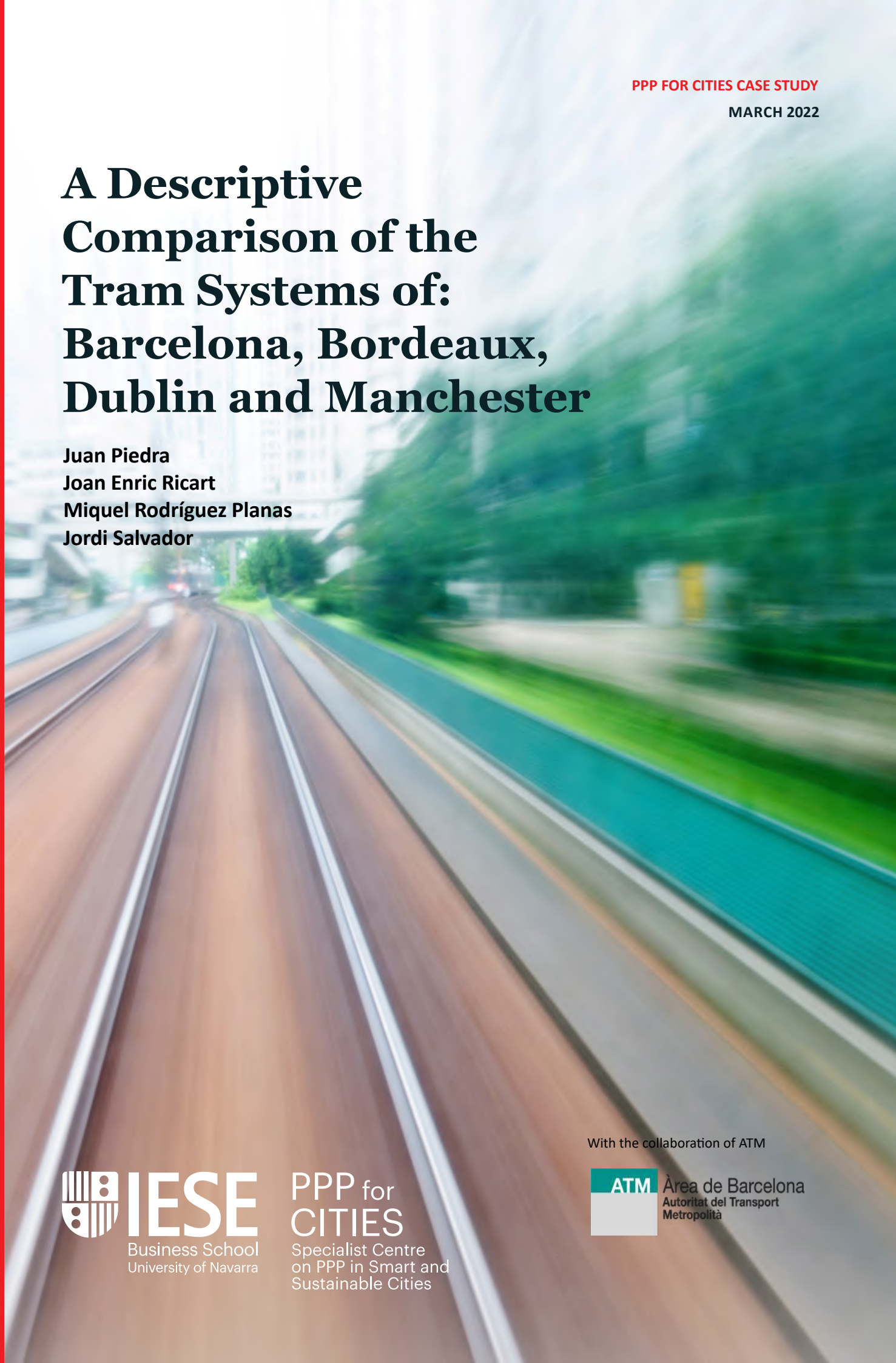

With the collaboration of ATM

IESE Business School University of Navarra

PPP for CITIES Specialist Centre on PPP in Smart and Sustainable Cities

ATM Àrea de Barcelona Autoritat del Transport Metropolità

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PPP FOR CITIES

The Specialist Centre on PPPs in Smart and Sustainable Cities (PPP for Cities) is a research, innovation and advisory center that aims to provide public authorities throughout the world with support in the organization, management and execution of projects involving collaboration between the public and private sector in the field of smart cities.

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List of Acronyms and Abbreviations

PPP: Public-Private Partnership
ATM: Autoritat del Transport Metropolità
BM: Bordeaux Métropole
BRT: Bus Rapid Transport
CUM: Bordeaux's Urban Community
FGC: Ferrocarrils de la Generalitat de Catalunya
NTA: National Transport Authority
TfGM: Transport for Greater Manchester
EMT: Entitat Metropolitana de Transport
SNCF: Société Nationale des Chemins de fer français
TBM: Transports Bordeaux Métropole
TII: Transport Infrastructure Ireland
TMB: Transports Metropolitans de Barcelona
OSP: Public Services Obligations
CET: Territorial Economic Contribution

Introduction

A century ago, the urban tram – one of the most important transportation systems in terms of urban mobility – was abandoned in many cities in favor of the car. However, it emerged at the end of the 20th century, in some cases re-emerging, in various metropolises, including the cities that will be the focus of this study: Barcelona, Bordeaux, Dublin and Manchester. The new tram model has proven to be a clean, efficient, economic and appropriate solution to the existing problems of urban traffic congestion and pollution.

Infrastructure management of the tram systems has generally been articulated through forms of Public-Private Partnerships that have allowed the knowledge, experience and technology of the private sector to be incorporated into infrastructure management.

The implementation of this transport system has been a success in most cases, as will be shown in the examples highlighted in this document.

While new forms of private mobility are currently being used, it seems unlikely that these transport systems will be capable of absorbing a significant part of the massive number of public transport users who currently use trams, subways and buses. Trams can be an increasingly important solution for providing safe, efficient, clean and suitable transportation for all demographic groups. So, will we see the growth or the return of trams in our cities?

1. Context

Rapid global population growth has been followed by a process of concentration in cities. This is raising multiple challenges for public authorities. In particular, cities face the challenge of meeting citizens' growing demand for transport services used to reach their jobs or educational centers in an effective and efficient manner. Identifying an adequate solution requires minimizing the negative externalities derived from private vehicle use: traffic jams, air and noise pollution, acceleration of climate change and accidents. Thus, public transportation can and must be part of the solution to this challenge.

The implementation of an efficient public transportation system, not necessarily managed exclusively by the public sector, should facilitate access to greater job, educational and health opportunities for the entire population, especially for women[1] and underprivileged groups of people who generally have less access to vehicles or private transportation systems.

Faced with such a challenge, the tram emerges as a valid and effective option for improving urban mobility, reducing road congestion and pollution, and improving mass access to high population density areas. The tram, like any other transport system, has advantages and disadvantages and that is why it is complementary to other existing transport systems.

The complexity of the construction and operation of tram systems' advanced technology infrastructure has led many transport authorities to opt for Public-Private Partnership schemes. In these contracts, the private sector can carry out the construction and/or exploitation tasks, taking advantage of its capacity for innovation, experience and economies of scale. On the other hand, the public sector bears the responsibility of guaranteeing that the service is provided according to the conditions defined by the contract.

For this reason, it is important to understand the operation and management details of existing tram systems in different European cities. Through comparative frameworks, a general perspective can be gained about the type of contractual relationship between public authorities and transport operators (public or private), as well as other indicators of interest. It should be noted, however, that differences in contractual and service provision models, as well as data confidentiality, present challenges when comparing different models.

The sources of information of this document include data disclosed in operator's websites, official statistics, public documents, official gazettes and private information provided by transport authorities or service operators.

Section 2 of this document presents a brief contextualization of the urban areas of interest. Section 3 deals with the origin of current tram services and Section 4 analyzes the tram systems in each of the above-mentioned cities. Finally, Section 5 presents the conclusions.

[1] World Bank Blogs. "Transport is Not Gender-neutral." World Bank Blogs. Last modified January 24, 2018. https://blogs.worldbank.org/transport/transport-not-gender-neutral

2. Urban Areas of Interest

This document focuses its analysis on Barcelona and three other European cities that are similar in political, economic, and demographic terms, and have implemented the tram as the main public transport system or as an alternative to existing public transport systems. Another common element shared by these cities is the growing importance of mobility for urban development. In addition to the city of Barcelona, the other cities that will be studied are Bordeaux, Dublin and Manchester[2].

For the purpose of this document, we will consider an urban area as the local administrative unit where most of the population lives in an urban center of at least 50,000 inhabitants. On the other hand, we will consider a metropolitan area as the city and its communal area (defined by Eurostat as a Functional Urban Area[3]). In this paper, reference will be made to urban areas of interest, which can consider both, urban and metropolitan areas.

As it can be seen in **Figure 1**, these areas cover a geographic, economic and demographically extensive area, which allows a varied analysis in the field of public transport policy and mainly in the tram service contracting system.

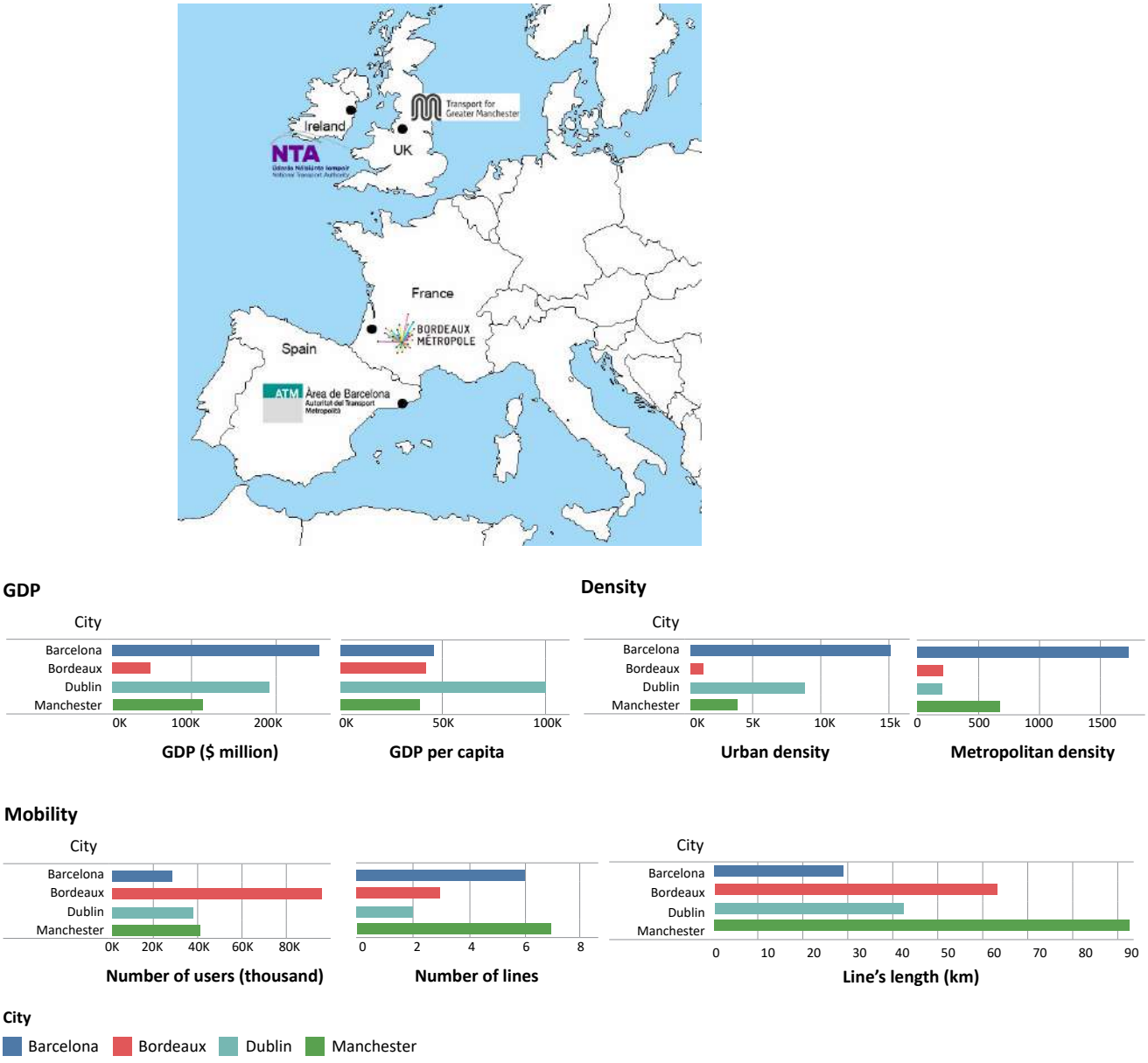
Regarding demographics, in 2017 Barcelona stood out as the city with the highest population density. This means that it concentrates a great amount of population per km^2, both in its urban (15,332 people per km^2) and metropolitan (1,694 people per km^2) area. Dublin, for its part, stood out as the second most densely populated city in its urban area (8,471 people per km^2) and Manchester in the metropolitan area (665 people per km^2).

Barcelona has a network of almost 30 km of tram tracks, in addition to 166 km of metro operated by the public companies TMB and FGC and bus lines. Trams transported almost 30 million passengers in 2019, 2.36% more than the previous year. In comparison, Bordeaux, with 71 km of tracks (more than double that of Barcelona), represents the area with the highest number of tram users in 2018 (more than 105 million trips), followed by Manchester, with a greater availability of km of tracks (101 km), which had 44 million passengers in 2019.

High urban density is highly correlated to high levels of infrastructure demand. However, the demand for a transport service depends on many other factors such as the quality of the service provided, the existing transportation alternatives, citizen preferences and specific moments within economic cycles. For this reason, accurate system planning is necessary to satisfy the demand for the use of the infrastructure and to avoid oversizing of the project. It is also important that the transport authority allows the integration and coordination of a multimodal transport system managed by different operators, both public and private.[4]

[2] Initially, an attempt was made to include Paris and Berlin in the sample. At the end these cities where not included due to lack of sufficient information for a correct analysis.
[3] The definitions of Spatial Units established by Eurostat are being followed. For more information visit Eurostat. "Spatial Units - Cities (Urban Audit) - Eurostat." European Commission | Choose Your Language | Choisir Une Langue | Wählen Sie Eine Sprache. Last modified 2022. https://ec.europa.eu/eurostat/web/cities/spatial%20-units
[4] Institut Cerdà. (2016). Actualització de l'estudi comparatiu sobre les tarifes del transport públic en diverses àrees metropolitanes. Barcelona. Available at: https://observatorimobilitat.atm.cat/docs-observatori/estudis/Estudi_comparatiu_tarifes_arees_europees.pdf

Figure 1. Areas of Interest: Descriptive Tram Mobility Data*



Source: Prepared by the authors based on statistical data from Eurostat / Euromonitor transport authorities / operating companies.

*The data presented shows only tram passengers.

Each of the selected cities has a transport authority in charge of the correct planning and integration of various public transport services. In this study, we will focus primarily on the management of the tram service. The respective transport authorities are listed below:

- Barcelona: Autoritat del Transport Metropolità (ATM), www.atm.cat/web/index.php
- Bordeaux: Bordeaux Métropole (BM), www.bordeaux-metropole.fr/
- Dublin: National Transport Authority (NTA), www.nationaltransport.ie/
- Manchester: Transport for Greater Manchester (TfGM), https://tfgm.com/

In later sections, a brief background of the tram system of each city will be presented, as well as the competencies of their respective transport authorities, operating companies and contracting methods.

3. Origin of the Current Tram Services

In this section, we will briefly explain the background that motivated the construction of the tram system for each of the areas of interest. We will also describe the competencies of the responsible transport authority, as well as the contracting systems used in each area.

3.1. Barcelona

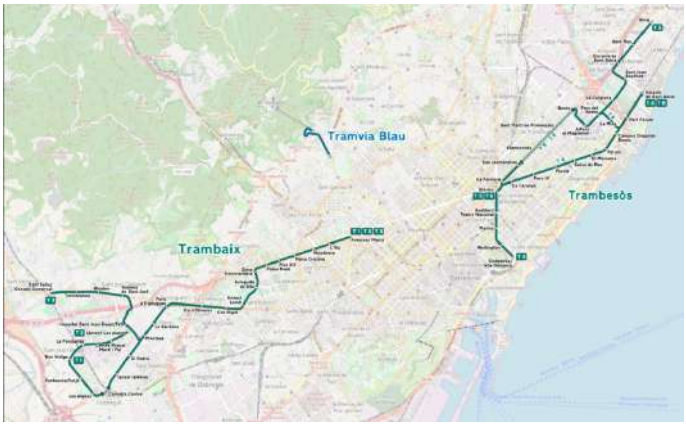
The origin of the current tram system in Barcelona dates back to 1987, when its transport authority, "Entitat Metropolitana de Transport" (EMT), conducted initial studies to reintroduce the tram network in the southeast of the city[5]. The original plan was published in 1989. However, the project was slightly modified after the creation of the contracting public authority, "Autoritat del Transport Metropolità" (ATM), which took over the project in 1997.

The ATM carried out the final design of the tram system for the Barcelona metropolitan area, which consisted of two separate networks at the two ends of Avenida Diagonal (Figure 2), an avenue that runs throughout the city[6]. The construction of the first network (Trambaix) began in 2001 and its last section was put into service in 2007. The second network (Trambesòs) began its construction in 2003 and its last section was put into service in 2008[7]. The tram system contract was designed as a Public-Private Partnership (PPP), where ATM was put in charge of supervising the evolution and fulfillment of the contract, which included the construction and operation of the infrastructure for 28 years.

ATM is a regional administrative consortium founded in 1997, whose territorial scope of competencies includes 14 regions of Catalonia. While ATM oversees for transport and mobility, it is specifically responsible for:

- Planning transportation infrastructures, scheduling future investments, establishing financing partnerships, overseeing the fulfillment of current projects and their planning goals
- Planning services and relationships with public transport operators, establishing new coordinated programs with all public and private companies that provide a public transport service
- The development and approval of an integrated ticket fare framework
- Financing of the public transport system through public administrative entities
- Communications and advertising
- Establishing relationships with other administrative bodies to fulfill assigned functions
- Other functions related to mobility

Figure 2. Barcelona's Tram Network: Trambaix and Trambesòs



Source: Wikipedia. "Tram de Barcelona." Wikipedia. n.d.
https://es.m.wikipedia.org/wiki/Tram_de_Barcelona#/media/Archivo:Barcelona_-_tramway_map.png

[5] Barcelona had a traditional tram network that operated for almost a century before disappearing in 1971.
[6] It is considered important to note for comparative issues that, currently, the Barcelona tram does not travel through the city center.
[7] Navarro, J., Ricart, J. E., Trillas, F., Rodríguez Planas, M., y Salvador, J. (2017). Barcelona tram service (Spain). Barcelona. Available at https://www.iese.edu/wp-content/uploads/2019/03/ST-0453-E.pdf

3.2. Bordeaux

The idea of implementing a public tram system in Bordeaux gained momentum in the mid-1990s, after failed attempts to modernize the public transport network in the 1960s, including an attempt to implement a metro system. As a consequence, the automobile road network was improved.

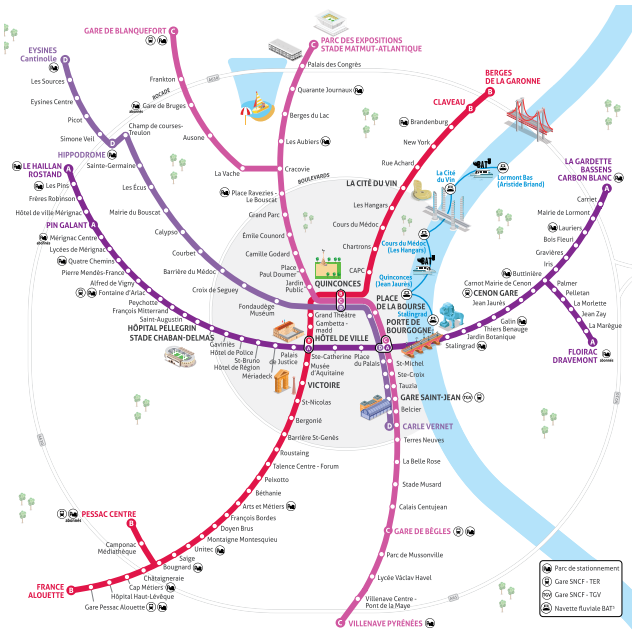
It was not until 1995 that the Mayor Alain Juppé launched a new tram project for Bordeaux's Urban Community. The main objectives of this project were the following:

- to revitalize the heart of the community by facilitating access from the city to neighboring municipalities, but first and foremost, to relieve traffic congestion in the city center.
- to modernize and increase the standard of living in the neighborhoods affected by the project.
- to support the economic integration of some municipalities located in low-income peripheral areas[8].

In the same year, the Urban Community of Bordeaux (CUB) began planning the first phase of the tram network. This consisted of the construction of three lines, with a total distance of 24.7 km and 53 stations, running through the city center. A second phase of the project consisted of the extension (19.6 km) of those three lines. The construction of the first phase began in 2000 and ended in September of 2005. The second phase began in 2006 and ended in October of 2008, which by then, had a total distance of 43.3 km with 84 stations[9]. Currently, there are currently 71 km of tracks.

The city has continued to expand the network, which has been planned by the Systra joint stock company since 1998. While construction is led by the public sector[10], management is entrusted to a private company. The company in charge of operating the tram service is Transports Bordeaux Métropole (TBM), formerly Keolis Bordeaux (a subsidiary of Keolis, a private operator 70% owned by SNCF), which has been operating the service since 2009 under a service concession contract. Its current tram network is presented in **Figure 3**.

Figure 3. Bourdeaux's Tram Network



Source: Transports Bordeaux Métropole. "Plan Tram." Transports Bordeaux Métropole- TBM. Last modified April 2021. https://www.infotbm.com/sites/default/files/medias/fichiers/2021-04/GD_PLAN_TRAM_AVRIL2021_HD.pdf

[8] Sari, F. (2015). Public transit and labor market outcomes: Analysis of the connections in the French agglomeration of Bordeaux. Transportation Research Part A: Policy and Practice.78, 231–251. Hausmann, Ricardo. "The PPP Concerto." Project Syndicate. Last modified April 30, 2018. https://www.project-syndicate.org/commentary/improving-public-private-partnerships-infrastructure-by-ricardo-hausmann-2018-04?barrier=accesspaylog

[9] Smith, K. "Bordeaux leads French light rail revival." International Railway Journal. Last modified August 2, 2013. https://www.railjournal.com/in_depth/bordeaux-leads-french-light-rail-revival

[10] Hausmann, R. "The PPP Concerto." Project Syndicate. Last modified April 30, 2018. https://www.project-syndicate.org/commentary/improving-public-private-partnerships-infrastructure-by-ricardo-hausmann-2018-04?barrier=accesspaylog

The authority in charge of supervising the fulfillment of the contract is Bordeaux Métropole (BM, formerly CUB), which works as a public institution of inter-municipal cooperation. Within its competencies as a planning body for the development of the metropolitan area, which includes this body as a planner of urban transport development, it is in charge of:

- The definition, creation and implementation of development projects of metropolitan interest
- Organizing mobility, public transport services and transport services on demand
- Establishing the accounts related to the different mobility practices, including the cost for users and other resulting costs for the community
- The creation, development and maintenance of public spaces dedicated to all modes of urban transport and their ancillary works
- Other functions related to urban development and mobility

3.3. Dublin

The Dublin metropolitan area tram (LUAS[11]) was created in 1988 when the Department of the Environment appointed the Dublin Transportation Review Group to review its transport policy and develop a plan to meet the increase in transport demand predicted for the area. This had been caused by an increase in urban population, employment, economic and household activity[12].

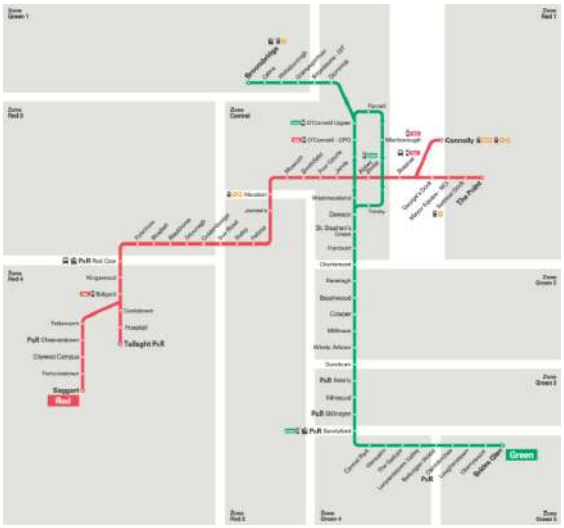
In a second planning stage, studies were carried out to analyze public opinion on the implementation of different means of transportation (among which was the option of a tram network). The studies had to meet three objectives:

- the creation of a long-term transport strategy for the Dublin metropolitan area
- the preparation of a medium-term investment program
- the ongoing implementation of transport planning processes

The survey confirmed that there was citizen approval of various means of transportation and laid the groundwork for approval and further studies in the planning of the LUAS tram project.

Consequently, the LUAS tram system began construction in 2001 and was completed in 2004. This project was part of the Dublin Transport Office's strategy of 2000-2016. The network includes two lines: the Green Line, which runs a north/south route from Broombridge to Bride's Glen and the Red Line, which runs an east/west route from Saggart to The Point (see **Figure 4**).

Figure 4. Dublin's Tram Network (LUAS)



Source: Luas. "Luas- Dublin's Light Rail Tram- Routes, Map, Schedule." Dublin- Dublin Travel and Tourism Guide. Last modified 2022. https://www.introducingdublin.com/luas

[11] Sounds like the Irish word "velocity".
[12] Fegan, O.; Sophistor, S. (2003). Cost-Benefit analysis of the Dublin LUAS light rail project. Student Economic Review.17, 213-224.

Since 2009, the National Transport Authority (NTA) has been the authority in charge of providing most of the public transport services (not the operation services) by managing Public Service Obligation (PSO) contracts with different operators. PSOs are financing contracts for transport services that are socially necessary but financially inaccessible without the intervention of private operators[13].

In the case of the LUAS tramway system, the NTA delegates its functions as service contractor to Transport Infrastructure Ireland (TII), which is in charge of contracting the operator (Transdev) under a gross cost contract. This differs from PSOs, whereby the NTA (as transport authority) retains all the revenue for the service and pays Transdev a fixed fee plus a bonus for performance efficiency.

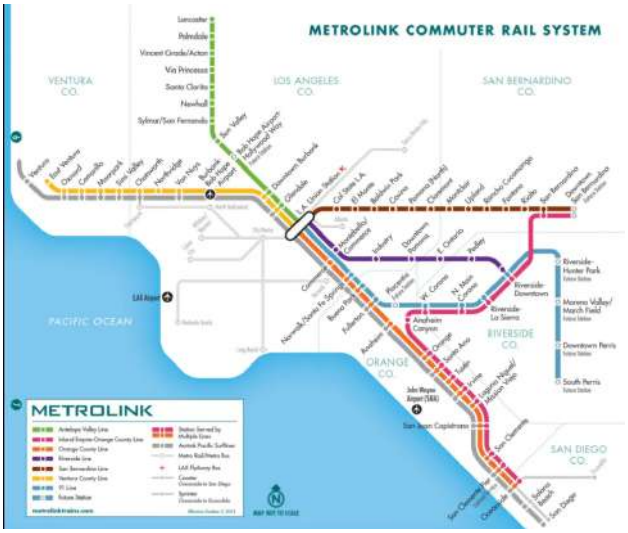
TII was born as a joint effort of the now extinct National Roads Authority and the Railway Procurement Agency in 2015, with the primary role of providing an integrated approach to the development and operation of the national road network and rail infrastructure across the country.

3.4. Manchester

The Manchester city tram has its origins in 1983, when the City Council decided to develop a tram network (later called Metrolink) with the objective of providing public transport services to reduce private vehicle traffic congestion – a growing problem in the city in previous years – and to help stimulate the regeneration of the city center, other town centers and inner-city areas[14].

The construction of the first phase of the tram system began in 1990 and was completed in 1992. The investment involved converting two "heavy" rail lines from Manchester city center to Bury and Altrincham to tram tracks, and connecting them with a street tram in the city center, with a link to Piccadilly train station. Phase 2, on the other hand, included a new route from central Manchester to Salford Quays (launched in 1999) and Eccles (launched in 2000)[15].The current tram network is shown in **Figure 5**.

Figure 5. Manchester Tram Network (Metrolink)



Source: Metrolink Commuter Railsystem. "Transit Maps: Submission – Official Map: Metrolink Commuter Rail System, Southern California." Transit Maps. Last modified January 28, 2016. https://transitmap.net/metrolink-2016/

Manchester Metrolink was originally designed under a Design, Build, Operate and Maintain PPP contract between the Greater Manchester Passenger Transport Executive (as the public entity and owner of the infrastructure) and Greater Manchester Metro Limited[16] (as the private entity responsible for building and operating the service). Today, this contract is held between Transport for Greater Manchester (TfGM), the local entity responsible for the public transport strategy of the Manchester's metropolitan area; and, Keolis Amey, the current operator of the service.

[13] National Transport Authority. "Public Transport Services." National Transport Authority. Last modified 2022. https://www.nationaltransport.ie/public-transport-services/
[14] Knowles, R.D. (1996). Transport impacts of Greater Manchester's Metrolink light rail system. Journal of Transport Geography. 4, 1-14.
[15] Senior, M.L. (2009). Impacts on travel behaviour of Greater Manchester's light rail investment (Metrolink Phase 1): evidence from household surveys and Census data. Journal of Transport Geography, 17, 187-197.
[16] Formed by GMA consortium (GEC Alsthom, John Mowlem and AMEC)

As the regional transport authority, TfGM is responsible for implementing the transport policies approved by the respective authorities, which include the Greater Manchester Mayor and the Greater Manchester Combined Authority. TfGM is responsible for directing investments to improve transport services and working with bus, rail and tram operators for the continuous improvement of the services.

Table 1. Summary (data from 2017)

	Barcelona	Bordeaux	Dublin	Manchester
Population (millions)	5.49	1.17	1.89	2.80
Annual passengers (millions)	28	96.76	37.6	41.2
Km of tracks	29.1	63.1	42	92.5

4. Tramway Systems

In this section, we offer a comparative description of the contracting systems of the tram system in the cities under study. For each city, we will describe its governance system, the specific contracting system in use for the tram system, payment methods and fare systems. Also, we will show data regarding supply, demand and financial return and provide a brief analysis of the performance of each fare system. Data displayed here is available public information, as well as other obtained from the respective authorities or operators. In some cases, contracting details are kept confidential; hence, some details are not available. Despite this limitation, the information showed here allows a comparative description of each system, which is the objective of this study.

4.1. Governance System

A brief introduction to the individual governance system of each geographic area studied was included in the previous section. The purpose of this section is to enable immediate comparison of the main governance traits contained in each contract (see **Table 2**). Not surprisingly, one of the main reasons for implementing a tram system was to meet the increasing demand for transport service and to solve the traffic congestion created by private means of transportation, one of the most serious problems in many cities.

Administrative competencies of transport authorities

For the most part, transport authorities have jurisdiction at a regional level. The NTA in Dublin is an exception, for it has statewide jurisdiction. Regarding specific areas of competencies, the case of Bordeaux (BM) stands out in comparison to the other transport authorities. BM's competencies go beyond public transport planning services and include planning for economic development, urban planning, water and sanitation, and the environment, among others. This demonstrates that transportation plays a central role for authorities regarding the economic development of a specific area. In contrast, transportation authorities of the other areas under study are only in charge of public transportation services, with the exception of Barcelona's transport authority, which is also responsible for mobility.

Operational competencies

All transport authorities are in charge of contracting service operators that will then integrate with other alternative transport system operators. Bordeaux and Manchester are responsible for financing and building the infrastructure, and for managing the operating contracts with private operators. In the case of Dublin, NTA acts through TII to manage the tram operators' contracts. In Barcelona, the authority manages the construction and operation agreement with a private company that recovers the construction and operation investment during the operation.

Table 2. Governance Traits

	Barcelona	Bordeaux	Dublin	Manchester
Authority	Autoritat del Transport Metropolità (ATM)	Bordeaux Métropole (BM) (antigua Communauté Urbaine de Bordeaux)	National Transport Authority (NTA)	Transport for Greater Manchester (TfGM)
Jurisdiction	Regional	Regional	National	Regional
Competencies	Transport and mobility in the entire transport network	Transport, economic development, urban planning, habitat, environment, water and sanitation, roads, signage, market of national interest, digital development, other development competencies.	Transport	Transport
Responsibility regarding the tram	• The contracting authority is in charge of supervising the evolution and fulfillment of the construction and operation agreement. • Integration with other transport services in Barcelona.	• Owner. Builds and finances the tram and supervises compliance with the operation agreement.	• Manages OPS contracts. Outsources tramway services through TII. • NTA assigns its duties as the transportation authority responsible for the provision of tram service to TII.	• Owner and planner of the tram and light rail service in the metropolitan area. • Contracting authority. Oversees compliance with the operating agreement.
Principal reason for implementation	• To meet the growing demand for medium-distance travel in the metropolitan area. • To facilitate social cohesion.	• To boost urban mobility. • To facilitate social cohesion.	• To meet the growing demand for transportation.	• To solve traffic congestion problems caused by private vehicles. Urban regeneration.

4.2. Contracting systems

This section shows the different contracting systems used for the implementation of the tram in each of the cities under study.

4.2.1 Contracting system used in Barcelona

In the case of Barcelona, ATM is the public transport authority responsible for the implementation of the tram network in the city. To this end, a PPP agreement was signed for the design, construction, financing, operation and maintenance of the service.

Two consortia were the winners in the different tenders submitted for the two tram lines:

- Tramvia Metropolità SA, in charge of the construction and operation of the Trambaix network
- Tramvia Metropolià del Besòs SA, responsible for building and operating the Trambesòs network

These companies were responsible for the construction and financing of the project and for carrying out the operation and maintenance of the tram network. The method of payment under the agreement consisted of a four-component revenue:

- An annual payment to the concession holder. ATM agreed to pay a capital subsidy for the Trambaix case and a fixed annual fee for the Trambesòs case.
- A technical fee. This is calculated on the basis of the amount of operating costs, the operator's profits and a fee that includes the return of part of the investment. This technical fee is subject to demand risk (bonus/malus), determined by a system of four cumulative bands that depend on the number of validations forecasted in the contract.
- Advertising revenues. 60% of net advertising revenue goes to the tram operators, while 40% goes to the ATM.
- Fare revenues. The operator receives income from the use (validation) of integrated tickets according to compensation rules established by the ATM.
- Sales commissions: the operator receives commissions for the sale of tickets.

Some contractual amendments were introduced in 2009 for the Trambaix agreement and in 2012 for the Trambesòs agreement. The initial contract was extended until 2032 (three additional years), making it possible to analyze the same agreement at the time of writing this document, unlike the other analyzed cases, where contractual and operator changes have been made. In comparison to Barcelona, the other three cities under study currently maintain relatively new service operation and maintenance agreements.

4.2.2 Contracting System Used in Bordeaux

In the case of Bordeaux, the current agreement has been in force since 2009. This is a concession contract to the private company Keolis Bordeaux Metropole[17] (under the name Transports Bordeaux Metropole, TBM) for the operation and maintenance of the service[18]. Maintenance, however, is not under the operators' full responsibility. Repairs are measured by their level of importance (but not severity) from 1 to 5, where 1 is the least important and 5 the most important. The operator is in charge of ordinary preventive and corrective maintenance, and the management of the operations called "major overhauls or renovations" considered as a reinvestment to renovate or extend the lifespan of the asset to be maintained. Since the contract corresponds to operation and maintenance, BM was fully responsible for financing the construction of infrastructure and material supply.

The payment method is based on a flat fee that allows TBM to carry out the operation and maintenance of the service, i.e., the operator is paid on an availability basis. Commercial revenues- comprising transport ticket sales and subscriptions (e.g., monthly)- and revenues from advertising and fines are given to BM, the transport authority.

4.2.3 Contracting System Used in Dublin

In the case of Dublin, as mentioned above, the contract is made and entered between TII, as the transport authority on behalf of NTA and Transdev, as the private operator. In terms of public transport contracting in Dublin, there are two types of contracting:

- net cost contract, where the operator retains all of the fare revenue
- gross cost contract, where the public authority retains the fare revenue[19]

LUAS, the tram service, falls into the second category, where NTA is responsible for funding and receives all the fare revenue.

[17] Keolis Bordeaux Métropole, belongs to Keolis. A 70 % of Keolis belongs to Société Nationale des Chemins de fer Français (SNCF) and a 30 % belongs to Caisse de dépôt et placement du Québec.
[18] https://www.infotbm.com/es
[19] National Transport Authority. (2016). Annual Report 2016.

Under the current contract, operated by Transdev since 2014, the payment method consists of a fixed fee payment as long as it meets the performance standards set out in the agreement. The payment can be modified in two ways. A positive modification may be included, if its performance is higher than the established performance standards (performance bonus). A negative modification may be included if it does not meet such standards (performance penalty).

In parallel, TII, the public authority, had two contracts until 2019 (one for the original fleet of vehicles and another for the new fleet) for the maintenance of the vehicles with Alstom, the constructor of the fleet. In addition, it also had another contract until 2019 for the maintenance of the fixed infrastructure with a consortium formed by Alstom and Veolia[20]. Both contracts, for vehicles and infrastructure, were renewed[21] to the operator Transdev, in such a way that the latter assumed all the rights and responsibilities of TII, apart from certain functions retained and controlled. These functions include the right to make changes to the contract and terminate the contract if applicable, among others. In addition, these contracts have performance elements that are closely aligned with the service quality performance aspects of the operating contract.

4.2.4 Contracting System Used in Manchester

In Manchester, the operation and maintenance agreement for the Metrolink service was made between TfGM and the private consortium Keolis Amey, and has been in place since 2017. The method of payment includes an annual fixed fee and a separate performance scheme fee that fluctuates each period based on a range of performance measures. The fixed fee constitutes most of the payment to the operator, covering the major portion of the operator's costs, such as infrastructure, personnel costs, etc. The performance fee is based on a series of operational performance measurements that are monitored on a period-by-period basis to determine the level of reimbursement due.

Tables 3 and **4** summarize the relevant data for each of the tram contracting systems in each metropolitan area.

As can be seen, a common factor among all the respective transport authorities is the choice of a PPP contracting system. Each agreement, however, has different characteristics, mainly in terms of the type of delivery and method of payment. Regarding the contracted delivery, most constitute service operation contracts. Regarding the payment method, many of the cases have a payment method that includes in some way a variable related to the operator's performance. These aspects are important in order to determine the risk distribution of the contracting system, which will be analyzed in the following section.

Table 3. Contracting System

	Barcelona	Bordeaux	Dublin	Manchester
Authority contracting the tram service	Yes	Yes	No	Yes
Operator	Private	Private	Private	Private
Contract model	PPP	PPP	PPP	PPP
Operation contract	Private operator	Private operator	Private operator	Private operator
Maintenance contract		Mixed	Other	
Infrastructure financing	Private	Public	Public	Public
Method of payment	Fixed + variable	Fixed	Variable range	Fixed + variable
Alternative transportation method in place	Yes	Yes	Yes	Yes

[20] Transport Infrastructure Ireland. "Vehicle and Infrastructure Maintenance." Transport Infrastructure Ireland-. Last modified 2022. https://www.tii.ie/public-transport/operations-and-maintenance/vehicle-infrastructure-maintenance/

[21] Modification or termination of a legal obligation

Table 4. Detailed Contracting System

	Barcelona	Bordeaux	Dublin	Manchester
Authority	Autoritat del Tranport Metropolità (ATM)	Bordeaux Métropole (BM) (former Communauté Urbaine de Bordeaux)	National Tranport Authority (NTA)	Tranport for Greater Manchester (TfGM)
Responsibility with Respect to the Tram	Contracting authority, in charge of overseeing the evolution and compliance of the contract. Integration with other transport services in Barcelona.	Owner (builds and finances) of the tram and in charge of supervising the fulfillment of the operation contract.	In charge of OPS contracts. Subcontracts the tram services through TII. NTA assignes its funcions as tranport authority responible for the provision of tram services to TII.	Owner and planner of the tram and light rail system in the metropolitan area of Manchester. Contracting authority. Supervises the fulfillment of the operation contract.
Tram Operator	Tramvia Metropolità SA Tramvia Metropolità del Besòs SA (Private)	Transports Bordeaux Metropole (TBM) (former Keolis Bordeaux) (Private)	Transdev (Private)	Keolis Amey (since 2017) (Private)
Responsibility (operation)				
Responsibility (maintenance)		TBM (repairing tasks 1 to 4), repairing task level 5 corresponds to BM	Alstom (Private)	
Responsibility (financing)		BM (public)	NTA (Public)	TfGM (Public)
Contract	PPP by design, Financing, Building, Operating and Maintenance	Operating and Maintenance concession	PPP for Operation and Maintenance	PPP for Operation and Maintenance
Duration of contract	28 years	8 years	5 years	10 years
Supervisor of Operation Contract	ATM	BM	TII	TfGM
Payment Method	Annual payment + technical fee + tariff income + advertising revenues + sales commissions	The authority pays a flat rate operating contribution that allows the operator to carry out the operation and maintenance. The operator grants all business revenue to the authority (ticket sales and subscriptions) and advertising revenue and fines	Gross cost contract: performance-based public pay. The authority withholds revenue from fees.	Annual fixed payment plus variable for performance
Transport System	Integrated	Integrated	Integrated	Integrated

4.3. Risk Allocation

For any agreement, and particularly for a PPP, an appropriate allocation of risk is a critical issue for the success of the service throughout the duration of the contract. In the literature, it is often said that risk should be transferred to the party that can best manage it.[22] Thus, optimal risk allocation requires consideration of both the incentives created by the contractual relationship and the ability to control the risks incurred by the various parties[23]. The distribution of some of the most important risks is laid out in **Table 5**.

An important factor for the description of risks is that the existing contracts of all the case studies, except for Barcelona, refer only to the operation and maintenance of the service. Thus, in the case of Barcelona, most of the risks are transferred to the private sector, as described below.

- **Risk of space and expropriation.** Associated with the physical space where the infrastructure is built. In the case of Barcelona, as the contract included the design and construction of the tramway, this risk was undertaken by the public administration, which was responsible for carrying out the necessary expropriations and making the land available to the constructor. In the other cases, this risk refers to the space for the construction of new tram networks and infrastructure, which was assumed by the public authority and is subject of another agreement.

- **Financial risk.** Total or partial award of project financing go to the contractor. This risk is taken on by the consortia created to build the Barcelona tram. In the case of Bordeaux and Manchester, since public authorities are responsible for the construction of the tram, they are responsible for financing the new infrastructure. As for Dublin, a special fixed infrastructure maintenance contract with the Alstom-Veolia consortium was valid until 2019 (renewed after the end of the agreement in 2019 with Transdev, the operator), part of this risk was undertaken by the consortium. Nevertheless, the financing of new transport infrastructure and the tramway network is provided by TII, so that the public authority takes on the financing risk for the most part.

- **Operation and maintenance risks** are linked to the costs of service operation and maintenance (in this case, of vehicles, systems, and others). They are borne in all cases by the private sector, i.e., the consortia and private companies in charge of operating the trams. As for Bordeaux, the operating risk is taken on by TBM, the concession holder. On the other hand, as mentioned above, level 5 maintenance is carried out by BM, so the maintenance risk is shared. Dublin, for its part, transfers these risks to the private sector, but they are distributed between two companies, since they have two different contracts, vehicle maintenance and infrastructure maintenance.

- **Demand risk** is one of the main risks in long-term projects. Demand risk should be shared between the authority and the concession holder, as demand depends both on how well the service is provided and on the timing of the economic cycle, transport alternatives, public preferences, ticket prices, etc. The risk arises from the fact that revenues from the demand for the service are not high enough for the operator to make a profit after meeting the generated operating and maintenance costs. As for Barcelona, this risk is partially borne by the public sector, since it guarantees a subsidy/fixed fee to the operators plus a technical fee to cover investment, operating costs and profits. Nevertheless, since the latter must be calculated on the basis of demand bands, part of this risk is also born by the operator. Bordeaux, Dublin and Manchester have a similar distribution of demand risks, as the payment rate is established at the time of bidding, based on performance standards. As long as the operators comply with the agreement, the public authority must comply with the respective payment. As for Bordeaux, BM may contribute financially if demand evolves differently than anticipated.

[22] Berrone, P., Fageda, X., Llumà, C., Ricart, J. E., Rodríguez, M., Salvador, J., y Trillas, F. (2018). Asociaciones Público-Privadas en América Latina. Una Guía para Gobiernos Regionales y Locales. CAF.
[23] Grimsey, D., y Lewis, M. K. (2004). Public Private Partnerships The Worldwide Revolution in Infrastructure Provision and Project Finance. Cheltenham, United Kingdom: Edward Elgar Publishing

Table 5. Distribution of Risk

Risk	Barcelona	Bordeaux	Dublin	Manchester
Space and Expropriation	Public	Public	Public	Public
Design	Private	Public	Public	Public
Construction	Private	Public	Public	Public
Financial	Private	Public	Private/Public	Public
Operation	Private	Private	Private	Private
Maintenance	Private	Private/Public	Private	Private
Demand	Private/Public	Public	Public	Public

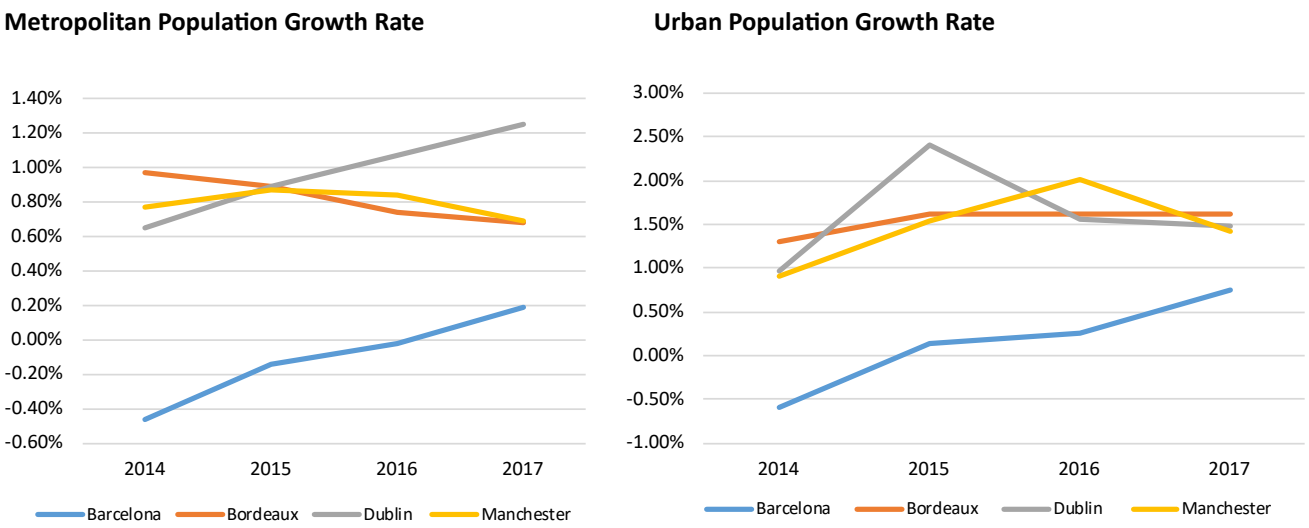
5. Indicators and Statistics of Interest

In the previous section, we discussed the different tram contracting systems in each metropolitan area under study. Some relevant indicators are discussed here in order to analyze the performance of these agreements according to their level of costs, supply and demand for the service. Due to the nature of each agreement, as well as the limitations faced in obtaining information, the comparison among financial indicators of different cities is complex. In this sense, we advise the reader to be cautious when attempting to compare the different financial data reported in this section.

5.1. Population Growth

As mentioned at the beginning of this document, population level is an essential factor in determining the potential demand for public transport in a given area, in addition to other already mentioned variables (existing transport alternatives, degree of urbanization, economic cycle, etc.). **Figure 6** shows population growth rate in the analyzed urban and metropolitan areas between 2014 and 2017. It is noteworthy that Barcelona is the only city that starts with negative growth trends in 2014, both for its urban and metropolitan area. This is because of the consequences of the strong economic crisis experienced by the city from 2009 onwards. In this sense, Bordeaux and Dublin are shown as two of the cities with higher levels of urban growth during that period, with an average of 1.54% and 1.61% respectively. Consequently, it is expected that higher levels of population growth will lead these cities towards higher levels of demand for public transportation (for all public transportation means, not only tram systems), in contrast to their counterparts. The next section looks at this relationship, using the evolution of demand, as measured by the number of annual tram trips in each city.

Figure 6. Urban and Metropolitan Population-Growth Rate



Source: Eurostat/Euromonitor.

5.2. Tram Demand: Evolution of the Demand and Per Capita Demand[24]

Growing population, mainly in urban areas, brings with it a potential increase in the use of the tram and other public transportation systems. The evolution of demand is a critical variable in determining payment to the operators and service supply. **Figures 7** and **8** show the annual trip growth rate and the evolution of trips by population (urban and metropolitan). The cities of Bordeaux and Manchester have the highest growth of usage rates- mainly in the last few years. Tram routes cover a larger portion of the urban area than those in Barcelona, and go through central areas, thus, boosting demand.

Figure 7. Tram Demand Growth Rate

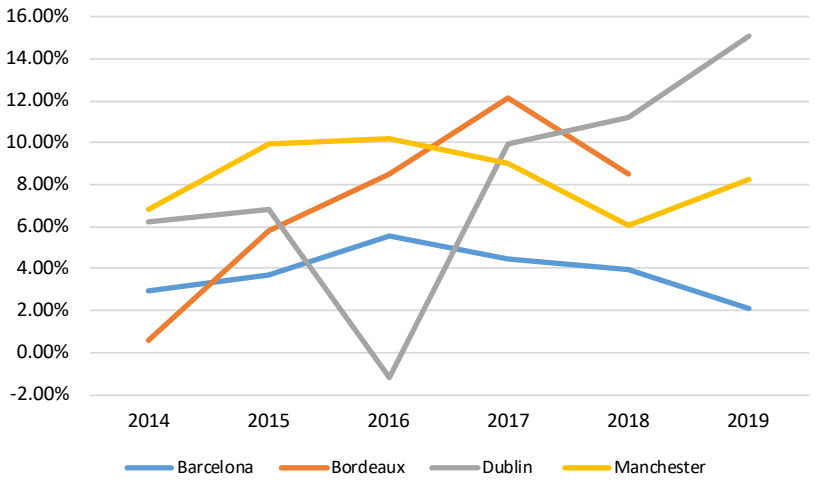
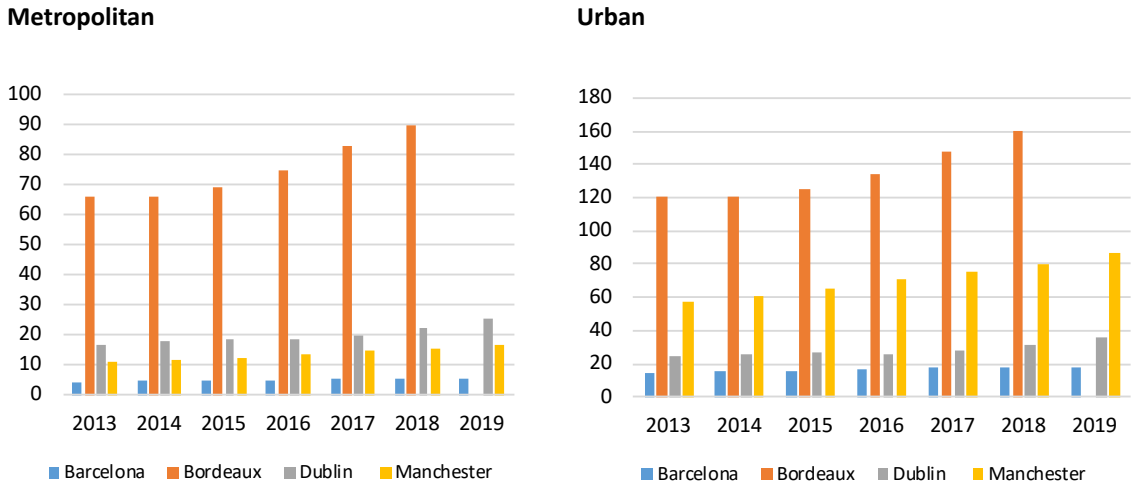


Figure 8. Annual Per Capita Tram Trips[25]

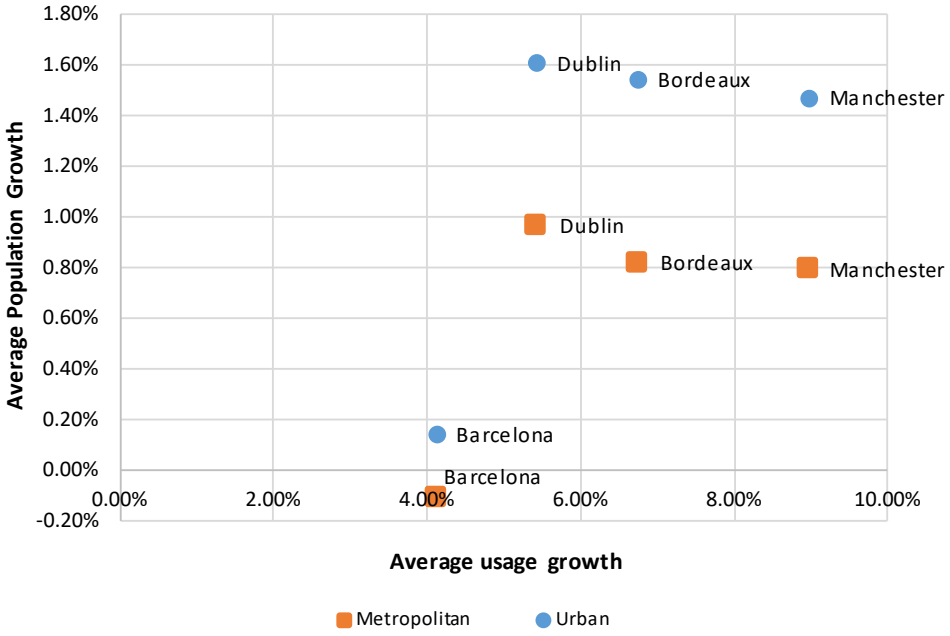


[24] The authors would like to point out once again that Barcelona, unlike other cities, has 177 km of subway, which is the main transportation platform in the city, rendering the data not very comparable with that of other cities.

[25] The population data that is being used corresponds to that of the total metropolitan area and not to the populated area that covers the infrastructure.

Upon observing **Figures 7** and **8** in conjunction with the level of population growth, it is clear that the cities with the highest level of growth are those with the highest level of demand. It is expected that there is a certain level of correlation among these variables. To corroborate this, **Figure 9** relates average usage growth (between 2014 and 2017) and average population growth over the same period. On average, the cities with the highest population growth are those with the highest demand for tram service, with Barcelona being the one positioned at low levels, as already observed (in part due to having other alternative public transportation systems).

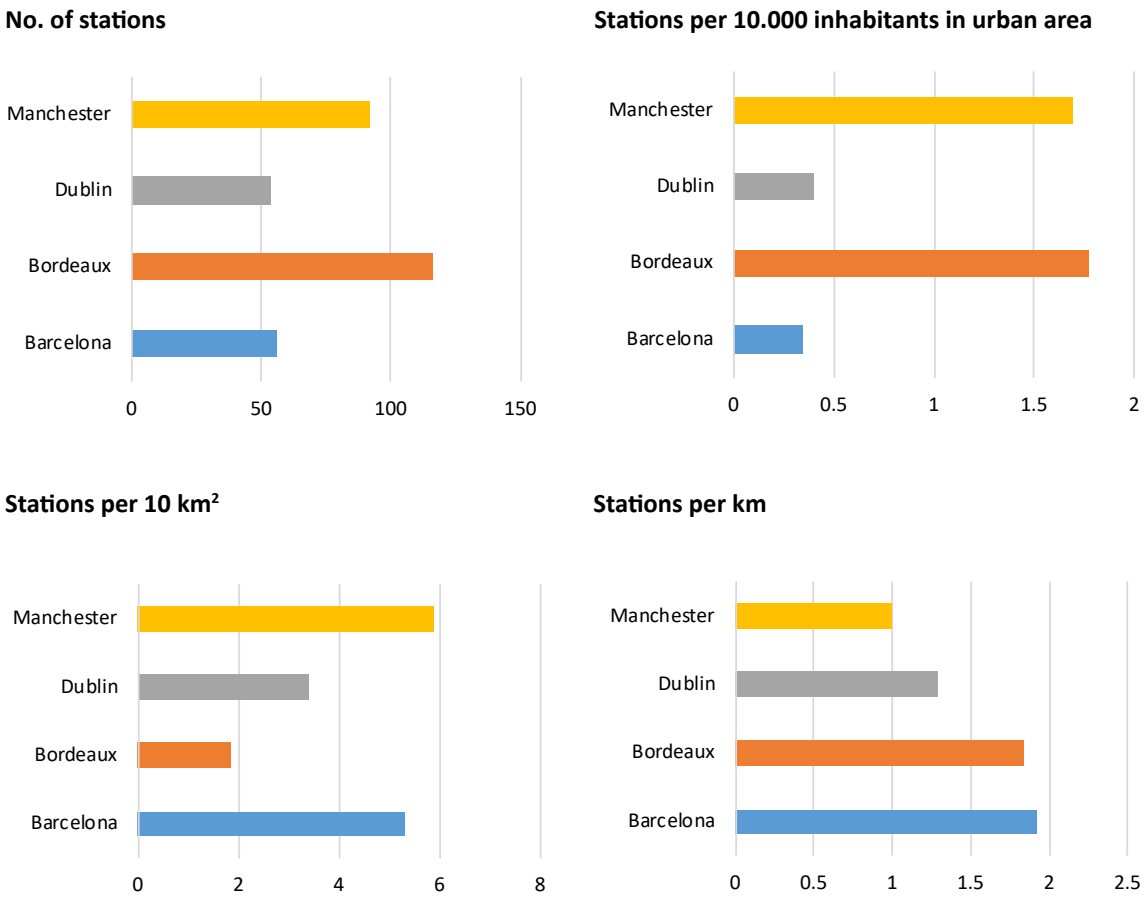
Figure 9. Population Growth vs. Demand Growth (2017)



5.3. Tram Offer: Tram Stations by Population, Area and Network Length

Figure 10 shows service offer data for 2017 that measures the density of tram stations. Specifically, it shows the number of stations per 10,000 inhabitants (of the total metropolitan area, not only the covered areas) in the urban area, as well as the number of stations per length of the tram network. It also compares the number of lines in each tram system. This data allows us to know the accessibility to the tram service at the urban level. Manchester's tram network is the largest, with almost six stations per 10 km^2 and one station per km of track. Also, it is the city with the highest number of lines (seven lines). The city of Barcelona is shown with the second place in offer, with five stations for every 10 km^2, two for every kilometer of track.

Figure 10. Number of Stations, Stations per Inhabitants, Area and Network Length



5.4. Fare System

To better understand each case studied, it is necessary to discuss the fare system that dominates public transport in each area of interest. All cases have an integrated transport system and have discounts that consider young people, the elderly and large families, among others. **Tables 6** and **7** present a description of the fare system with costs for an adult. These tables do not include the different discounts offered, since the objective of this section is to offer a contextualization of the fare system and not a specific analysis.

Table 6. Fare System (euros)

Type of ticket	Barcelona	Bordeaux	Dublin	Manchester	Average
Single	2.40	1.70	2.10	1.54	1.93
T-10 or equivalent	10.2	13.70	16.5	11.67	13.01
T-month or equivalent	54	50.30	66	40.09	52.59

* Manchester's ticket fares have been converted to their equivalent in euros using the official exchange rate of the European Central Bank for 2018.

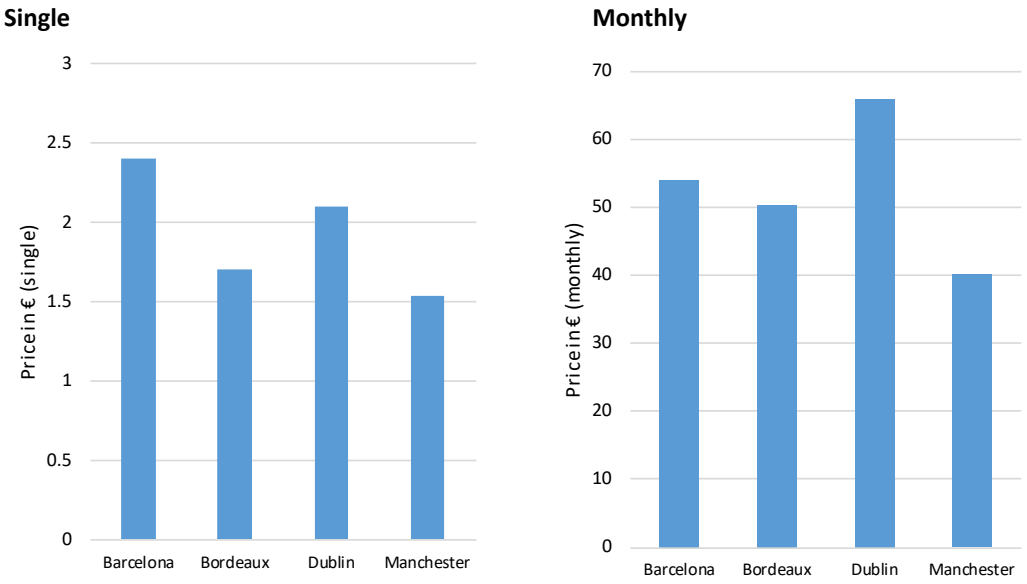
Table 7. Detailed Fare System

Area of interest	Type of ticket	Description	Vality of the ticket	Price (1 Zone, in euros)
Barcelona	Single	Single	1 use	2.40
	T-10	10 integrated trips with the possibility of transfer within 1 hour	10 trips	10.20
	T-50/30	50 integrated trips in 30 days with the possibility of transfer within 1 hour	50 trips or 30 days	43.50
	T-70/30	70 integrated trips in 30 days with the possibility of transfer within 1 hour	70 trips or 30 days	60.90
	T-Month	Unlimited trips	30 days	54
	T-Trimester	Unlimited trips	90 days	145.30
	T-Day	Unlimited trips	24 hours	8.60
Bordeaux	Single	Single	1 use	1.70
	1-2-10 days	10 integrated trips to be used within 1 hour	1 use	13.70
	1-7 days	Unlimited trips	7 days	14.20
	Le Pass	Unlimited trips (weekly, monthly or annual)	30 days	50.30
Dublin	Single	Single	1 use	2.10
	7 days	Integrated trips	7 days	16.50
	30 days	Unlimited trips	30 days	66
Manchester*	Single	Single	1 use	1.54
	1 day	Unlimited trips	1 day	2.97
	7 days	Unlimited trips	7 days	11.67
	28 days	Unlimited trips	28 days	40.09
	1 year	Unlimited trips	1 year	458.26

* Manchester's ticket fares have been converted to their equivalent in euros using the official exchange rate of the European Central Bank for 2018.

In the first table, we can see that, on average, for the four areas of interest the cost of a single ticket is €1.93. The equivalent in Barcelona is the T-10 ticket (10 trips) and T-month (unlimited monthly trips), which reaches an average of €13.01 and €52.59 respectively. Among the different alternatives that each transport authority offers, the single ticket and the monthly ticket are considered for comparative purposes. Figure 11 shows a comparison between these two alternatives for each city. As for the single ticket, it can be seen that Bordeaux and Manchester have the cheapest fares, costing €1.70 and €1.54 respectively and that Barcelona has the most expensive single ticket (€2.40). As for Barcelona, such fare represents part of the direct income that operators receive, as part of the payment method established in the contract. A similar price relationship is observed for the monthly payment rates for unlimited trips, having Manchester, again, the lowest prices (€40.09 per month), and Dublin the highest (€66 per month).

Figure 11. Single and monthly ticket prices



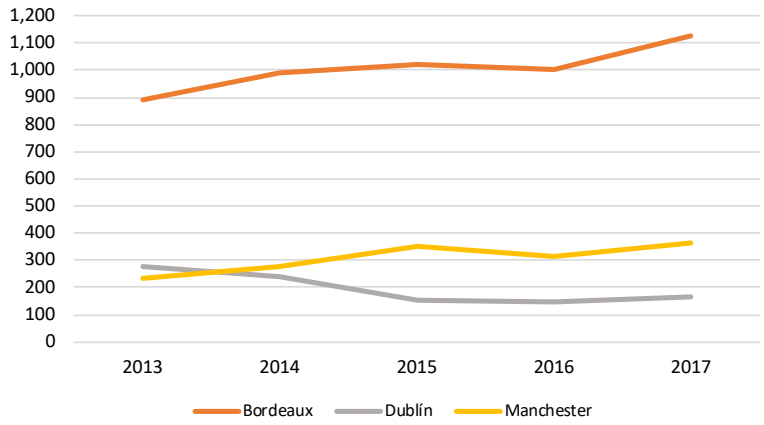
Taking into account the current fares, and the price relationships between the different areas, relevant financial indicators are shown below.

5.5. Financial Indicators: Payments to the Operator

Figure 12 compares public payments made to the operator following the corresponding contract. Data is showed as a comparative indicator, with a base of 100 for Barcelona. It should be considered that payments will vary according to each contract requirements. For example, the Barcelona tram contract requires public payments to include a compensation to the operator for the return on the infrastructure investment. In order to achieve the greatest comparability, the Barcelona data discussed here does not consider such payment. Payments to the operator, necessary to cover operating costs (from fare revenues, fines and advertising) are thus taken into account.

In the case of Manchester, it is also necessary to clarify that, although the data represent mostly the payment to the operator, other minimum contractual payments are also included, such as ticket vending machine operations and support agreements. The Bordeaux data, on the other hand, comprise the operator's contributions plus a territorial economic contribution tax (CET), which varies according to the volume of business[26].

Figure 12. Indicators of Public Payments Made to the Operators (Barcelona=100)

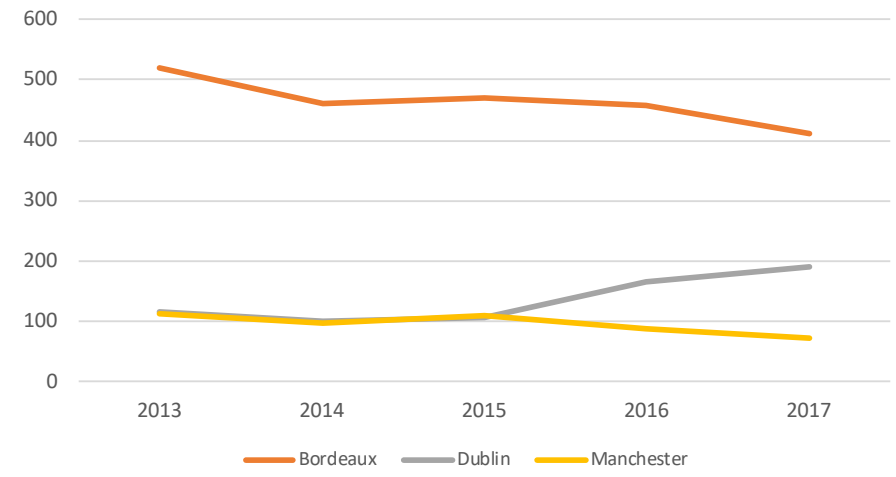


Source: Transport authorities / operating companies.

[26] The data used depends on the availability of the information provided by the corresponding transport authority.

Figure 12 shows that, in comparison, the Bordeaux tram operator receives more than eight times the payment of Barcelona operators. Dublin, on the other hand, shows more similar but still, higher payments. When operator payments are weighted by kilometers of network (see **Figure 13**), the differences with respect to Barcelona are moderated, with Manchester's operator payments being lower than Barcelona's, as Manchester has a network of 92.5 km compared to Barcelona's 29.1 km.

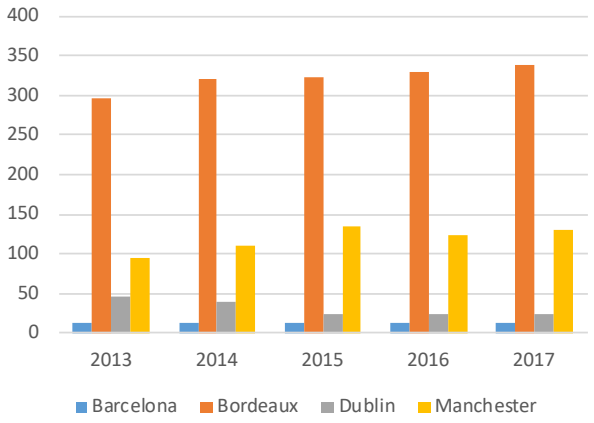
Figure 13. Public Payments to the Operator per Each Km of Network Index (Barcelona=100)



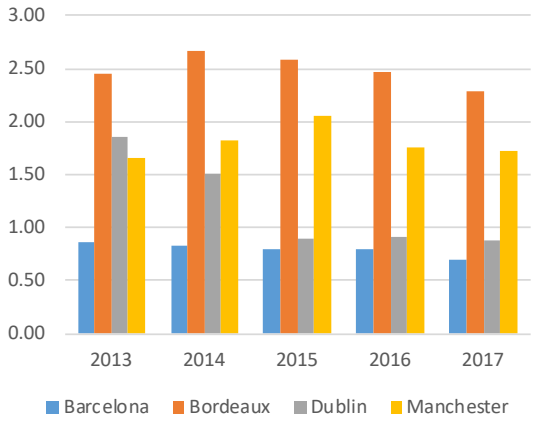
Regarding public costs, it can be observed that, although Barcelona has a higher fare system, the transport authority's outlay to cover the payment to the operators is lower than in other cities. This data can also be illustrated at the level of cost per urban inhabitant and per annual demand presented in **Figure 14**. It can be confirmed that Bordeaux is the most expensive, in terms of payments to the operator. Considering the cost per trip, for example, it can be seen that for 2017 the cost in terms of payment to the operator, for use of the service was €1.73 per trip; compared to €0.70 in Barcelona in the same year.

Figure 14. Public Cost Per Trip, Inhabitant and Km

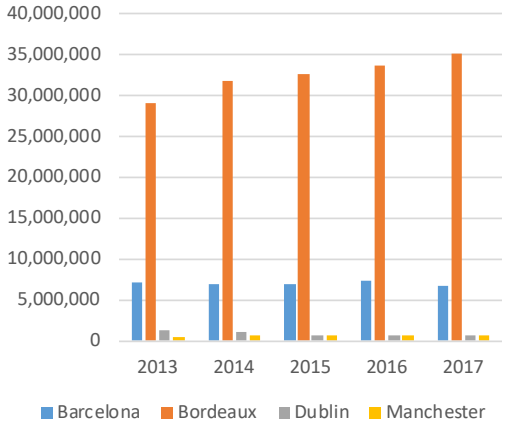
Cost per inhabitant



Cost per trip

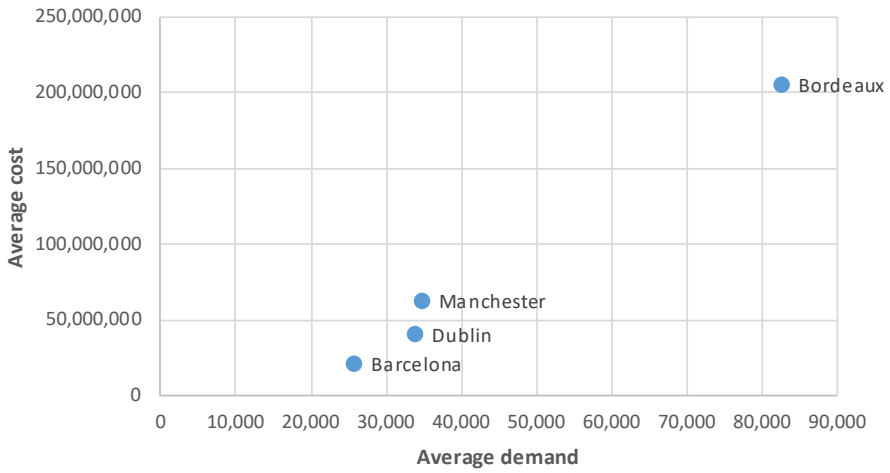


Cost per 10 km



It is interesting to note that operating costs seem to have a positive correlation with the level of demand in each city. Thus, as Bordeaux shows the highest level of average trips between 2013 and 2017, it also represents the highest operating and maintenance costs for the transport authority. This relationship becomes noticeable in **Figure 15**, where this city stands out from the rest, showing high levels of cost and average demand. Similarly, Barcelona is the city with the lowest average cost level, which is correlated with low levels of average demand.

Figure 15. Average Costs vs. Average Demand



It is important to clarify, once again, that the indicators that are being showed cannot be taken as conclusive. The values used for the calculation, as mentioned above, vary according to the type of contract and the availability of information. Nevertheless, they can be taken as approximations to the cost represented by the payment made by the public authority to the private operator to cover (at least) the latter's operating costs.

Conclusions

This document aims to provide to the reader a comparative description of the contractual performance of different tram systems in four European cities. It also explores different relevant indicators that help to better contextualize the supply, demand and payments to the operator in each case. As noted, the comparison among the various systems is complex because of the multiple variants both in construction and conditions of service provision.

In all the cases described, the service is controlled or owned by a public authority, mostly of a regional nature. The four cases discuss a contracting system in force through PPPs. In the case of Barcelona, the contracting system involves the entire process, design, construction, operation and maintenance; while in the other cases, construction is not included, and only the operation of the service is considered. In this regard, an attempt was made to include European cities that had a contracting system where the service was managed by a public company (such as Berlin or Paris), but this was not possible due to lack of sufficient information for analysis. Nevertheless, future work may consider this additional element, mainly for a comparison in terms of costs and service performance.

Due to the nature of the contracting systems, risk sharing is standard for all cities, with the exception of Barcelona. The latter transferred the construction, financing and demand risks (partially) to the private sector under the same contract, whereas the public sector assumes them in a great part in the remaining three cases or transfers them through third party contracts. All cities share a contracting system that considers the operation of the service, leaving other risks (such as expropriation or construction) to the public authority. It is also observed that, because the agreements involve a payment made to the operator upon signature as an availability payment (mostly conditioned to performance indicators: punctuality, frequency, etc.), the demand risk is generally undertaken by the public authority. However, in the case of Barcelona, part of its revenues are conditioned to the fulfillment of forecasted demand bands. This contractual framework is reasonable because the operator has a certain capacity to increase the demand for the service by knowing users' habits in detail.

As for factors directly related to the service, it is not surprising that the evolution of the demand is correlated with population growth. In this sense, Barcelona presents a lower average growth rate than the rest of the cities, which leads to a lower growth in demand, partly as a consequence of the strong impact that the latest economic crisis had in the population. In addition, the low correlation between population and use is due to the fact that both lines are located on the outskirts of the city, and do not currently cross through the city center. The Bordeaux or Manchester tram network is distributed throughout the main urban sectors of each city, which results in a higher level of tram usage. A more relevant data is the indicator of density per service stations, which shows a high level of accessibility in Barcelona, only below Manchester.

Fare and financial indicators show that Barcelona has lower costs for the public authority (payments to the private operator) than the rest of the cities in overall terms, and has the second lowest costs (below Manchester) when considering the spread of the network. The Bordeaux authority has the highest costs.

Again, it should be noted that the data discussed here should not be considered conclusive, nor is it intended to place any one transport system as better as or worse than another. In order to do so, a more detailed analysis is needed, with more information and taking as a reference a greater number of cities and similar contracting methods. The different systems discussed above vary according to different contextual factors. Therefore, this document offers a descriptive analysis that provides an initial look at the operation of each system.

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