WORLD BANK GROUP
Transport & ICT

Imperial College London

Railway and Transport Strategy Centre

The Operator's Story

Appendix:

Barcelona's Story

Community of Metros
CoMET

Nova
Group of metros

The Operator's Story: Notes from Barcelona Case Study Interviews

– January 2017

Purpose

The purpose of this document is to provide a permanent record for the researchers of what was said by people interviewed for 'The Operator's Story' in Barcelona. These notes are based upon 12 meetings between 4th and 7th April 2016. This document will ultimately form an appendix to the final report for 'The Operator's Story' piece. Although the findings have been arranged and structured by Imperial College London, they remain a collation of thoughts and statements from interviewees, and continue to be the opinions of those interviewed, rather than of Imperial College London. Prefacing the notes is a summary of Imperial College's key findings based on comments made, which will be drawn out further in the final report for 'The Operator's Story'.

Method

This content is a collation in note form of views expressed in the interviews that were conducted for this study. Comments are not attributed to specific individuals, as agreed with the interviewees and Transports Metropolitans de Barcelona (TMB). However, in some cases it is noted that a comment was made by an individual external not employed by TMB ('external commentator'), where it is appropriate to draw a distinction between views expressed by TMB themselves and those expressed about their organisation.

List of interviewees

Internal views:

- Enric Cañas Alonso, Chief Executive Officer
- Joakin Granados, Budget and Auditing
- Ivan Altaba Marin, Energy Efficiency Project Manager
- Jordi Mitjà Villar, Director of Metro Operations
- Josep Mension Camps, Director – Central Services Bus & Deputy Bus Chief Officer
- Francesc Plana Ordóñez, Project Manager – Metro Central Services
- Ismael Uruén Pueyo, Director of Financial Economic Services
- Carlos Luque Dengra, Technologies of Sale and Access to Transport

External commentators:

- Edward Unzeta Nuez, Head of Service Management for Transport Operations, AMB
- Cristina Pou – Head of Transport Management, ATM

Key Messages: Relevance to International Learning about Metro Operators

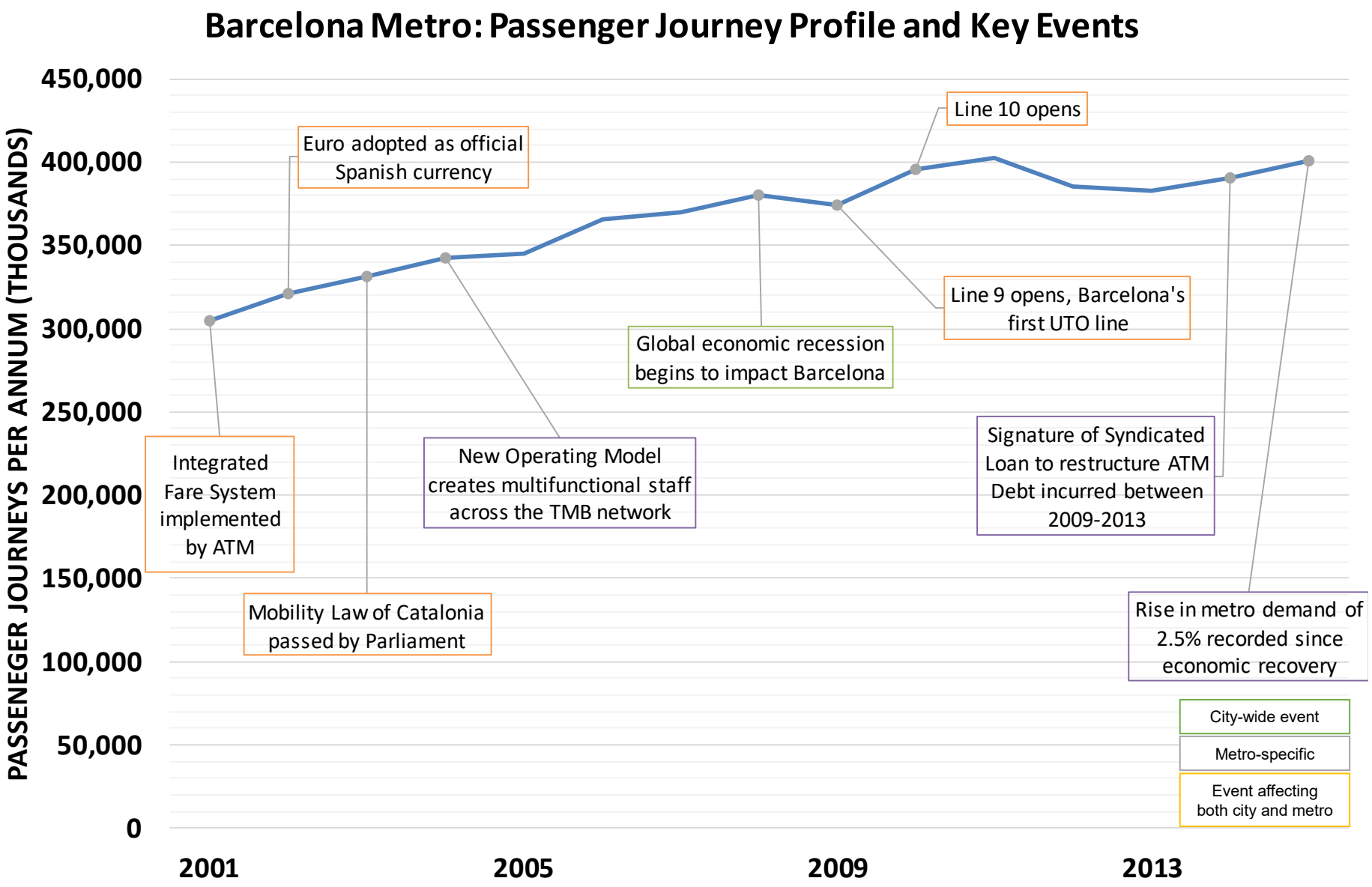
Barcelona's metro provides a highly interesting and multi-faceted case study on how metro success is fostered, and where less optimal governance has influenced metro success. The Community of Metros benchmarking has shown that the metro operated Key lessons from the interviews include:

- TMB has developed and introduced an **innovative staffing model consisting primarily of multi-functional roles**, with proven benefits for productivity, efficiency, staff and customer satisfaction. This model is most effectively deployed when Grades of Automation (i.e. Grade 2 or higher) are applied on the network, as technology reduces the effort required to effectively carry out tasks on the network.
- **The public may be more receptive to fully automated trains than is often pre-supposed**. Barcelona's new Line 9 trains operate without on-board staff (Grade of Automation 4), offering high levels of labour efficiency; despite initial reservations about the perception of a fully automated line, it was quickly accepted but the public in Barcelona.
- Energy consumption incurs both fixed and variable cost elements (e.g. stations and trains respectively) and may comprise a significant proportion of operating costs, depending on macroeconomic conditions. Another success factor has been **how TMB has adjusted energy power procurement**, point by point and period by period. TMB has demonstrated that by ensuring that the Operator thoroughly understands its energy consumption, is able to propose a prioritised set of interventions and thereby enable greater control over energy consumption and cost.
- **TMB's experience with Line 9 demonstrates that new lines should be constructed to serve the sections with strong passenger demand from the outset, particularly when lines need to open in sections**. This may also be the most expensive element of construction but will create the critical interchanges, revenue and capacity relief earliest in the project. New lines with poor demand can negatively affect the operator's financial sustainability for many years.
- **High-quality integration** as a key strategic priority will significantly improve public transport mode share and limit private car use. **TMB avoids excessive competition for trips between metro and buses by maintaining a high degree of integration between the two** and the introduction of **multi-modal ticketing and fares integration** by the ATM in 2001 was seen as a great success.
- Where **major investment decisions** cannot be made by the Operator, it is prudent to keep that decision as close as possible to the Operator so that as much technical expertise as possible influences its outcome. **The Barcelona Metro Line 9 experience of delayed implementation and prioritising outer alignment construction first is a consequence of the lack of Operator input into the process,** a lesson learned from the Public Administration owner.
- **An economic downturn or recession** can have rapid but long-lasting impacts for metros and their authorities. This can impact major projects, such as Line 9 in Barcelona, but can also have long-term operational implications, such as through the introduction of a greater range of concessionary fares, which are very difficult to rescind. In order to provide similar level of service, the public administrations required TMB to take on debt due to the decrease in tax collection. Thanks to this Barcelona TMB has successfully maintained metro service levels and quality during the economic downturn avoiding a 'spiral of decline' experienced in other cities. TMB maintained very good results in customer satisfaction surveys.

- **Public Administrations committed a long term loan (2014-2031) supporting TMB operations through the Authority (ATM),** based on the metro's importance, and historical good performance of the metro and bus systems. This provided TMB with resilience through difficult economic circumstances.
- **Gross cost operating contracts** can provide greater certainty over funding and incentivise improved operator performance if Key Performance Indicators (KPIs) are established contractually and monitored. A balanced set of effective KPIs covering a range of attributes such as service provision, quality and safety, with incentives and penalties clearly linked to these areas, is good practice.
- Having a **dedicated transport planning department** responsible for integrating planning between the bus and metro networks, with access to high-quality transport and land-use planning data, will help avoid piecemeal or reactive projects between the two modes and ensure that policies such as integrated fares and ticketing can be exploited.

Growth in Passenger Journeys and Key Events in Barcelona

The following graph demonstrates TMB's growth in passenger journeys from 2001 – 2015 and includes selected key surrounding events that took place in Barcelona, Catalonia or Spain, and selected events in the history of TMB.


Barcelona Metro: Passenger Journey Profile and Key Events
PASSENEGER JOURNEYS PER ANNUM (THOUSANDS)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
2001
2005
2009
2013
Euro adopted as official Spanish currency
Line 10 opens
Line 9 opens, Barcelona's first UTO line
Global economic recession begins to impact Barcelona
Integrated Fare System implemented by ATM
New Operating Model creates multifunctional staff across the TMB network
Signature of Syndicated Loan to restructure ATM Debt incurred between 2009-2013
Mobility Law of Catalonia passed by Parliament
Rise in metro demand of 2.5% recorded since economic recovery
City-wide event
Metro-specific
Event affecting both city and metro

Transit Map


© www.mapametrobarcelona.net
2017
ENERO
Metro
FGC
Rodalies
TRAM
HORARIS METRO BARCELONA 2017
Horarios metro - Metro Schedule
FUNICULAR DE MONTJUÏC
PRECIOS ENERO 2017 (€)

General Summary of TMB

GENERAL SUMMARY		
Background and history	▪ A grid urban street layout was defined in the 19th century, with diagonals, creating a uniformly dense (16,000 people/km²) and liveable city form (building heights are typically 8 stories). In the early 20th century it was recognised that this city form favoured the development of a metro system to replace its existing tram network. ▪ Ferrocarril Metropolitano de Barcelona, SA was set up in 1920, stimulating the first metro development in the city. In 1924 the first metro line opened, forming the alignment of today's Line 3. ▪ Subsequent line openings took place in 1926 (Line 1), 1959 (Line 5), 1973 (Line 4) and 1995 (Line 2), 2003 (Line 11), 2009 (L9 Nord branch), 2010 (first section of Line 10) and 2016 (L9 Sud). ▪ The 1992 Olympics led to much new development and investment around the waterfront, catalysing subsequent tourism. The metropolitan region has expanded hugely, from a population of approximately 2 million in 1950 to 5 million in 2016. ▪ Public finances in Catalonia and Spain have been sorely threatened during some economic downturns periods at 1957, 1974, 1993 and 2008. Finally, support for public transport has been throughout this testing period. ▪ The Catalan regional administration has a major influence on TMB, impacting its finances and deciding major new-build metro projects. The local administrations are able to influence bus network planning through providing financial support to public transport.	
Key dates and why they matter	1872	First tramway line in Barcelona (predecessor of the bus company).
	1920s	Ferrocarril Metropolitano de Barcelona is formed, responsible for installing metropolitan railways in Barcelona.
	1921	The Gran Metropolitano de Barcelona is formed, incorporating several companies. A metro line running from Lesseps to Liceo begins construction.
	1924	The Lesseps to Liceo line opens, which is now Line 3 of Barcelona Metro.
	1925	Set up of the Bus Company a transformation of the tramway co.
	1926	Line 1 of Barcelona Metro opens.
	1929	The Barcelona International Exposition takes place, including 20 nations. The Exposition stimulates the development of the Montjuïc area. A Funicular railway is opened to serve the Exposition and is still in operation. TMB operates the Funicular within the current integrated fare network and interchanges with metro lines 2 and 3.
	1936-1939	The Spanish Civil War takes place between left-leaning Republicans and right-leaning Nationalists. The Nationalists ultimately won the war, and General Franco ruled Spain under a dictatorship until 1975.
	1959	Ferrocarril Metropolità de Barcelona SA (the metro company) and Transports de Barcelona, SA (the Bus company) private companies become public owned companies: 100% owned by Barcelona City Hall.
	1959	Line 5 of Barcelona Metro opens.

	1973	Line 4 of Barcelona Metro opens.
	1975	General Franco dies and King Juan Carlos I adopts power, starting the process for implementing democracy in Spain.
	1977-1978	A referendum is held resulting in the Spanish Constitution of 1978. This officially declared Spain a constitutional monarchy and democratic state.
	1979	Regional Government Act, starting the transfer process of competences From the Spanish Central Government to the Regional Authorities
	1985	Local Government Act is passed giving greater powers to Municipalities in urban planning from the national government.
	1986	Spain joins the European Union, beginning a period of liberalisation of the Spanish economy. Between 1986 and 2005, Spain's economic growth was higher than the European average.
	1991	Barcelona City Hall transfers all Ferrocarril Metropolità de Barcelona SA (the metro company) and Transports de Barcelona, SA (the Bus company) shares to the local public administration (EMT: Metropolitan Transport Entity).
	1992	The Summer Olympics are held in Barcelona and the Games were a significant stimulus to city restructuring and rebranding, including investment in sanitation systems, green spaces, roads and the existing city beach. The Spanish Government and Barcelona City Council established a joint venture (HOLSA) to manage the investment and construction of infrastructure for the Olympics.
	1995	Line 2 of Barcelona Metro opens.
	1996	Framework Agreement devised between the State, Government of Catalonia and local authorities acknowledges the need for a co-ordinating body for public transport in Barcelona; effectively a precursor law to the establishment of its transport authority, Autoritat del Transport Metropolità (ATM).
	1997	Autoritat del Transport Metropolità (ATM) is established in Barcelona through the Agreement of the Constitution of ATM. This organisation operates by voluntary participation and acts as the clearing house that receives all funds from authorities and allocates them to Operators under 4-year contracts. ATM is administered by the Government of Catalonia (51%) and local organisations (49%) including the Metropolitan Area of Barcelona (AMB – 24%) and Barcelona City Council (25%).
	2000	Lines 9 and 10 are approved and will be the longest 'Grade 4 of Automation' metro line in Europe at 47.8km long. The two lines share the same route for a large proportion of the alignment, with the two lines branching at the eastern and western extents of the alignment.
	2001	The Integrated Fare System is implemented by ATM, creating a single ticket with free line changes.
	2002	The Euro is adopted as the currency of Spain, replacing the peseta.
	2003	Line 11 of Barcelona Metro opens.

	2004	TMB introduce their “New Model of Operations”, based around the deployment of multifunctional station and operational roles throughout their system. Automation on the system is perceived to be the enabler of this staff model, as automation reduces the skill level required to operate a train. This initiative was driven by a strong corporate strategy towards multi-functional working, supported by TMB’s understanding that the future of metro operations is unlikely to rely on traditional, fixed staff roles.
	2006	The most recent draft of the Statute of Autonomy of Catalonia law is approved by a referendum to the population of Catalonia. Although voter turnout was considered low, 74% of votes supported the law.
	2007	‘Bicing’, a city-wide bike hire scheme, is launched in Barcelona.
	2007-2008	Global financial crisis affects Spain, sending the economy into recession. The years of the recession, approximately between 2008 and 2016, created instability in public transport usage. For example, passenger numbers declined between 2007 and 2009, and again between 2011 and 2014, which TMB attribute to decline in economic activity in the Barcelona area, leading to decline in public transport usage. Fares also increase during the recession: an increase in VAT to protect government income caused fares to rise between approximately 3.2 in 2011.
	2009	One branch of Line 9 opens between La Sagrera and Can Zam (L9 Nord). Lines 9, 10 and 11 form Barcelona’s CBTC metro lines. Lines 9 and 10, (37,8km) when complete, will be the longest Grade 4 of Automation metro line (i.e. driverless and unattended trains) in Europe at 47.8km long. Two sections of Line 9 are currently open on the outer extents of the alignment,
	2010	Line 10 of Barcelona Metro opens.
	2010	The Catalan Autonomy Protest takes place in the streets of central Barcelona. Over a million people demonstrated against the perceived constrained autonomy of Catalonia in Spain.
	2011	TMB records its highest ever ridership on the metro following the opening of extensions to Lines 2, 3 and 5 and the opening of the first sections of Lines 9 and 10.
	2011	The Catalonian Parliament approves the setup of the Barcelona Metropolitan Area (AMB) a Local Public Administration who takes all shares from FMB & TB (previously owned by EMT).
	2014	Contract-Program 2014-17 includes re financing of ATM debts.
	2015	TMB sign an agreement with the Government of Catalonia’s Agency for Development Co-operation and AMB to create an annual work plan focusing on greater collaboration and co-ordination. This annual work plan ranges from policies to include training for TMB staff on gender issues and human rights, to strategies for obtaining international financing for development co-operation projects.
	2015	TMB’s buses are included in the Government of Catalonia’s environmental quality seal of approval scheme based on criteria including fleet management and efficient driving.
	2015	A pilot project is implemented installing Wi-Fi at 5 metro stations, in line with Barcelona City Council’s plans to install Wi-Fi access in public spaces.

	2015	TMB record a rise in demand for the metro network of 2.5% and attributes this to the country's economic recovery.
	2015	Mrs Ada Colau is elected as the Mayor of Barcelona. Mayor Colau's background is in campaigning for people affected by the economic recession, particularly in relation to housing.
	2015	A new regional law on the financing of public transport is approved by the Catalonian Parliament,
	2016	A second branch of Line 9, L9 Sud, opens linking the airport to Zona Universitària and the MWC site. The two operational Line 9 branches are intended to be joined by a central spine but some tunnel sections and stations have not yet been constructed.
Current ownership and oversight	▪ TMB is a how the citizens know the metro & bus services run by Ferrocarril Metropolità de Barcelona SA and Transports de Barcelona, SA , Both companies 100% owned by AMB (Barcelona Metropolitan Area). AMB comprises 36 municipalities across 636km² with a total of 3.2 million inhabitants. The city of Barcelona is 101.4km² of this total area (1.6 million inhabitants). AMB is responsible for land-use, environmental management, transport and mobility planning (biding bus services outside Barcelona city) and economic development.	
Complementary public transport and non-motorised transport services	▪ Buses: 30 private bus companies enter into Barcelona, but TMB is the main bus operator managing almost all Barcelona City bus day lines. (TMB operates 45% of the bus routes in the AMB region, but carries 66% of the total bus passengers) ▪ Suburban rail is operated by FGC across 3 lines (146km), and further suburban rail lines operated by the State (Renfe). Regional, inter-city and high-speed rail is operated by Renfe. ▪ Trams: 3 tram lines connecting other Municipalities of Catalonia with Barcelona, one line of which is operated by TMB. ▪ Cycling: 'Bicing' bike share operates in Barcelona since 2007, with approximately 6000 available bikes in the city. Cycle parking and cycle routes are the responsibility of Barcelona City Council. ▪ Pedestrian infrastructure is managed by Barcelona City Council. Walking is a key mode of transport in Barcelona owing to its compact and liveable city form. The Urban Mobility Plan, a strategy developed until 2018, promotes walkability through reducing traffic and creating "superblocks" for traffic to flow around, rather than within, creating walkable spaces. ▪ Car sharing: Catalunya Carsharing SA promotes, organises and manages car-sharing in Catalonia. Car sharing is provided through Avancar provides vehicles which can be used flexibly and are the first car sharing company in Spain. BlaBlaCar, an international carpooling firm, operates in Barcelona. ▪ Taxis and other ride sharing schemes: There are a number of private taxi companies operating in the city, licenced by AMB under the Metropolitan Taxi Regulations. Some official ride sharing apps connect taxi drivers with customers, such as Hailo and mytaxi. Cabify is a transportation network company operating in Barcelona. Uber was banned in Spain until 2016 because of perceived unfair competition and lack of licencing and still does not operate in Barcelona.	

Technical and operational summary as of 2015 (TMB only)	▪ 119km under management ▪ 20.3km of new lines under development (the central section of Line 9/10) ▪ 156 stations ▪ 816 train cars, 1060 buses under management ▪ 873km of bus routes managed directly, with 163.6km of bus lane in the city ▪ 385 million passenger journeys per year ▪ €255 million (USD $272 million equivalent) in annual fare box revenues (2015/16) ▪ €435 million (USD $464 million equivalent) in total revenue per year(2015/16) ▪ Approximately 7700 employees ▪ €503 million (USD $540 million equivalent) in capital expenditures over past 5 years
Regulatory, oversight, and policy bodies:	*Autoritat del Transport Metropolità (ATM):* A co-ordinating body for public transport in Barcelona, which operates by voluntary participation. Its participants include the Government of Catalonia (51%), Barcelona City Council (25%) and Àrea Metropolitana de Barcelona (AMB, 24%). It is responsible for infrastructure planning, managing operator contracts and fare integration.
Summary of legal and policy framework:	*Contract Programme or Framework Agreement 1996*: Established need for a co-ordination agency for public transport in Barcelona; essentially the precursor legal act to the creation of ATM. *Mobility Law of Catalonia (2003):* This law establishes the principles that must be met by mobility management or schemes and includes the right for citizens to travel safely with minimal environmental impact, prioritising public transport, participation in planning and sustainable development. The law creates the framework for other statutory plans such as Mobility Master Plans (region-wide level), sector-specific plans and Urban Mobility Plans (Municipality level). *National Mobility Guidelines:* Created under the Mobility Law of Catalonia (2003) these guidelines must be used for the preparation of statutory plans as described above. *Barcelona Urban Mobility Masterplan (2013-2018):* This is the instrument to co-ordinate implementation of mobility and transport strategies and proposes 75 measures in 9 key areas, including high-quality rail transport, energy efficiency, co-ordinated planning, prioritising inter-modal journeys and effective surface public transport. *Infrastructure Master Plan:* Comprises infrastructural investments for public transport over a 10 year period (2002-2010 & 2011 – 2021)

Key stakeholders:	▪ **Government of Catalonia (regional administration)**: Responsible for funding TMB's needs and is the majority sponsor for major rail projects, providing it with substantial influence. The Government of Catalonia is the key stakeholder of ATM. ▪ **Barcelona City Hall (local administration)**: Responsible for general public transport policy in Barcelona, including walking and cycling initiatives and a key participant in ATM, providing also funding to TMB needs.. ▪ **Barcelona Metropolitan Area** (local administration): Is TMB Owner (FMB & TB) and also provides funding to TMB. ▪ **Spanish government**: by law is also responsible for funding TMB and also owns Renfe. ▪ **Renfe**: Spanish railways. Part of their lines operate as a suburban network in Barcelona, both feeding and competing with the Metro ▪ **FGC**: operates 3 suburban rail lines on the network, which run through the city centre as well as suburban districts. Decisions on metro operation therefore affect FGC & Renfe. ▪ **Unions**: There are several active transport Unions in Barcelona: Conferedación General del Trabajo (CGT), Unión General de Trabajadores (UGT) Comisiones Obreras (CCOO), Sindicato Unitario (SU), Colectivo de Personal de Trenes de Catalunya (CPTC) and Colectivo Independiente del Metro (CIM). CGT, UGT and CCOO represent the majority of both TMB metro and bus workers. ▪ Users (locals & tourists) and citizens ▪ Media and social media ▪ Suppliers.

Introduction

Transports Metropolitans de Barcelona (TMB) is the commercial brand name for Ferrocarril Metropolita de Barcelona, SA and Transports de Barcelona, SA, and manages the metro and bus networks on behalf of the Barcelona Metropolitan Area (AMB). It operates eight metro lines, three of which are automated to 'Grade of Automation 4' (GoA 4), that is, they are both driverless and unattended.

TMB is widely recognised by its stakeholders and as evidenced through international benchmarking, as a highly competent organisation, with experience in supervising construction as well as operations in both Metro and bus networks. The case study interviews have demonstrated that TMB is proactive in trying to influence and manage its enabling environment through active participation in forums with its authorities and other transport operators. A key issue facing TMB and its authorities is how TMB can continue to increasingly influence stakeholders to achieve more efficient and effective public transport outcomes, because the main challenges TMB faces arise from those activities it does not control or significantly influence. In particular:

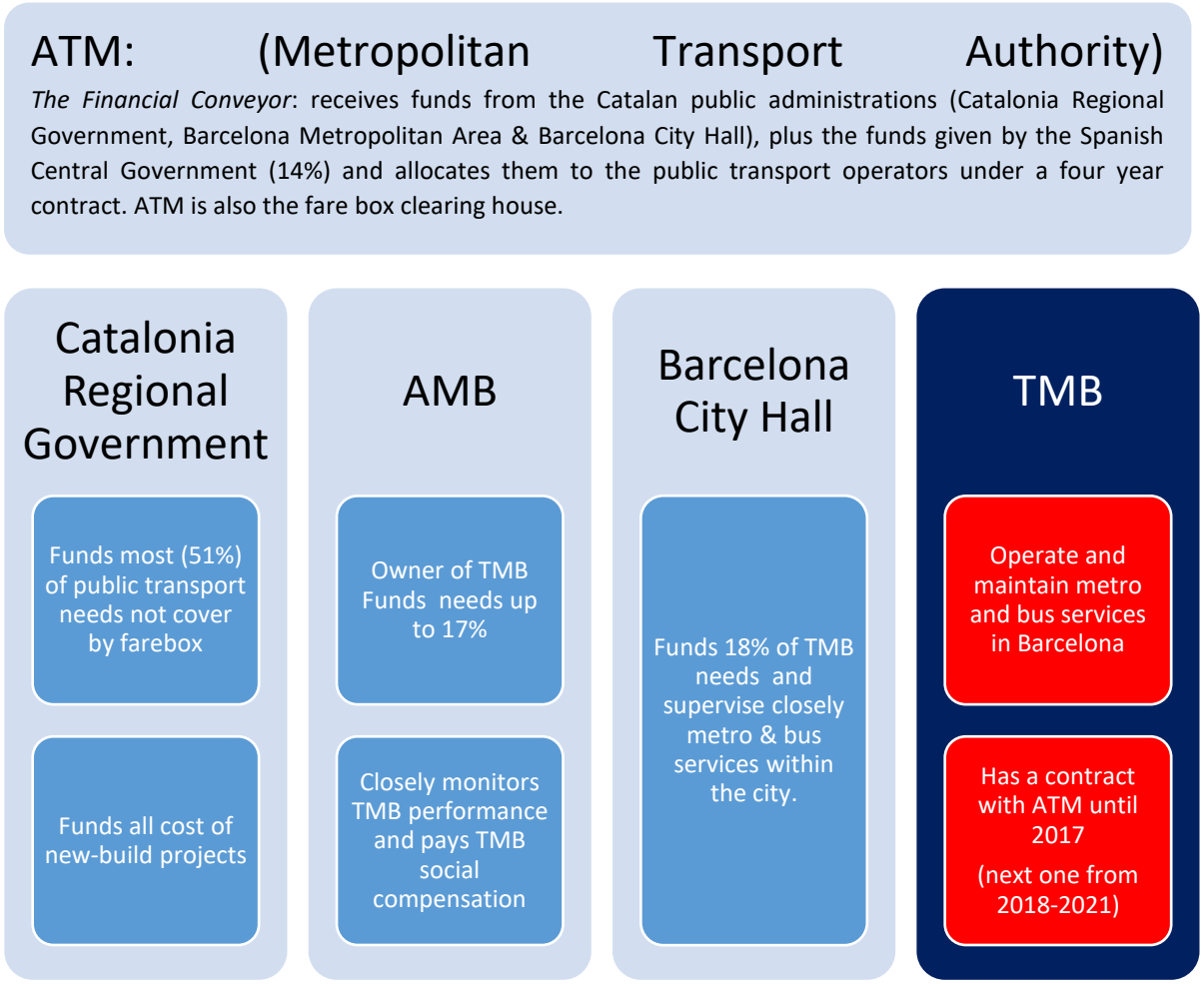
- Ticketing and fares integration, both of which are the responsibility of ATM;
- Line 9, which is funded, planned and implemented by the Regional Government of Catalonia.

Scope of TMB's Public Transport Offering

TMB is a public transport operator that also develops and implements upgrades to its 90+ year old metro system. It is responsible for most metro and bus services in the main urban area of Barcelona. This has facilitated the development of today's integrated public transport system. This and previous benchmarking research has revealed that TMB managers tend to have a strong sense of duty towards serving customers and aim to provide improvements to service within their capabilities and budget; interviewees have stated *"Our job is to provide an outstanding Public Transport service in Barcelona no matter the resources we count.;* "*It's the management cultural pattern of the company. If we think something can be improved, we try as far as we can afford it".*

Authority and Regulatory Structure

The institutional arrangements that TMB operates within are complex. Case study interviews suggest that TMB is a trusted operator by all institutions and its operational and technical expertise is widely recognised. This extends to inviting TMB to comment on occasion, but not to allowing TMB to significantly influence projects instigated by the Regional Government or ATM.



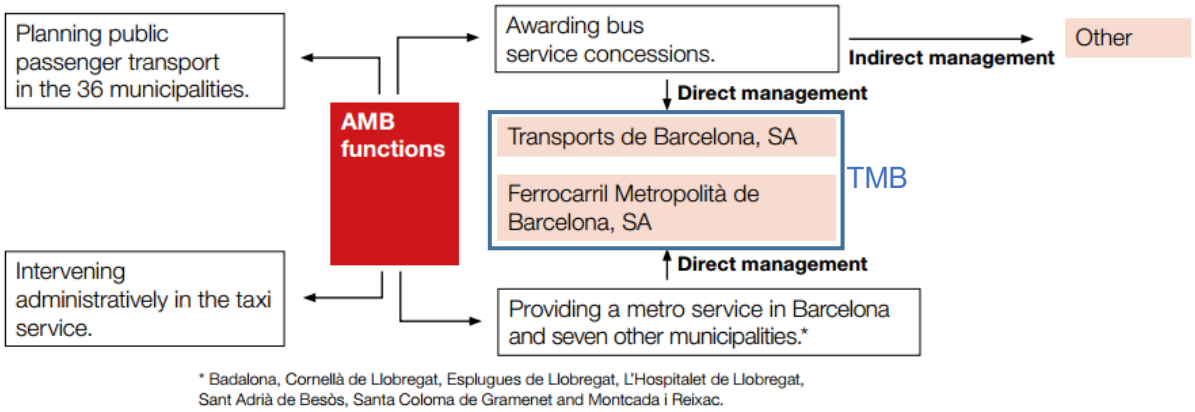
Main accountabilities of each public administration, the transport authority and the main operator in Barcelona.

Catalonia Regional Government (Generalitat)

The Regional Government of Catalonia funds the majority of any public transport subsidy and the full cost of new-build rail projects. This leads to it being the key decision-maker for any major expenditure including projects relating to expanding the network. The Regional Government of Catalonia has an incentive for the Tramway private operator where if number of passenger trips exceeds expectations, extra revenue is split between the government and operator.

AMB (Àrea Metropolitana de Barcelona)

AMB fully owns TMB. It closely monitors TMB performance and pays the TMB subsidy. TMB submits annual accounts to AMB and is answerable at hearings to its politicians.



Schematic of AMB's relationship duties and relationship to TMB

Barcelona City Hall (Ajuntament de Barcelona)

Barcelona City Hall has an important role to play in TMB's governance structure, as the majority of TMB activities take place within its territory. Political representatives of Barcelona City Hall are often vocal on matters of public transport. Barcelona City Hall contributes a similar level of funding to public transport as AMB, affording it a similar weight in decision-making and discussion.

ATM (Autoritat del Transport Metropolità)

ATM was established as a legal body in 1997, partly in response to a perception that there were too many organisations speaking directly to the government. It operates a system by voluntary participation. It is the 'financing hub' (clearing house) that receives all funds from authorities and allocates them to Operators under 4-year contracts. Its Board seeks consensus with a two-thirds vote by stakeholders. It is also responsible for fare integration (including the clearing-housing of the integrated fare system) infrastructure planning and owns the Infrastructure Master Plan of Barcelona. ATM is a well-resourced professional administration that implements modern transport planning and appraisal methods and promoted decision-making through negotiation and collaboration.

Spanish Central Government:

Although it is not officially within the ATM consortium, its annual budget contribution halved between 2003 and 2015, from approximately €200 million to €98 million.

Transports Metropolitans de Barcelona (TMB)

TMB has a contract programme with ATM until 2017; its focus is the next contract term to 2021. TMB perform forward-looking business plans to ensure that they are able to deliver against their contract requirements; an interviewee stated, *"Before negotiating contracts with [the] Authority, we make our own business plan."*

When capital and new-build projects are completed by the Administrations, operations and responsibility for maintenance are handed over to TMB. TMB recognises the trade-offs in place between high quality services and minimising subsidy, and to some extent appreciates that the balance between these needs to be taken in concert with the collective wider government and authorities. TMB had the autonomy to make decisions within its agreed budget, for example hiring permanent staff or consultants, With recession the Spanish Central Government stability and austerity plans has restricted those activities..

Funding and Regulatory Environment

TMB's gross cost contract with ATM defines KPIs for the provision of services, and AMB monitors performance closely. In ATM's view "*we have quite a good system*". ATM considers that further quality indicators for customer experiences may be needed in the future, with incentives/penalties for operator performance.

Municipalities are able to provide public transport services in Spain, but the Spanish Government and the Regional Governments create public transport policy, following European directives. Municipalities must have a sustainable mobility plan and be up to date in their reporting information to receive national funding; there are 90 cities (in which Madrid and Barcelona are not included) who get €55,000,000. It is mandatory in Catalonia for all municipalities to have a sustainable mobility plan, under a law passed by the Regional Government of Catalonia in 2003. These cities obtain subsidies from the Spanish Government in function of network length in km (5%), demand: trips/inhabitants (5%) and exploitation deficit (90%).

Barcelona, Madrid and the Canary Islands have got its own funding arrangements with the Spanish Central Government.

Operational Characteristics

TMB's 2015 network comprised a 103km (now 122km) 8-route metro system and an 873km 100-route bus system. The metro is almost completely accessible with 88% of stations equipped with lifts.

Demand

Within Barcelona's integrated fare system area 47% of travel is by non-motorised modes, almost all comprised of walking trips. 18% were by public transport and 35% private transport. Barcelona's demand profile is one of the least "peaky" amongst its benchmarking peers in CoMET, creating a sustainable and efficient operation on the network.

Since ticketing integration was introduced in 2001, public transport demand has increased by 24%, or 183 million passengers, per annum. In 2015, public transport demand was as follows:

Company / Mode	2015 passengers per annum (millions)	Increase from 2014 %
TMB total	573	2.3
Metro	385	2.5
Bus	188	1.9
FGC rail	80	3.2
Renfe rail	106	1.2
Tram	25	3.8
Metropolitan buses	115	4.2
Other buses	39	2.8
Total	**939**	**2.5**

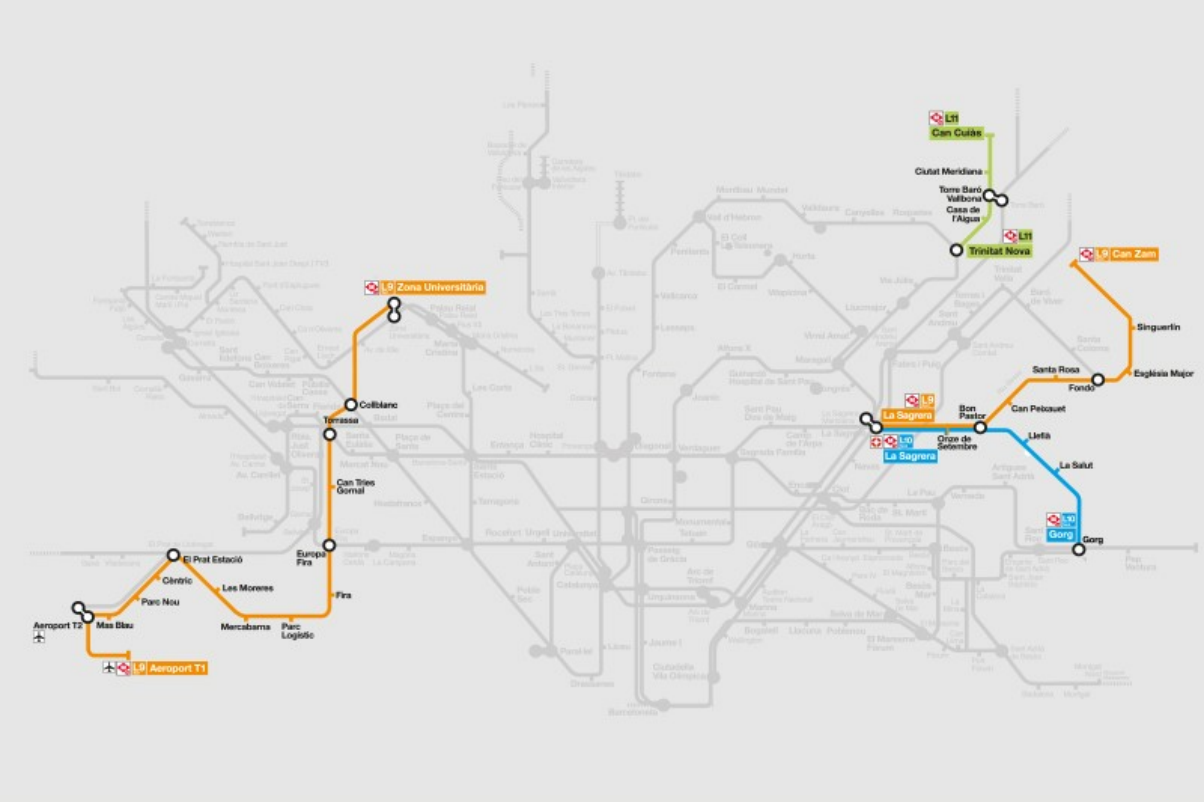
Challenge 1: Line 9, Barcelona's Automated Line

Line 9 is currently Barcelona's and the Regional Government of Catalonia's most significant infrastructure project since the 1970s, when it was originally conceptualised.

Line 9 is designed with Grade of Automation 4 (GoA 4), meaning that the line is capable of fully Unattended Train Operation (UTO). This technology is acknowledged by TMB to be the future for metro system operation in Barcelona. When complete, Line 9 is expected to transport 330,000 passengers per day and 165 million passengers per annum across the 48km line. The majority of the line is underground, with a unique, large single bore for both running tracks, contributing to the project's high cost, with only approximately 4 to 5 kilometres operated over ground.

Today the southern and northern parts are open, but the central spine is not, owing to an overriding decision by the Regional Government of Catalonia to commence construction from the ends of the line towards the centre. A TMB interviewee verbally stated *"When building a new line, start in the centre, and build out to the edges. It sounds simple/obvious, but we didn't do that."* This is a key learning point from the case study for the planning and construction of new projects. It is thought that the Regional Government of Catalonia was hoping that the peripheral construction would stimulate wider investment in these areas, although this was ultimately stifled by the economic recession from 2008 onwards: The interviewee stated *"The planners didn't know in 2007 [that] the economic crisis was going to be this way."*

At the time of writing, 24 stations are open. It is expected that Line 2 will be retrofitted for GoA4 in the future as it shares some infrastructure with Line 9.



Current automated metro network in Barcelona

The alignment of Line 9 when complete; the central section which has not yet been fully constructed is highlighted

Planning and Implementation

TMB had no involvement in the planning of this project. During interviews, it was not apparent as to whether there was any conventional planning for the project, such as feasibility work that tested alternatives and optimised a preferred alignment. Politics appears to have been the major driving force. The line links the centre of Barcelona to the airport in the south (passengers must pay a small premium to travel to/from and the airport), aims to serve peripheral communities not well served by the existing metro network and is planned to serve a university located in the north. As one interviewee stated "*Sometimes infrastructure planning is not based on cost benefit but social (political) objectives*", "*Planning is a very complex political game*."

It is not clear whether the Regional Government of Catalonia fully comprehend the implications of their approach: an interview explained, "*We made them realise all systems must be integrated (there are 37 separate systems) - each system with every other one*." This illuminates, within this case study, that to manage project development effectively, the Operator must be involved at the front end of planning, assessing mobility needs and developing the line concept.

The Regional Government of Catalonia managed implementation via a limited liability, publicly owned company; the rolling stock fleet is leased to TMB by the government. It is felt that testing in advance of the north and south sections becoming operational was rushed owing to pressure to complete.

A key learning point for TMB as revealed in the interviews were the company's reservations about the public perception of a fully-automated line, although it was quickly accepted by the public in Barcelona.

Outcomes

A politicised planning process has resulted in a mega-costly problem at a time of limited funding, and a legacy of high-cost and potentially modest ridership. The original budget was €2 billion. There was a very serious street collapse at a Line 5 station that led to major changes, delay and cost escalation. The budget is now approximately €6 billion. Separately, a PPP contract has been let for the maintenance of stations for 31 years.

Key issues experiences include:

- Construction has started with the outer ends rather than the trunk part of the system that is expected to serve the greatest passenger demand and interchange potential. The missing central section faces many recognisable problems of deep high-cost construction. Some of the northern branch's stations are 50-70 metres underground, requiring a 30 metre diameter shaft to be sunk, linking with 12 metre running tunnels. There is no timetable estimate for completion; as TMB explained "*Nowadays there is no funding from the Catalan Government*";
- The southern extension that opened in February 2016 is indirect, through areas that are not dense and some stations remain unopened. This has resulted in low passenger volumes and a belated recognition that it is operationally not possible to run express airport services. More widely, aerobuses and the existing rail system already serve the airport.

Challenge 2: Finance, Fares and Funding

According to the Community of Metros benchmarking, TMB can be considered as a relatively moderate-cost metro, on the verge of becoming a low-cost metro (based on the CoMET 2014 Metro Cost Index, which considers four efficiency cost measures and two effectiveness measures). TMB's farebox ratio is just above 1 (i.e. operating costs being approximately matched by fare revenue). According to interviewees, TMB finances are described by the simple relationship between a system's needs and its funding requirements:

[Operational costs + investment] = [fares, non-fare revenue + public contribution], where tax payers do not fund >50% of the cost

According to interviews, there is consensus at the local political level that fares income should equal approximately 50% of total costs, but it is acknowledged that this will vary depending on the politicians in power during the electoral cycle. Subsidy is funded by ATM in proportion to its shareholders (i.e. Regional Government of Catalonia contributes 51%, The remaining 49% is shared between Barcelona City, AMB, and the Spanish Government.

Until 2008, fares grew in real terms, that is, at a faster rate than inflation, but at a lesser rate than the growth in GDP/capita or consumer purchasing power. TMB are receiving a €1300m subsidy over their current 4 year contract. However, throughout interviews it was clear that TMB are conscious that their subsidy is derived from the public and accordingly aim to spend wisely, an element of their company culture: "*we try to be efficient because it's the taxpayers' money… if we don't need to spend it, we don't spend it"; "we are not in a typical civil servant mentality".*

The economic crisis created a very serious situation for TMB, since our administrations were unable to collect enough taxes while maintaining services they (ATM) ask TMB to get debt, at the same time that the demand suddenly dropped down. TMB considered obtaining a rating so that it could issue bonds; but in the event this course was not followed and got debt with commercial banks. Operating costs were cut, fares were increased (while wages were declining) and debts increased. Operationally, improvements in total commercial revenue over operating costs have been achieved since the lowest recorded fare box ratio in 2008-2009. TMB was pressed by the banks to obtain a public administration commitment through an agreement to support its operations and finally in November 2014 a contract programme between public administrations was signed and also bank syndicated loan was signed for a 17 year tenor. From then on, any new service required by a public administration or freeze tariffs should come with the necessary funds to cover that new service or that measure.

Social (Concessionary) Fares

The economic recession was a driving force behind Barcelona's social / concessionary fare policies. Social and concessionary fares are reduced fares applicable to certain socio-demographic groups, including the young, the old, the disabled and the unemployed. TMB experienced minimal loss of staff during this time, however the absence of wage increases in the 8 years since the recession has driven the industrial action now taking place on the network. Elsewhere in Spain, the rail firm Cercanias Mostoles Navalcarnero (delivering a suburban rail project in Madrid) were rendered bankrupt by the financial crisis.

In principle, TMB believe that it should be compensated for groups of passengers who are provided with concessionary fares, a growing passenger group, particularly since the recession of 2008 onwards. TMB estimate that 10.8% of journeys were made in 2008 using social fares, compared with 17.6% in 2015, yet for 20 years, the concessionary fare support that TMB receives from Government has been frozen.

In Barcelona, there had previously been spare metro capacity resulting in low marginal costs for offering lower fares to certain socio-demographic groups.. However, TMB maintains a view that if the political administration want social fare policies, the cost of this needs to be met by the government and continuing to assume such revenue risk is not a continuing viable option.

Integrated Fares and Ticketing

Integrated ticketing became available in Barcelona in 2001 and is managed by ATM. Before this, each operator in Barcelona issued their own ticket, regardless of whether two operators provided part of a single journey. Integrated fares allowed for a passenger interchange between public transport modes without a second charge, which has reduced revenue for TMB overall: as TMB stated, *"Since this decision of the administration we recovered less money from the cost than we recorded before".*

New technology system	Contactless chip smartcard and smartphone payments
New fare system	• As now - if a passenger uses 3 modes, the journey attracts one fare payment • A 7-zone concentric zonal system for ATM's 5.7 million population; most of Barcelona city's dense development is within zone one • All tickets to be within the system, valid for all modes/operators. The most used ticket is the T-10 ticket that provides 10 trips within one zone (Barcelona for example) • Price to be based on the number of zones travelled, reviewed annually • Discounts to be introduced based on the use of one ticket – the greater the use the greater the discount
New payment system	Customers decide between pre-payment or post-payment by direct debit
New management system	Public-private contract to share the risk of technology change, financing, customer service Contract entered into 3 years ago with a 4-company Joint Venture partner

Despite reducing the actual revenue to TMB, TMB feel that technological integration of their ticketing system won some new trips for the company (for example, through customers now being able to make a metro journey within their previously bus-only fare. However, this was not an easy project to implement. Key issues raised in interviews include:

- The basis for ticketing integration came from TMB, which was met with resistance by other stakeholders, as well as by passengers, who did not feel that validation at the point of entering the paid side was necessary. ATM feel that this technology is already viewed as very old.
- The basis for collaboration is set up between TMB and the joint venture partners within multi-stakeholder working groups, although there is confusion over who "owns" the ticketing products, and therefore roles and responsibilities are not clear (for example, who owns ticketing data). There is no direct link of communication between TMB and the joint venture partners to establish clarity over these issues.
- Fare evasion is approximately 4.2% and this is expected to increase under a system where customers have the option of post-payment for their fares and operator payments are deferred: "*Why is ATM going down this route? No-one in the world does this with payment by direct debit".*

There are still opportunities however for unintegrated ticket types to circulate providing that no ticketing product directly competes with ATM's ticketing system. For example, TMB is able to offer 5 day passes for use on the network, because this is a product not offered by ATM.

Non-fare Revenue

An interesting source of non-fare commercial revenue (which usually includes retail and advertising revenue) is TMB's role in consultancy through "TMB Consulting". The availability of suitable staff to TMB Consulting may depend on workload (for example, seconding staff during the commissioning of Line 9 was unfeasible). However, as an operator TMB see the opportunity of collaborating with construction companies as technical advisors, for example, or sharing operator experience for new projects. As an interviewee pointed out "*when you make a new metro line you have to think of all the things in advance, if you don't, you can't fix it later",* a statement which is pertinent to this research as a whole. TMB studies each consulting opportunity on its own merits, and so far has consulted to other Spanish metros such as Seville and Bilbao, and several central and South American cities.

Successful TMB Projects and Initiatives

Multi-functional Staff: TMB's New Model of Operation

Since 2004, TMB has successfully managed the deployment of multifunctional station and operational roles throughout their system. Notably, train operator and station staff roles have been merged into one; for example such staff could be working in stations in the morning, and then operating trains in the afternoon. Particularly flexible and multi-skilled staff have been introduced on TMB's automated lines (9 and 10). Automation on the system is perceived to be the enabler of such an effective staff model; ATO (or GoA 2) reduced the skill level required to operate a train, making it easier to train prospective train operators and reducing the staff allocation required for this task to be successfully undertaken. This initiative was driven by a strong corporate strategy towards multi-functional working, supported by TMB's understanding that the future of metro operations is unlikely to rely on traditional, fixed roles but instead required the deployment of staff to "do whatever needed to make the metro work".

TMB's approach to creating these multi-functional positions is as follows:

1. Identifying potentially compatible tasks that could be undertaken by a single role, and quantifying benefits of creating these positions
2. Identifying the existing issues on the network that could be solved through the creation of these roles, such as staff absenteeism, supporting rising demand, increasing response speeds, increasing visibility of staff to customers
3. Piloting the proposed roles and making continuous adjustments: TMB tested these roles on the semi-automated (Grade of Automation 2/3) line across 5 stations.

The outcome of this process was the creation of multi-functional roles combining station duties and train driving. Customer Attention Agents and Operational Technical Command staff are deployed on TMB's conventional lines (1-5). It is aimed that Customer Attention Agents spend approximately 50% of their time in each shift driving, and 50% on station. Automated Lines Operational Technician staff are deployed on Lines 9, 10 and 11 (lines with some degree of automation) and are able to operate trains, offer customer service, carry out operational repairs and some maintenance tasks, and facilitate quick incident or emergency response.

Creating these roles has had a number of benefits and TMB rank highly on measures of staff productivity. These include:

- *Reduced absenteeism and increased reliability:* Reduced by 75%, as roles can be quickly filled by other staff who are equipped with the necessary skills. Overall system reliability improved through increased driver availability.
- *Reduced network "downtime" due to internal causes:* Reduced by approximately 78% based on improved incident response and reliability
- *Increased customer and staff satisfaction:* Customer satisfaction is highest on the automated lines, and staff satisfaction has increased significantly too, based on increased motivation, increased qualification and range of responsibilities.

TMB note some key lessons for new metros incorporating this multi-functional strategy into their operations:

- There will likely be upfront infrastructure and technology investments to fully enable this staffing model, for example, reliable automated ticket vending and ATO technology.
- Ensure that multi-functional staff use and apply their various skills through rotation amongst their skill areas. Unfamiliarity with procedures, for example, is a potential risk of using this model, if staff are unable to practice and refine them. Productivity and efficiency of multi-functional staff requires them to be able to undertake all necessary tasks successfully at any point.
- Union relations can be managed by ensuring that job quality stays high and that proposals cannot dis-benefit staff. For example, allowing for an increase in salary, seniority, pay premiums, holiday allowance, and lump sums to cover differences in pay. Ensuring continuous engagement with unions is beneficial. Driving staff in particular were offered the opportunity to retain their role "as is". In 2016, out of 1500 driving and station staff at TMB, 1200 were multi-functional.

Bus Route Integration

Since integrated fares and ticketing was introduced in 2001, TMB did not observe a large change of customer behaviour. This is attributed to the public transport network still being too complex for passengers to take advantage of integrated fares across modes. Following several years of no revisions to the bus network, in 2009 TMB agreed with Barcelona City Council to re-plan the bus network to enable TMB to better take advantage of the integrated fare system, primarily by achieving shorter passenger journey times.

TMB operates premium, conventional, neighbourhood and feeder/local bus routes. TMB is able to change premium bus routes without wider approval by other stakeholders, making restructuring of these routes easier to implement.

Its approach to rationalising the bus network to improve the integration of the public transport system was:

- *Outcome definition:* This was to maximise customer satisfaction, interpreted as minimising generalised time (with weightings for walk and wait time). The objective was not to reduce operated bus kilometres/cost, but to better direct buses to better serve demand for public transport trips;
- *Focusing on critical areas:* Any revised network structure would comprise horizontal (H) and vertical (V) routes that served a prioritised "Central Area", and could be implemented incrementally;
- *Use high-quality data:* The latest OD demand data (updated from a large 2007 survey) was used and assigned to a range of alternative networks, searching for that which maximised customer satisfaction;
- *Incremental implementation:* Implementing the final network in stages, measuring customer satisfaction with the changes;
- *Improving surrounding bus facilities:* For example, designing and implementing clear signage for shelters to guide pedestrians from and to all premium bus routes.

The result was the definition of 28 premium routes: 8 'H' (horizontal routes), 17 'V' (vertical routes) and 3 'Diagonal'. 17 of these routes are operational at the time of writing having been implemented gradually since 2013. 90% of passengers required either zero or only one transfer between services and customer satisfaction amongst users has increased from 7.2 to 7.7. This has been further supported by an increase of approximately 40 kilometres of dedicated bus lanes in Barcelona.

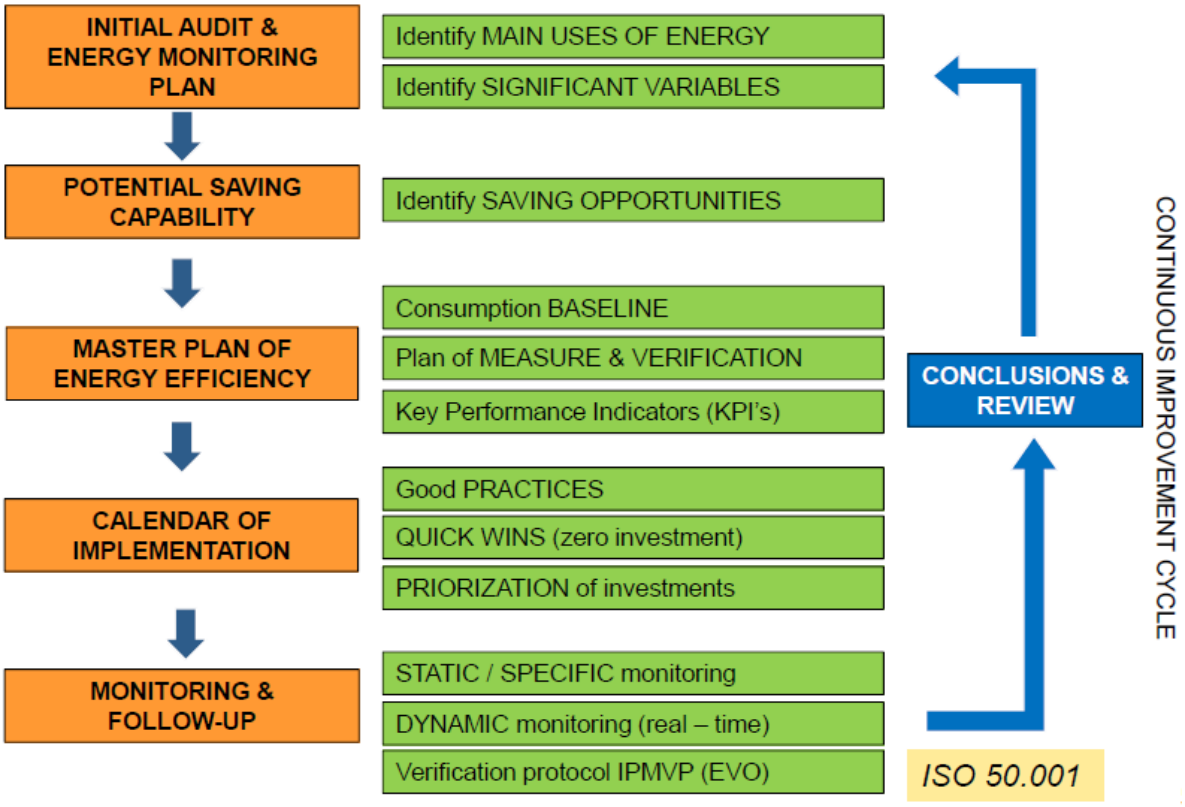
TMB recommend that operators have a specific department for integrating planning between the bus and metro networks, as the bus route rationalisation project was instigated reactively following the implementation of fare integration. Having a company-specific, transport planning network assignment model rather than using the Authority's own model allows for thorough testing of various scenarios.

Energy Saving Innovation

At the time of writing, TMB's energy cost is €27 million per year and absorbs 9% of total railway energy consumption in Spain. Significant focus has been placed on this area since 2012 and TMB have been trying to increase their influence on decisions affecting energy consumption more widely, as well as implementing a number of technical projects. TMB aims to control its metro energy consumption as far as possible through measuring and managing necessary energy usage, applying smart energy systems, buying energy efficiently, including adjustment of power procurement point by point and time period by time period (with other utilities to

secure economies of scale) and influencing others to make good decisions that benefit energy costs. TMB believe that controlling energy consumption requires a conscious strategy from the outset of metro design, as operators could effectively be 'held hostage' to energy prices which are predominantly governed by macroeconomic conditions.

The approach to reducing energy consumption and applying smart initiatives is set out in the following TMB diagram, detailing the process from a strategic approach to identifying detailed projects for implementation:



Plan to control future energy consumption. Source: TMB

The most important investment decisions, from an energy consumption point of view, are not made by TMB, which, for example, does not have the final say on purchase of rolling stock. It therefore acts to influence others by defining what it wants and why. These decisions are often require considerable technical expertise, proactive upwards engagement with the authorities, and can only be made where those authorities have confidence in the Operator. An example of this is the Line 9 interconnector project, a set of internal electric connections between lines and substations to reduce excess power requirements. This project was identified by TMB as potentially important to allow for lower unit prices of electricity. The cost is €25 million and savings in operating expenditure are estimated to be €5 million per annum. This is going ahead with Regional Government of Catalonia funding and will be given to ATM to operate.

The importance of TMB being able to influence asset investment decisions is critical to ensure that new projects do not undermine the effectiveness of existing projects, in this instance, energy efficiency. The Authority purchasing rolling stock, for example, with a low level of energy efficiency is an undermining factor to quick wins and longer-term projects that TMB is successfully delivering.

Examples of projects that TMB have implemented as part of their energy programme are:

- The development of 4 speed profiles on their ATO system, creating a combination of 256 operational modes depending on the conditions at the time of operating the train. These were extensively simulated to establish marginal gains in energy efficiency while retaining journey times;
- Contributing to the wider transport environment through feeding unused regenerative braking energy to recharging points for electric cars in the city;
- Using an overhead 3rd rail catenary system to reduce the number of feeder systems required for maintenance;
- Installing smart energy meters in stations.

Conclusion and Commentary from Interviews

International benchmarking shows that TMB runs a high performing metro system, relative to its key peers. Its effective management and forward-thinking nature have been demonstrated through its notable successful projects, such as implementing its New Model of Operations. Reliability is high by European standards, supported by its effective management approach, relatively young fleet, spare capacity with limited crowding and its forward-thinking use of automation and multi-skilled staff.

It provides an example of a public transport system embracing technology; automation and energy efficiency for example are critical to TMB's operating model, which provides high service quality to customers relative to the cost of operations. When examining the metro system in Barcelona, it is clearly part of a public transport network structured with the customer in mind, providing high levels of accessibility and good integration with other modes.

TMB's Key Objective: Increasing its Role within its Authority Environment

As an operator which has proved its technical capability, TMB's key challenge going forward is likely to be expanding its role within its authority environment to create more influence on key decisions. There were notable examples raised during interviews of when TMB's influence would have substantially improved eventual outcomes. Interviewees suggested that the planning and implementation process for the modernised ticketing system would have likely been more efficient and effective if TMB had the opportunity to meaningfully influence the project. According to interviews, TMB's experience is that its views are taken into account by ATM, but the process by which it communicates and engages with its authorities could be more open.

The primary constraint on TMB's influence is caused, in part, by Barcelona's politicised, rather than technocratic environment. A challenge for TMB will be to promote more technocratic business processes and the growth of technical knowledge within its authority environment, so that the authorities involves understand the complexities of operating a metro system before adverse consequences become tangible.

One long-term positive to come from the difficult Line 9 planning and implementation process, which is not yet complete owing to a funding shortfall, is that TMB's expertise may be sought by the Regional Government of Catalonia in the future, at least on some critical operational issues. This olive branch needs to be extended to allow TMB to influence asset investment decisions as well as capital construction projects, for example, ensuring new assets are able to meet TMB's energy-saving programme. However, there is currently little expectation that TMB will become influential in advising on the prioritisation of projects and how the metro system should be expanded.

Key Quotations

Owner – Operator Relationship

“Because we don’t have single authority as in London, all agreements within AMB take a lot of time because of negotiations between 27 municipalities. It can be better, but I think it works.”	
“I think that as a consortium it’s working very well.”	
“It was necessary to make a global vision, not just separate municipalities.”	
“Three admins; Transportation, Environment and Urban functioned under BMA common brand. They worked very strongly together.”	On 1987-2010 joint function of the three admins
“We have a lot of steering committees.”	
“The public operator guarantees us some things. A very important knowhow, research and to ensure that knowhow comes to possible administration.”	
“TMB provides many things that other operators can’t provide.”	
“For us it’s a very important support, the technical staff of TMB.”	
“One of the big mistakes authorities make is to not take into account enough opinions.”	

TMB’s Culture

“It’s the cultural pattern of the company. If we think something can be improved, we try as far as we can afford it.”	
“We are always fighting-sportingly-with the private companies.”	
“Although we are public we are very efficient, and these efficiencies go to society.”	
“If you stop this company, Barcelona collapses.”	
“They say the level of service you have to get and we say this is the kind of money we need.”	
“Our job is to provide Public Transport in Barcelona in cooperation with any transport authority.”	
“Usually the administration takes our view into account. Sometimes they don’t and you need a lot of time to change that.”	On influencing the enabling environment
“It doesn’t make much sense having the two companies with the same stakeholders.”	On the relationship between TMB and FGC
“It’s not really us. Maybe we can sit but we don’t really have a vote.”	On TMB’s limited influence

Decision-making

“A negotiated decision is going to be comfortable for everybody.”	On negotiating decisions with Public Administrations
“We are an example of negotiation and agreements.”	
“It’s a negotiated process with multiple rounds.”	
“It takes time to reach decisions, but typically decisions are shared by all political forces.”	On negotiating decisions and compromise
“At the same time they take the decision, they have to say how they will pay for this decision.”	Financial consequences of decisions
“At a big table, they sit and fight.”	On operators calculating their needs
“Once the executive committee and board approve these plans, they are like the Bible”	On the influence of the Infrastructure Master Plan and Mobility Master Plan

Funding and Financing

“In time of crisis we got debt because the public administrations were not able to fund our needs because they wanted to keep a good service.”	On TMB debt incurred through policy decisions
“We try to be efficient because it’s the taxpayers’ money. If we don’t need to spend it, we don’t spend it.”	On spending taxpayers’ money
“We are not in a typical civil servant mentality to spend all the money they give us.” “If we save money we’ll try to invest it to improve the service”	
“Maybe we pay more in that moment, but we save a lot of money in the lifetime of the train.”	On upfront investments
“I think fare revenue should always be divided journeys or passenger km. not by cost, or you are encouraging inefficiency.”	On optimising fare efficiencies
“Our biggest supplier is our employees, and they are paid every 30 days.”	On staff costs

New Lines and Major Projects

“The point of view of the operator is very important for this kind of construction.”	
“Engineers say Barcelona has the worst ground in the world for building underground metro.”	
“It is really important for governments to plan good transportation systems not only based on underground. Sometimes the demand doesn’t justify the investment.”	
“It’s not always possible to draw the most common-sense line from one place to the other. “	On new alignments
“It’s a very complex political game.”	
“The operator should sit with the authority and design the line together.”	
“We need to functionally design the line with them.”	
“A metro line has a social comeback.”	
“We cannot get there because they didn’t dig big enough.”	On the inability to extend Line 4
“When you plan infrastructure, you have to see not only what you have now, but also a future.”	On future-proofing design

Line 9

“Sometimes infrastructure is not planned with a business plan according to ridership or use of the line. Sometimes it’s a social or expansion objective.”	
“When building a new line, start in the centre, and build out to the edges. It sounds simple/obvious, but we didn’t do that.”	On building Line 9
“Our company doesn’t remain the same before and after Line 9, we had to make a change of paradigm.”	On the learning experience of Line 9
“Our main concern is how the operator fits in this process, from the very concept.”	On the role of the Operator in major projects
“We are the Project Managers, but not only the technical, also operations, maintenance…”	
“We are not operating a very common thing.”	On operating Line 9 N/S
“It’s a bit messy.”	On Line 9 N/S
“Here there are special needs.”	On Line 9 serving the airport, trade fair and Camp Nou
“I don’t know [if the Regional Government did cost-benefit analysis. Seeing how the line is drawn on the city map, I wouldn’t say so.”	On the two sections of Line 9 being lossmaking

“We made them realise if you contract 57 different contracts on auto-line where everything is so integrated, you need a project to integrate those systems in a safe way.”	
“We are now using all the trains we have, finally.”	On the running of Line 9

Assets

“To renew some part of the train fleet we will need support from the public administrations, fare box it is not enough.”	
“In a few years we are going to need more trains.”	
“The maintenance of elevators is completely different to the escalators’ maintenance.”	On elevators being preferred over escalators due to maintenance needs
“When you design new stations, please do it with elevators because it’s cheaper and people like it.”	
“How can you value the use of assets built 50-60 years ago?”	
“Good asset management save costs and provide reliability”	

Contracts

“Before negotiating contracts with Authority, we make our own business plan.”	On the need to understand desired outcomes before setting contracts
“I’ve participated (as a consultant) in tenders where the potential operator has no decision. We are not like that.”	
“I think we should introduce not only penalty, but bonus.”	
“Every contracting process has a deep ideological substructure.”	

Operations

“Running a train or not has no impact on labour cost.”	
“The main cost is buying the train and having someone driving it. We already have the train.”	
“We are now using all the trains we have, finally.”	On the running of Line9
“The impact on demand is terrific. After you drop 4 or 5 trains people are unhappy and they stop using the train.”	On optimising frequency
“That means you need more lost kilometres.”	On depots outside the city
“When you build a CBTC system, you have to consider that the system allows you to do anything, as long as the infrastructure allows doing that.”	
“Now I think that every metro line in the world should be built for 40 trains per hour- you may not need it now, but in the future you can’t add that infrastructure while the metro is operating.”	On future-proofing operational capacity
“Finally, the problem will be mine [the operator’s].”	On unique Operator vulnerabilities
“You are the operator, you are in front of the customer.”	
“The operators are always on a knife’s edge.”	

Automated Operations and Testing

“We fought for them to participate in the technology tests of the project, but in the end we did not succeed.”	
“We are afraid [in 2009] of how people would perceive trains without a driver, stations without someone in them.”	On perceptions of automated technology
“People didn’t even notice it was automatic, even when standing at the front of the train!”	
“At the end, the most valued experience was the Platform Screen Doors”	
“It’s safe. This is what people most valued of automated lines.”	

“They were able to foresee this trend.”	On automation technology
“If you are going to build a new line, I think most decisions now would go to an automatic line.”	
“Test something in a real environment before going live on hard lines.”	On testing and implementation of new systems
“If you don’t guarantee [system integration] you won’t succeed.”	
“The tech safety case for each system has an impact on O&M because the risks are exported to the operator.”	
“The testing needs of the operator tend to be shorter than we want,”	

Integrated Public Transport in Barcelona

“Have the determination to carry out a long-term multimodal public transport strategy”	
“If you don’t give us the resources to fund Public Transport, we will collapse.”	
“It’s very difficult to give a good quality bus service and make money at the same time, so we give that decision to the administration”	On bus subsidy in Barcelona
“The best decision I could make economically rational would be to close the whole bus system and make everyone take the metro.”	
“It’s difficult for private operators to make experience with buses. TMB has the capacity for that.”	On TMB’s experience managing buses
“We have three networks in one. [premium routes, conventional routes, local and feeder routes]”	
“People don’t like to transfer.”	On creating high-quality integration
Typically, when you arrive to the surface, you see the bus stop.”	
“You don’t know what is the point where the metro starts removing traffic, until you reach it.”	
“Instead of high commercial speed, we try to run buses well regulated.”	On preferring bus regularity to commercial speed
“You see much more tourists in regional bus than six years ago. Not with a map but with an iPhone.”	On tourist expectations
“Typically for tourists bus networks are very opaque. That is changing.”	
“As the accessibility of the underground has improved, people with reduced mobility who before used our access buses, changed to the underground.”	On customer accessibility needs and how the metro can meet these
“The only moment to do that, is when you’re building the metro.”	On prioritising connectivity during system design
“When you’re building the metro, you can do a lot of things to improve connectivity.”	

Integrated Fares and Ticketing

“Since that decision of the administration we have collected less money than we did before.”	On the decision in 2001 to have integrated fares (no charge for second connection)
“The ticketing system has overcome the Metropolitan Region of Barcelona, due to political willingness.”	
“One of the conditions of the integrated system is we operators can create own fix, provided it is not in competition with ATM product.”	
“Social fares don’t really have a high cost because if people can’t pay, they won’t travel.”	On social fares
“Policy is that if the administration wants more social policies, they have to pay for it.”	
“Miracles don’t exist if customer don’t pay. Someone has to.”	On the policy of increasing every year the fare
“In the first three years we integrated the system, we won 100 million trips.”	On the integrated system

“Post-payment means fare evasion risk is much greater.”	On having a post-payment system
“Nowhere in the world is there post-payment system for public transport.”	
“The risk of technology change means people will install validation in our stations. We are not happy with people working in our station who we do not control.”	
“The most worrying thing is post-payment.”	
“First you have to know your business model, then you create the technology for that.”	On the business model for managing a widespread integrated fare and ticketing area
“With millions of transactions, you cannot manage this in an amateur way.”	

Multi-functional Staff: The New Model of Operation

“That was the biggest change in the metro in the last twenty years.”	On the New Model of Operation
“Anybody can solve anything.”	
“Here, people stay working in this company for 30-40 years.”	On staff retention and career progression
“We need to buy a big amount of ticket machines.”	On upfront investments to make the New Model of Operation work
“We can pay a bit more because we win a lot of time from each person.”	On the value of increasing productivity
“We are buying their jobs, but we are buying their power also.”	
“The driver in the metro is a person with a lot of privileges. The unions don’t want to end that model.”	On labour relations and unions
“Before the New Model of Operation it was really easy for them to stop Barcelona. They have never been able to after that.”	
“The unions are professional negotiators.”	
“Without that it’s not possible to make that change.”	On the need for a level of automation to enable the New Model of Operation
“Replacing people with technology, for the time being makes sense.”	
“This technology [ATO] has reduced the number of incidents.”	
“Public Transportation is a business of people working alone.” [bus driver, station staff, train driver]	
“They have the autonomy, the skills and the empowerment to take decisions.”	On staff autonomy and empowerment and collaboration

Energy Saving and Technology

“The potential for energy savings in new metros is much higher than in old metros.”	On energy savings potential
“In order to reduce the fixed cost, it’s not necessary to spend a lot. Don’t contract more than you need.”	On 30% of the energy cost being fixed
“We cannot be a generator nowadays because we are not an electrical company.”	On TMB becoming an energy generator
“In our case, the problem is we don’t buy the trains directly. We explain what we need but we don’t make the final decision.”	On not being able to specify the energy consumption in the contract
“It’s more difficult to save if you have manual driving.”	On the energy saving possibility having manual driving
“They are very very close to these big companies”	On electricity companies being protected by the government
“If you can’t measure it, you can’t manage it.”	On auditing energy use
“We have analysed from zero all the systems.”	On new Line 9

“It’s important to make simulations and study different scenarios in 15 and 25KV. Analysing not only the technical, but also the economical and safety parts.”	On deciding the voltage use
“We cannot skip technological steps, so nowadays I would recommend hybrid buses.”	On the procurement of an environmentally-friendly bus fleet
“We want to apply tested technologies.”	On technologies used
“We are a public company, we cannot spend a lot of money on technologies that have not been proved previously.”	
There’s a long tradition of putting the technology first.”	On being led by technology and disapproving of this approach