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# CONVERSION OF RAILWAY LINES FOR SUBURBAN PASSENGER SERVICES

(CONVERSION DE LINEAS DE FERROCARRIL EN  
SERVICIOS METROPOLITANOS DE PASAJEROS)



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## 1 Alternative uses of railway infrastructures in Spain for suburban traffic: introduction to the study.

Many of Spain's major metropolitan areas grew alongside rail transport infrastructures.

Subsequently, the cities grew between and around these rail infrastructures, which then formed obstacles in city centres and caused road safety and noise problems.

Finally, the widespread use of private cars and the technical obsolescence of the railways led to a reduction in their functionality and rejection by people living near to railway lines.

In the recent past, different governments have taken steps to integrate these infrastructures into the metropolitan environment, which in many cases has involved restoring them to their former use.

In this respect, it is possible to distinguish two different kinds of actuation:

- ♦ **Use of suburban sections of conventional railway infrastructures** to implement metropolitan services, sharing all or part of those infrastructures.
- ♦ **Abandonment of old railway facilities** and use of the same lines to implement a new railway system.

The first alternative has been adopted by **Renfe** and will be studied in the first section of this report.

The second alternative has been applied on several occasions in Spanish towns and cities and will be addressed in the second section of the work by analysing the case of **Valencia**.

The third section contains **conclusions** drawn from the previous points.

Finally, the accompanying **appendices** contain additional information not included in the text, which will serve to obtain a better understanding of the issues exposed in this paper.

The criteria used to select the most suitable alternative varies considerably and depends on the objectives pursued, the resources available and the specific circumstances of the urban setting and its transport system.

The reason that hides behind the use of the rail platform for the suburban metropolitan transport is to take advantage of the best features of each transport mode.

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In this sense, the most suitable method of transport depends on the objectives pursued and the characteristics of each project. The following table illustrates the suitability of each mode in terms of possible project requirements.

A range of possible solutions will therefore be identified based on the definition of project goals.

	<b>PRIVATE VEHICLE</b>	<b>BUS</b>	<b>LIGHT METRO</b>	<b>CONVENTIONAL METRO</b>	<b>SUBURBAN RAILWAY</b>
<b>EFFECT ON CONGESTION</b>	VERY NEGATIVE	LIMITED	POSITIVE/LIMITED	POSITIVE	POSITIVE/NONE
<b>ENVIRONMENTAL IMPACT</b>	VERY NEGATIVE	LIMITED	VERY POSITIVE	VERY POSITIVE	POSITIVE
<b>INVESTMENT REQUIRED</b>	HIGH	MODERATE	MODERATE	HIGH	HIGH
<b>OPERATING COSTS</b>	QUITE HIGH	AVERAGE	LOW	LOW	AVERAGE
<b>FLEXIBILITY</b>	HIGH	HIGH	LOW	NONE	NONE
<b>DIFFICULTY CONSTRUCTION INFRASTRUCTURE</b>	HIGH	HIGH	LOW	HIGH	HIGH
<b>CAPACITY</b>	VERY LOW	AVERAGE	HIGH	VERY HIGH	VERY HIGH
<b>ACCESSIBILITY</b>	VERY HIGH	HIGH	AVERAGE	LOW	LOW
<b>CO-ORDINATION CAPACITY</b>	LOW	HIGH	HIGH	HIGH	HIGH

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## 2 Use of rail infrastructures for suburban traffic: Renfe's suburban Rail system

This section contains an analysis of the experience in the use of Renfe's lines, originally created for medium- and long-distance traffic, to provide suburban rail services.

The term suburban ("cercanías") services refers to Renfe's metropolitan rail service.

The starting point, issues to be resolved during implementation and the operating system finally established are addressed below.

### 2.1. Starting point

Spain's state railway company, Renfe, traditionally operated medium- and long-distance lines, paying little attention to suburban traffic.

Consequently, neither the infrastructure nor the stations nor, in general, Renfe's service organisation permitted the use of railways for metropolitan or suburban traffic. The number of users was therefore low due to the poor quality of the service.

Since the eighties, as a result of the growth of Spanish metropolitan areas, the increasing use of private transport, the consequent congestion of roads and, finally, the progressive population growth in the areas through which Renfe's lines passed, the possibility of increasing the use of this method of transport in metropolitan areas became an issue. Steps were taken in this respect, though as yet with limited scope.

In 1982 the Central Government entered into an agreement with Madrid City Council to develop the first Suburban Railway Plan.

Since then, railway networks in the major Spanish cities have gradually developed specific suburban services, adapting the functionality of the existing lines, originally built for a different purpose.

Along the remainder of the eighties suburban services were progressively implemented in the main Spanish cities.

It is, however, at the end of the decade when the decision was taken to fully launch Renfe's suburban services by preparing a **Suburban Transport Plan** covering the four-year period 1990-1993.

For the present purposes, it is interesting to note that the Suburban Transport Plan (STP) forms part of a Transport Plan for Major Cities approved by the Spanish Government in May 90.

This Plan defines the measures to be implemented in relation to suburban services, indicating that they were to be provided by the two companies operating in Spain, Renfe and FEVE<sup>1</sup>.

The STP further develops the steps envisaged in the Rail Transport Plan and in the Contract-Programme Renfe State, proposing new steps for the period 1990-93.

## 2.2. Suburban Transport Plan 1990-1993

Given the relevance of this plan to the purpose of the study, the implementation of suburban services using pre-existing rail infrastructures<sup>2</sup>, the STP will serve as a point of reference, since it led to definitive implementation of rail services in Spanish cities.

When the Plan was first implemented, there were in Spain suburban rail services, as it figures in the following table and in the map attached.

<b>SUBURBAN SERVICES 1990</b>	
<b>METROPOLITAN AREAS</b>	15 largest areas
<b>POPULATION COVERED</b>	16,000,000 inhabitants
<b>AVERAGE USERS WORKING DAY</b>	600,000 passengers
<b>GEOGRAPHICAL DISTRIBUTION</b>	50% Madrid, 50% rest

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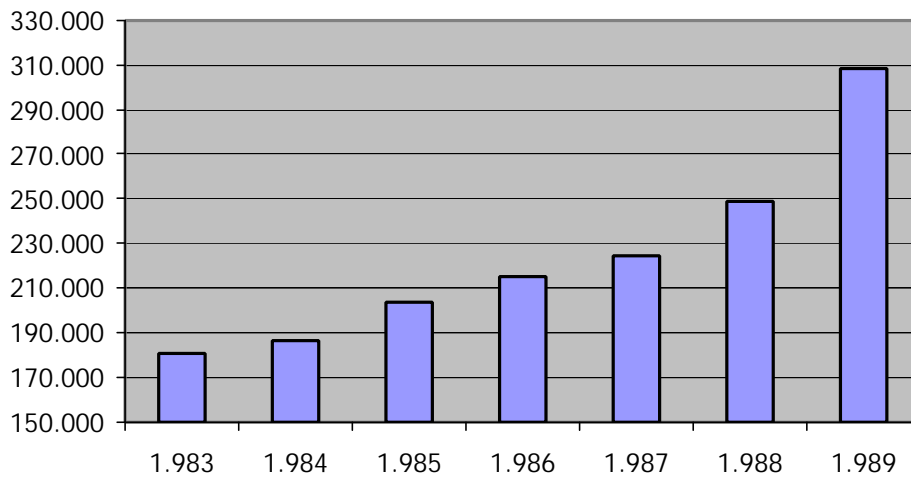
<sup>1</sup> Spain's railway system consists of Renfe, the main state-owned railway company; FEVE, a company operating nation-wide, responsible for narrow-gauge railways and with limited involvement in general traffic; and the regional railway companies in Catalonia, the Basque Country and the Valencia region.

<sup>2</sup> The STP is relevant since it established the conditions that allowed specific suburban services to develop, using Renfe's preexisting network, and successive measures basically furthered the progress that had already been achieved. An analysis of the STP will therefore allow us to ascertain the organizational, economic, legal, etc. needs and opportunities, which arose as a result of its implementation.

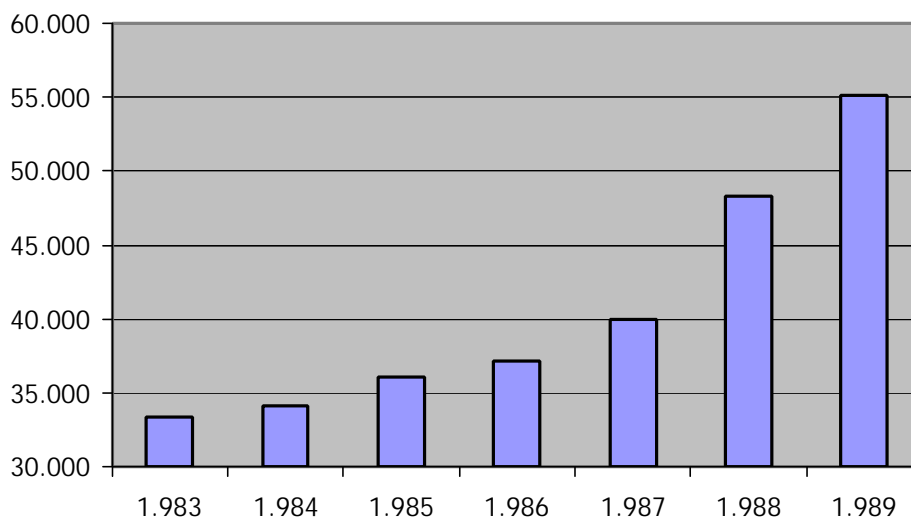
As indicated, at the beginning of the eighties the quality of the services offered began to improve, leading to increased use of rail transport.

To observe a first relationship between the quality of the service and the demand, lets consider the information contained in the following charts in which the evolution of the supply and the demand in Madrid's suburban rail for the period prior to the Plan are shown.

### PASSENGERS/DAY MADRID



### SEATS/HOUR AND DIRECTION MADRID



The logical correlation existing between the increase in supply and the parallel of the demand in the suburban services in Madrid can be observed comparing both graphics.



The implementation of the STP implied a number of different kinds of proceedings that are expounded in the above section.

### 2.3. Implementation of the Suburban Transport Plan 1990-1993

The implementation of new suburban services using mainly pre-existing lines which are shared with Renfe's other services, entailed adopting the following measures, all of which were necessary to start up the new services:

- Administrative
- Organisational
- Investment
- Functional

Set out below it is shown the proceedings made and a brief description of each one of them.

<b>STEPS TAKEN TO IMPLEMENT STP</b>	
Administrative	Co-ordination with regional authorities
	Adaptation of fare pricing framework
Organisational	Internal restructuring
	Creation of Suburban Service Management Unit
Investment	Measures relating to local networks in the affected urban areas
	Voltage changes
	Remodelling stations
	Rolling stock: acquisition and conversion
	Duplication of lines
	Other investments in infrastructure
Functional	Design
	Maintenance
	Information

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As indicated, the progress achieved through the STP is reflected in the results obtained towards the end of the eighties. As congestion on access roads in major cities worsened there is a considerable increase in demand for public suburban transport services. In fact, the forecast numbers of new suburban passengers are exceeded by a large margin, with 1991 targets being achieved in 1989.

Supply had not risen in line with demand due to the inadequacy of rolling stock and facilities available for suburban services, despite the growth achieved. The planned investments had to be increased if supply were to meet demand in the future.

This lack of resources available to maintain supply in line with demand, justify the STP, that during the four-year period concentrated most of its proceedings in the first part of its execution period.

#### *2.4. System established. Potential conflicts and solutions adopted*

For the purposes of our work, the impact of the decision to implement special suburban services using the pre-existing network on the various areas of Renfe is worthy of note.

As indicated, the impact was significant and widespread, reaching all areas of railway operations, since it entailed a major change in the service model:

##### □ **Administrative:**

- ♦ Co-ordination with public authorities: Spain's regional authorities are responsible for suburban transport services. At the same time, organisms that co-ordinate the metropolitan transports, framework in which we can include suburban rail services, exist or are being created.

This circumstances requires, on the one hand, co-ordination with the authorities responsible for unified transport systems and, on the other, adaptation of rail service organisation, since the functional and geographical limits established for organisational purposes do not generally coincide, with those required in metropolitan areas.

The fact that Renfe reports to the Central Government and to Spain's regional co-ordination bodies creates a legal and administrative conflict, since the regional authorities are responsible for all integrated services except those provided by Renfe.

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In general, the conflict is resolved by adopting the following measures:

- Regulations governing the co-ordination bodies **permit** the integration of Renfe
  - Renfe **becomes integrated voluntarily** in the metropolitan co-ordination bodies
  - Renfe has **representatives** in the governing bodies of the metropolitan transport
  - Renfe **adapts its operations** to the metropolitan system, in terms of both services and fares.
- ♦ Adaptation of fare pricing framework: Renfe's fares are set based on the distance travelled. Where suburban services become integrated into metropolitan zones that have created or are creating a unified service, fare prices are converted to a zone-based pricing system.

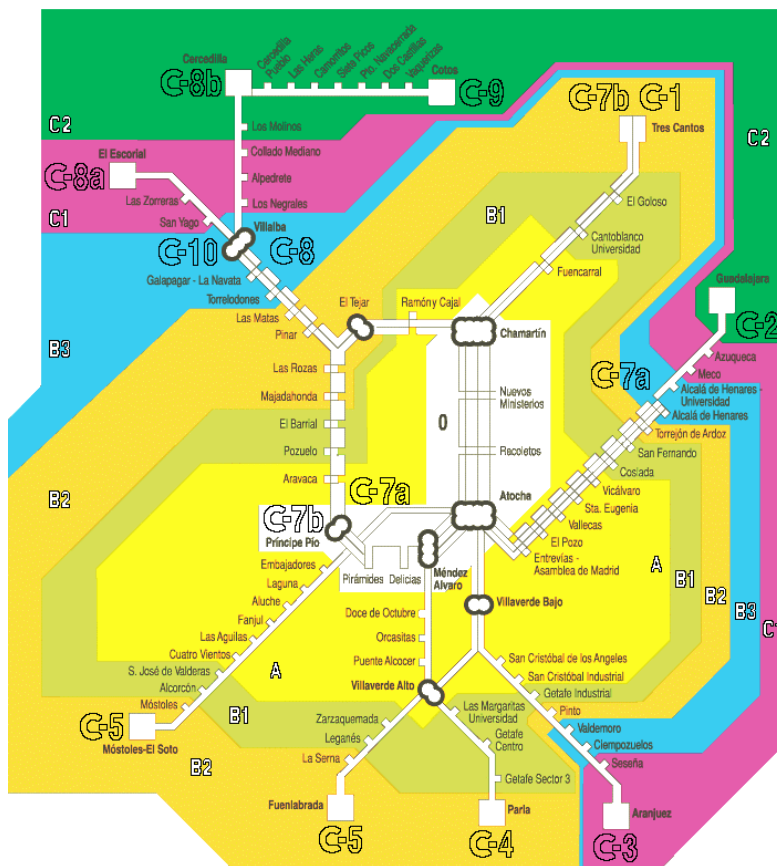
The fare pricing systems have also been adapted through the integration of the transport passes modalities used in the Metropolitan Area: 10-journey tickets, monthly passes, ...

The ticket selling network and the distribution of ticket revenues is also affected. The impact on Renfe has been greater than on other operators, since the suburban fare pricing system must co-exist with Renfe's own system.

As indicated, the issue is resolved through Renfe's acceptance of this system and Renfe's proposals made within the co-ordination bodies.

In short, Renfe has replaced its previous distance-based system, for suburban traffic, with a system including the following:

- ♦ Single tickets
- ♦ Return tickets
- ♦ Train pass
- ♦ Monthly pass and Pass 2000
- ♦ "Studio" card
- ♦ TAM: card issued by the Madrid Transport Consortium
- ♦ Commercial offers: tour card, combined tickets, etc



The plan illustrates the adaptation of Renfe's suburban network in Madrid to the zone-based co-ordination system used in the city of Madrid.

□ **Organisational:**

One of the most significant changes occurs with the creation of the Suburban Business Unit.

Renfe has always used a centralised management system. When the management system is changed, through the creation of Business Units, the Suburban Business Unit is created. This decision represents a definitive vote of confidence for the development of specific suburban services on Renfe's general network.

Renfe has a national management team and managers in each metropolitan area, with the capacity to organise services and having specific targets to meet and resources with which to fulfil objectives. This represents a drastic change from the previous system.

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The new organisation has an impact on all the functional and organisational areas: rolling stock, maintenance, fare pricing policy, etc.

Specific suburban rail transport plans can also now be drawn up and investments made in this type of traffic.

As part of general government policy and in accordance with European Union policy, suburban rail transport services receive special treatment, particularly in respect of costs, operating deficits, operating grants, etc.

In the opinion of Renfe managers responsible for suburban services, management standards are similar to those which could be achieved under private management, considering unnecessary the privatisation in terms of both operations and infrastructure.

□ **Investment:**

The adaptation of a traditional railway system to the needs of suburban operations requires, in addition to changes in operating policies, significant investment in order to provide a quality service acceptable for daily users and to enable growth in demand, which is essential if such traffic is to be consolidated.

Investments must be made in the following areas:

- ◆ Tracks: A system based on traffic frequency instead of the traditional timetable-based system requires, in many cases, an increase in the number of general tracks, improvements in train crossing points and, on occasions, the creation of tracks reserved for suburban traffic.

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- ♦ Stations: One of the components most affected by the conversion of services and by co-existence with general medium- and long-distance traffic are stations. Changes must be made in the following areas:

- access
- signs and information
- separate platforms
- ticket sale

Stations are remodelled to a greater or lesser extent, depending on the design and the volume of suburban traffic. In some cases, such as Atocha station in Madrid, the two types of traffic are totally separated in two different areas.

In general, passenger access zones must be wide, direct and well signpost. Ticket sale points, whether automatic or manual, must be designed specifically for suburban services and able to serve a large number of passengers in a short period of time, particularly during rush hours.

Access zones must be monitored and segregated where possible from other types of traffic.

In general, priority must be given to fast and easy access to trains and general service quality, all based on service frequency rather than timetable.

- ♦ Interchange zones: The need to co-ordinate with other metropolitan transport systems, whether private or public, collective or individual, requires the adaptation or construction of interchange zones. Station management generally determines the location and design requirements for these zones. Special attention must be paid to rapid access to and from platforms, bearing in mind that rail transport is less flexible than other methods.
- ♦ Traffic control post allows a frequency-based increase in line capacity. Both circumstances are essential to service quality.
- ♦ Rolling stock: Service quality implies, necessarily, the acquisition of new rolling stock, remodelling of existing rolling stock and changes in guidelines applied to concepts which are basic to rail operations such as availability, maintenance, etc. New rolling stock refers also to new types of wagons not used in other operations, such as double-decker cars, in order to increase capacity, particularly during rush hours.

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As regards operations, the usual approach in other types of service was to hold reserve rolling stock in case of breakdown or repair and maintenance.

The general rule in suburban services is to have the entire fleet available in order to offer the highest possible capacity and frequency. This means that rolling stock must be maintained and repaired during idle periods.

Maintenance must include service quality requirements, such as cleaning and hygiene.

- ♦ Metropolitan networks: In general, significant investment may be necessary in metropolitan rail networks to enhance operations and traffic safety. Services must be operated as independently as possible, avoiding traffic conflict. Certain solutions adopted involve assigning priority to specific types of traffic during certain time periods, if full separation is not possible. During rush hours priority is given to suburban services, which may be relaxed during off-peak hours.

The following table shows the investments scheduled for the first four-year period of the STP:

<b>MAIN INVESTMENTS</b>		
<b>MADRID</b>	GREEN CORRIDOR ("PASILLO VERDE")	12.000
	TRACKS EXTENSION	3.812
	STATIONS	6.684
	CENTRALISED SUBURBAN TRAFFIC CONTROL POST	600
	INTERCHANGE ZONES	814
	STATION ACCESS	521
	OTHER INVESTMENTS	2.249
	<b>TOTAL MADRID</b>	<b>26.680</b>
<b>BARCELONA</b>	METROPOLITAN RAIL NETWORK	200
	ACCESS AND STATIONS	542
	OTHER INVESTMENTS	567
	<b>TOTAL BARCELONA</b>	<b>1.309</b>
<b>SEVILLE</b>	METROPOLITAN NETWORK	7.460
<b>VALENCIA</b>	METROPOLITAN RAIL NETWORK	3.432
	TRACKS DUPLICATION	627
	OTHER INVESTMENTS	130
	<b>TOTAL VALENCIA</b>	<b>4.189</b>
<b>BILBAO</b>	STATION ACCESS CONTROL	295
	OTHER INVESTMENTS	987
	<b>TOTAL BILBAO</b>	<b>1282</b>
<b>ASTURIAS</b>	METROPOLITAN RAIL NETWORK	161
<b>OTHER SUBURBAN AREAS</b>	INVESTMENTS	343
<b>OTHER METROPOLITAN AREAS</b>	INVESTMENTS	31.992
<b>SUBURBAN ROLLING STOCK</b>	100 NORMAL UNITS	23.266
	60 DOUBLE - DECKER UNITS	5.824
	CONVERSIONS	3.870
	<b>TOTAL ROLLING STOCK</b>	
<b>TOTAL (not including green zone)</b>		<b>94.376</b>

Figures in millions of pesetas



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□ **Operation:** As indicated, one of the most conflictive aspects of implementing suburban services is the operation of these services as part of traditional rail operations. The issues raised are summarised below:

- ♦ service considerations: the dominant criteria are capacity and frequency, instead of timetable and punctuality. This change of priorities usually generates conflict in areas such as track occupancy, waiting trains, assignment of platforms,... In certain cases a traditional approach may contribute to poor performance, particularly when lines are shared, which is most often the case. A service plan must be implemented and accepted by suburban and long-distance services, with priority given to suburban services during rush hours. In those zones where such consensus cannot be reached, forecast demand must be analysed, in order to decide whether to increase the number of lines, improve the signalling system or take any other measure to increase capacity.
- ♦ maintenance: rolling stock, stations and ancillary facilities must be maintained based on different policies than those generally used for long-distance services, in terms of both available time bands and type of maintenance work. Certain services can be carried out through external enterprises. A target-based management policy can also be implemented to improve performance.
- ♦ information: these objectives have been mentioned in relation to investments required in stations. Station design and remodelling must be focused on permitting fast access and exit for passengers, including information, signs and ticket sale and validation. Users must head towards platforms without hesitating, trains must be clearly identified and information on the route and stopping stations must be easy to access. Station signposting must be similar to that used in conventional metro systems, including zone plans, connections with other methods of transport, etc.

Particular attention must be paid to distinguish between sign-posting for conventional trains and sign-posting for suburban services, mainly inside trains and on platforms, providing clear information on any special features of each journey: such as whether the trains stop at all stations. It should be noted that a suburban transport user values above all travelling time and, normally, he is not willing to waste much time in stations.

As regards the possibility of implementing measures to permit the use of conventional transport networks for suburban services, based on Renfe's

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experience, we may conclude that **this is only possible if potential conflicts are anticipated and solutions developed.**

The following table contains a summary of conflicts that could arise and possible solutions, based on Renfe's experience:

TYPE OF CONFLICT	MEASURES ADOPTED
Co-ordination with Public Authorities	Adaptation of metropolitan transport regulations
	Voluntary integration
	Representation on governing bodies
	Adaptation of rail operations
Fare pricing framework	Change of zones and/or rail fare system
	Adaptation of passenger tickets
	New ticket selling network
Internal competition	Creation of an independent Suburban Business Unit
Line capacity	Tracks duplication or extension
	Reservation of some lines for suburban services
	Improvements at traffic crossing points
	Improvements in signalling, safety and communications
Stations	Full remodelling
	Access control and separation
	Sign-posting and information
	Specific ticket sale points
	Reserved platforms
Interchange zones	Construction of direct access routes
	Creation of park & ride zones
Traffic control	Construction of centralised traffic control post
	Improved signalling and safety systems

TYPE OF CONFLICT	MEASURES ADOPTED
Rolling stock	Assignment of rolling stock to suburban services
	Acquisition of new rolling stock
	Remodelling of available rolling stock
	New design: two decks
	Quality equipment: air conditioning, information systems, etc.
Metropolitan rail networks	Actions orientated to improve capacity and increase safety in metropolitan networks
	Prioritisation of use of the network based on time bands
Provision of services	All rolling stock available
	Increase capacity and frequency to a maximum
Maintenance	Specific sign-posting
	Flow separation
	Focus on quality: cleaning and hygiene, minor repairs, etc.
	Immediate response
Information	Specific signs
	Flow separation
	Consistent with other metropolitan transport systems

Appendix 1 contains the most significant data on the current status of Renfe's suburban services, provided using the general rail service network.

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### 3 Conversion of rail infrastructures for suburban traffic: Light Railway Systems

As indicated, the other alternative for making use of pre-existing rail infrastructure to create suburban systems is to convert them into light railway systems, using the pre-existing platforms.

As with the infrastructure-sharing alternative, this alternative is analysed based on a specific experience, the **Valencia metro system**, although appendix one contains further information on the Spanish experience in this matter, focused on the financial aspects.

#### 3.1. Reference framework.

In addition to the current growth in suburban rail services using conventional systems, light railway systems are also being developed and implemented in metropolitan areas.

This situation is summarised below:

- ♦ **Systems implemented:**
  - ♦ Valencia: - light metro system, created using old train lines.
    - metro lines 1, 2 and 3: certain sections use pre-existing railway lines
  - ♦ Madrid: metro line to Arganda, with a private financing system
  - ♦ Bilbao: metro line 1, part of which uses pre-existing railway lines
- ♦ **Implementation in progress:**
  - ♦ Valencia: extension of line 5 and the new tram line
  - ♦ Alicante: light metro, sharing part of the line with conventional rail services
  - ♦ Bilbao: light metro, part of which uses pre-existing railway lines
  - ♦ Barcelona: La Diagonal tram system, part of which is financed privately
- ♦ **Systems being studied:** in numerous Spanish cities: Murcia, Granada, Santa Cruz de Tenerife, Mallorca, etc.

Although our analysis is based on the project in Valencia, the conclusions and recommendations are general in nature for purposes of comparison with other projects.

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Certain specific issues relevant to other projects are also addressed, such as financing, organisation, etc.

The following section contains a brief analysis of Valencia system, followed by an explanation of how implementation issues were resolved.

*3.2. Use of pre-existing rail infrastructure to implement a light suburban railway: the Valencia tram line.*

The Valencia tram line runs along line 4 of the metro network (see plan).

In Valencia, as in many Spanish and European cities, there was a tram network until the end of the nineteen sixties. In this case the network was large and even reached the outskirts of Valencia.

The entire tram network stopped operating, leaving not even a single line in service.

Simultaneously, in the present metropolitan area, with interurban characteristics then, there was a conventional rail network that played an important role in the development of the surroundings cities and towns.

The existing conventional railway lines, all metric-gauge surface lines, mainly single-track and electrified were:

1. Valencia Puente de Madera Station to Bétera
2. Valencia Puente de Madera Station to Liria
3. Valencia Puente de Madera Station to Rafelbuñol
4. Valencia Puente de Madera Station to Grao
5. Valencia Giorgeta Station to Villanueva de Castellón

The first two lines met in the old Empalme Station, now named Ademuz Station, and then shared a section to access Puente de Madera terminus. The third line also terminated in this station.

The fifth line was the longest, with the terminus in the south of the city.



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This configuration meant the existence of a railway lines belt with a great number of inconveniences:

- ◆ They were subject to railway regulations, which were highly inappropriate for metropolitan areas
- ◆ The obligation of fencing off the lines, even in metropolitan areas, created barriers on both sides
- ◆ The limited number of stations prevented the provision of services for residents of affected areas
- ◆ The prohibition on any increase in the number of level crossings aggravated the barrier effect by limiting traffic flows along the city's roads, except for the few pre-existing crossing points
- ◆ Level crossings with barriers and unsophisticated control systems generated major hold-ups at crossings
- ◆ There were a significant number of accidents, many of which were fatal
- ◆ The areas surrounding the railway lines were in an extremely poor state

These circumstances existed not only in the city of Valencia, but also in other municipalities in which there was railway lines.

It should be noted that this method of transport, that was initially efficient and allowed the city of Valencia to achieve balance growth, while neighbouring towns grew around rail networks built at the end of the nineteenth century, had, however, become obsolete, losing a million passengers per year not being able to serve the city's inhabitants living near to the lines.

Pressure from citizens became extraordinarily intense, seeking solely to eliminate the lines without proposing any alternative method of transport, which was due partly to bad memories of previous trolleys and tram systems.

In addition to the disadvantages indicated above, the transport system as a whole had a number of weaknesses:

- ◆ Limited town centre services
- ◆ Poor connections
- ◆ Technical obsolescence in all areas
- ◆ Total and persistent under-capitalisation due to lack of investment
- ◆ Poor management for a metropolitan system, which was centralised in Madrid



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The improvement began with a project which was insufficient in itself but, when subsequent changes had been made, represented a first step towards finding a solution.

Following the changes which were made, this first step involved linking lines 1 and 2 with line 5 by means of an underground line crossing the city of Valencia.

This solution brought considerable advantages, as listed below:

- ♦ A significant part of the lines which formed a belt around the city were eliminated
- ♦ Connectivity was enhanced
- ♦ Metropolitan centre services were improved considerably
- ♦ Obsolescence decline due to improvements in and renewal of facilities and rolling stock

This was the first experience in the Valencia area in which a conventional rail system was converted to create a suburban metro system.

### 3.3. *The Valencia tram line: basic features*

As a result of this new line entering into force, the common line between the Empalme station and Puente de Madera was practically in total disuse, which put the little used and highly seasonal Valencia-Grao line, as it connected North Valencia with the beach areas, in a precarious position.

Logically, social pressures mounted to demand the dismantling of both lines since they only caused problems in the areas through which they ran.

Under these circumstances, the Regional Government drew up the first overall document which covered the railway problem in the Valencia area: the Extension of the Valencia Light Railway Programme.

We will have the chance to refer to this programme again, but now we should note that it proposed, for the first time, the construction of a modern tram line in Valencia, almost 30 years after the last one disappeared.

In this respect, the proposal included the use of the platform used by the above-mentioned common line and the Valencia-Grao line, measuring 10 kilometres, a loop at the Puente de Madera station and a unified route.

The line's most significant features are as follows:

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- ◆ No underground portions
  - ◆ Only single-use platform used throughout the whole route
  - ◆ Inter-station of approximately 350 meters
  - ◆ Dual track
  - ◆ Totally new infrastructure
  - ◆ Signal light priority and operation assistance system

The project included:

- ◆ Single platform eight metre wide, dual track, platform raised a few centimetres (eight) above the pavement
- ◆ Overhead power cables which are practically invisible and connected to the lighting system
- ◆ Three sub-stations
- ◆ Stops that allow the operation of double units, with shelters, ticketing machines. Tickets are cancelled prior to boarding the vehicle.
- ◆ Cars with low floors between all doors, which allows access for disabled or handicapped persons through any door and along the whole inner of the tram
- ◆ Specific depots and repair workshops
- ◆ Integral urbanisation between facades throughout the tram's route
- ◆ Urban fixtures, including lampposts, benches, waste bins, trees, etc.

#### *3.4. Balance of the Proceedings*

The implementation of the light railway system using pre-existing railway lines in Valencia gave rise to very positive impact on the transport system, some of the consequences of which are:

- ◆ Improvements in service quality have resulted in an increase in the number of passengers originating from other public means of transport and even from private cars.
- ◆ The improvement in the service provided to citizens affected by the route have undergone significant impact in terms of quality of life as not only was a traditional barrier eliminated, it was replaced by a high-quality and efficient means of transport.

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- ♦ Commercial speeds and capacity are much higher than those of competing means of transport, public or private.
  - ♦ The investment in the tram project represents approximately the seventh part of that necessary for a conventional metro.
  - ♦ The use of a pre-existing railway platform is advantageous, in some cases decisively so, to implementing a tramline.
  - ♦ The tram/light metro has a feature that makes it an ideal means of resolving mobility problems in medium-sized and large cities as well as for specific areas or corridors.
  - ♦ The impact on certain groups of people, particularly the disabled or handicapped, has been well received by users.
  - ♦ The elimination of the existing physical barrier has given way to urban development in the affected areas, in terms of both residential infrastructure and services
  - ♦ The demonstration effect sought has been achieved without doubt, helping the development of subsequent projects
  - ♦ The process was long. Complex and required additional efforts to obtain information and public and political consensus.
  - ♦ The tramline runs through areas that are socially and economically very different. The project did not give rise to any type of discrimination in its design and has contributed to integrating and redistributing urban development.
  - ♦ The investments involved in the projects, although high, have met the objective of reinforcing collective means of transport.
  - ♦ Trams or light metro, means of transport with a very negative image until recently, has undergone a radical change of image and currently projects are being executed or studied in numerous Spanish cities (Bilbao, Barcelona, Granada, Murcia, Tenerife...).

*3.5. Questions to be consider regarding the implementation of a light railway system in a suburban/urban environment.*

Numerous conflicts arose during the implementation of the tramline in Valencia and affected relationships between government administrations, operating companies and residents in affected areas. In turn, significant administrative, legal, economic and

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functional problems arose which had to be resolved in order to make the operation of the tram line a reality.

♦ **Institutional matters**

The **institutional** difficulties arise both from different ownership of the means of transport and differing jurisdictions over this area. On the one hand the regional government owns the railways within the Autonomous Community, whereas the municipal authorities have authority over municipal means of transport. In addition, there is a Metropolitan Transportation Co-ordination organisation created by a law passed by the Regional government.

The conflict arose due to the transformation of a traditional railway infrastructure into a light railway that used roadways in its operations, such as other traditional means of transport like buses.

The problems affected all possible areas:

- ♦ Ownership of the service
- ♦ Operating conditions
- ♦ Construction permits and operating licences
- ♦ Maintenance obligations
- ♦ Roadway security questions
- ♦ Locations of stops
- ♦ Relationships with other traffic
- ♦ Guarantee of the reserved platform
- ♦ Traffic discipline

In all these areas the jurisdiction of both government levels overlapped. In this case an explicit and tacit agreement was reached between the municipal and regional authorities covering all these areas. In this respect representatives of the municipal and regional governments formed a permanent-working group <sup>3</sup>

- ♦ The city granted a municipal licence without requiring the payment of any fee

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<sup>3</sup> The co-ordination organisation, then in its initial stages, is controlled by the same institutions affected by the light metro project and therefore its presence was not essential.

- 
- ◆ Investments, including the urban development, fixtures, signals, etc. were covered by the regional government.
  - ◆ The city accepted the exclusive platform for the light railway, and the railway operator accepted the use of a short part of the platform by busses in the summer months.
  - ◆ The metro operator, which reports to the regional government, took responsibility for maintaining and cleaning the tram line infrastructure.
  - ◆ Stops and other matters that require physical action are agreed jointly, through construction proposals supervised by the municipal authorities.

Currently there are some **legal** matters which remain to be resolved, mainly those relating to the title to and ownership of the platform used by the light metro, although almost all of it originated from the land used by the pre-existing traditional suburban railway and part of the initial route and subsequent extensions were made on non-railway land owned by the city.

This matter is important because at least two important questions are affected by it: the maintenance of the exclusive use of the platform <sup>4</sup> and the maintenance and security obligations, which include lighting, signals, etc. The possibility of drawing up a treaty between the municipal and regional governments has been considered, whereby ownership of land not already held by the city would be ceded to it, and the operating company would hold railway service rights in usufruct for an indefinite period.

- ◆ **Financial matters**

The financing of the implementation of the light metro on pre-existing suburban routes was covered entirely by public funds. <sup>5</sup>

Bearing in mind the characteristics of the project, the following financing arrangement was used:

- ◆ **Regional government:** covered the guarantees for and the execution of all investments, including development work within the affected areas and equipment and fixtures, including lighting and signals, etc.

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<sup>4</sup> The difference between a reserved-use platform such as that of the Valencia light metro, which only it is authorised to use, but which could easily be modified by administrative order to a shared use status, and a railway line, which is segregated and exclusive and cannot be shared in any way, should be borne in mind.

<sup>5</sup> Currently steps are being taken to encourage private initiatives to finance these types of projects. The current situation in Spain is described in the relevant appendix.

- ♦ **Central government:** through a general treaty, the central government participated in the financing of the Valencia Metro Network Extension Programme.
- ♦ **European Union:** granted a FEDER grant to the light railway line
- ♦ **European Investment Bank:** provided loans for the entire extension programme.
- ♦ **Rolling stock:** acquired by the operating company which is wholly owned by the regional government with loans from private banks guaranteed by the Regional Government
- ♦ **Integration matters**

The integration of the light metro system as a result of using the pre-existing railway platform, had to take into account the following matters:

- ♦ Urban integration
- ♦ Integration into the transport system

With respect to **urban integration**, the questions to consider and resolve originate from the very different conditions imposed by conventional railway and the light metro replacing it.

It should be taken into account that the level of urbanisation has to be at least of the same quality of the surrounding areas and the areas affected by a traditional railway line usually present a high level of urban degradation.

In addition, since this involves a linear project, it may run through areas which have very different characteristics, which raises problems regarding urban designs:

- Demolition of physical barriers (walls) which protected the railway line
- Continuity of transversal roadways until then not blocked
- Dismantling of railway installations: overhead power cables, supports, substations, crossings, etc.
- Urban rehabilitation of the affected area
- Integrated implementation of a new platform for the light metro
- Continuity of affected public services: sewerage, drinking water, telephone, etc.
- Urbanisation of the new environment: sidewalks, trees, lighting, etc.

- 
- Items for the new system: stops, shelters, signals, etc.
  - Urban fixtures

The decisive importance of these items on the initial acceptance and subsequent successful operation of the new system makes it very advisable to accept and introduce them into the proposal itself, even when involving matters which are not directly attributable to it. The cost of these items can represent approximately 20% of the total.

With respect to **integration into the transport system**, in addition to the points mentioned below, it should be noted that a means of transport that gave rise to tremendous rigidity is being replaced and therefore it is expected that the new system be capable of providing flexibility in all areas.

In this connection, it should be borne in mind that the light metro provides for levels of flexibility which are sufficiently high during the proposal and construction stage, but once it has entered into service its flexibility is significantly reduced.

For this reason, it is essential to expressly take care of these issues during the design stage, taking into consideration all the requirements of the transport system and present and future urban development.

It is not necessary to issue a reminder that the physical features of the co-ordination between means of transport require proximity, the highest level of comfort possible and good informational signs.

The matters most affected by **transport system co-ordination** are:

- Execution of the urban lines on the previous railway line
- User access: pedestrian walkways, ramps for disable or handicapped persons, etc.
- Placement of stops in ideal areas both for general users and those making transfers
- Connection with other railway systems, either conventional or metro, which exist or are projected
- Integration into the general road system: signals, priority signals, Operating Assistance systems, resolving of crossings with general traffic, etc.

- 
- Rate integration: ticketing and or cancelling machines on platforms and in vehicles
  - Competition between means of transport: this is a particularly relevant matter. As the number of stops is raised notably, as is the area of influence of the new system, the population served increases. In general, and as was the case in Valencia, undesired redundancies arise between the new system and the pre-existing bus network which, through the co-ordination mechanisms, should lead to a restructuring of the network.
  - Shared use of the platform: if, as was the case in Valencia, the decision is made to develop an exclusive use platform <sup>6</sup>, agreements can be reached regarding the sharing of the platform in certain areas and at certain times with some bus lines. In general, the platform should be designed to be used by emergency services.

With respect to the stability of the co-ordination mechanisms, these lines become part of the metropolitan transport co-ordination system as another part of the system.

The matters relating to the co-ordination of the new means of transport and the transport system, can give rise to up to 15% of the cost of the project.

In general, the matters relating to development and transport system integration can give rise to between 15% and 30% of the cost of the project, depending on the situation of the environment and the design criteria applied and, in any event, it is advisable to include them in the total cost of the project.

The following table shows the problems affecting implementation and the solutions adopted:

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<sup>6</sup> The advantages of the exclusive platform, which translates into higher capacity, speed and regularity and, therefore higher service quality, makes it advisable to implement this exclusivity as much as possible, including physical defence mechanisms such as bollards for the platform itself.



<b>MATTERS DERIVED FROM THE TRANSFORMATION OF THE SUBURBAN RAILWAY INTO A LIGHT METRO</b>	
<b>INSTITUTIONAL MATTERS</b>	
<b>OWNERSHIP OF THE SERVICE</b>	<b>REGIONAL GOVERNMENT</b>
<b>OPERATING CONDITIONS</b>	<b>CITY AND REGIONAL GOVERNMENT AGREEMENT</b>
<b>LICENCES</b>	<b>REQUESTED AND GRANTED WITHOUT FEES</b>
<b>MAINTENANCE</b>	<b>OPERATING COMPANY (REGIONAL GOVERNMENT)</b>
<b>SAFETY AND SECURITY</b>	<b>CITY AUTHORITIES</b>
<b>ESTABLISHMENT OF STOPS</b>	<b>CITY AND REGIONAL GOVERNMENT AGREEMENT</b>
<b>OTHER TRAFFIC</b>	<b>CITY AUTHORITIES</b>
<b>RESERVATION OF PLATFORM</b>	<b>CITY AND REGIONAL GOVERNMENT AGREEMENT</b>
<b>TRAFFIC DISCIPLINE</b>	<b>CITY AUTHORITIES</b>
<b>FINANCIAL MATTERS</b>	
<b>PUBLIC FINANCING:</b>	
<b>REGIONAL GOVERNMENT</b>	<b>GUARANTEE OF ALL FINANCING:</b> <ul style="list-style-type: none"> <li>◆ <b>INFRASTRUCTURE</b></li> <li>◆ <b>SUPERSTRUCTURE</b></li> <li>◆ <b>INSTALLATIONS AND EQUIPMENT</b></li> <li>◆ <b>ROLLING STOCK</b></li> <li>◆ <b>URBAN DEVELOPMENT</b></li> <li>◆ <b>INTEGRATION</b></li> </ul>
<b>CENTRAL GOVERNMENT</b>	<b>PARTICIPATES IN FINANCING UNDER TREATY</b>
<b>EUROPEAN UNION</b>	<b>GRANTS FEDER FUNDS</b>
<b>EUROPEAN INVESTMENT BANK</b>	<b>PROVIDES LOAN</b>
<b>OPERATING COMPANY</b>	<b>ACQUIRES ROLLING STOCK THROUGH A PRIVATE LOAN GUARANTEED BY THE REGIONAL GOVERNMENT.</b>

<b>MATTERS DERIVED FROM THE TRANSFORMATION OF THE SUBURBAN RAILWAY INTO A LIGHT METRO</b>	
<b>INTEGRATION MATTERS</b>	<b>ACTION TO BE TAKEN</b>
<b>URBANISTIC INTEGRATION</b>	<b>DEMOLITION OF PHYSICAL BARRIERS</b>
	<b>CONTINUITY OF EXISTING ROADWAYS</b>
	<b>DISMANTLING OF EXISTING RAILWAY STRUCTURES</b>
	<b>URBAN REHABILITATION</b>
	<b>NEW PLATFORM</b>
	<b>CONTINUITY OF PUBLIC SERVICES</b>
	<b>URBANISATION OF AREA</b>
	<b>ELEMENTS OF THE NEW SYSTEM</b>
	<b>URBAN FIXTURES</b>
<b>INTEGRATION OF THE TRANSPORTSYSTEM</b>	<b>RENOVATION OF URBAN ROADWAYS</b>
	<b>USER ACCESS</b>
	<b>ESTABLISHMENT OF STOPS</b>
	<b>CONNECTION WITH OTHER RAILWAY SERVICES</b>
	<b>INTEGRATION INTO THE GENERAL ROADWAY SYSTEM</b>
	<b>RATE INTEGRATION</b>
	<b>REPLACEMENT OF PREVIOUS MEANS OF TRANSPORT</b>
	<b>SHARING OF THE PLATFORM</b>

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## 4 Conclusions and recommendations

This study analyses the Spanish experience with occupying commuter rail platforms for the suburban traffic, either by sharing them with these services which is the case with Renfe, or by dismantling the pre-existing traditional railways, and replacing them by a light railway which is geographically integrated.

The most emphasis has been placed on institutional, financial and integration matters, and the scope of this study does not include certain essential matters which are a fundamental part of implementation, especially those of a technical nature.

To prepare this study, Renfe's commuter railway and Valencia's light railway have been taken basically into consideration and meetings have been held with the persons responsible for each area.

Based on the experience analysed, the conclusions reached and recommendations arising therefrom are set out below. To establish these conclusions other experiences have been studied which, although not included in this report, have been taken into account.

In the relevant appendix, comments relating to financing matters have been made.

The conclusions/recommendations mentioned below are applicable to either both or one of the experiences:

- ◆ Conventional railway systems (CRS) entirely or partially lose operational functionality in suburban areas.
- ◆ CRS give rise to a barrier effect in the area and do not provide general service to metropolitan areas.
- ◆ The transformation of a CRS into a commuter service, using current tracks and sharing infrastructure is possible to a greater extent when:
  - ? Stations are centrally located with respect to the population
  - ? Priority or exclusive use of the track is permitted during rush hours
  - ? Punctuality and frequency can be guaranteed
  - ? Stations are adapted to commuter rail traffic
  - ? The company's organisation is adapted and independent management is obtained
  - ? Rolling stock is adapted

- 
- ? Operating criteria are adapted, mainly consisting of moving from basic criteria concerning regularity and schedules to others regarding frequency and capacity
  - ◆ The implementation of a light system on a conventional railway track which is dismantled, is more viable and functional when:
    - ? The affected area is fully urbanised
    - ? Most of the route consists of a reserved platform

Using specific rolling stock, taking special care with design and accessibility,

- ? The infrastructure and superstructure is carefully designed for urban integration
- ◆ For both alternatives, special care must be taken:
  - ? With urban and geographic integration:
    - Minimising the effect of urban barriers
    - Locating stations in population activity centres
    - Permitting general traffic to cross the infrastructure
  - ? Transport integration:
    - Becoming integrated into the co-ordination systems
    - Adapting to uniform rate systems
    - Generating or utilising transfer stations
    - Adapting ticketing and cancellation machines
  - ? Institutional integration:
    - Through consensus with competent administrations or authorities responsible for the metropolitan system
    - Becoming integrated into the co-ordination organisations
    - Adapting legislation regarding both service and jurisdiction matters
  - ? Service quality: It is absolutely essential for the success of the project to keep the maximum quality service in matters such as: frequency, speed, capacity, accessibility, comfort, etc.
  - ? Signalling, information, extension of the ticketing network, i.e. all the elements forming part of the marketing of metropolitan transport.

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◆ Financing:

- ? Both systems allow the total or partial participation of private initiatives.
- ? In the case of sharing infrastructure and private financing, it is essential to conclude a contract between both parties, which clearly establish the circumstances of the relationship:
  - Fees for the use of infrastructures and installations
  - Opportunities for the use of the tracks in the event that no exclusive use is contemplated
  - Energy supply and other matters
  - Participation in the management of the system
  - Use of rolling stock
  - Investments to be made and list concerning concession periods
  - Objective compliance indicators
  - Causes for termination

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# **Appendices**

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## **Appendix 1 Considerations regarding procedures for financing railway lines in Spain**

In Spain the procedure for financing transport infrastructure consists mainly and traditionally, in recent history, of obtaining public funds.

The first intervention of private initiatives in transport infrastructure arose in the 70's and related to toll motorways.

The financing of the rail system has been obtained through public funds, either directly from the government or through operating companies, which are all public entities, which obtained loans guaranteed by the government.

Recently different procedures have been applied to the financing of transport infrastructures.

Firstly, we should note the so-called "shadow-toll", which has been applied to some parts of the motorway network. This system is in reality a deferred payment system based on certain criteria which, in the long term, seem not to be advisable for the government authority responsible for the infrastructure, as the construction and operating companies that finance the project and its subsequent management include such items as investment risk, collection deferment costs, etc. in their cost schedules such that it is very possible that the solving of the immediate problem: lack of liquidity, and no short-term debt, is converted into a significant liability in the medium term, in addition to other questions which are out of the scope of this report.

The so-called "German method", considered for some infrastructures, is more similar to deferred payment with the project's financing covered by the construction company instead of using other debt facilities.

In the specific case of experience in Spain with respect to the private financing of rail infrastructures, there are two different models, one of which is already in used and the other is being developed.

The first is the Arganda railway ("Ferrocarril de Arganda"). The project consisted of construction by private initiatives of the extension of a metro line which, in theory, was to use part of an abandoned railway line but in the end no part of this railway line was used.

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A consortium of several construction, operating and finance companies was created and the rail line was built. The operation and the management of this line was the responsibility of the consortium, after it was appropriately adapted.

The finance system used consisted of the consortium taking responsibility of the construction and the operation of the line in exchange for an amount being paid for each passenger-kilometre travelled. Furthermore, as material pertaining to Metro of Madrid, as well as part of its installations, are used, the consortium pays a fee. There is a gradation of the fee based on the actual number of passengers transported.

The short-time this experience has been taking place has revealed a negative situation for the consortium bearing in mind that the expected number of passengers has not been reached. When the project was adjudicated a transitional stage was foreseen and benefits were provided to the successful bidder as it was believed that a certain time would pass before expected passenger levels would be reached and therefore during the first few years traffic assumptions were reduced. However, reality has been even worse than these reduced expectations and a high operating deficit has been recorded which has already forced the modification of the operating conditions.

The system developed in Barcelona for the Diagonal tramline seems to be more stable. A consortium was again established although in this case the participation of the Public Administration is different.

This project uses both public and private financing.

When the bid conditions were established for the implementation of the tramline, points could be obtained by requiring less public financing.

This bid was organised under the BOT (Build, Operate and Transfer) system with both public and private initiatives in the construction and operation stages.

Presented bids had to contain, apart from technical requirements:

- ♦ A financing system based on an initial contribution of public capital and the rest would be financed by the private group.
- ♦ Recovery of the private investment by the application of a operating technical rate together with components of amortising capital as well as operating and maintenance costs
- ♦ Shared demand risk between the concession holder and the government

The groups presenting bids were formed by groups of public works construction companies, rolling stock manufacturers and financial institutions.



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The successful bidder was a group formed by, among others, FCC, Alstom, Banco de Sabadell and Société Générale.

The total expected investment amounts to Ptas 36,000 million, approximately \$200 million, of which the initial public contribution was set at close to Ptas 26,000 million.

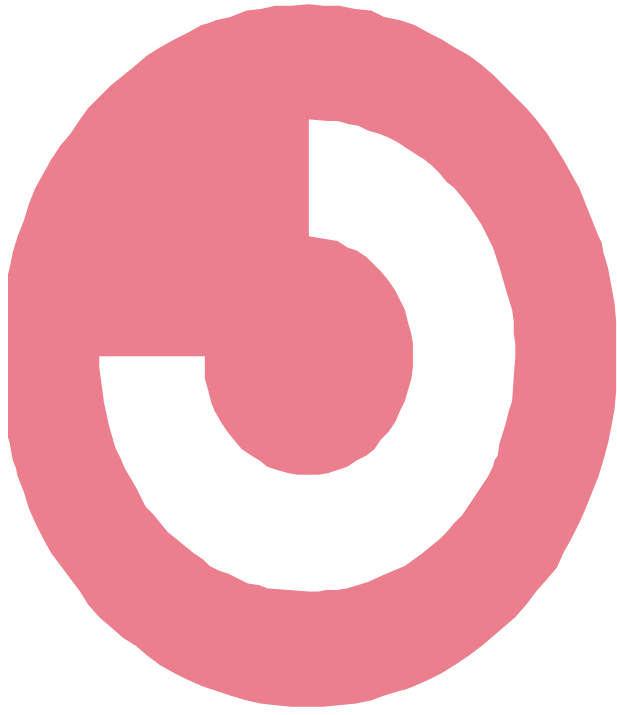
The average technical rate during the operating period is 140 pts/km (constant 2000 pesetas), including capital amortisation and operating costs.

The concession is for 25 years and the government will have a 20% interest in the operating company.

The line is expected to enter into service during the first half of 2003 and will total 16.8 Kms of railway, 10.8 of which will be dual track, and 35 stops.

It is obviously premature to speak of results but it does seem to be a reasonable financing system applicable in general to this type of service.

Finally, it should be noted that different projects that are in earlier stages of development are considering totally private financing arrangements and will have greater freedom with respect to the operation of the service.



*Cercanías  
Renfe*

**APPENDIX 2**

**Renfe's SUBURBAN SERVICES**

## Appendix 2: Renfe's suburban services (1999)

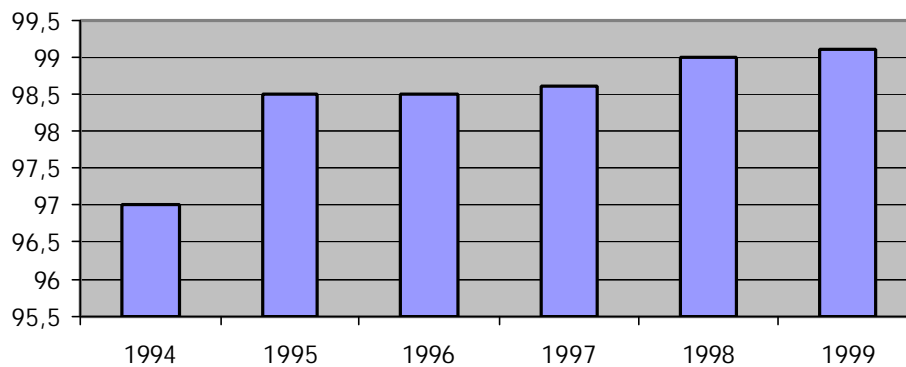
Since the implementation of the Commuter Transport Plan, Renfe has reinforced suburban services in a manner to consolidate its participation in metropolitan traffic in the main metropolitan and urban areas in Spain.

Finally, 11 commuter lines run by the Commuter Business Unit are taken into consideration. Below the most significant information regarding the current situation and development over the past few years is indicated.

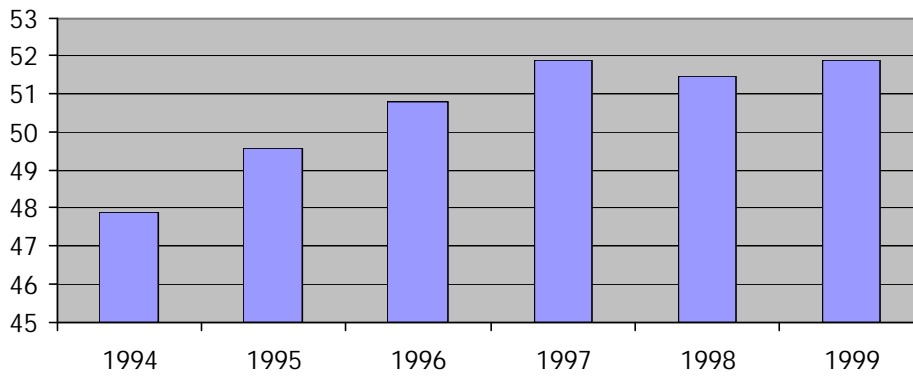
INVESTMENTS IN COMMUTER LINES		
	1998-1999	1999
TRAINS	236.112	19.452
STATIONS AND INSTALLATIONS	52.022	2.233
OTHER	2.180	235
TOTAL	290.314	21.920

MILLION PESETAS

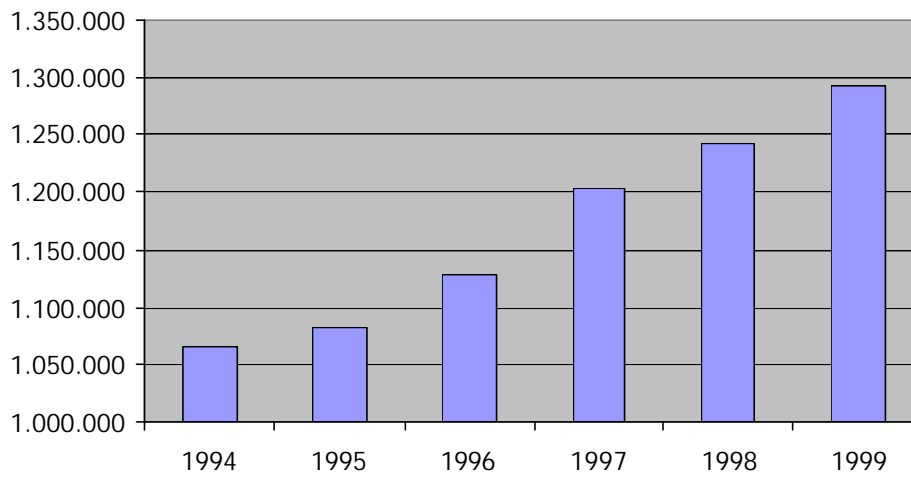
## QUALITY INDEX: PUNCTUALITY



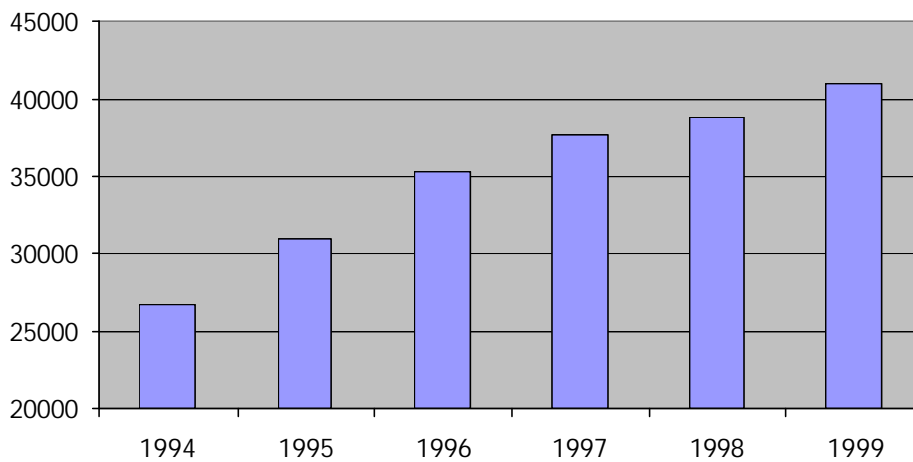
### EVOLUCION DE LA ACTIVIDAD (CIFRAS EN MILLONES DE VIAJEROS-KM)



### DEMANDA DIA LABORABLE MEDIO (VIAJEROS DIA)



### INGRESOS POR VIAJEROS (CIFRAS EN MILLONES DE PESETAS)



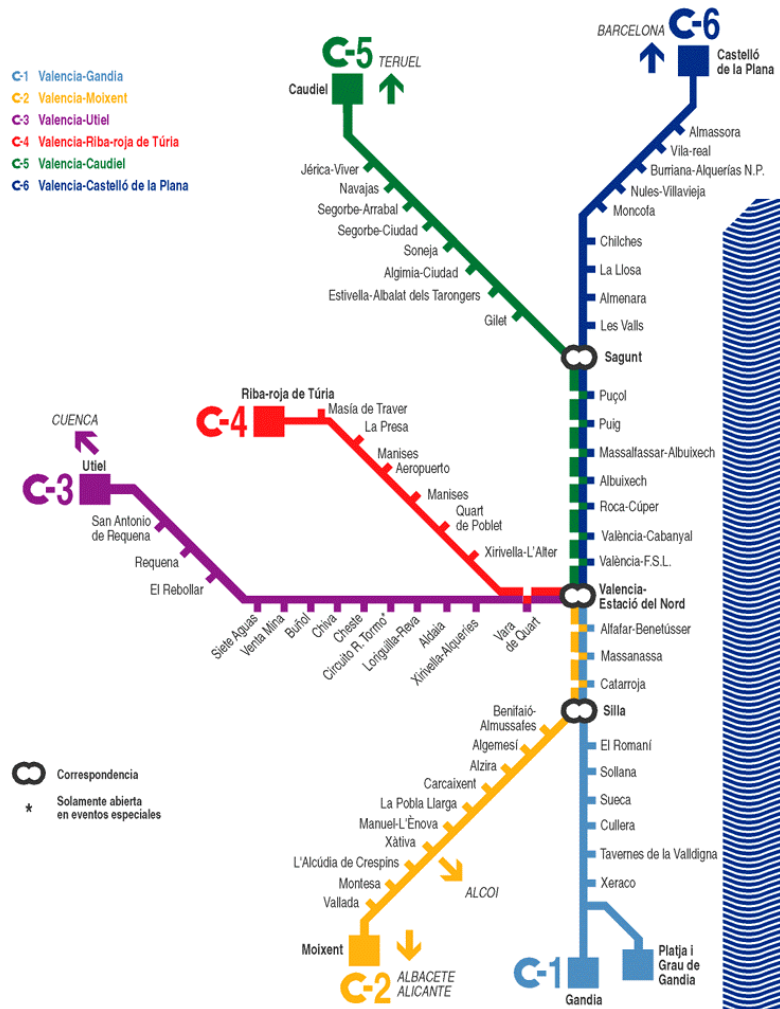
	ASTURIAS	BARCELONA	BILBAO	CADIZ	MADRID	MALAGA	MURCIA	SAN SEBASTIAN	SANTANDER	SEVILLA	VALENCIA	TOTAL
<b>FIXED ASSETS</b>												
<b>TRAINS</b>	18	156	23	4	218	7	11	12	8	13	48	518
<b>STATIONS</b>	42	104	42	8	84	25	27	29	23	22	71	457
<b>TRACK (KMS)</b>	140	451	68	49	293	68	195	82	88	134	372	1.940
<b>HUMAN RESOURCES</b>	178	987	303	51	1.321 (1)	103	96	133	49	127	395	3.743
<b>OFFER (2)</b>	174	734	559	41	1.246	90	80	83	53	86	377	3.523
<b>DEMAND (3)</b>	29.538	301.499	80.270	11.315	730.161	17.978	10.271	24.687	2.924	19.197	69.192	1.267.494
<b>INCOME (4)</b>	868	12.143	1.652	417	19.082	879	604	839	155	664	3430	.30.733

# STRUCTURE OF THE MOST IMPORTANT NETWORKS: MADRID





## STRUCTURE OF THE MOST IMPORTANT NETWORKS: VALENCIA



## VIAS DE USO EXCLUSIVO POR CERCANIAS FERROVIARIAS

### MADRID:

C - 1 : TRES CANTOS

C - 4: PARLA

C - 5: FUENLABRADA - MÓSTOLES

C - 9: COTOS

Y ALGUNOS TRAYECTOS MÁS (PASILLO VERDE,...)

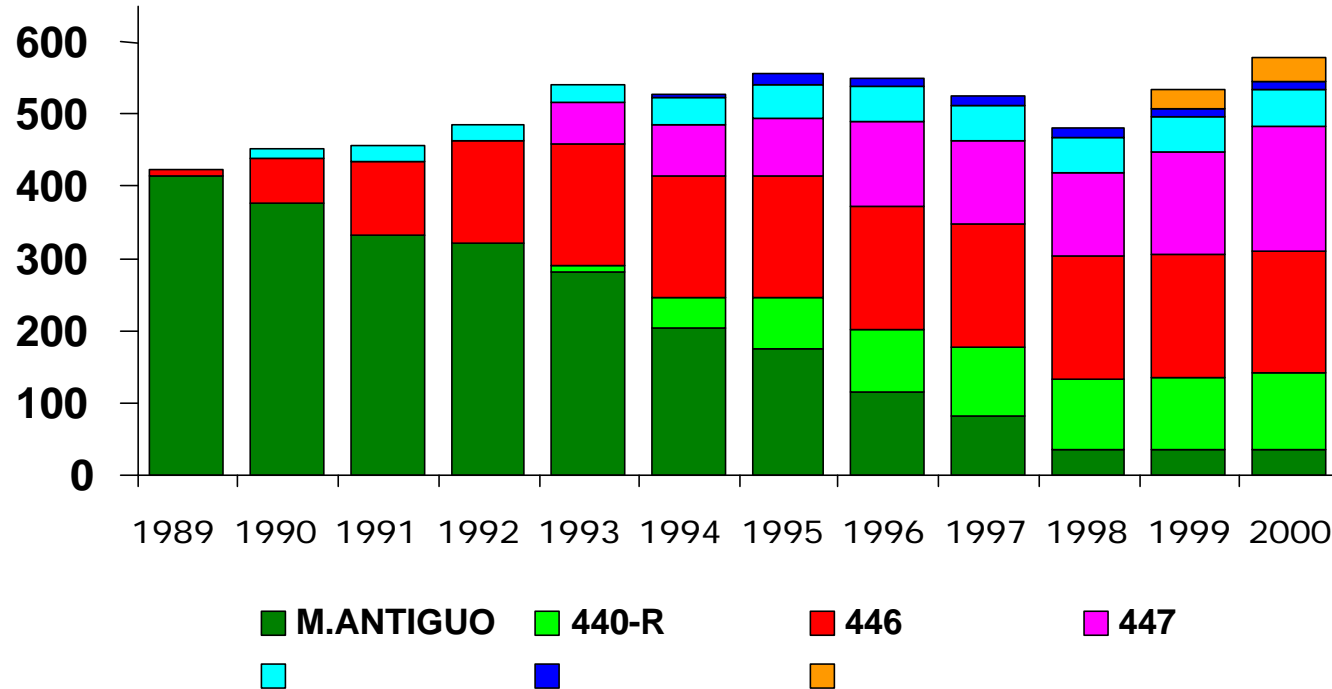
### BARCELONA:

C - 1: - AEROPUERTO

- MARESME (MATARÓ - BLANES - MAÇANET) Y ALGUNOS TRAMOS CONCRETOS



## EVOLUCION DEL PARQUE DE CERCANIAS



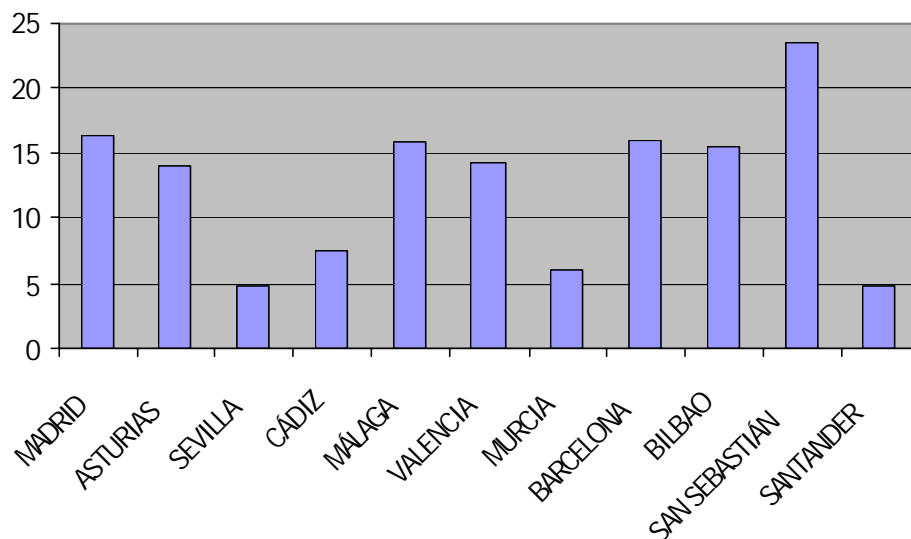
EXPECTED DELIVERIES: 66 447: 26 IN 1999 / 32 IN 2000 / 8 IN 2001

<b>MATERIAL INCIDENTS</b>	<u>1997</u>	<u>1998</u>	<u>1999</u>
NUMBER OF INCIDENTS	1.596	1.493	1.182
KMS. BETWEEN INCIDENTS	44.806	48.347	57.390
INCIDENTS U/T	2,84	2,74	2,45

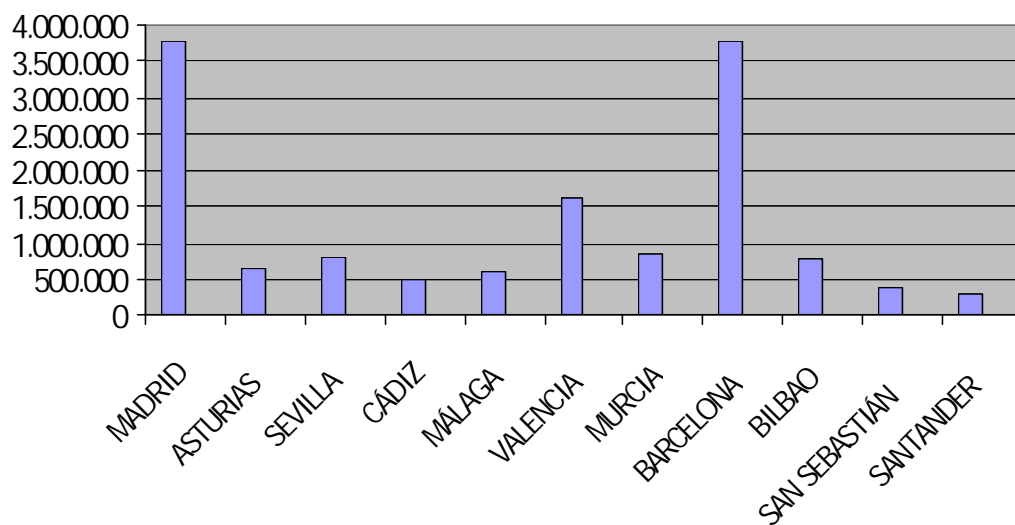
**ROLLING STOCK USED BY COMMUTER LINES**



## CUOTA DE TRAFICO FERROVIARIO EN EL TRANSPORTE METROPOLITANO



## POBLACION SERVIDA

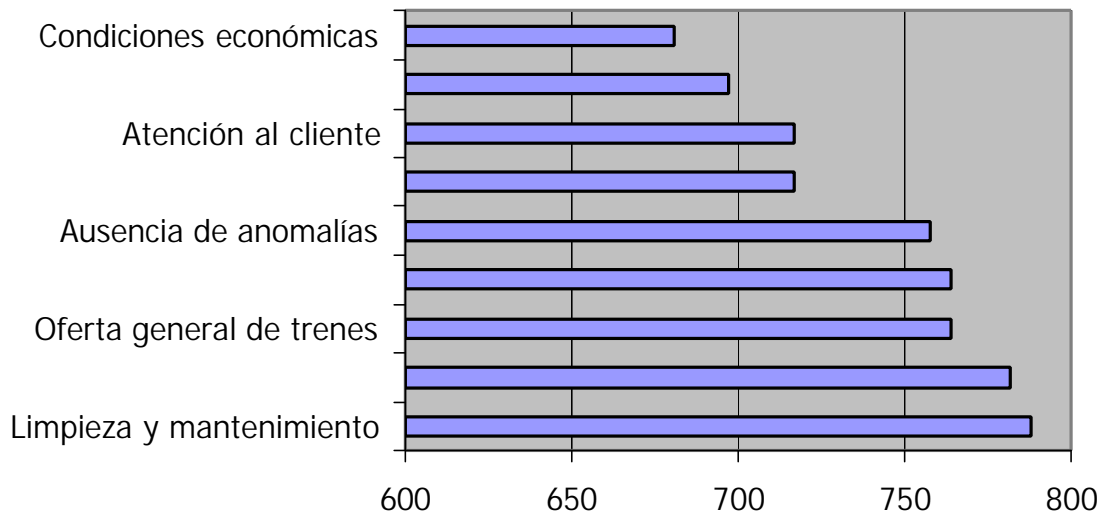


## SERVICE QUALITY

As is indicated in the text of this report, the critical factors for the service's acceptance is the quality index. In this connection, Renfe has designed and applies a system for evaluating the quality level perceived by users.

The graph and the table indicate the evaluation criteria used and the level obtained:

### ELEMENTS OF PERCEIVED QUALITY (Base of 1000)



### Appendix 3: Light metro in Valencia: photographic survey

1.- Calle Actor Mora, before and after the replacement of the railway by the light metro



2.- Calle F.J. Vives, before and after the replacement of the railway by the light metro



3.- Port District, before and after the replacement of the railway by the light metro



4.- Calle Mondúber, before and after the replacement of the railway by the light metro





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## BIBLIOGRAPHY

- ? Memorias de Ferrocarrils de la Generalitat Valenciana 1992-1998
- ? El Tranvía de Valencia. Generalitat Valenciana. 1994
- ? Estudio de satisfacción de clientes. Ferrocarrils de la Generalitat Valenciana. 1999.
- ? Plan de Transportes de Cercanías 1990-1993. Ministerio de Transportes, Turismo y Comunicaciones. 1990
- ? Memoria 1999. Gestión de Calidad. Unidad de Negocios de Cercanías. Renfe
- ? Unidad de Negocios de Cercanías. Renfe. 1999 (CD-Rom)
- ? Cercanías Renfe. Renfe 2000.
- ? Suburban Railways- A chance for our cities. UITP. 1989.
- ? Mobility for a better future. UITP. 1997