



Optimization in tramway networks planification:

*Optimization of design and allocation of stops and frequencies
depending on the costs of operation and maintenance of the line.*

DOCTORAL STUDENT: M^a CONCEPCION ORTEGA ORTIZ

TESIS DIRECTORS: D. JOSE LUIS MOURA AND D. LUIGI DELL'OLIO

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Plan of Research (3rd year).

Content:

- ▶ Optimization in tramway networks organization: Optimization of design and allocation of stops and frequencies depending on the costs of operation and maintenance of the line.

Plan of Research (3rd year).

Why:

- ▶ Actually main projects and planification of mass transport networks are designed in according to the needs of demand and orographic conditions and population of cities, to choose between mass transport systems such as
 - BRT (Bus Rapid Transit)
 - Trams and light rail.
- ▶ Designing taking into account operational and maintenance costs for long life cycle will help the selection and design of network operations more efficiently.

Plan of Research (3rd year).

Goals

- ▶ To analyze the parameters to design and plan the tram networks in consolidated urban area
- ▶ To analyze the costs of operation and maintenance of the tramway networks
- ▶ To analyze the design of tram networks (vehicle size, frequency, ..) as well as the conditions and limits thereof (geometrical, operational, ..)
- ▶ To develop a model for optimizing operational and maintenance costs from the design and planning of the lines (frequencies, stops, ..)

Plan of Research (3rd year).

SOWT (DAFO)

STRENGTHS

- Technical expertise in tramway projects for 17 years
- High interest in the Company to develop a new tool for planning
- Other tesis in relation with this one

WEAKNESSES

- Unknowdlege in specific tools (VISUM, Mathematics formulation)

OPPORTUNITIES

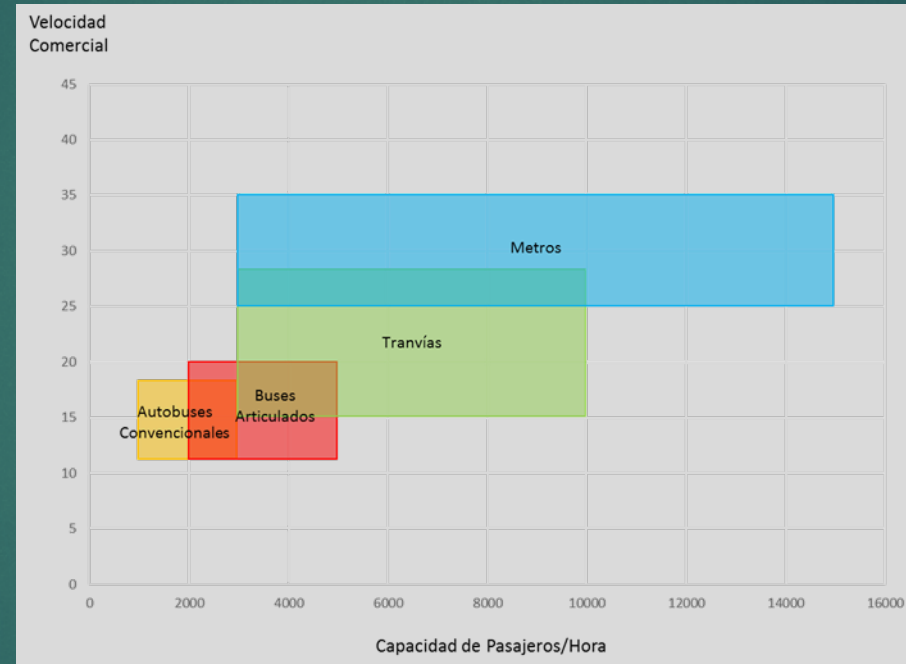
- More efficient design and planning in tramway systems
- A software tool to design

THREATS

- Not available data in operation and maintenace costs

Previous Results

Analysis of modes



In terms of capacity, the tram significantly outperforms BRT and conventional buses and the increased useful life of the vehicles would indicate that over the lifetime of the infrastructure, operational costs would also be reduced.

Previous Results

Cost Analysis Investment

The following table compares three transport solutions (TRAM, BRT and conventional bus). Apart from capacity and operating speeds, we have also analysed factors such as the investment cost per kilometre, average distance between stops, and the expected useful life of the vehicles.

Characteristics:	TRAM	BRT	Conventional bus service
Capacity Passengers/ hour	3,000-10,000	2,000 - 5,000	< 3,000
Commercial speed (km/h)	20-28	12-20	12-18
Accessibility	Low floor	Low floor	None
Investment average Million Euros / km/ Km (*)	8-30	6-16	4-8
Average between stops (metres)	400-800	400-800	400
Life expectancy of vehicles	30-35 years	10-12 years	10 years

Type of vehicle	Dimensions	Average price Euros	Average price Euros/m ² available per passengers
Long Trams	44 x 2.4 m	2,800,000	31,000
Medium Tram	32 x 2.4 m	2,200,000	24,000
Long BRTs	18 x 2.5 m	450,000	12,000
Small BRTs	12 x 2.5 m	300,000	13,000

Figure 6: Type of Vehicles and costing (Source: Libertin)

Previous Results

Cost Analysis Maintenance and Operation

The main factors to be analysed in determining the operation and maintenance costs will depend on the service provided and may include:

- Costs of operations personnel (drivers, managers, PMC controllers...)
- Cost of maintenance
- Cost of energy to traction

In terms of operation, TRAMs will be less expensive because of:

- lower energy consumption – 4 times less per available square meter, approximately 0.1 per kWh in both cases
- lower driving costs because of the higher vehicle capacity