

**SEMINARIO CENIT/UPC – UNIVERSITAT POLITECNICA DE  
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# **The Decision for Bus Rapid Transit in Rio de Janeiro:**

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## **Role of the tramway**

TORRES, A. (1991). Le Tramway Moderne a-t-il un Rôle dans une Grande Agglomération ? , Master (DEA) - University of Paris XII, Paris - France.

## **New Perception**

TORRES, A. (2000). Contribuição à Avaliação de Sistemas de Transporte – Uma Nova Percepção Metodológica na Tomada de Decisão, Doctoral Thesis - COPPE – UFRJ, Rio de Janeiro - Brasil.

## **Mobility Solution**

TORRES, A. (2013), Melhoria dos padrões de mobilidade: Existem soluções no curto prazo? Revista do Tribunal de Contas do Município do Rio n° 54, pp 39-44 , Rio de Janeiro, Brasil.

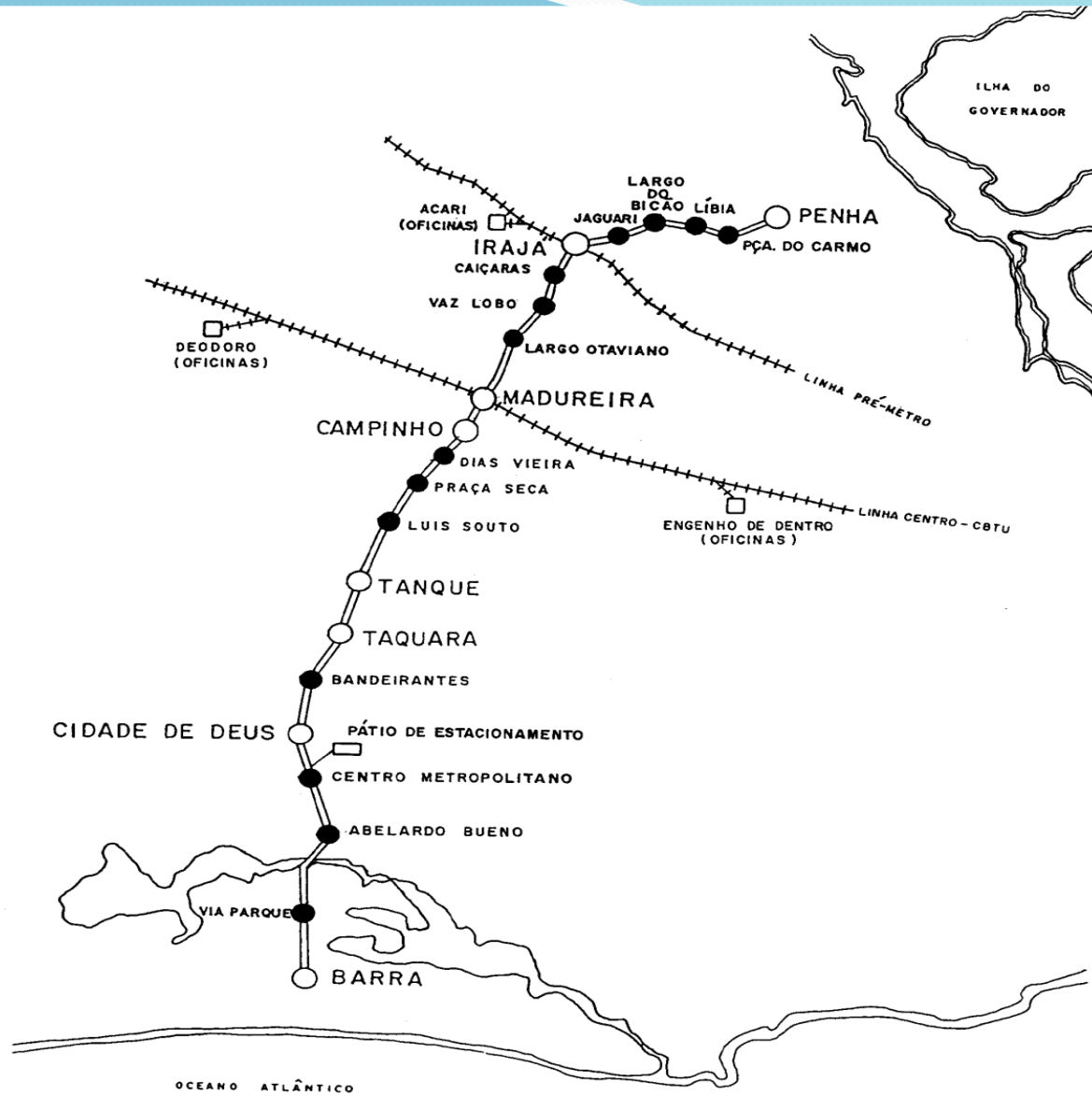
**Current project evaluation methods:** (i) use of the classic economic techniques in project feasibility studies and (ii) the limited approach of the involved staff of experts.

**New methodological perception:** the incorporation of the decision maker's approach to the project evaluation procedure, as a mediator of all involved lobby groups.


**This paper is based:** (i) doctorate thesis on Decision in Public Transports COPPE/UFRJ - Altair Torres (ii) observation development of recent decisions BRTs projects in Rio de Janeiro.

## “Classic” feasibility study (SMTR, 1994)

LRT system the best option among a set of technically feasible alternatives - conventional and articulate buses, and LRT itself - for the TransCarioca urban public transport (Figure). Policy adopted by the City of Rio: (i) a deliberate will for rail transit revival, (ii) innovative improvements on the urban transportation system (TORRES, 1991 and TORRES, 2000).



The Barra da Tijuca-Penha LRT Line



Besides considering the mentioned strategic criteria, it pointed out excellent results from the economic evaluation, as displayed in table 1. The project economic feasibility indicators confirm its profitability: the internal refund rate was above 12% and the benefit- cost ratio was 1,5.

# Table 1: Outcomes from the Barra da Tijuca – Penha LRT Line Economic Analysis

<i>Cash Flows</i>	<i>Line 1 (Taquara – Madureira)</i>		<i>Line 2 (Alvorada – Madureira)</i>	
	<i>Headway (min.)</i>		<i>Headway (min.)</i>	
	<b>5</b>	<b>3</b>	<b>5</b>	<b>3</b>
	Annual Internal Refund Rate (%)			
Net operational outcomes	8,6	8,6	8,6	8,6
Net operational outcomes + depreciation	10,9	11,0	10,9	11,0
Net operational outcomes + depreciation+ fuel savings	12,0	12,3	11,6	11,7
Net operational outcomes + depreciation + fuel savings + time savings	12,8	13,0	12,5	12,7
	Benefit – Cost Ratio ( B/C ) for a 6% Annual Refund Rate			
Net operational outcomes	1,26	1,24	1,26	1,25
Net operational outcomes + depreciation	1,52	1,52	1,52	1,51
Net operational outcomes + depreciation+ fuel savings	1,65	1,67	1,60	1,60
Net operational outcomes + depreciation + fuel savings + time savings	1,76	1,77	1,73	1,72
<b>Cost per passenger (US\$)</b>	0,3584	0,2986	0,3497	0,3089



## New methodological perception

The proposed new methodological, combined with the selected evaluation technique, apart from easy handling, ranks, by order of precedence, all analyzed project alternatives. Table 2 summarizes the steps of the procedure. The studied alternatives for the LRT are displayed in table 3.



## Table 2: Guidelines of the Evaluation Procedure

<b><i>Step</i></b>	<b><i>Guideline</i></b>
1	Identification of the main lobby groups
2	Definition of a set of project alternatives
3	Definition of the evaluation criteria
4	Interviews with the lobby group representatives
5	Criteria weights association to project alternatives (TODIM's Matrix of Partial Utilities)
6	Simulator (TODIM method) running

# Table 3: TransCarioca Line Project Alternatives

<b><i>Number</i></b>	<b><i>Project Alternative</i></b>
1	Implementation of the LRT system project
2	Implementation of the Taquara-Madureira Section of the LRT system project
3	Improvement / Expropriation and postponement of the LRT system project implementation
4	Implementation of a conventional bus line
5	Implementation articulate bus line

With the alternatives (table 3), project evaluation criteria (table 4) and interviewing group's representatives, a table of weights for each criteria (table 5) was obtained.

With this table and the running of the TODIM simulator (tables 6 to 10), the ranking of the project alternatives was obtained.

Table 4: Barra da Tijuca – Penha Line Project Evaluation Criteria

<b><i>Number</i></b>	<b><i>Evaluation criteria</i></b>
1	Improvement of people's quality of life
2	Benefit - cost ratio under the decision maker's approach
3	Relation between implementation time and duration of public administration terms of office
4	Amount of resources from a third party
5	Duration of private undertaking, fixed by the City of Rio
6	Amount and guarantees from private funding
7	Refunding and payback time
8	Technological knowhow
9	User's time savings
10	User's comfort improvement
11	User's cost savings

# Table 5: Matrix of Partial Utilities

<b><i>Project Alternative</i></b>	<b><i>Criterion Weight</i></b>											
	1	2	3	4	5	6	7	8	9	10	11	12
1 – Implementation of the 1994 LRT system project	0	0	0	7	0	0	0	0	9	9	0	0
2 – Implementation of the Taquara - Madureira Section of the 1994 LRT system project	5	3	7	7	4	4	7	8	9	0	4	4
3 – Improvement / Expropriation and postponement of the 1994 LRT system project implementation	9	7	9	7	5	4	7	8	4	6	7	4
4 – Implementation of a conventional bus line	4	5	9	7	5	4	7	8	0	6	7	4
5 – Implementation of an articulate bus line	0	9	9	0	0	0	0	8	5	6	9	3
Maximum weights	9	9	9	7	5	4	7	8	9	9	9	4

Table 6: Matrix of the Normalized Partial Utilities

<b><i>Project Alternative</i></b>	<b><i>Criterion Normalized Utility</i></b>											
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
1 – Implementation of the 1994 LRT system project	0	0	0	1	0	0	0	0	1	1	0	0
2 – Implementation of the Taquara-Madureira Section of the 1994 LRT system project	0,5	0,3	0,7	1	0,8	1	1	1	1	0	0,4	1
3 – Improvement / Expropriation and postponement of the 1994 LRT system project implementation	1	0,7	1	1	1	1	1	1	0,4	0,6	0,7	1
4 – Implementation of a conventional bus line	0,4	0,5	1	1	1	1	1	1	0	0,6	0,7	1
5 – Implementation of an articulate bus line	0	1	1	0	0	0	0	1	0,5	0,6	1	0,7

Table 7: Matrix of Pair Comparisons

<b>Criterion</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b>1</b>	1	9	7	4	4	0,1	4	0,1	9	9	5	0,1
<b>2</b>	0,1	1	4	4	7	0,1	0,1	0,1	7	7	4	0,1
<b>3</b>	0,1	0,2	1	4	4	0,1	0,1	0,1	7	7	4	0,1
<b>4</b>	0,2	0,2	0,2	1	4	4	4	0,1	8	8	7	0,1
<b>5</b>	0,2	0,1	0,2	0,2	1	4	4	0,1	0,1	0,1	6	0,1
<b>6</b>	9	9	9	0,2	0,2	1	4	0,1	9	9	8	0,1
<b>7</b>	0,2	7	9	0,2	0,2	0,2	1	0,1	9	9	8	0,1
<b>8</b>	7	9	9	9	9	9	7	1	9	9	9	4
<b>9</b>	0,1	0,1	0,1	0,1	9	0,1	0,1	0,1	1	1	0,1	0,1
<b>10</b>	0,1	0,1	0,1	0,1	9	0,1	0,1	0,1	1	1	0,1	0,1
<b>11</b>	0,2	0,2	0,2	0,1	0,1	0,1	0,1	0,1	7	7	1	0,1
<b>12</b>	7	9	9	9	9	9	9	0,2	9	9	9	1

# Table 8: Reference Criteria Matrix

Criterion	1	2	3	4	5	6	7	8	9	10	11	12	Sum
<b>1</b>	0,04	0,23	0,12	0,31	0,01	0,01	0,01	0,01	0,10	0,09	0,08	0,12	1,13
<b>2</b>	0,01	0,03	0,17	0,56	0,26	0,01	0,01	0,01	0,12	0,10	0,09	0,14	1,51
<b>3</b>	0,01	0,00	0,02	0,01	0,01	0,21	0,17	0,14	0,00	0,07	0,06	0,00	0,70
<b>4</b>	0,01	0,00	0,21	0,06	0,58	0,46	0,37	0,32	0,15	0,13	0,12	0,18	<b>2,51</b>
<b>5</b>	0,27	0,01	0,17	0,01	0,06	0,21	0,21	0,18	0,12	0,10	0,09	0,14	1,57
<b>6</b>	0,27	0,23	0,01	0,01	0,02	0,05	0,17	0,14	0,12	0,10	0,09	0,12	1,33
<b>7</b>	0,19	0,23	0,01	0,01	0,01	0,01	0,04	0,14	0,12	0,10	0,09	0,16	1,11
<b>8</b>	0,19	0,23	0,01	0,01	0,01	0,01	0,01	0,04	0,15	0,13	0,12	0,10	1,01
<b>9</b>	0,01	0,00	0,14	0,01	0,01	0,01	0,01	0,00	0,02	0,06	0,05	0,00	0,31
<b>10</b>	0,01	0,00	0,00	0,01	0,01	0,01	0,01	0,00	0,00	0,01	0,09	0,00	0,15
<b>11</b>	0,01	0,00	0,00	0,01	0,01	0,01	0,01	0,00	0,00	0,00	0,01	0,00	0,06
<b>12</b>	0,01	0,00	0,14	0,01	0,01	0,01	0,01	0,01	0,12	0,10	0,12	0,02	0,56
<b>Reference Criteria Line (# 4)</b>	0,01	0,00	0,21	0,06	0,58	0,46	0,37	0,32	0,15	0,13	0,12	0,18	<b>2,51</b>




# Table 9: Dominance Matrix

<b><i>Project Alternative</i></b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1 – Implementation of the 1994 LRT system project	0,000	-2,032	-2,378	-2,128	-1,060
2 – Implementation of the Taquara-Madureira Section of the 1994 LRT system project	2,032	0,000	-0,346	-0,096	0,972
3 – Improvement / Expropriation and postponement of the 1994 LRT system project implementation	2,378	0,346	0,000	0,250	<b>1.317</b>
4 – Implementation of a conventional bus line	2,128	0,096	-0,250	0,000	1,068
5 – Implementation of an articulate bus line	1,060	-0,972	-1,317	-1,068	0,000

# Table 10: Project Alternative Ranking

<b><i>Project Alternative</i></b>	<b><i>Total</i></b>	<b><i>%</i></b>	<b><i>Rank</i></b>
1 – Implementation of the 1994 LRT system project	-7,600	0,00	5
2 – Implementation of the Taquara - Madureira Section of the 1994 LRT system project	2,562	85,46	3
3 – Improvement / Expropriation and postponement of the 1994 LRT system project implementation	4,290	100,00	1
4 – Implementation of a conventional bus line	3,041	89,49	2
5 – Implementation of an articulate bus line	-2,297	44,59	4

**The LRT line project implementation was ranked in fifth place, while the project postponement (only the improvement and the expropriation) was the indicated alternative.**



Finally, in May 2007, the City of Rio de Janeiro decided for the implementation of a corridor of conventional buses, with the participation of private bus operators.

Currently, there have been planted 3 lines of BRT's in Rio de Janeiro. Especially because of the 2014 world cup and the 2016 Olympic games, by consortium of the bus operators.

The different conclusions from the two compared procedures and the actual decision of the City authorities confirm that the new proposed perception can precisely capture the factors of decision. The “classic” economic evaluations projects cannot provides more realistic decisions.

## **CONCLUSIONS:**

- With the introduction of some innovative evaluation criteria in a decision maker's mediator role simulation - is that its results fit better the actual contextual conditions than the "classic" approach. Indeed, the new approach is an extension of the current multicriteria analysis methods.
- The decision maker's performs his mediator role based on how he captures the different effects of his decision over the many dimensions and interests this kind of project arouse. When he weighs up the evaluation criteria for each studied alternative, the perspectives of all involved agents are incorporated.

- The adoption of this new methodological perception is also a contribution to aid to reduce some frustration feelings of the project technical staffs when their “classic” analysis are not confirmed by the decision makers.
- In de case of Rio de Janeiro - BRT as intermediate solution: Flexibility, capacity, cost and time-to-value to TransCarioca, TransOeste, TransOlímpico.
- Immediate partnerships, including foreigners, within the context of events to Rio and other Brazilian cities. Our country has great tradition in public management model with private operation and "know-how" in the road modal, industries of bodies and chassis for buses.

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