A New Methodological Perception Applied to Public Transportation System Project Feasability Analysis: The Barra da Tijuca – Penha Line in Rio de Janeiro

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Introduction

The *ex-post* analysis of most of recent transportation projects has revealed that maybe some significant aspects related to their achievement are not considered by the current evaluation procedures. Indeed, there is a gap between many recommendations from project final reports and the actual concerned decisions. An overview of some current project evaluation methods (HIRSCHFIELD, 1992 and GLAISTER, 1981) and some official funding agencies procedures (BNDES, 1991 and REBELO, 1991) has allowed the identification of two of the main conceptual deficiencies on project evaluation: (i) the use of the classic economic techniques in project feasability studies and (ii) the limited approach of the involved staff of experts. There are other factors, such as the duration of public administration terms of office, political strategies and the amount of resources from private partners, which seem to be decisive and are not usually taken into account.

This paper introduces the case study of the Rio de Janeiro LRT (Light Rail Transit) system to show the possible changes in decisions a new methodological perception (TORRES, 2003) brings, by means of the consideration of some aspects not yet used in the current evaluation methodologies and procedures, compared to the resulting outcomes from the official project final report feasability study.

The Barra da Tijuca - Penha Line Official Feasability Study

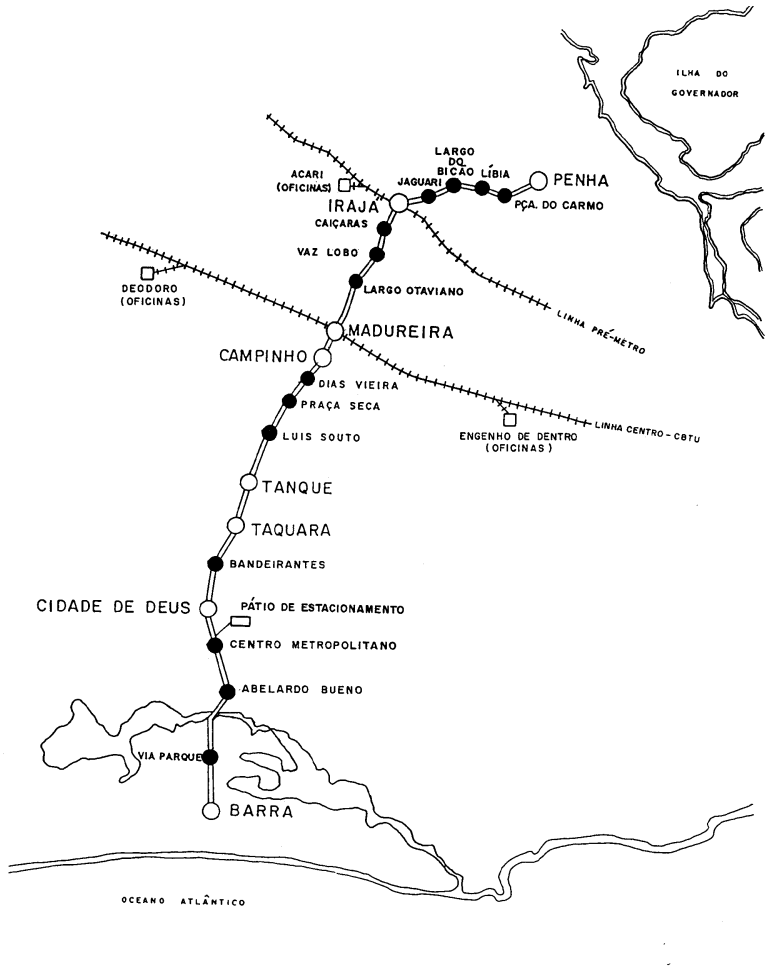
This "classic" feasability study (SMTR, 1994), assumed that a LRT system was the best option among a set of technically feasible alternatives - conventional and articulate buses, and LRT itself - for the Barra da Tijuca – Penha urban public transport supply (Figure 1). Such decision was mainly based on previous studies and has already taken into account some unusual evaluation criteria, as a part of the strategic public transportation planning policy then adopted by the City of Rio de Janeiro admnistration. These criteria were: (i) a deliberate will for rail transit revival, (ii) the need for innovative improvements on the urban transportation system and (iii) the interest of international builders to supply the required equipment (TORRES, 1991 and TORRES, 2000).

The 1994 feasability study has ratified the earlier studies. Besides considering the mentioned strategic criteria, it pointed out excellent results from the economic evaluation, as displayed in Table 1. The project economic feasability indicators undoubtly confirm its profitability: the internal refund rate was above 12% and the benefit- cost ratio was above 1,5.

The Barra da Tijuca – Penha LRT line project has never been implemented, although the "classic" procedure, applied in its 1994 evaluation, was technically correct and rather innovative. There were some other contextual factors on decision making such procedure

could not take into account. Actually, only the needed site expropriation and some improvents to local road infrastructures have been made.

Figure 1: The Barra da Tijuca – Penha LRT Line



Source: TORRES (2000)

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

Cash Flows	***Line 1 (Taquara – Madureira)***		***Line 2 (Alvorada – Madureira)***	
	Headway (min.)		***Headway (min.)***	
	5	***3***	***5***	***3***
	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
Cost per passenger (US$)	0,3584	0,2986	0,3497	0,3089

Source: TORRES (2000)

The New Methodological Perception Applied to Evaluation of the Barra da Tijuca – Penha Line Public Transportation System Project

The proposed new methodological perception is the incorporation of the decision maker's approach in the project evaluation procedure. In fact, he usually acts as a mediator of all involved lobby groups. A simulator of his choices in such role, the TODIM Method – Multicriteria Interactive Decision Making (GOMES, 1989, GOMES, 1992 and GOMES, 1998) -, using the Aid to Decision Multicriteria Method (ROY, 1985, GODARD, 1973 and VINCKE, 1989), was selected to be the analytical tool. Such approach, 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.

Table 2: Guidelines of the Evaluation Procedure

Step	***Guideline***
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

The studied alternatives for the Barra da Tijuca – Penha Line project are displayed in Table 3. The new methodological perception consisted in the consideration of the following evaluation criteria: duration of public administration terms of office, political benefits for the current public administration and amount of resources from a third party. Other "classic" factors, such as user's comfort and savings on time and costs have also been compared by the relative weight each lobby group in the project gave to each of them. The identified main lobby groups were (i) the public administration technical staff, as the project designers; (ii) the bus operators, as both the eventual LRT operators or the project opponents and (iii) the users of the public transport system.

Table 3: Barra da Tijuca – Penha Line Project Alternatives

Number	***Project Alternative***
1	Implementation of the 1994 LRT system project
2	Implementation of theTaquara-Madureira Section of the 1994 LRT system project
3	Improvement / Expropriation and postponement of the 1994 LRT system project implementation
4	Implementation of a conventional bus line
5	Implementation of an articulate bus line

After interviewing each group´s representatives, a table of weights for each criteria (Table 5) of the examined project alternatives 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

Number	***Evaluation criteria***
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
12	Political benefits for the current public administration rulers

Table 5: Matrix of Partial Utilities

Project Alternative	***Criterion Weight***											
	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 theTaquara-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 theNormalized Partial Utilities

Project Alternative	***Criterion Normalized Utility***											
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***
1 – Implementation of the 1994 LRT system project	0	0	0	1	0	0	0	0	1	1	0	0
2 – Implementation of theTaquara-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 Pairs Comparisons

Criterion	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1	1	9	7	4	4	0,1	4	0,1	9	9	5	0,1
2	0,1	1	4	4	7	0,1	0,1	0,1	7	7	4	0,1
3	0,1	0,2	1	4	4	0,1	0,1	0,1	7	7	4	0,1
4	0,2	0,2	0,2	1	4	4	4	0,1	8	8	7	0,1
5	0,2	0,1	0,2	0,2	1	4	4	0,1	0,1	0,1	6	0,1
6	9	9	9	0,2	0,2	1	4	0,1	9	9	8	0,1
7	0,2	7	9	0,2	0,2	0,2	1	0,1	9	9	8	0,1
8	7	9	9	9	9	9	7	1	9	9	9	4
9	0,1	0,1	0,1	0,1	9	0,1	0,1	0,1	1	1	0,1	0,1
10	0,1	0,1	0,1	0,1	9	0,1	0,1	0,1	1	1	0,1	0,1
11	0,2	0,2	0,2	0,1	0,1	0,1	0,1	0,1	7	7	1	0,1
12	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*
1	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
2	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
3	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
4	0,01	0,00	0,21	0,06	0,58	0,46	0,37	0,32	0,15	0,13	0,12	0,18	2,51
5	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
6	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
7	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
8	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
9	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
10	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
11	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
12	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
Reference Criteria Line (# 4)	0,01	0,00	0,21	0,06	0,58	0,46	0,37	0,32	0,15	0,13	0,12	0,18	

Table 9: Dominance Matrix

Project Alternative	*1*	*2*	*3*	*4*	*5*
1 – Implementation of the 1994 LRT system project	0,000	-2,032	-2,378	-2,128	-1,060
2 – Implementation of theTaquara-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	1.317
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

Project Alternative	*Total*	*%*	*Rank*
1 – Implementation of the 1994 LRT system project	-7,600	0,00	5
2 – Implementation of theTaquara-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.

The New Project Evaluation Approach and the Actual Decision about the Barra da Tijuca – Penha LRT Line Implementation

In 1994, with the official project studies achieved, many of the City local representatives and rulers were afraid of the feasability of its total implementation before the end of their terms of office, in 1996. Besides, among any possible bidders, the local bus operators seemed to be the more qualified to be the winners of the LRT line operation rights. But they were, and they still remain, bus operators for more than fifty years, whose itineraries match the projected LRT line. Because LRT systems technolology was not their business and they did not know very much about it, questions about LRT performances have arisen. They were also afraid of the duration of the line's private undertaking, of the necessary amount of resources they would have to raise and the required related guarantees.

The new approach, where all decisive factors have been examined and weighed up, was more effective to preview the decision makers' real actions. From its outcomes, the project postponement was the more feasable among all other alternatives, whose most relevant evaluation criteria were: (i) the amount of resources of a third party (the Table 8 Reference Criterion); (ii) the relation between implementation time and duration of public administration terms of office; (iii) the amount and guarantees from private funding and (iv) the technological knowhow.

Finally, in May 2007, the City of Rio de Janeiro decided for the implementation of a corridor of conventional buses, whose bid for auction, published in May 2007, admits a huge participation of private bus operators in the future SPC to be created for the concession contract.

The different conclusions from the two compared procedures and the actual decsision of the City authorities confirm that the new proposed perception can precisely capture the decisive factors the "classic" economic evaluations of transportation projects can not, and provides more realistic decisions.

Conclusions and recommendations

The main conclusion from the application of the proposed new methodological perception for the evaluation of transportation systems – 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. Using such approach, the evaluation of the Barra da Tijuca – Penha LRT line project was the worst placed among al other studied alternatives. But "classic" evaluation procedures for transportation projects still remain useful. Indeed, the new approach is an extension of the current multicriteria analisys methods.

It is evident that the more feasable technical and economic project alternative is always a good one. However, the decision is a commitment solution among all interested parties toward the contextual feasability of the process. 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. Anybody can perform the decision maker's role and the procedure may be used anytime, from the project feasability studies to the final decision time.

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