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Economic appraisal of road investment projects in Portugal:
Estimation of User Costs and Benefits

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ABSTRACT

Throughout the decades of 1990 and 2000, the responsible entities for decision making in the sector of the transports have becoming aware of the necessity to improve its methods of economic appraisal of road investment projects. The World Bank and the OECD underline the importance of the integration of the total costs, in the decision making on pricing policies in transports. At the European level, several projects have been financed, in the scope of the European Commission Framework Programme, that aim the identification and quantification of impacts of the activities of transports, being the most recent, UNITE and HEATCO.

This dissertation will tackle the barriers in order to maximise the opportunities for the transfer and adaptation of the theoretical results on road costs and benefits estimation to the Portuguese context.

The growth of individual transport in Portugal is becoming a threat due to the negative externalities such as: atmospheric pollution, road noise, congestion and accidents. According with the principle of the user-payer, the user must assume his share of these costs.

The final output consisted in an integrated set of cost benefit models, ready to be used in road transport policy making, namely, decision on infrastructure investment and pricing. The specificities of the data availability in Portugal were fully considered in the design (functional form and specification) of the Portuguese cost and benefits models.

Key words: Economic appraisal, cost benefit models, appraisal methodologies, road investment, congestion.

1. INTRODUCTION

1.1. GENERAL OVERVIEW

The European interest in the assessment of costs and benefits from transport modes in general and from infrastructure investment projects in particular, has grown since the beginning of the 90s. The attention of the policy makers has been focused not only on these aspects, but also in the combat of congestion and supporting the implementation of pricing policies.

In 1995, the European Commission published the Green Paper "Towards fair and efficient pricing on transport-Policy options for internalising the external costs of transport in the European Union", which introduced a change in the opinion about the pricing policies. The previous interest of creating systems of fair competition in the European transport market has become the concern to internalise transport externalities through pricing policies, by suggesting the use of marginal social costs as the base of those policies. The introduction of the universal principle of polluting-payer, has been widespread to the user-payer principle. When the user directly pay the total cost of the transport that he it consumes, increases economic efficiency and reduces the distortions of the market.

The European Union (EU) funded several projects related to pricing policies within the Research Framework Programmes and published two White Papers for Transportation (one related to pricing) and joined the High Level Group on Transport Infrastructure Charging (HLG - TIC) to study pricing policies and cost benefit estimation.

The European documents with rules and recommendations on this area consulted for this dissertation were the following:

- Green Paper "Towards fair and efficient pricing on transport-Policy options for internalising the external costs of transport in the European Union", 1995;
- White Paper "Fair Payment for Infrastructure Use: A phased approach to a common transport infrastructure charging framework in the EU", 1998;
- Final HLG-TIC Report, "Estimating Transport Costs", 1999;
- Final HLG-TIC Report, "Calculating Transport Congestion And Scarcity Costs", 1999;
- White Paper "European transport policy for 2010: time to decide, 2001";
- *Guide to Cost- Benefit analysis of investment projects, EU, 2003;*
- *Evaluating Socio Economic Development, Sourcebook 2: Methods & Techniques: Cost-Benefit Analysis, DG-Política Regional, 2003.*
- *Commission of the European Communities, Proposal for a directive of the European parliament and of the council amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures, 2003; e*
- *The New Programming Period 2007-2013: Guidance on the Methodology for carrying out Cost-Benefit*

Analysis, 2006.

The international studies/projects considered relevant for the development of this dissertation were:

- Project **PETS** (*Pricing European Transport System*), 1996-1999;
- Project **EUNET** (*Socio-Economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements*), 1996-1999;
- Project **FISCUS** (*cost evaluation and Financing Schemes for Urban transport Systems*), 1998-1999;
- Project **UNITE** (*UNification of Accunts and Marginal Costs for Transport Efficiency*), 2000-2002;
- Project **IASON** (*Integrated Appraisal of Spatial economic and Network effects of transport investments and policies*), 2001-2003;
- Study **ECT** (*External Costs of Transport*), 1995, actualização mais recente em 2004/2007; e
- Project **HEATCO** (*Developing Harmonised European Approaches for Transport Costing and Project Assessment*), 2004-2006.

The state of the art concerning the theory on road transport costs and benefits is quite developed and sound, allowing practitioners (road transport authorities, consultants, etc) to improve the information that feeds the investment political decision. However, there are some barriers hindering decision makers of taking full advantage of all that research work developed, namely:

- 1) Significant variation and uncertainty of many cost estimates: cost values are often reported as simple point values with little discussion of their variability.
- 2) It study location, specific road infrastructure characteristics, vehicle characteristics and the “traffic-mix”.
- 3) Several transportation costing studies provided insufficient details of assumptions and analysis to allow readers from different contexts to understand how estimates cost were calculated and if the results can be generalised.
- 4) Due to the variations in the availability of transport data per country, it is likely that cost functions used in a given national context could not be used in a different context.

The dissertation will tackle the above barriers in order to maximise the opportunities for the transfer and adaptation of the theoretical results on road costs and benefits estimation to the Portuguese context. The final output consists in an integrated set of models and recommendations about economic evaluation of road investment projects, ready to be used in road transport policy making, namely, decision on infrastructure investment and pricing. The specificities of the data publicly available in Portugal will be fully considered in the design (functional form and specification) of the Portuguese cost and benefits models. is likely that the empirical results of the cost studies are related to a specific context, which will include the case

1.2.OBJECTIVES

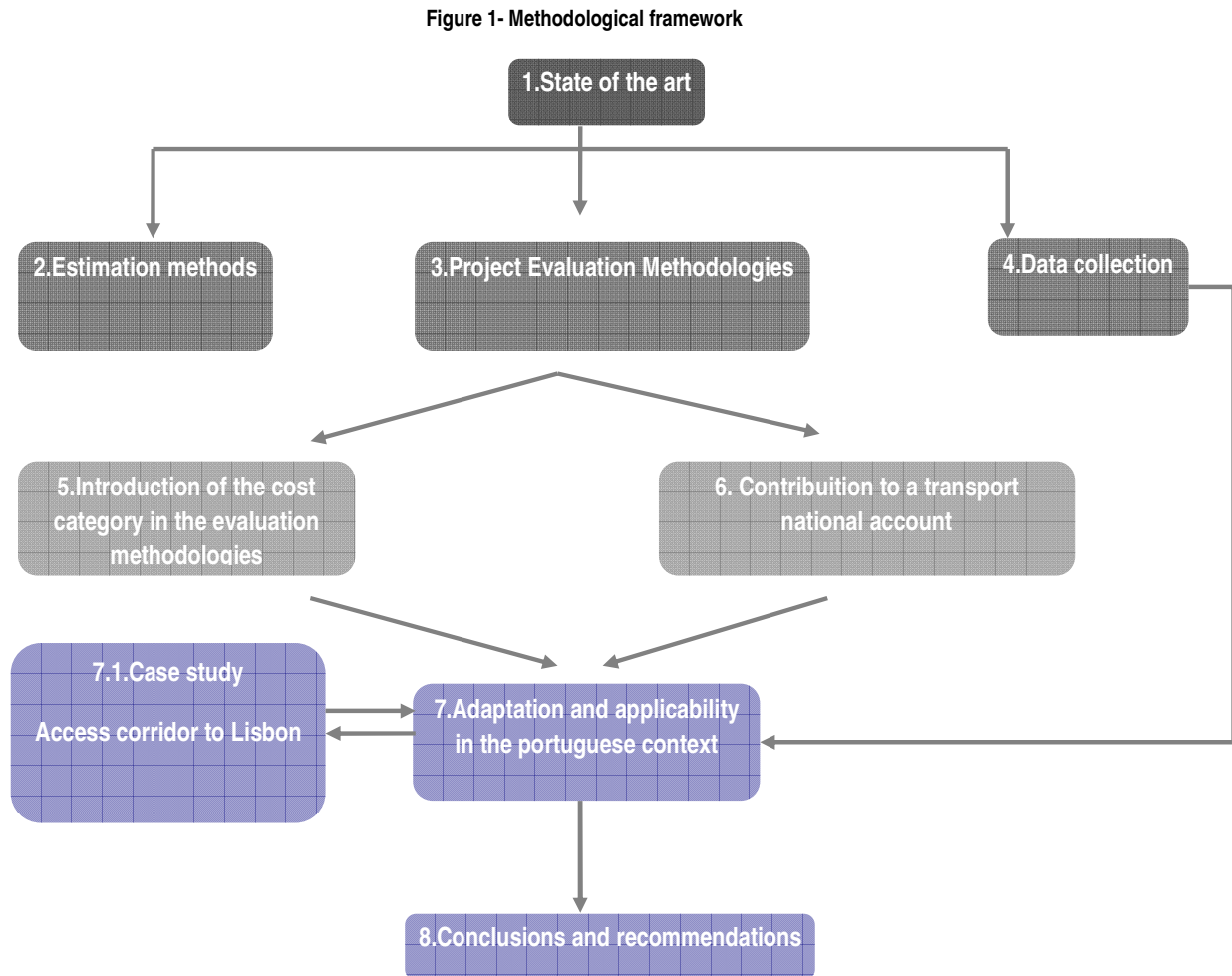
The objectives defined in this dissertation are defined below:

- Importance / need to know the social costs of transports, to know the optimum level of investment, in order to achieve higher cost / benefit ratios. Which underlines the need to improve economic evaluation methods;
- Need of a national road account for transports, which indicates the methods to estimate cost and benefits and the allocation of costs;
- To realise the users for the costs they incur when they use the individual transport;
- Provide a review of the state of the art about the methods to estimate costs / benefits to the category "User Costs and Benefits, regarding:
 - definition;
 - sub-categories;
 - disaggregation;
 - unit of cost,
 - reference figures; and
 - appraisal methodologies of investment projects;
 - Adapt the methods for the estimation of costs and the evaluation methodologies, to portuguese context.

The growth of individual transport in Portugal in the past years, is becoming a threat due to the negative externalities such as: atmospheric pollution, road noise, congestion and accidents. According with the principle of the user-payer, the user must assume his share of these costs. This dissertation appears as a methodological guide, presenting the relevant categories, the methodologies of cost benefit estimation and considered values of reference, the introduction of this category in project evaluation methodologies (based on the recommendations of the European Union), the contribute for a national account of transports (based in the pilot account of UNITE for Portugal and in the Study of DGTT/CESUR/ITEP/LNEC 2000).

1.4. METHODOLOGICAL FRAMEWORK

The methodological framework of this work consisted in the tasks defined below as shown in the figure.



Source: Own elaboration

In **chapter 1 and 2** (task 1, 2, 3 and 4 of the figure) are described the objectives and the context of the study object, as well as the state of the art regarding the estimation methods for each sub category, the methodologies of evaluation of road infrastructure projects and the existing data for the category, such as the value of time (VOT).

In **chapter 3** (task 5 and 6 of the figure) is dedicated to the evaluation methodologies of road investment projects, namely to the introduction of the study category in the evaluation methodologies and to the contribution of the category to a national transport account.

In **chapter 4** (task 7 and 7.1) are presented the adaption to the portuguese context of the methodologies of cost/benefit estimation and economic appraisal, according to the Portuguese availability of data and specifications of the country and legislation.

The task 7.1 is a portuguese case study that present one of the access link to Lisbon that better characterize congestion, the corridor Sintra-Lisboa. The objective of the case study is to quantify the user cost/benefit by measuring the additional value spent by a user of IC19/A5, comparing two scenarios (free-flow and current situation).

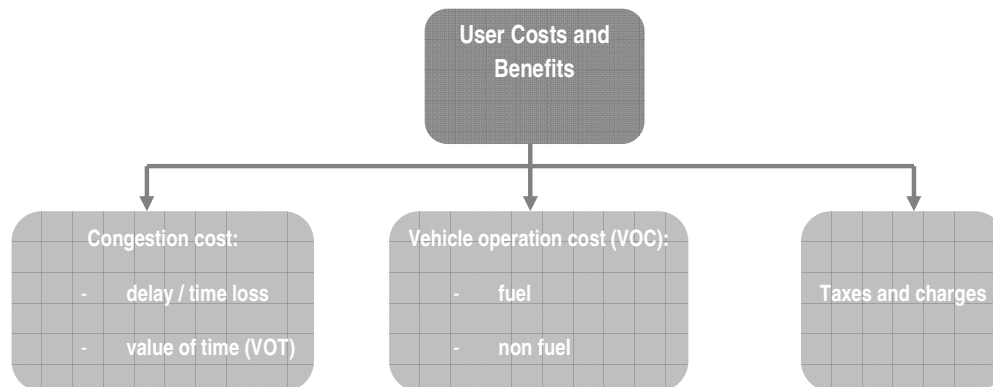
Finally in **chapter 5** (task 8 of the figure) is presented the conclusions and development recommendations.

2. ECONOMIC APPRAISAL OF ROAD INVESTMENT PROJECTS IN PORTUGAL

In economic evaluation of road investment projects this category present two items very important to evaluation, the value of time (VOT) and the vehicle operation costs (VOC). This reflects the importance given to the time savings and vehicle operation costs.

The user cost/benefit categories considered in this dissertation, according to the state of the art, are presented in the figure.

Figure 2 - User Cost/ Benefit categories



Source: Own elaboration

This dissertation present the several cost/benefit estimation methods for each category presented in the figure, discuss the better specifications and values, according to the portuguese context. The table resume the state of the art in estimaton metods according to the national and international state of the art.

Figure 3 – Estimation methods

Categories	Sub categories	Estimation methods and inputs
Congestion costs	Delay (time loss)	<ul style="list-style-type: none"> • Speed-flow relationship of HCM and COBA Manual • Calibration parameters of PETS D12 • Ozbay et al. methodologies Time loss as a function of: <ul style="list-style-type: none"> - Travel characteristics: distance between O/D pairs, traffic flow, road capacity); and - travel time.
	Value of time	Willingness to pay studies Values presented in European projects ¹

¹ The actualized values for Portugal are the ones presented in UNITE(2000) and HEATCO(2002) and from the national country reports.

Vehicle operation costs	Fuel Non fuel	<ul style="list-style-type: none"> • Coba Manual • Calibration parameters of PETS D12 • Ozbay et al. methodologies
Taxes and charges		Portuguese legislation

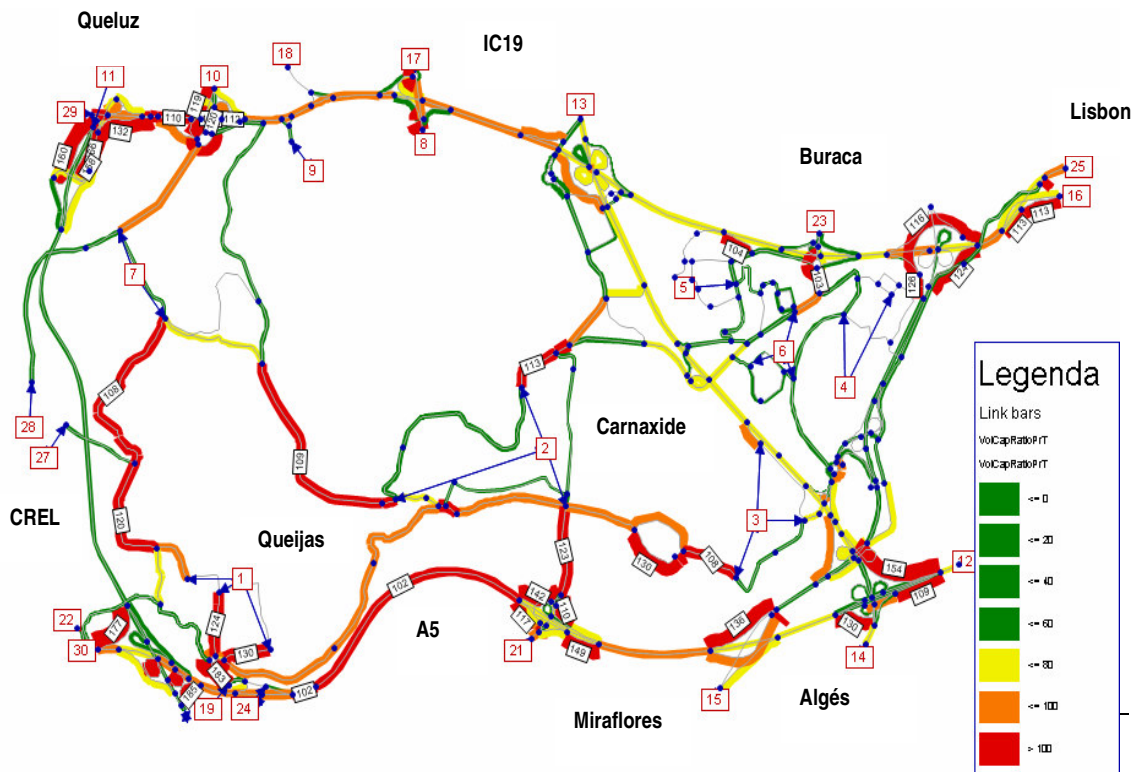
Besides the estimation methods and appraisal methodologies of road investment projects considered best practice and according to the specifications of Portugal (e.g. data availability), this dissertation present a portuguese case study.

The case study of this dissertation is one of the access links to Lisbon that better characterize congestion, the corridor Sintra-Lisboa.

The objective of the case study is to quantify the user cost/benefit by measuring the additional value spent by a user of IC19/A5, comparing two scenarios (free-flow and current situation).

The figure below is the output of the software VISUM of the area of the case study the colors represent the ratio volume/capacity. The links in red corresponds to the links that exceed their capacity (congestion situation) and the links in green are below 60%.

Figure 4 – Output of the case study



3. CONCLUSIONS AND DEVELOPMENT RECOMMENDATIONS

The analysis of the methodology and national practice on issues such as estimation of costs and benefits of road infrastructure as well as the study on the availability of data and international methodologies, allow the selection of a set of methods and values to be adopted as best practice in the assessment of road projects in Portugal. It also identifies the areas that need methodological development and values update.

In a country without directives (rules) on evaluation of projects and national cost figures such as the value of time, the terms of reference should be more detailed about the specifications of the economic studies of roads. It is not valid to compare roads whose economic studies have adopted different methodologies and figures because this will cause different results and enlarge the bias. Portugal should have an official guide for the evaluation of road projects for the transport sector in Portugal, with the methods and values (such as value of time). In the absence of such document, a fair and correct comparison between alternative projects is quite compromised.

The introduction of the category in the evaluation methodologies has a normative character that allow the regulation and standardization of the evaluation of investment road projects. It is presented what is defined in the terms of reference, where it was possible to improve that there are already some relevant requirements, however, they are not carried out yet, although they are defined as compulsory.

In what the contribute to the national account of transport is concern, 4 types of contribute can be defined, as we can see in the report, chapter 3.

The principal difficulties were at the following levels:

- **Input level:** not enough data, different and separated sources of data, different disaggregation of the data according to the models requirements. The culture of data collection and monitorization is not yet a priority and it is possible that some of the data needed are not collected in Portugal;
- **Methodology level:** methods not rigorous or use of those methods because of the lack of inputs (or bad quality). Some entities that collect the data does not make them public, and demand special authorizations which represent slow processes; and
- **Reference values:** inexistent or insufficient quality national reference values. Sometimes the process of transferability is not shown, so the values could not be adjusted to the Portuguese reality.

The state of the art has shown that there are a few methods to estimate the subcategories of the User Costs and Benefits, although there is not an agreement about the ones to use. The issue of congestion is still a polemic issue, and there's not a unique best practice method to apply.

The time loss and the vehicle operation costs has already adapted parameters to Portugal, in PETS project.

The methods described in chapter 2 and 4 are the best practice to analyse this category, but the better method for each category varies from case to case, and it is conditioned to the data availability.

Finally, it should be underlined the necessity of the existence of a normative document that works as a guide of estimation and evaluation of costs and benefits, that consider not only this category **User Costs and Benefits**, as well:

- Infrastructure costs;
- Accidents costs;
- Environmental costs; and
- Indirect Socio-economic costs.

This will allow to measure the total social costs and benefits of a road investment, define better pricing policies and evaluate the investment in a proper way. The projects will be comparable, because the costs and benefits were evaluated in a common base.

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