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An evaluation on the criteria to prioritize transportation infrastructure investments in Brazil

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ABSTRACT

This paper presents a study on the criteria priorities on the decisions of transportation infrastructure investments in Brazil, based on the application of the Analytic Hierarchy Process – AHP. We consider the definition of a set of seven criteria and respective parameters, structured in four groups: logistics/transportation, economic/financial, social and environmental. Representatives of four different sectors, which contribute to the decision making on transportation in Brazil, were used to find their different points of view about the criteria. With the main aim of prioritization of the criteria, it was considered one of the national policies of Brazilian transportation goals, *i.e.*, the modal split balance of interurban cargo transportation. Thus, each expert provided a pair comparisons of the criteria and pondered their relative importance, attributing weights based upon the scale used by AHP. These comparisons do not consider which projects should be prioritized, but only the importance of each criterion in relation to the others. As a main result, the criterion "reduction of transportation costs" was presented in several scenarios as the most relevant.

1. Introduction

In the last decades, technological changes in the communication sector have overly influenced meeting the demand for transportation. They also affected the operating and controlling practices and redirected some of the tendencies hitherto prevailing during the 20th century. Recently, opening the markets to the international competition was also applied to the transportation services, previously managed and held as domestic affairs of States. Regardless of these variations, over time, the transportation planning has become increasingly crucial so that they could understand, in the same context, all the variables involved with this sector, and their decision making, have become increasingly complex (Pinto Junior et al., 2009).

This complexity began to be observed in the planning and transportation policy of Brazilian Government over the 90s, being inserted in the development process of their respective transportation investments plans. However, only with the elaboration of the National Plan for Logistics and Transportation – PNLT (MT and MD, 2007), it is explicitly observed a scientific and methodological approach applied in favor of evaluations integrated to the Brazilian transportation network.

Consequently, during a long time the Brazilian transportation planners worked in a non-optimized way, without a systemic vision. Hence, we can find several infrastructural problems and the decision makers continue evaluating and prioritizing new transportation projects considering their own way of thinking.

Among the tools of transportation policy to be considered by the planning are: expansion of road infrastructure, reducing transportation costs and expanding the accessibility and/or mobility and modal split balance of transportation, especially cargo. These constitute one of the main mechanisms that drive investment, enhance productivity, extend the road circulation and promote economic development means to remain competitive. However, such mechanisms should be distributed geographically, aiming to provide an increased regional integration and the reduction of the inequalities (MT and MD, 2007).

PNLT re-started the strategic transportation planning by the Federal Government which considered the formation of a national transportation model with a set of methodologies for structured geographic databases. The demand for transportation considered a macroeconomic model developed to determine the financial flows between microregions of Brazil. The method used (MT and MD, 2007):

1. a reference scenario for the base year, considering the structural features of the current economic system, recent

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developments and knowledge about how economic spaces are interrelated; and
2. a general equilibrium model – Equilibrium Economic Forecasting System – EFES (Haddad and Domingues, 2001) to the reference scenario which allowed generating future scenarios.

The results provided by EFES show the socio-economic dynamics of the country establishing an analysis of the spatial implications of the megatrends of the Brazilian economy in the period 2007–2023, highlighting the demand for transportation services.

This modeling allowed establishing projections for the production and consumption of 80 types of products and services in each of the 558 microregions of Brazil, for the periods 2007–2011, 2012–2015, 2016–2019 and 2020–2023 (MT and MD, 2007).

Currently the quantities of the types of products used in macroeconomic modeling have been increased, exceeding the 110 types, and extending projections for the year 2031 (MT and MD, 2009).

The macroeconomic model was used in subsidy to conventional transportation model, giving the main references of growing rates to be adopted for the development scenarios of various products which are dependents on multimodal freight transportation.

The proposal established by the PNLT predicted change significantly the percentage of participation of each mode in the cargo transportation. The main objective was a reduction of the cargo transportation cost in Brazil which represents one of the most important and complex problems faced by its emerging economy.

In the international scenario, it is verified that there are considerable differences in the priorities adopted in several countries in relation to those practiced in Brazil. For example, according to TBS (2008), Canada stated needs for connections for a more competitive continuous and strategic intermodal transportation that integrated sea, rail, road and air networks. Thus, transportation policies, programs and regulatory initiatives were elaborated to create economic opportunities, improvements of security and protection of the environment.

Thus, considering that the decisions made in transportation policies and plans depend on several technicians and experts, the collective consciousness resulting from these decisions have particular features due to the type of economy, the characteristics and territorial dimensions of the countries, cultural aspects, among others.

Therefore, this paper presents a study to evaluate the relative tendencies of the transportation decision makers, taking into account a set of parameters associated to the Brazilian socioeconomic environment, by using the Analytic Hierarchy Process – AHP (Saaty, 1980). We believe that our findings can help decision makers in Brazil plan new and efficient cargo transportation systems. We also believe that this methodology can be adapted for developing countries to find the collective consciousness, which depends on the history of the country.

The remainder of the paper is divided as follows. Section 2 presents the transportation benefits principles, due to the importance in the investment evaluations. Section 3 presents the main methodological approaches used in the evaluations and the AHP approach. The criteria proposed to be used in the decision making related to transportation investments in Brazil are presented in Section 4. Section 5 presents an application of the AHP and the tendencies of the experts involved with transportation decision making in Brazil. Finally, Section 6 presents our main conclusions.

2. Evaluations on the benefits in transportation

The relation between transportation and socioeconomic development involves the dealing of two associated issues. Firstly, it is necessary to consider the representation of the main aspects involved with transportation infrastructure, the regional development and spatial characteristics, in order to identify and select the appropriate indicators. Secondly, it is necessary to define the analysis techniques to be adopted in order to identify and assess the causal relations among the mentioned aspects (DFT, 2005).

The transportation economic benefits are usually assessed in a context of long term planning. Thus, the quantification of the benefits of a transportation infrastructure project is made by considering the understanding of the costs supported directly by the users and their externalities, according to a socioeconomic and environmental context.

However, the dimension of these evaluations can be wider, considering issues on the regional economic development, interfaces with environmental protection areas, income and employment generation, besides others that can be listed and assessed in the context of the promoted gains by transportation infrastructure projects (Vasconcellos, 2003).

According to Vasconcellos (2003), the evaluation of benefits in transportation depends directly on the quantification of the associated costs and can be classified according to its nature, *i.e.*: direct/indirect, internal/external for the user or of being or not represented in the market transactions (tradable/not traded). So, all the benefits applicable to the transportation sector can be assessed according to the reduction of costs to the society.

For example, the items to be included in the perceived costs for a private trip are: changes in the travel time, changes in the utilization rates and changes in the operation cost of the vehicles (DFT, 2004).

The main externalities to the transportation benefits that must be considered are: the air pollution and the greenhouse effect, noise, accidents and traffic jams, with markedly socio-environmental feature and, lastly, the costs associated to the utilization of the infrastructure, predominantly socioeconomic. Besides these externalities classified as primary benefits, there is a series of other impact phenomena of reduced cost that should be taken into account such as: vibrations, soil pollution and groundwaters, changes in nature and landscape, changes to the urban balance, lack of parking space, *etc.* (Martins, 2002).

To quantify the direct benefits, it is always necessary to start from a comparison of the project that wants to invest with the situation currently established, usually defined as base case. The base case considers the current costs supported by the users of a transportation system. Thus, in economic terms, the direct benefits are quantified by the cost reduction in comparison to the base case.

Regarding the indirect benefits, their quantification follows another logic. They are evaluated in terms of expanding the economic factors of the area of influence of the enterprise. Among these benefits, we highlighted those related to the real estate valuation in the area of influence of the project and the expansion of local and regional wealth related to the production and commerce (DNIT, 2005). In short, the indirect benefits express the positive economic results absorbed by society due to the improvement of a transportation system.

Thus, the socioeconomic objectives of the transportation projects are usually related to the improvement of the travel conditions for passengers and goods. In more detail, the transportation projects deal with the following issues (EC, 2006):

- reduction of traffic jam, with the elimination of capacity restrictions;