

# MULTIPLE VIEWS OF SUSTAINABLE URBAN MOBILITY IN A DEVELOPING COUNTRY – THE CASE OF BRAZIL

Antônio Nélon Rodrigues da Silva <sup>1</sup>  
Marcela da Silva Costa <sup>1</sup>  
Márcia Helena Macedo <sup>2</sup>

<sup>1</sup> University of São Paulo  
São Carlos School of Engineering  
Department of Transportation  
Av. do Trabalhador São-carlense, 400 – São Carlos, SP, Brazil  
anelson@sc.usp.br, marcelac@sc.usp.br

<sup>2</sup> Ministry of Cities  
National Secretary of Transport and Urban Mobility  
Esplanada dos Ministérios - Bloco A - 1º Andar – Brasília, DF, Brazil  
marcia.macedo@cidades.gov.br

## ABSTRACT

This article presents a method for identification of variables and conditions to promote the concept of sustainable urban mobility based on the methodology of Multiple Criteria Decision Analysis MCDA-C. Application to ten cities from five regions of Brazil revealed the different attributes in focus from the social, economic and environmental dimensions that constitute the concept of sustainability, including the themes of greatest importance in each context. The method was adequate to demonstrate the knowledge of fundamental aspects to be considered for the formulation of public policy for sustainability and sustainable urban mobility, being able to be applied in different contexts.

## 1. INTRODUCTION

Many of the urban transportation problems affecting developing countries are nowadays a combination of historical shortcomings and recent worldwide trends. While the historical deficiencies are mainly a consequence of the lack of both human and financial resources, the recent problems are essentially an extension of the strong reliance on the automobile as the main transportation alternative to provide mobility to urban citizens.

Congestion, pollution, and extremely long travel times are some of the problems that are currently widespread in many cities of either developed or developing countries. One of the reactions to the problem in developed countries was to look for alternatives to private motorized transportation modes in order to enhance urban mobility. However, the problem is actually bigger than the solution offered only by a transportation mode shift. Therefore, many efforts have been applied to build a new concept of mobility, which is apparently the starting point to redirect any consistent planning efforts to enhance the overall mobility patterns of urban areas.

One of the first concepts of sustainable urban mobility applied by OECD and later complemented by the European Commission Group of Specialists in Transport and Environment, defines sustainable transport as the one that “contributes positively to the economic and social state without harming human health and the environment. Integrating the social, economic and environmental dimensions, it can be defined as that which:

- Allows the satisfaction of the basic accessibility and mobility needs of access and mobility of people, companies and society, of a form compatible with human health and the equilibrium of the ecosystem, promoting intra and inter-generational equality;
- Has acceptable costs, functions efficiently, offers the possibility to choose transport modes and supports a dynamic economy and regional development;
- Limits emissions and residues in function of the earth’s capacity to absorb them, utilises renewable resources at a rate below or equal to their regeneration, utilises non-renewable resources at a rate below or equal to the development of renewable substitutes and reduces land use and sound emissions to the minimum level possible” (OECD, 2000 apud MOURELO, 2002).

For GUDMUNDSSON and HÖJER (1996) four basic principles that make up the concept of sustainable development should be applied in the context of transport:

- The protection of natural resources within the pre-established limits, levels and models;
- The maintenance of productive capital for future generations;
- The improvement of the quality of life of the individuals;
- And the guarantee of a just distribution of quality of life.

However, even with these definitions already accepted and distributed internationally, the mobility concept is highly context-dependent. Because of this, every country has to work at several levels, in order to reflect the priorities of different regions and areas. Besides that, transportation systems are complex and such complexity is derived from existing structural differences (infrastructure and vehicles) along with the differences among technicians and organizations involved in their planning and management. The existence of different modes and services, regulatory rules, financing agencies, technologies, land use patterns and aspects of the human behavior contribute to make them much more complex (Richardson, 2005).

Some European countries have pioneered in the search of this new mobility concept and in the development and application of indicators to monitor the implemented policies and strategies. Europe has developed actions focusing on the integration of environmental policies with other sectorial policies. In USA, systems of indicators are developed in several levels, formalizing plans and programs and maintaining strong relationships with the established government goals. In Canada, tools including technical reports about sustainable development based on the monitoring of indicators

combined with structures and elements present in European and American experiences are used to evaluate public policies (Gudmundsson, 2000).

The initiative is now reaching other continents, which includes developing countries such as Brazil. In the Brazilian case, the movement towards sustainable urban mobility was primarily fostered by a government action at the national level. Given the strong regional inequalities and differences throughout the country, one of the first steps of the process was to look for particular views of mobility that could fit into each of the main cities and metropolitan area profiles. The federal government then established a training program for mid-level planners and technicians working at the local urban and transportation planning agencies, which started with ten of the largest cities and was designed to reach close to 400 professionals. One of the purposes of this training program was to work on a new concept of mobility entirely adapted to the local reality where the process was carried out.

Considering this condition a computer-based tool was developed in order to identify and look more closely into local mobility so that the particularities imposed by regional differences and inequalities could be identified and understood and their impacts into the structure of sustainable urban mobility concept could be highlighted. Of this form, the preparation of a tool that permits the understanding of these particularities and the structure of the concept of sustainable urban mobility was pondered. A method was then developed to identify the associated dimensions and themes applicable to different contexts. In this article the results from the application of this method to ten cities from five different Brazilian geographical regions are presented and discussed. In addition, some aspects related to the planning and management of urban mobility in Brazil are

initially discussed to show the differences between the traditional model and the new paradigm that is currently being developed in Brazil.

## **2. PLANNING AND MANAGEMENT OF URBAN MOBILITY IN BRAZIL**

Generally speaking, urban mobility matters have been treated in Brazil until recently essentially as a question of provision of transport services. According to ANDRADE *et al.* (2005), the transportation planners concern to match service supply with demand, equally for passengers as for goods, was considered the central problem of transport planning until today.

Since 1970s Transportation Plans have been considered by Brazilian urban transportation planners very important instruments to be applied in the management of urban and metropolitan transport. From this period can be denoted: the involvement of federal government with the planning, the provision and the management of local transport; the dissemination of a transport planning culture; the implementation of various organizations of transport management in municipalities and the formation of technicians and managers for the public administration sector (MINISTÉRIO DAS CIDADES, 2006).

The results of this phase can be described by the provision of infrastructure for road transport mainly through the opening of multilane roadways and expressways, the prioritization of individual transport to the detriment of collective transport, the disregard of non-motorized modes and the complete separation between urban and transport planning. It can be said that the Action Plans were focused essentially on the availability of transport infrastructure and services, and were based mainly on the construction of roads and the provision of public transport. These Action Plans were

also very often not associated to a comprehensive and integrated urban and metropolitan transport plan. Their continuity was not always assured, because they could be changed any time depending on changes in the municipal management. The result of these uncoordinated actions has been the loss of financial resources, the lack of social control and the disregard of environmental questions in the planning of urban transport in Brazil.

The country experienced concurrently a very rapid urbanization process. In only fifty years it became essentially urban, moving from a low share of urban population to over 80 % of its population living nowadays in cities. The urbanization process also concentrated the population in a small number of cities – initially in nine capitals. This metropolization process initially verified in nine capitals kept going on in most Brazilian capitals.

The multiple and consequential worsening of the resulting urban mobility problems of the city and its transport system in this fragmented form have stimulated a revision of the currently applied concepts and the development of a new paradigm of urban mobility in Brazil.

The new paradigm of urban mobility in Brazil has its bases in the 1998 Federal Constitution, which for the first time incorporated a chapter about urban politics in the constitutional text and defined the service of public transportation as an essential public service of municipal responsibility. As such, it is through the City Statute enforced in 2001 (Law number 10.257 that regulates the articles 182 and 183 of the Federal Constitution), and the creation of the Ministry of Cities, in 2003, that the theme started to be debated in Brazil.

The City Statute established a requirement for cities with more than 500 thousand inhabitants, to create an Integrated Transport Plan, which had to be a part of the Municipal Master Plan or to be compatible with it. This disposition was complemented with Resolution number 34 of the 1<sup>st</sup> of July, 2005, of the Council of Cities, where the Integrated Urban Transport Plan was altered to become the Transport and Mobility Master Plan, or simply PlanMob (IBAM and MINISTÉRIO DAS CIDADES, 2005).

The PlanMob consisted of the instrument of execution of urban mobility policy, establishing regulations, instruments, actions and projects focused on the organization of public transport, traffic circulation and traffic services. This instrument had to agree with the regulations of the National Policy of Urban Mobility, which was created by the Ministry of Cities in the context of the National Policy of Urban Development.

The National Policy of Urban Mobility is configured in the instrument by diffusing the concept of sustainable urban mobility indicated by the Ministry of Cities and by the National Secretary of Transport and Urban Mobility (SEMOB). In agreement with the National Secretary, sustainable urban mobility is the result of a collection of transport and traffic circulation policies, integrated with an urban development policy that allows ample and democratic access to urban space through the prioritization of public transport and non-motorized transport modes in a socially inclusive and ecologically sustainable manner (SEMOB, 2005).

The Ministry of Cities searches, in this way, to establish a reference model for the organization of urban mobility. It gives to the different levels of state, metropolitan and municipal governments the necessary liberty to configure their systems of mobility. The

Federal Government possesses the power to structure and articulate diverse public policies, and strategically orientate the system of mobility through the National Policy of Urban Mobility. The municipalities, cities or metropolitan regions possess the power to implement strategies for their systems of mobility conforming to national policy, including the development of adequate plans for the necessities of their residents.

However, each city has particular characteristics that limit the elaboration of one unique solution for all mobility problems. As such, the formulated policies have to consider these peculiarities to define their regulations. This means that in a country like Brazil, where the economic, social and structural differences of the systems of mobility of the municipalities are accentuated, the mobility plans have to assume distinct characteristics, and have to adapt the discussed concepts to the social context and the necessities and potentials of each region.

Considering these factors, the construction of the concept of sustainable urban mobility at the municipal level, including the process of elaboration of public policies for its implementation, is a complex and multidimensional problem. It involves an extensive number of variables, the participation of different actors and it can present significant differences from one municipality to the other in function of the aspects analysed. Because of this, for a better understanding of the structural elements and how these elements interact in distinct geographic contexts, it is possible to use auxiliary tools to organize the ideas and to assist in creating a more effective and practical planning and decision making approach. Multiple Criteria Analysis methods can be used to orientate investigations and to contribute for the systemization of strategies and identified actions in the different municipalities being analysed. A method to identify these variables based on Multiple Criteria Analysis is presented in the following section.



### **3. METHOD**

In function of the proposed objectives, a set of procedures was developed to be applied in workshops with groups of public managers and regional and municipal planners, promoted by the Ministry of Cities. The method was structured in a way to permit the characterization of the concept of sustainable urban mobility with focus on the specifics of each context analysed. At the same time, it could draw the attention of the parties involved in the process to the differences between the traditional planning model and the new paradigm of urban mobility been discussed in the country.

In developing these activities, Multiple Criteria Analysis resources known as the MCDA-C were used. This consists of an evaluation technique that takes into account all of the aspects considered important for decision makers. The choice of this technique as the guide to obtain data for analysis involves two principle characteristics:

- The methodology MCDA-C presumes that those responsible for the decision do not know in advance all elements involved in a decision problem. In this way, the understanding of the subject is gradually made while the problem is structured and debated.
- The solution of the problem is focused on the values and objectives involved. In this way, the way a decision maker understands reality influences how the problem is structured.

In function of the characteristics of the proposed analysis and the limited time available for the development of the activities (approximately eight hours for each workshop), the method was based essentially in the Structural phase of the MCDA-C methodology, developed with adaptations until the Identification of the Fundamental View Points

(FVPs) step. More details of this methodology and the description of all steps can be obtained in ROY (1993); ROY (1996), BANA E COSTA (1993); BANA E COSTA and PIRLOT (1997) and ENSSLIN *et al.* (2001).

In the context of this study, the MCDA-C method was implemented in electronic spreadsheets, in a way to permit the registration and the management of the obtained information. The implementation of the method in this environment made easy the process of driving the participants along the activities and it also allowed them to easily reproduce data for later situations in their work environment. Electronic spreadsheets are resources commonly utilised in municipal administration organizations and institutions and were widely known by the majority of the participants of the activity. As such, it was neither necessary to acquire specialised software nor to provide previous training for the development of the activities that were part of the proposed methodology.

Throughout the process, four specific sheets are manipulated and developed in the following way.

### **3.1. Characterization of the problem (Sheet 1)**

In the initial sheet the basic analysis details are identified, understanding objectives and actors involved in the process, conforming to the following description:

- Objective or Goal: Principal objective to be analysed. In the specific case of this evaluation, the objective consists of “Identification of Actions for Sustainable Mobility”;

- Decision-maker: Individual delegated with the responsibility to resolve the problem. In that case, the decision-maker is not a person, but a group of municipal, state, and metropolitan public managers and technicians;
- Facilitator: Person responsible to assist the decision maker in the process of construction of the model of negotiation and evaluation, i.e., the coordinator of the activity;
- Interveners: Individuals or institutions that can directly influence the decisions through their value system. In this case, interveners are made up of attending technical and management staff and the institutions they represent.
- Third Parties: Individuals or institutions that indirectly influence decisions. They do not have direct contact with the decision makers. In this situation, the third parties are the community of the cities or regions, represented by the interveners.
- Time Horizon: Reference point established by the participants for the defined goals and objectives.

### **3.2. Identification of the Primary Elements of Evaluation (PEEs) and construction of the Action Orientated Concepts (Sheet 2)**

The Primary Elements of Evaluation (PEEs) are made up of ideas and concepts related to the theme being analysed. In this case, they represent goals, objectives, actions, ideas, perspectives and values expressed by the participants with relation to the sustainable urban mobility question. Through them the participants reveal the way they see the problem in that specific context by taking into account their knowledge of the local reality and of the existing mobility problems.

The PEEs are obtained through the technique of brainstorming. This technique is used to stimulate creativity and generate ideas for the solution to a problem, allowing the

participants to freely express their opinions, without criticism or invalidation of any idea. The facilitator has to drive the process, although keeping a neutral position throughout it.

The collection of PEEs obtained has to be transformed into a collection of Action Orientated Concepts. These are constructed by placing a verb in the infinitive sense to the idea expressed in the PEE, arranging the first concept pole, named Positive Pole. For the concept to remain complete and to have meaning it is necessary to define the other pole, named Negative Pole, which consists of the psychological opposite. For example, the idea “Integrated Planning” can be transformed into the following concept:

To plan in an integrated way...	To plan in a sector orientated way...
<i>Positive Pole</i>	<i>Negative Pole</i>

From exploration of the complete concepts, a collective analysis is performed and the major lines of action or Strategies that better characterise the obtained ideas are identified. This activity has to be developed with ample group participation, in such a way as to ensure that the identified concepts accurately reflect the way of thinking of the group’s profile. The identified lines of action are to be used in the construction phase of the Cognitive Map.

### **3.3. Construction of the Cognitive Map (Sheet 3)**

The construction of the Cognitive Map permits the identification of the cause and effect relationships established between the concepts. The map is constructed for each Strategy or line of action defined in the previous phase, what requires an initial classification of the generated ideas. After classification, the construction of the map is made by drawing lines that represent the existing connections between the concepts. For this operation, the following convention is adopted:

- The “operational” concepts (ways to reach other objectives) are positioned below the strategic concepts;
- The “strategic” concepts are positioned at the top of the map;
- The lines are drawn from the operational concepts towards the strategic concepts.

Connections can be established between concepts from the same group or from different groups.

The cognitive map provides, in this way, the ability to visualise the global problem and to also identify possible missing links in the understanding of the question. As such, it should be possible, during the construction, to add ideas that could have been forgotten or not initially considered, increasing the understanding of the question.

#### **3.4. Identification of the Fundamental View Points (FVPs)**

The Fundamental View Points are identified through analysis of the Cognitive Map and from the identification of the concepts considered as fundamental by the decision makers with relation to the question. The analysis can be made by scrutinising the strategic and operational concepts and their hierarchal structure.

After exploration of a collection of preliminary FVPs obtained from the separation of the strategic concepts, the group is questioned about the representation of the concepts, confirming if these represent fundamental aspects related to the question. If it is deemed necessary to add another concept to the list of FVPs, this can be done in this stage of the exercise. After this verification and through final collection of the FVPs, a complete

representation is made, formed by the objective, strategies or areas of interest and for all of the FVPs.

#### **4. RESULTS**

The meetings with technical and political staff promoted by the Ministry of Cities in the context of the course programmed occurred in ten Brazilian cities distributed in five different regions between the months of May 2005 and October 2006. The main objective of the course was to provide local actors with managerial and technical skills to implement adequate policies for enhancing local mobility conditions. At the same time, it was a way to capture a detailed picture of the mobility problems and management conditions in different urbanized regions of the country. The active involvement of the agencies and institutions in charge of the mobility planning and management at the local and regional levels was therefore a necessary condition for the success of the initiative.

Each meeting involved approximately 40 participants from different backgrounds, but all involved in activities connected to urban and transport planning, from both municipal and metropolitan administration. Between the organizations and institutions represented there were secretaries of urban planning, transport, environment, residential, housing and infrastructure, transport service operators, management and traffic control organizations as well as others. The cities covered by the research in each of the regions of the country are presented in Figure 1.

The workshops were planned in such a way that the participants could have contact with the concepts of urban sustainability and sustainable mobility. These concepts were then thoroughly discussed and applied in the local context. The activities followed then the

sequence already described in the previous section, starting with the identification of the main actors, and going through the identification of the PEEs and the selection of the FVPs. Through the proposed method, it was possible to structure a reference point for sustainable urban mobility with a base of the values, perspectives and understanding of the local reality by the activity participants.

The results presented here refer to the identified Strategies, which represent the main areas of concern in relation to the question, and FVPs, that reveal more specific focuses on the themes covered, synthesising as such, the principal aspects related to the promotion of the concept of sustainable urban mobility at the local level. All terms and expressions were obtained during the discussions with the local actors involved in the workshops. They reflect: local aspects of the mobility problems; constraints for the implementation of the sustainability concept; and objectives, goals and perspectives connected to the concept of sustainable mobility.

The results obtained were grouped by region and presented in trees or hierarchy of criteria, as shown in Figures 2 to 6. The first level of the hierarchy corresponds to the identified Strategies for the cities from each region. The second level represents the FVPs associated to each of the Strategies. For each region distinct results were obtained, for both the Strategies and the FVPs. However, some aspects in common could be identified, that represented fundamentally the traditional focus covered by the questions of urban mobility in Brazil. Besides this, new aspects were incorporated, including themes and dimensions related to the concept of sustainability being introduced.

The results obtained were analysed under two principal foci:

- With relation to the fundamental dimensions that structure the concept of urban sustainability: social, economic and environmental, searching to identify the relative importance or weight attributed to each dimension of the different Brazilian regions through the analysis of the identified Strategies in each context;
- With relation to the themes covered, expressed through the FVPs, trying to find how they relate to the social, economic and environmental aspects in each region.

Before analysing the results obtained, it is necessary to present some basic characteristics that differentiate the five Brazilian regions, those which can be related to the different dimensions and themes in each context. These characteristics are summarized in Table 1.

The analysis of the results of the five regions considered, still in preliminary form, the principal social, economic and environmental characteristics, as well as the different dimensions covered and themes related to the concept of sustainable urban mobility. These analyses are synthesised in the following subsections.

#### **4.1. Analysis of the dimensions of sustainability**

For the relative analysis of the dimensions of urban sustainability in the context of each region, a classification of the Strategies was completed, in the first instance, of the three different dimensions that make up the concept.

To reduce the subjectivity of this classification, a relationship between the themes was established that represented each of the dimensions. This relationship was developed



with its base as a collection of urban sustainability indicators analysed in the work of COSTA (2003). From the group of sixteen systems evaluated in that study, which includes social, economic and environmental indicators, the principal themes related to the dimensions of sustainability were extracted, comprising a total of approximately one hundred and seventy key-words or expressions, which constitute a theoretical background for the classification of the Strategies.

As such, each Strategy was related to one dimension, in agreement with the focal question and with a base of the information contained in this preliminary relationship. Grouped together, the Strategies revealed the evidence or relative importance of each dimension for the five Brazilian regions, as shown in Figure 7.

For the southern region, the social dimension represented 62 % of the total of the identified Strategies. The environmental dimension represented close to 38 % of the total. In the southeast region, the social dimension corresponded to 53 %, 40 % environmental and 7 % economic. In the centre-west region, the social and environmental dimensions represented 50 % each of the total Strategies. In the north region, the social, economic and environmental dimensions represented, respectively, 39 %, 17 % and 44 %, and the northeast, 47 %, 10 % and 43 %.

In this way, in three of the five regions, the social dimension was the most crucial (South, Southeast and Northeast), while the environmental dimension remained in second place for these localities. In the centre-west region, the social and environmental dimensions were equivalent. In the north region, the environmental dimension was the most crucial, concentrating most of the concepts related to the theme.

The economic questions were not thought of in two regions: Centre-west and South. It must be noted that these regions have relatively high economic indices compared with most other regions in Brazil, including per-capita income, corresponding to the first and third greatest value in Brazil. That may be the reason why the economic dimension was not among the main issues discussed in both cases. In the three regions that included economic factors, these regions presented different values. The highest were noted in the North and Northeast regions. Those regions have the worst economic indicators of Brazil, in addition to deep social problems, such as an unequal income distribution, low life expectancy, and low levels of school attendance.

For the northern region, the weight given to the environmental dimension can be justified by the specifics of the North's ecosystem and by the difficulty to maintain equilibrium between human activities (especially the activities related to urbanization and the mobility of people and goods) and the environment. Another concern was the maintenance of the environmental quality of the cities in a region with a lack of resources and infrastructure. When compared to the other regions, the indicators of the northern region presented a clear equilibrium in the three dimensions of sustainability. That is probably a sign that major needs are equally observed in all aspects of the development.

It should be noticed that the environmental dimension was not important only in the northern region, but also in all other regions. That can be an indication of the growing importance given to the environmental aspects involved in the urban mobility planning in Brazil.

#### **4.2. Analysis of specific themes**

Even that the social dimension has received the major focus in the majority of the Brazilian regions, as indicated in the analysis based on the classification of the Strategies of the three fields that make up the concept of urban sustainability, variations could be observed in the analysis of each context. And this was also observed for the economic and environmental dimensions, for which several distinct characteristics also appeared in the different regions.

These differences were understood through analysis of the FVPs associated with the Strategies. These revealed the specific aspects in the treatment of the questions of social, economic and environmental character. In the same way, the main limitations and potentials of the localities covered in the study were revealed in the manner of implementation of sustainable urban mobility policies. The FVPs identified for each region, classified in the three dimensions of sustainability are shown in Table 2.

For the southern region, the social dimension was focused on aspects related to the provision, quality and integration of the systems of urban public transport, considering the social field as a fundamental factor for progress in the direction of sustainable urban mobility. Other themes deal with questions of integrated urban and metropolitan planning, as well as safety concerns and pedestrian and cyclist prioritization. In the environmental field, the concerns are concentrated in the questions of territorial planning, including the development of adequate Urban Development Master Plans, including the zoning of urban activities. In addition to this, the consumption of non-renewable energy, quality of infrastructure and environmental actions were part of the sustainable mobility concept in the region.

In the southeast region, the themes of the social dimension also included public transport, metropolitan integration and concerns with non-motorized modes of transport. Of these themes, respect for the rights and necessities of the citizens and disabled persons made up part of the focus of this field. Regarding the economic question, concerns were limited to costs and investments of mobility systems. The environmental dimension included the provision of infrastructure for cyclists, the equilibrium between transport and environment, universal accessibility and traffic congestion.

In the centre-west region, the social dimension was broken down into the formulation of public policies, especially sustainable urban mobility policies. The questions of planning and modes of transport were also considered. With respect to the environmental dimension, the questions of infrastructure, accessibility and spatial occupation defined the region's focus.

In the northern region, the social dimension included, as well as public policies, mass transport and consideration of disabled persons, also focuses of other regions, aspects such as education, social inclusion, and integration of public services. The economic dimension involved public-private partnerships for the raising of capital and investments in mobility systems. In the environmental dimension, aspects related to urban accessibility and elimination of physical barriers, the question of land use and the utilization of natural resources, were highlighted.

Finally the northeast region included in the social dimension access to opportunities, popular participation, diversity and integration between modes of transport, socialization of the knowledge and of the urban space and the problems of lack of incentive for public transport and preference for private modes. The economic field

covered questions related to investments in education and social policies, alternatives for raising and managing funds and economic equity. The environmental field addressed the problem of environmental pollution, accessibility through adequate public space and the improvement of urban infrastructure, planning and management of land use and specifically the problem of the destruction of the ecosystem formed by lakes and beaches. That is a common problem in beachfront cities in the north east of Brazil that creates direct impacts on the environmental quality of these cities.

In all of the regions questions related to urban planning and integrated transport were present in the social dimension.

## **5. CONCLUSIONS**

Two outcomes were reached through the courses discussed in this work. At the same time that local planners and managers discussed the concept of sustainable mobility they worked together with the Ministry of Cities in the definition and development of policies adjusted to the local context and tuned with the National Policy of Urban Mobility. That was made possible by the identification in each city of the key elements, i.e. Strategies and FVPs, needed for the implementation of the concept at the local level. That is certainly an important step towards the definition of urban mobility policies that can be adopted by the cities and even metropolitan areas when developing their Mobility Plans recommended by the City Statute. In addition to that, the data collected make up a very reach source of information for future research. It can help to understand the regional differences in the country regarding urban mobility.

Based on the results obtained in the workshops, we note that the concept of sustainability has been incorporated in a varying grade for the activities of urban

planning and management, especially in what we refer to as mobility. This situation was confirmed, principally through the response given to the questions of integrated planning and social and environmental concerns, given by the majority of the cities evaluated during the activities. It is important to remember that historically these themes were placed as a secondary element in the treatment of the questions of urban mobility in Brazil. Its insertion in the process of planning demonstrates, in part, the identification of new concepts and dimensions that drive the notions of sustainability and sustainable development, already consolidated internationally and still in construction in Brazil.

However, in function of the continental dimensions and the profound economical, social and cultural differences between the Brazilian regions, the notion of sustainability takes on different forms, associated to the specific local particularities. As such, the weight given to the environmental, economic and social questions in each context is distinct, reflecting the degree of development of each region. At the same time, very specific questions were discussed in the different localities, in agreement with the FVPs, reflecting particular problems or potentials that inhibit or facilitate, respectively, the process of sustainable urban development.

In this way, we realise that the understanding of regional differences allows different ways of understanding and application of the concept of sustainability. That is fundamental for the formation of public policies. In this way, policies for the promotion and improvement of quality of life in Brazilian cities can be elaborated, with consideration of local sustainability and through the implementation of national policies.

The incorporation of the dimensions of urban sustainability, especially social and environmental questions, indicates, finally, the establishment of a new paradigm of urban planning and management in Brazil. However, in function of the initial stage, the results of this new mode of thinking still have to be discussed and developed, from theory to practical actions that aim to improve the conditions of mobility in Brazilian cities.

## **6. ACKNOWLEDGEMENTS**

The authors would like to express their gratitude to the Brazilian agencies CAPES (Post-Graduate Federal Agency), FAPESP (Foundation for the Promotion of Science of the State of São Paulo), and CNPq (Brazilian National Council for Scientific and Technological Development), which have supported our efforts for the development of this work in different ways and periods. Finally, we thank the referees for their valuable comments.

## **7. REFERENCES**

ANDRADE, A. R.; BALASSIANO, R.; SANTOS, M. P. S. (2005) 'Gerenciamento da Mobilidade: Princípios para sua Aplicação com Base na Informação'. *Revista do Centro de Estudos de Transporte e Meio Ambiente*, Universidade Federal da Bahia, 2(2), pp. 15-24.

BANA E COSTA, C. A. (1993) 'Processo de Apoio à Decisão: Problemáticas, Actores e Acções'. Lisboa: CESUR.

BANA E COSTA, C. A., PIRLOT, M. (1997) 'Thoughts on the Future of the Multicriteria Field: basic Convictions and Outline for a General Methodology'. *Multicriteria Analysis*, Berlin: Springer.

BANA E COSTA, C. A. (1992) 'Structuration, Construction et Exploitation d'un Modèle Multicritère d'aide à la Décision'. Thesis (Doctorate). Universidade Técnica de Lisboa, Portugal.

BANA E COSTA, C. A., VANSNICK, J. C. (1995) 'Uma nova abordagem ao problema de construção de uma função de valor cardinal: MACBETH'. *Investigação Operacional*, 15, pp.15-35.

COSTA, M. S. (2003) 'Mobilidade Urbana Sustentável: um Estudo Comparativo e as Bases de um Sistema de Gestão para Brasil e Portugal'. Master's Thesis. Escola de Engenharia de São Carlos, Universidade de São Paulo, Brasil.

GUDMUNDSSON, H.; HÖJER, M. (1996) 'Sustainable development principles and their implications for transport', *Ecological Economics*, 19, pp. 269-282.

GUDMUNDSSON, H. (2001). 'Indicators and performance measures for Transportation, Environment and Sustainability in North America'. Report from a German Marshall Fund Fellowship 2000 individual Study Tour October 2000. National Environmental Research Institute, Denmark. 87 p. – Research Notes from NERI number 148.

ENSSLIN, L.; MONTIBELLER NETO, G.; NORONHA, S. M. (2001) 'Apoio à Decisão: Metodologia para Estruturação de Problemas e Avaliação Multicritério de Alternativas'. Florianópolis: Insular.



IBAM; MINISTÉRIO DAS CIDADES (2005) 'Mobilidade e Política Urbana: Subsídios para uma Gestão Integrada'. Lia Bergman e Nídia Inês Albesa de Rabi (coord.), Rio de Janeiro, Brazil.

IBGE (2000) 'Censo 2000'. Instituto Brasileiro de Geografia e Estatística. Available in: <http://www.ibge.gov.br/>. Accessed on November 10, 2006.

IBGE (2004) 'Indicadores Sociais'. Instituto Brasileiro de Geografia e Estatística. Available in: <http://www.ibge.gov.br/>. Accessed on November 10, 2006.

MINISTÉRIO DAS CIDADES (2006) 'Guia PlanMob para Elaboração dos Planos Diretores de Transporte e Mobilidade'. Secretaria Nacional de Transportes e da Mobilidade Urbana, Brasília, Brazil, May 2006.

MOURELO, A. C. A. (2002) 'Un sistema de indicadores para avanzar en la movilidad sostenible'. Memorias do V CONGRESO DE INGENIERÍA DEL TRANSPORTE, Santander, Spain, pp. 171-180.

PNDU (2000) 'Atlas do Desenvolvimento Humano no Brasil'. Programa das Nações Unidas para o Desenvolvimento. Available in: <http://www.pnud.org.br/atlas/>. Accessed on November 10, 2006.

RICHARDSON, B. C. (2005) 'Sustainable transport: analysis frameworks'. Journal of Transport Geography, 13, pp. 29–39.

ROY, B. (1993) `Decision Science or Decision-Aid Science?' European Journal of Operational Research, 66 (2) pp. 184-203.

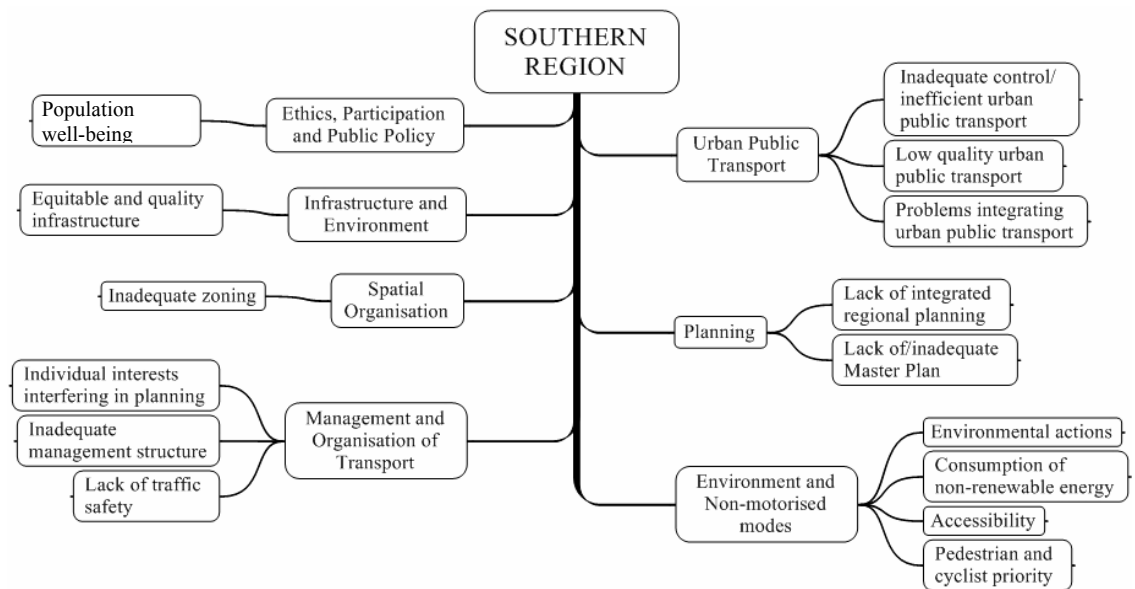
ROY, B. (1996) `Multicriteria Methodology for Decision Aiding'. Dordrecht: Kluwer Academic Publishers.

SEMOB (2005) Secretaria Nacional de Transporte e Mobilidade Urbana. Available in: <<http://www.cidades.gov.br/index.php?option=content&task=section&id=14>>.

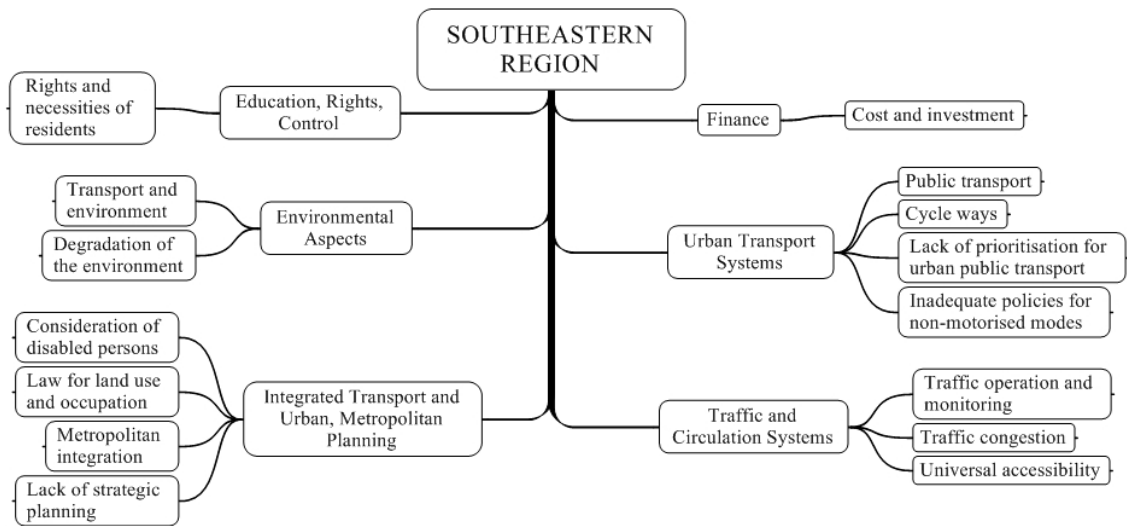
Accessed on December 6, 2005.



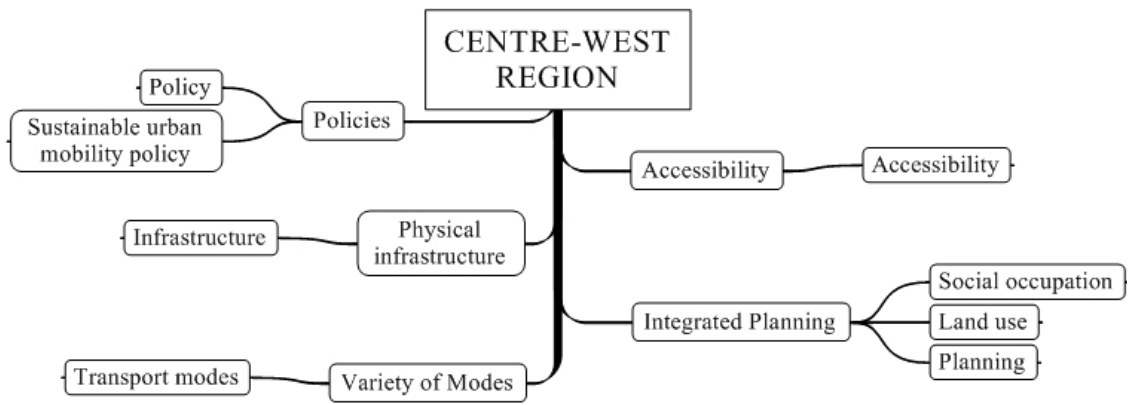
**Figure 1:** Brazilian cities covered in the study.



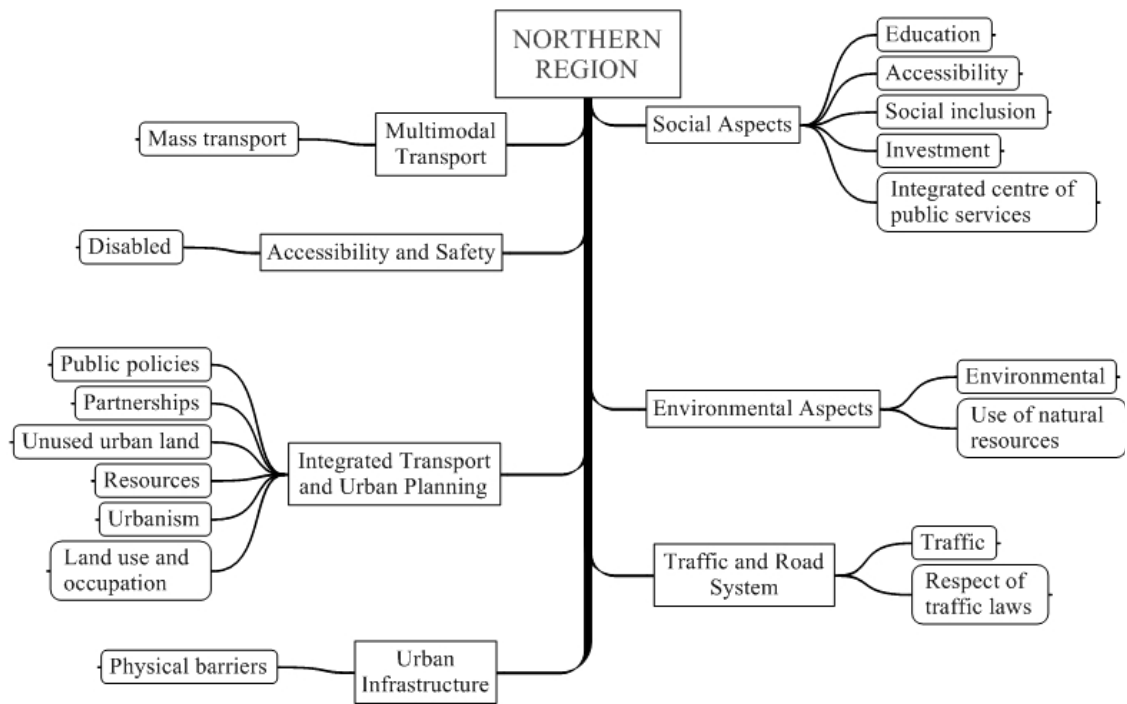
**Figure 2:** Hierarchy of criteria for the cities in the southern region of Brazil



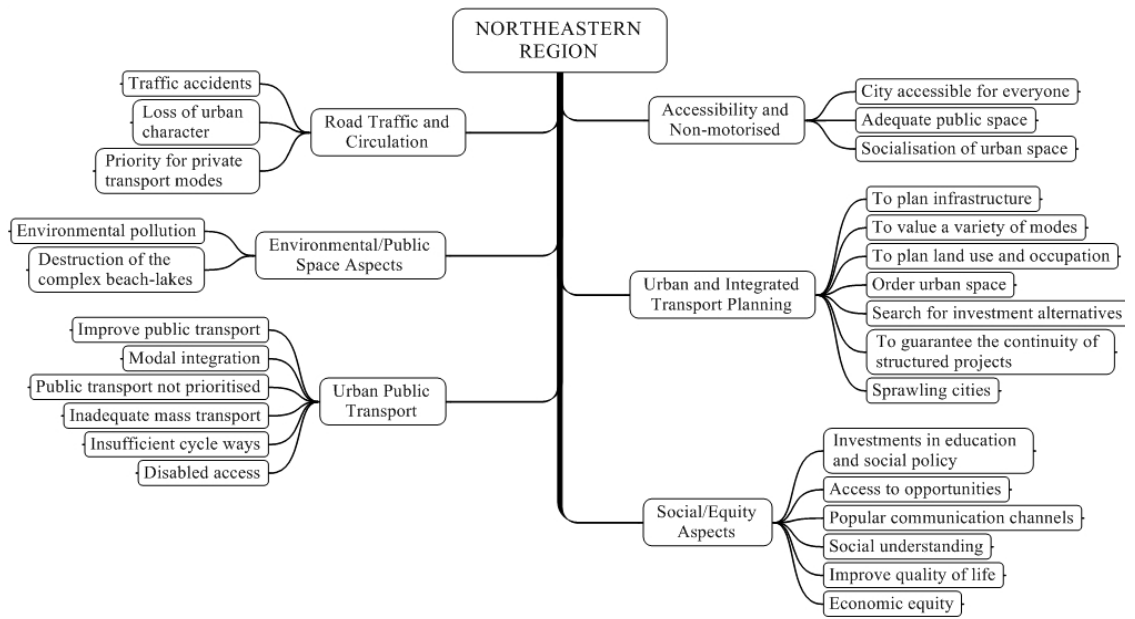
**Figure 3:** Hierarchy of criteria for the cities in the southeastern region of Brazil



**Figure 4:** Hierarchy of criteria for the cities in the center-west region of Brazil.

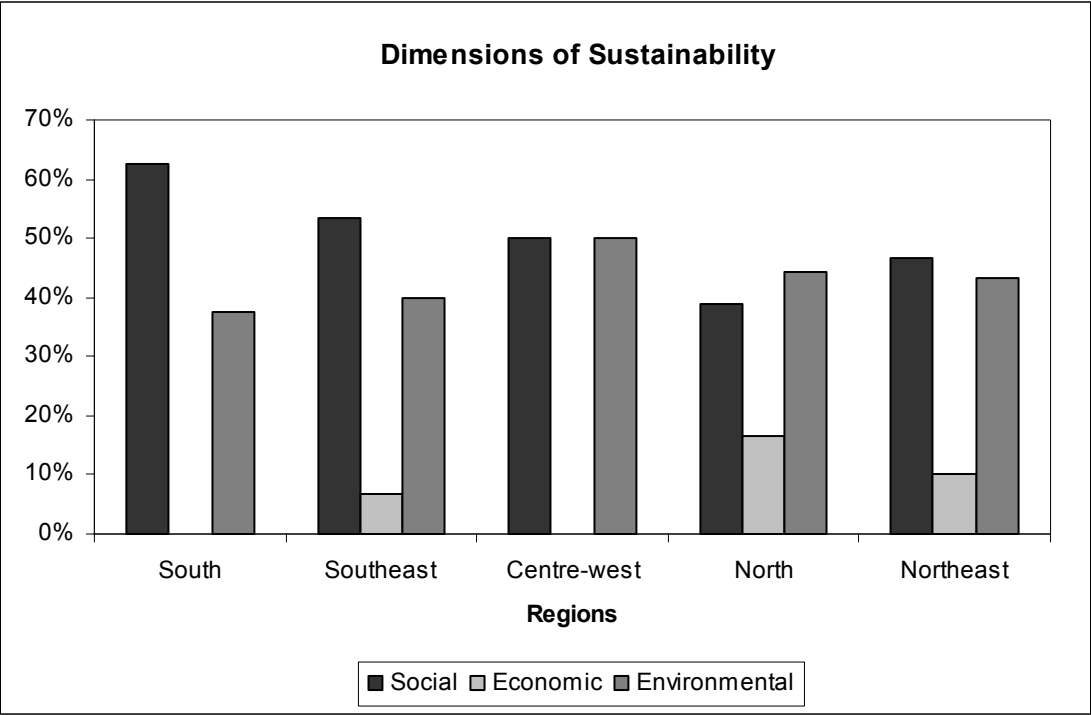


**Figure 5:** Hierarchy of criteria for the cities in the northern region of Brazil.



**Figure 6:** Hierarchy of criteria for the cities in the northeastern region of Brazil.





**Figure 7:** Relative importance of the dimensions of sustainability for the cities of the different Brazilian regions.

**Table 1:** Characteristics of Brazilian regions.

<b>Characteristics</b>	<b>South</b>	<b>Southeast</b>	<b>Centre-west</b>	<b>North</b>	<b>Northeast</b>
Population <sup>1</sup>	25,107,616	72,412,411	11,636,728	12,900,704	47,741,711
Área <sup>1</sup> (km <sup>2</sup> )	576,409	924,511	1,606,371	3,853,327	1,554,257
Territory (%)	6.77	10.86	18.87	45.25	18.25
Demographic Density (inhab/km <sup>2</sup> )	43.55	78.32	7.24	3.34	30.71
Urbanization <sup>2</sup> (%)	82	92.1	86.3	73.5	71.5
Average Human Development Index <sup>3</sup>	0.807	0.791	0.792	0.725	0.683
Per-capita Income <sup>3</sup> (R\$)	342.62	355.69	366.72	196.22	152.16
Literacy <sup>3</sup> (%)	92.5	90.77	89.71	73.5	71.5

Sources: <sup>1</sup>IBGE (2001); <sup>2</sup>IBGE (2004); <sup>3</sup>PNDU (2000).

**Table 2:** FVPs classified in the dimensions of sustainability.

	<b>Social</b>	<b>Economic</b>	<b>Environmental</b>
<b>Southern</b>	Inefficient/inadequate control of urban public transport		Lack of/inadequate Master Plan
	Low quality urban public transport		Environmental actions
	Problems integrating urban public transport		Consumption of non-renewable energy
	Lack of integrated regional planning		Accessibility
	Pedestrian and cyclist priority		Equitable and quality infrastructure
	Individual interests interfering in planning		Inadequate zoning
	Inadequate management structure		
	Population well-being		
	Integrated planning		
	Lack of traffic safety		
<b>South-eastern</b>	Public transport	Cost and Investment	Cycle ways
	Rights and necessities of residents		Transport and environment
	Disabled persons		Law for land use and occupation
	Metropolitan integration		Universal accessibility
	Traffic operation and control		Environmental degradation
	Lack of strategic planning		Traffic congestion
	Public transport not prioritised		
<b>Centre-west</b>	Inadequate policies for non-motorized modes		
	Transport modes		Infrastructure
	Politics		Accessibility
	Sustainable urban mobility policy		Spatial occupation
<b>North</b>	Planning		Land use
	Education	Partnership	Environment
	Social Inclusion	Resources	Accessibility
	Respect for traffic laws	Investment	Physical barriers
	Public policies		Vacant urban areas
	Mass transport		Use of natural resources
	Integrated centre of public services		Urbanism
	Physically disabled		Land use and occupation
<b>North-eastern</b>			Traffic
	Access to opportunities	Investment in social education and policies	Environmental pollution
	Popular communication channels	Search for alternative finance options	City accessible for everyone
	Promote various transport modes	Economic equity	Adequate public space
	Guarantee the continuation of structural projects		Promote universal accessibility
	Improve public transport		Land use and occupation planning
	Guarantee inter-modality		Order urban space
	Socialization of understanding		Insufficient cycle ways
	Improve quality of life		Disabled access
	Integration of modes		Sprawling cities
	Public transport not prioritised		Lack of urban planning
	Inadequate mass transport		Destruction of the complex sand dunes
	Traffic accidents		Loss of urban character
Private transport prioritised		Infrastructure planning	
Socialization of urban space			