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Multiple views of sustainable urban mobility: The case of Brazil

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ABSTRACT
The aim of this work is to identify key factors of a sustainable urban mobility concept in a particular context. A multiple criteria decision analysis method was developed to identify the main variables associated to the concept. Looking at the results obtained in 11 cities of the five Brazilian regions, we conclude that the method is able to capture the different views and approaches discussed in the formulation of the mobility concept. Therefore, it can be used as a starting point for the formulation of public policies and also in the development of tools designed for monitoring the mobility conditions.

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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. Therefore, many efforts have been applied to build a new concept of mobility, as can be seen in several works produced in the last decade or so. Among them are documents of the World Bank (1996), of the Transportation Research Board (TRB, 2001), and of the Organization for Economic Co-operation and Development (OECD, 2002). These efforts were apparently the starting point to redirect any consistent planning efforts to enhance the overall mobility patterns of urban areas.

Until the end of the 1970s, the concept of mobility was predominantly seen as a matter of transportation services provision. Thus, the main problem faced by transportation planners was to match infrastructure supply with transportation demand, for both goods and passengers. In addition, the planning approach at that time was marked by: (i) an emphasis on road transport, (ii) a priority for private rather than for public transportation, (iii) limited efforts to promote non-motorized modes, and (iv) a frequent separation of urban and transportation planning.

However, the way cities and their circulation systems are planned started to change in the last decades of the last century. That change resulted not only in new planning strategies, but also in the development of a new urban mobility concept. The new concept is based on the assumption that the mobility problems are not only a consequence of a limited physical access to the transportation modes. On the contrary, they involve complex environmental, economic, social and behavioral issues. These are directly connected to the physical planning of the city, to financing issues, and to a system management approach to deal with mobility problems. In summary, the new concept focuses on the improvement of the mobility and accessibility conditions aiming at a better quality of life for urban citizens, and hence on the pursuit of what is currently called sustainable urban mobility.

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 people, companies and society, so that it can be 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 according to the earth’s capacity to absorb them, utilizes renewable resources at a rate below or equal to their regeneration, utilizes 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 the search for the new mobility concept and in the development and application of indicators to monitor the implemented policies and strategies. This can be seen, for example, in projects such as TRANSPLUS (2002), ECOCITY (2001), and SCATTER (2008). In addition, a connection between several of these initiatives was established by the LUTR project (May, 2003; EUROFORUM, 2007). The search for a new mobility concept is now reaching other continents (Gudmundsson, 2001), which includes developing countries such as Brazil.

Brazil has a population of approximately 192 million inhabitants, which are not homogeneously distributed over the country area of 8,500,000 km$^2$. It is the biggest country in Latin America and the fifth largest country in the world in terms of territorial area and population. The country had an annual population growth rate of 1.41% in 2006 and a HDI (Human Development Index) of 0.80 in 2005 (UNDP, 2007). It spreads out north to the equator line and south to the Tropic of Capricorn. As a consequence of that large territory and of its geographical location, it presents many physical differences. The country is also marked by several economic and social contrasts. All those differences are consolidated into five geo-political regions, as summarized in Table 1.

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 of urban planners and managers that were appropriate to 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 11 of the largest cities. At that stage, it was designed to reach close to 450 professionals. The professionals involved in the training program were selected from the staff of government planning agencies at the city level (in a few cases also at the state and metropolitan level). Those individuals were key elements for spreading the new ideas and concepts throughout their organizations, for two reasons. Firstly, as they do not work at the top management level, their position is not so easily affected by political bargaining. In other words, they are long-term components of the municipal administration. Secondly, they have a greater opportunity for changing the current work practices within the administrative structure than the operational teams.

The meetings with technical and political staff promoted by the Ministry of Cities in the context of the course occurred in 11 Brazilian cities distributed in five different regions between the months of May 2005 and November 2006. The main objective of the training program 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.

As one of the goals of the training program was to work on a new concept of mobility entirely adapted to the local reality, some techniques and tools had to be developed or adapted for that purpose. One of them was a computer-based tool designed to support the management of the workshops while registering the information obtained from the participants during the sessions. The tool was essentially based on the description phase of a MultiCriteria Decision Analysis method with a Constructivist approach, from now on referred simply as MCDCA-C. As we will further discuss in Section 3, the method is sensitive enough to capture differences between distinct groups when discussing a problem (or a concept, as in our case). In the case of the sustainable urban mobility concept, the differences can be a consequence, for example, of dissimilar environments. That ability of reflecting the particular conditions of the place under analysis makes the method particularly useful for the formulation of public policies or for the development of tools for monitoring urban mobility conditions.

In this article the results from the application of this method to 11 cities from five different Brazilian geographical regions are presented and discussed in Sections 4 and 5, respectively. In addition, some aspects related to the planning and management

### Table 1
Characteristics of Brazilian regions.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>South</th>
<th>Southeast</th>
<th>Centre-west</th>
<th>North</th>
<th>Northeast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population a</td>
<td>25,107,616</td>
<td>72,412,411</td>
<td>11,636,728</td>
<td>12,900,704</td>
<td>47,741,711</td>
</tr>
<tr>
<td>Area (km$^2$) b</td>
<td>576,409</td>
<td>924,511</td>
<td>1,606,371</td>
<td>3,853,327</td>
<td>1,554,257</td>
</tr>
<tr>
<td>Territory (%) c</td>
<td>6.77</td>
<td>10.86</td>
<td>18.87</td>
<td>45.25</td>
<td>18.25</td>
</tr>
<tr>
<td>Demographic density (inhab/km$^2$)</td>
<td>43.55</td>
<td>78.32</td>
<td>7.24</td>
<td>3.34</td>
<td>30.71</td>
</tr>
<tr>
<td>Urbanization (%) d</td>
<td>82</td>
<td>92.1</td>
<td>86.3</td>
<td>73.5</td>
<td>71.5</td>
</tr>
<tr>
<td>Average human development index e</td>
<td>0.807</td>
<td>0.791</td>
<td>0.792</td>
<td>0.725</td>
<td>0.683</td>
</tr>
<tr>
<td>Per-capita income $c$ (R$) f</td>
<td>342.62</td>
<td>355.69</td>
<td>366.72</td>
<td>196.22</td>
<td>152.16</td>
</tr>
<tr>
<td>Literacy (%) f</td>
<td>92.5</td>
<td>90.77</td>
<td>89.71</td>
<td>73.5</td>
<td>71.3</td>
</tr>
</tbody>
</table>

*a* IBGE (2000).

*b* IBGE (2004).

*c* PNDU (2000).
of urban mobility in Brazil are initially discussed to show the differences between the traditional model and the new concept 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 (Ministério das Cidades, 2006). The results of this process 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. Those uncoordinated actions have resulted in the loss of financial resources, the lack of social control and the disregard of environmental questions in the planning of urban transport in Brazil.

That was already registered some years ago by Vasconcellos (2001), who stated that poor transit supply, low accessibility, badly maintained vehicles, discomfort, congestion, pollution and accidents are daily problems faced by most people living in the large Brazilian cities. He also observed that structural political and economic conditions maintain social exclusion, poverty and unemployment and confine the decision-making process to selected groups. Moreover, private transportation has often been favoured, and local public transportation and non-motorized means have been neglected. The consequential worsening of the resulting urban mobility problems of the city and its transport system have stimulated a revision of the currently applied concepts and the development of a new concept of urban mobility in Brazil.

The new concept of urban mobility in Brazil has its basis in the 1998 Federal Constitution, which for the first time incorporated a chapter about urban policies 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 500,000 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 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. The development of such a plan has to support the overall idea of a new mobility concept that must be incorporated by the municipal administrations. In order to do so, the PlanMob is not similar to the traditional Urban Transportation Master Plans. Among the characteristics that make the PlanMob different from the traditional plans are: the introduction of a strategic component in urban mobility management, particularly in institutional and financing aspects; a more adequate approach to deal with the social conflicts produced by the use of public spaces or market-related conflicts; and extensive public participation in all planning phases. The plan has 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 (Ministério das Cidades, 2006).

The Ministry of Cities searches, with the standard given by the PlanMob, to establish a reference model for the organization of urban mobility. However, the PlanMob gives to the different levels of state, metropolitan and municipal governments the necessary liberty to configure their systems of 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. This means that in a country like Brazil, where the economic, social and structural differences of the systems of mobility between municipalities are accentuated, the mobility plans have to assume distinct characteristics. They have to adapt the concepts to the social context and the needs and potentials of each region.

3. Method

To accomplish the proposed objectives, we developed a set of procedures to be applied in the 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 allow the characterization of the concept of sustainable urban mobility with focus on the specificities of each context analyzed. 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 concept of urban mobility being discussed in the country.

In general, the aspects associated to the traditional urban mobility planning concept, strongly adopted in Brazil from 1960 to 1990, focused on the following issues: traffic management (through strategies to reduce congestion, for example), transportation services (such as public transportation provision), and transportation infrastructure (e.g., expansion of the urban road networks). In contrast, the new mobility concept gradually introduces social, environmental, and equity issues into the planning process, which was often not considered, or even rejected, in the past.

In developing these activities, Multiple Criteria Analysis resources known as the MCDA-C were used. MCDA-C consists of an evaluation technique that takes into account all of the aspects considered important for decision makers. The method is used to support decision-making processes in different ways: (i) to clearly identify the objectives, (ii) to evaluate the relative importance of those objectives, and (iii) to assess the impact of different alternatives on the objectives. In addition to that, it accepts that frequently a decision-making process cannot be based only on objective criteria and quantitative factors. Subjective factors may have to be considered as well, even if that brings some operational difficulties to the analysis procedures.

The decision-making process with the MCDA-C method has the following stages:

- **Problem definition:** The boundaries of the decision context and a label for describing the problem are defined in that phase. Also in that phase, the primary elements of evaluation (PEEs) and the fundamental view points (FVPs), which are key elements in the decision-making process, are identified.

- **Evaluation:** Value functions and compensation or replacement rates are defined in that phase. These parameters make it possible to anticipate the future impact of selected actions and to conduct a global evaluation of the decision-making process. Sensitivity analyses are used for that purpose.
• Conclusions and recommendations: Looking at the results obtained in the previous phases, conclusions and recommendations are then incorporated into the decision-making process.

More details of this methodology and the description of all steps can be obtained in Roy (1993, 1996), Bana e Costa (1992), Bana e Costa and Pirlot (1997) and Ensslin et al. (2001).

The choice of this technique as the guide to obtain data for analysis involves two main 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 of those involved in the process (in the case discussed here, the workshops participants). As the method extracts those values and objectives directly from the participants’ viewpoints, the way they understand the reality influences how the problem is structured.

Given the characteristics of the proposed analysis and the limited time available for the development of the activities (approximately 8 h for each workshop), the method was based essentially on the structural phase of the MCDA-C methodology, developed with adaptations until the identification of the fundamental view points step.

In the context of this study, the MCDA-C method was implemented in electronic spreadsheets, to permit the registration and the management of the obtained information. The implementation of the method in this environment simplified the process of taking the participants through the activities. It also allowed them to easily reproduce data for later use in their work environment. Electronic spreadsheets are resources commonly utilized in municipal administration organizations and institutions and were widely known by the majority of the participants of the activity. As such, it was not necessary either to acquire specialized software or to provide prior training for 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, conforming to the following description:

• Objective or goal: Principal objective to be analyzed. 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 are made up of ideas and concepts related to the theme being analyzed, as stated by the workshop participants. 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 their 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 rejection of any idea. The facilitator has to drive the process, although keeping a neutral position throughout it. In order to exemplify the diversity of concepts and ideas discussed, some of the PEEs identified in the workshops are listed below:

• integrated planning;
• accessibility;
• centralization and decentralization of activities;
• congestion;
• integration of public transportation;
• infrastructure;
• social inclusion;
• urban facilities;
• pollution;
• non-motorized modes.

The collection of PEEs obtained is transformed into a collection of action-orientated concepts. Those concepts are also suggested by the workshop participants, who build them 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…

Positive pole Negative pole

From exploration of the complete concepts, a collective analysis is performed and the major lines of action or strategies that better characterize 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. A few examples of the strategies in which the initial ideas were classified are listed below:

• social aspects (equity issues, access to opportunities, policies for citizens with special needs, social inclusion and exclusion, etc.):
• environmental aspects (use of natural resources, use of non-renewable energy, environmental degradation, etc.);
• accessibility;
• integrated planning;
• public transportation.

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, which 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 were not initially considered, increasing the understanding of the question.

3.4. Identification of the fundamental view points

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 scrutinizing the strategic and operational concepts and their hierarchical structure.

After exploration of a collection of preliminary FVPs obtained for each 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. The FVPs derive, therefore, from the PEEs identified in the initial workshop phase. As such, they represent key elements of the sustainable urban mobility concept identified by the participants.

For a relative analysis of the dimensions of urban sustainability in the context of each region, the strategies identified in the workshops were classified in one of the dimensions: social, economic and environmental. 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 analyzed in the work of Costa et al. (2005). The objective of that work was to identify indicators that could be used to monitor the mobility conditions in cities of Brazil and Portugal. In order to do so, the authors selected sustainability indicators from experiences in Brazil and in several other countries (as those described, for example, in UNCED (1992) and Dickey (2001)). As the themes and indicators considered in those experiences represent attributes and characteristics that should be monitored in any attempt to promote the concept of sustainable urban mobility, they provide the ground for our theoretical framework.

4. Results

Each workshop session 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 Fig. 1.

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

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, and thus synthesize 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 and branches, as shown in Figs. 2–6. The first level of the hierarchy (the first box in each branch) corresponds to the identified strategies for the cities from each region. The second level (the final box in each branch) 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:

• **Urban public transport**: strategy found in the hierarchy of criteria of the south and northeast regions, as shown in Figs. 2 and 6, respectively.
• **Traffic and circulation systems, traffic and road system, or road traffic and circulation**: found, respectively, in the southeast, north and northeast regions (Figs. 3, 5 and 6).
• **Infrastructure and environment, physical infrastructure and urban infrastructure**: found in the south, centre-west and north regions (Figs. 2, 4 and 5, respectively).

Besides this, new aspects were incorporated, including themes and dimensions related to the concept of sustainability being introduced, as follows:

• Planning, integrated transport and urban metropolitan planning, integrated planning, integrated transport and urban planning, and urban and integrated transport planning—strategies found in the hierarchy of criteria of the five regions, as shown in Figs. 2–6.
Environment and non-motorized modes, environmental aspects, environmental/public space aspects—found in the south, southeast, north, and northeast regions (Figs. 2, 3, 5 and 6).

Social aspects and social/equity aspects—found in the north, and northeast regions (Figs. 5 and 6, respectively).

The results obtained were analyzed under two principal foci:

- Environment and non-motorized modes, environmental aspects, environmental/public space aspects—found in the south, southeast, north, and northeast regions (Figs. 2, 3, 5 and 6).
- Social aspects and social/equity aspects—found in the north, and northeast regions (Figs. 5 and 6, respectively).

The results obtained were analyzed 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.

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 synthesized in the following subsections.
4.1. Analysis of the dimensions of sustainability

From the group of 16 systems evaluated in the work of Costa et al. (2005), which includes social, economic and environmental indicators, the principal themes related to the dimensions of sustainability were extracted, comprising a total of approximately 170 keywords or expressions, which constitute a theoretical background for the classification of the strategies. That list of themes, classified according to the social, economic and environmental dimensions, was then associated to the concepts identified in the cities under analysis, for each sustainability dimension.

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. The
distribution of strategies relevant to each sustainability dimension in percentage terms is shown in Fig. 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%, 11% and 42%.

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 the highest and third highest economic indices of the regions of Brazil, including per-capita income. 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 specificities 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 noted 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 though the social dimension has received the major focus in the majority of the Brazilian regions, 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

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Social</th>
<th>Economic</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>Inefficient/inefficient control of urban public transport</td>
<td>Lack of/inadequate Master Plan</td>
<td>Lack of/inadequate Master Plan</td>
</tr>
<tr>
<td></td>
<td>Low quality urban public transport</td>
<td>Environmental actions</td>
<td></td>
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<td></td>
<td>Problems integrating urban public transport</td>
<td>Consumption of non-renewable energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of integrated regional planning</td>
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<td>Improve quality of life</td>
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environmental character. They also revealed the main limitations and potentials of the localities covered in the study for implementing sustainable urban mobility policies. The FVPs identified for each region, classified in the three dimensions of sustainability, are shown in Table 2. They were classified in the social, economic and environmental dimensions of sustainability, following what was earlier suggested by Costa et al. (2005).

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, and 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, public participation, diversity and integration between modes of transport, transit level of service, integrated planning, public policies for disabled persons, socialization of the knowledge and of the urban space, 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, economic equity, and fare policy. The environmental field addressed the problem of environmental pollution, traffic congestion, 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 northeast 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 work discussed in this paper. 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 fundamental view points, 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 degree for the activities of urban planning and management, especially in what we refer to as mobility. This evidence was supported by the responses given to the questions of integrated planning and social and environmental concerns, highlighted 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. Inclusion in the planning process 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, given 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, as shown by the distinct fundamental view points, reflecting particular problems or potentials that inhibit or facilitate, respectively, the process of sustainable urban development.

Attention must be given to the categorization method adopted in our study, because it may help to explain the surprising finding about the un-importance of economic issues. As described in Sections 3.4 and 4 earlier, in our method we have categorized the policy instruments (themes) into environmental, economic and social ones, rather than the objectives which they are designed to meet. The adoption of a different classification method could have produced different outcomes for the five Brazilian regions with regard to the concepts associated to the social, economic, and environmental dimensions. Despite the classification method, however, the analysis of the results found in the workshops conducted in the 11 Brazilian cities reveals evidences of different views of the sustainable urban mobility concept in the five country regions.

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 for the promotion and improvement of quality of life in Brazilian cities. Such policies should be elaborated, both with consideration of local sustainability and through the implementation of national policies.

In summary, looking at the results obtained in the five Brazilian regions analyzed and their particularities, we conclude that the MCDA-C method is able to capture the different views and approaches discussed in the formulation of the sustainable urban mobility concept. Therefore, we strongly suggest its use as a starting point for the formulation of public policies. It can also be useful in the development of tools designed for monitoring the
mobility conditions, given it makes possible to identify key geographical and temporal elements.

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