MOBILITY MANAGAMENT IN TRIP GENERATORS: THE CASE OF EDUCATIONAL INSTITUTIONS

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ABSTRACT
This paper aims to present a comparative analysis of various techniques used for Mobility Management in educational institutions in different contexts. Considering major Trip Generators, educational institutions can justify the systematization and analysis of experiences of implementation of Mobility Management techniques in a national and international environment in order to provide information for decision making. The literature review and analysis of the studies produced shows that Brazil is still far behind when it comes to Mobility Management in educational institutions when compared to European countries and The United States. On the other hand, surveys indicate a higher acceptance by communities of these institutions in relation to the implementation of such measures, despite the specificities met in different studied contexts.

1.INTRODUCTION

In the current decade, traffic has been in focus of debates about the problems of modern society. According to the data from DENATRAN (2010), in 2010, the vehicle fleet raised 8,4 % in Brazil, totaling 64.817.974 vehicles in the country. These data prove the dimension of the problem. With this in mind, ways have been searched in order for minimizing the impact of this vehicle fleet's fast growth in the dynamic of the cities. Mobility Management appears in this context.

According to Feitosa (2003), Mobility Management can be defined as a set of techniques aimed at changing the way people act, think, get around and work.
Mobility Management is, therefore, a set of transportation planning techniques which, among other things, seeks more appropriate solutions and alternatives to automobiles use, promoting more sustainable means of traveling in order to make the transport system more efficient. Some of the Mobility Management measures includes carpooling, encouragement of walking, cycling, public transportation instead of individual transportation, improvement of urban areas, restricting access to certain areas for cars, parking restriction, rotation system, change in travelling habits, among others.

2.MOBILITY MANAGEMENT IN EDUCATIONAL INSTITUTIONS

According to Portugal and Goldner (2003), Trip Generators are places or facilities that develop activities capable of producing a significant quantity of trips. These sites or facilities may be of different kinds: supermarkets, shopping malls, hospitals, schools, restaurants etc.
Educational Institutions are important Trip Generators (TP), as they are responsible for a great number of trips. Therefore, this is the reason for researches that aim at reducing the impacts on traffic due to the generation of trips from these institutions. Another significant aspect pointed out by Parra and Portugal (2006) is that the educational institutions are important places for teaching and forming individuals, they constitute themselves as favorable environments for implementing Mobility Management measures and they could spread to the rest of society.

This article aims at describing some successful international experiences and some national ones concerning the implementation of Mobility Management techniques in educational institutions and, thereafter, making an analysis of the experiences presented from different contexts.

This study therefore aims at, through the systematization of knowledge of these experiences, providing support for future decision-making in educational institutions with regard to Mobility Management.

The methodology used to make the achievement of the proposed aim possible is presented in **Figure 1**.

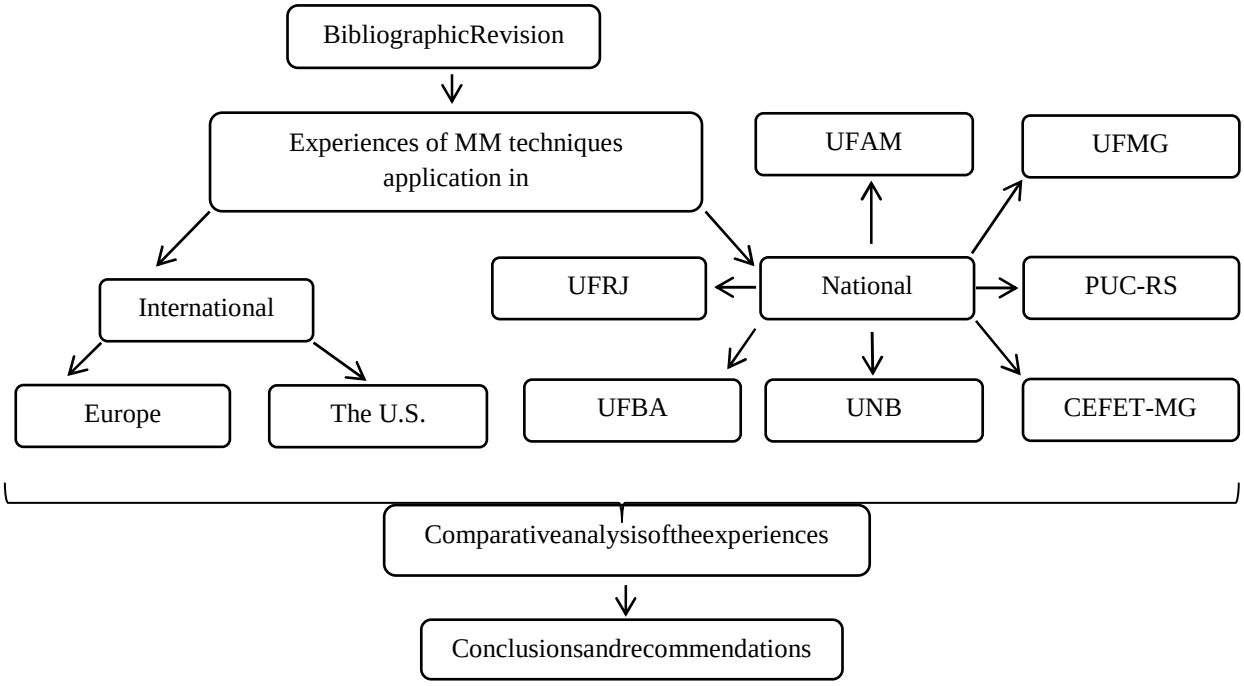

Figure 1: Schematic of the procedure adopted in the preparation of this work

3.INTERNATIONAL CASES

Urban mobility and the impacts of the indiscriminate use of private cars, such as pollution, traffic congestion and loss of quality of life among others have been constantly discussed worldwide. Early studies concerning Mobility Management were alreadymade in the 50s. In the 70s, the concept of Transportation Demand Management (TDM)was widespread in the United States but it is in Europe, in the 90s, that the concept of Mobility Management arises with a set of strategies that are well structured and comprehensive. This effort to create alternatives for improving mobility is already rooted in public policies and in the very culture of these countries, as we can identify in the examples that follow.

3.1. Europe

According to Parra and Portugal (2006), Mobility Management has a very important role in Europe. Several initiatives have been adopted in order for implementing such measures in the urban context. Some prominent initiatives that can be cited are the projects MOMENTUM (Mobility Management for Urban Environment) MOSAIC (Mobility Strategy ApllicationsIn the Community) and MOST (Mobility Strategic Management for the Next Decade). Among

these, the MOST project showed the highest success. This project is divided into areas of activity, especially educational institutions, healthcare, tourism, local development, mobility centers and temporary places and events. Also according to Parra and Portugal (2006), the measures of the MOST project implemented in institutions had the objective of encouraging more sustainable forms of transportation, improving safety and activities within the campi.

According to Delgado (2006), the successful experiences of Mobility Management are the Leicester's ones in England, where through collaboration between two universities and a hospital, it was able to significantly reduce the amount of trips made in individual vehicles. In Portugal, the University of Coimbra has created a mobility center where people can find information about trips with an indication of origin and destination of them. The Polytechnic University of Cataluña, in Barcelona, has implemented a parking restriction system and promotion of public transport and rides in addition to conducting an awareness and information program about the environmental impacts of the car. At the University of Paris, France, they have implemented a carpooling program. In the case of the city of Rennes, bicycle use is encouraged through a system of bike rental at reduced fees. In addition, bike racks are close to the metro and bus stations, facilitating intermodality. In the city of Nantes, an organization called "velocampus" offers bike rental at low cost. The major European experiments are summarized in **Table 1**.

Table 1: Educational Institutions and Mobility Management measures adopted

EducationalInstitutions/Country	Measuresadopted
PolytechnicInstituteof Leiria (Portugal)	Bike sharing system, carpooling, promotion of public transport, education campaigns and public awareness..
Polytechnic University of Cataluña UPC - Barcelona, (Spain)	System of carpooling (UPC-POOL), education and awareness campaigns, testing of electric bike, increased availability of sustainable transportation.
MontfortUniversity andUniversityof Leicester (ReinoUnido)	Collection of parking fee, encouragement to the use of public transport and infrastructure for the use of bicycles.
University of Paris (France)	System of carpooling, bike rentals

3.2. USA

In the United States, there are some programs called Campus Transport Management (CTM). These programs try to reduce the number of trips to university campi and schools. Therefore, measures such as improving the quality of public transport, reduced fare, carpooling, awareness campaigns, integration of transport routes, improvement of traffic conditions for pedestrians and cyclists, among others, were implemented.

Brown, Hess and Shoup (1998) discuss the student unlimited access to public transportation as a way to improving mobility and reduce the number of trips by private cars. This program is called UPASS (Unlimited Access Programs). According to these authors, in the UPASS, universities get in contact with local transportation agencies and pay for the provision of such service.

This measure has several positive aspects from the viewpoint of improving traffic conditions, among which the authors mention: increase in the students' mobility, reduction of trips made by private vehicle, decreased demand for parking, attraction and retention of students, improvement of students' performance, increase in the students' access to employment, reduction of education costs, increase in the equal access to transport, congestion reduction, improvement of air quality and preservation of natural resources. Thus, the program provides benefits for all, students, universities, transit agencies and society. This program works as follows: students have a card that gives them access to public transport without having to pay the fare. Students only pay an annual fee at a low cost to join the program, (about $ 36). Brown, Hess and Shoup (1998) located 23 universities in the United States that have implemented the program, among them, we have the University of California, University of Massachusetts, University of Texas, University of Colorado .

For the operation of this program, there is a partnership between the administrator of the Campus, students and staff and transportation and trade agencies. In some situations, even residents of nearby neighborhoods to schools are consulted. That is, the planning is done jointly by all people involved and is beneficial for everyone.

4.EXPERIENCE IN BRAZILIAN INSTITUTIONS

Despite the importance of the universities in Latin America and that, as happens elsewhere in the world, major cities present major problems regarding mobility, according to Parra and Portugal (2006), there are few studies on the Management Mobility in educational institutions in these countries. In Brazil, studies on Mobility Management are already being made and indicate a good prospect of implementing these measures.

4.1. Federal University of Bahia – UFBA

Was presented at the Federal University of Bahia a paper titled "Mobility Management on the UFBA Campus." According to Figueiredo and Moreno (2004) the objective of the study was to examine the problems of mobility present in two Campi and assess the possibility of deploying Mobility Management techniques. Thus, a profile of users was drawn in order to scale the possibility of migration of users of private vehicles to more sustainable means of travelling. Furthermore, another goal presented by the authors was to encourage people to change the way they travel to the campuses and within them opting for more sustainable means of travelling. Also according to Figueiredo and Moreno (2004), there are major barriers to physical access between the university campuses. Despite the physical proximity between campuses, the steep topography of the access associated with the lack of infrastructure for pedestrians and cyclists, the deactivation of some bus lines that used to do the internal circulation and the lack of public safety in some places cause an increase in the use of private cars.

The authors note that the results obtained with this study already configure a positive scenario. The results were, sensitization of the people involved, data collection such as existing infrastructure, population, existing problems, possible solutions to the campi in question (with its critical factors, restrictions and potentials of implementation), the profile of the users of the campuses, as well as evaluating the degree of satisfaction with the existing system and acceptability in relation to the implementation of measures for Mobility Management. As measures to improve mobility on the UFBA Campus Figueiredo and

Delgado (2004) propose: information and advice on public transport, implementation of other forms of transport and public transport largest contingent, besides coordination, promotion and awareness of the environmental impacts of the traffic among students of UFBA.

4.2. University of Brasilia - UNB and other universities in the Federal District

Nunes and Jacques (2005) analyzed the travelling pattern of 11 Higher Education Institutions in the Federal District. The study aimed at only presenting a survey of travelling patterns in these institutions, since they are characterized as major trip generators, and therefore the study gives no hint or implementation planning measures of Mobility Management. Despite not making suggestions or proposals to the reality studied, the authors presented results that can serve as a benchmark for such propositions.

According to Nunes and Jacques (2005) the private car is the predominant choice of students and professors with regard to the means of transport used for going to and/or from the educational institution. The survey results show that among the universities analyzed, the highest and lowest percentage of car use was 96.37% and 65.22%, respectively (for professors), 84.97% and 34.40% (for students) and 89.041% and 80% (among employees). The study also showed that most users live in the same administrative region of the educational institution they are attending, what makes the percentage of walk trips significant in some institutions. The authors also point out that despite the receptiveness by some institutions; still there must be awareness of the administration of these institutions about the importance of their participation in the definition and inclusion of specific strategies.

4.3. Federal Universityof Rio de Janeiro– UFRJ

Parra and Portugal (2006) developed a study on the Mobility Management on the Fundão Island Campus of the Federal University of Rio de Janeiro. The achievement of this research was done through analysis of existing literature on Mobility Management in general and of existing strategies for university campi. From this point, it was made a query to the existing projects and to the direction of the university, a survey of the specificities of the Fundão Island Campus of the Federal University of Rio de Janeiro, as well as a survey with users in order to check the acceptability concerning the implementation of some measures. From the experiences found in existing literature, the survey conducted with users, which pointed out the strategies suggested by users of the campus, and the collection of the specific characteristics of the campus, the authors presented recommendations of implementation of strategies for Mobility Management.

According to Parra and Portugal (2006), the most suitable Mobility Management measures for the Fundão Island Campus are: transportation to the Campus (terminal integration, organization of carpooling, partnerships with bus companies in order to ensure improved service), awareness campaigns, transport within the Campus (increase of the domestic fleet, bike rental, improved infrastructure for pedestrians and cyclists, speed control and signaling).

4.4. Federal University of Minas Gerais – UFMG

Pereira et al (2011) did a survey through the application of online questionnaires to evaluate the acceptability of using bicycles as their own means of transport to get to university and bike rental system for internal trips on the Campus of the Federal University of Minas Gerais.

The survey was conducted through the application of online questionnaires designed in Google Docs ®. A sample of 380 respondents was obtained. The survey showed that 51% of respondents have private cars; nevertheless, 69% of these said they would be willing to use bicycles as a means of transportation to the Campus if there were adequate infrastructure,

namely, bike lanes, safe bike racks and locker rooms.

When asked about the use of bicycles for rent in order to get around within the Campus, 74% of respondents said they would use the service as long as the points were accessible. The authors also pointed out that a portion of these respondents would be willing to pay a small fee for using this service. Pereira et al (2011) conclude that cycling, both for access to the campus in question, as for internal trips, could be a good alternative because the data indicate a good acceptance by users of the Federal University of Minas Gerais. However, for a better understanding of the subject matter, one could do a more detailed survey, considering the distances traveled by each respondent, their origin and destination (to assess whether the route characteristics such as steepness, arborization, safety, etc. are influencing the answers), the time they attend the Campus, the neighborhood where they live, among others.

4.5. Federal Center for Technological Education of Minas Gerais– CEFET-MG

In the article entitled "Acceptability of carpooling as a way of managing demand for parking in an educational institution" Ferreira et al (2011) presents the results of a survey conducted at an educational institution of high school / technical / higher levels. The institution in question is the Federal Center for Technological Education of Minas Gerais (MG-CEFET), more specifically the Campus I of this institution.

The presented study consisted of a questionnaire to students, staff and faculty to evaluate the acceptability of the implementation of the carpooling to reduce the demand for parking. According to Ferreira et al (2011) there is a notorious dissatisfaction concerning parking in the institution, since the number of lots is not able to meet the existing demand and there is little access control. As a result, there is a constant formation of queues, which recursively disrupts traffic on Amazonas Avenue (which is a major arterial way in the city of Belo Horizonte).

Regarding the characteristics of the Campus in analysis, an interesting aspect that can be said is that all classes are held in a single building, or attachments in this building. There are no internal streets. Preliminarily, this characteristic may mean a greater chance of good results in the case of the implementation of the carpool system, since the community that accesses the establishment and the use of parking lot can be easily identified and controlled. Another aspect to be considered is that the total number of users of the campus is small compared to other educational institutions (5520 students, 323 employees and 269 tenured teachers and professors), besides the fact that the activities occur in concentrated form within the Campus and that it has only one entrance for entry and exit of vehicles. This makes data collection easier and the sample size more representative, in this case 20% of total employees and 3% of teachers and professors responded to the survey.

The survey results showed that 80% of users believe that the parking does not fully address the demand and that 43% of respondents use their private car when they go to the institution and that 46% of these said they stay more than 5 minutes waiting for a vacancy in the parking lot. The study also shows that when asked if they would stop using a private car if they had guaranteed ride, 41% said yes and 67% said they have already given rides and 90% said they would give rides. Also, according to Ferreira et al (2011) carpooling could be a good alternative to the reality of CEFET-MG.

However, a fact that could serve as a parameter for the analysis of the implementation of this solution is that when asked about what users consider efficient alternatives to improving the use of the parking lot, 82% indicated a larger number of lots, while only 22% pointed to carpooling as a possible solution. At this point, it may be suggested that prior to the implementation or in its process, a campaign for warning and informing users about the subject was made.

4.6. Federal University of Amazonas – UFAM

The article entitled "Alternatives to the Management of Mobility on the UFAM Campus" aimed at analyzing the potential implementation of some measures of Mobility Management, such as carpooling encouragement to walking and cycling around the Federal University of Amazonas. To do so, a questionnaire was administered in 3% of the total population of the community in order to characterize these users and verify their acceptance to the implementation of the measures previously mentioned.

According to Kuwahara*et al* (2008) the UFAM Campus presents the same problems present in the city of Manaus in terms of Transportation Planning. There is prioritization of individual motorized transportation over others. Both the city and the Campus do not have any structure that favors the use of more consonant forms of transport according to the precepts of Mobility Management. Still according to the authors, more control and registration of users could make the carpooling viable. Another solution that could also facilitate mobility within the campus is the construction of bike lanes and bike racks to users, in addition to improving the conditions for getting around on foot to stimulate such journeys within the Campus. The UFAM Campus has 13,050 students, 1160 teachers and 660 employees. Despite having only one entry, it gives access to two distinct sectors within the Campus (Sectors South and North). Although there are buses that circulate internally, the author states that they are not able to meet the demand satisfactorily.

According to Kuwahara*et a*l (2008) the incorporation of forms of Mobility Management, mainly the construction of bike lanes and improved sidewalks can not only improve mobility within the campus but make it an atmosphere of leisure and tourism for the city population. Social integration and incorporation of the community as a whole in the university environment are very positive aspects of the implementation of these measures of Mobility Management.

The result of this research showed that 27% of people use private vehicle and 20% are already used to getting rides. When asked whether they would give rides or not, 65% said yes although by means of getting some kind of safety or reward. Regarding acceptability in relation to getting around the campus on foot, 43% of respondents were in favor. In relation to the use of bicycles, 53% were in favor.

4.7. Pontifical Catholic University of Rio Grande doSul–PUCRS

Schmitt (2006) conducted an analysis of the impacts of measures of Mobility Management in an urban area of Porto Alegre, Rio Grande do Sul .One of the points raised by him was that of the carpooling implementation in higher education institutions.

This work was carried using data from a case study conducted at the Pontifical Catholic University of Rio Grande do Sul (PUCRS). To do so, a questionnaire was administered in the evening shift for the students of that institution in order to assess the profile of these students concerning their means to get around and their receptivity to carpooling. Professors and other

employees were not considered, since they use a different parking lot. It would be worthwhile assessing whether or not despite not sharing the same parking lot with the students, it would be interesting to have them included in the study, since they could participate in the carpooling even if among themselves. The survey showed that 1898 students access the campus between 6:30 and 7:30 pm (entrance of the evening shift). Among the students, 24.52% use private cars and 5.1% get rides.

According to Schmitt (2006), the implementation of the carpooling is in this case, intended to reduce automobile traffic. However, according to the author, the existing arterial ways in the surrounding areas will be affected to a limited extent.

The sample represented about 7% of users accessing the Campus by private car. Information about arrival and departure, gender, age, origin and destination were collected in order to defining the profile of the respondents. Other questions have been directed specifically to evaluate their receptivity to the carpooling system implementation. When asked if they would stop using private transport to go to university and what would lead them to doing so, 29% responded that they would no longer use the car if they had the opportunity to get a ride with someone. This rate was higher among women between 20 to 30 years old and for trips that lasted between 20 and 30 minutes. Of these respondents, 20% admitted that they would not stop using the car under any circumstances; however 57% of them would be willing to offer rides. According to Schmitt (2006), the percentage of respondents in favor is greatest among those who go from home to university, and from the total of respondents, 50% go from home to university.

The results showed good responsiveness to carpooling between the students at PUCRS. Among the students who already use a car, more than 40% already participate in the carpooling in an informal way. Among those who usually travel alone, 85% said they would participate in the carpooling. The author also made a study of compatibility of routes in order to verify that the rides would be viable in certain areas co came to the conclusion that the system would not be a good alternative in all cases.

5. COMPARATIVE ANALYSIS OF EXPERIENCES

The problem to be faced by the Mobility Management is differentiated according to the environment and culture found in a particular region. Some large cities of the third world record significant population growth is not always accompanied by economic development compatible (ROCHA et al, 2006).

It is a consensus the fact that Educational Institutions are important Trip Generators and therefore Mobility Management measures become necessary. In all studies discussed in this article, there was the intention of solving an existing problem, either by seeking to reduce the number of vehicles circulating within the Campus, the number of trips by car drawn by the Campus or even by seeking an alternative to the problem of the saturation of the parking lots.
All Brazilian institutions used for the case study are located in very different contexts, in addition to also having quite different physical configurations. The CEFET I-MG Campus is inserted near the central area with the parking entrance located on an arterial way where there is great flow of vehicles. Furthermore, it presents different physical configuration when compared to other because it is not a campus with distant buildings and streets.

The CEFET-MG also differs from the others by the fact that the vast majority of attendees are students who are minors, i.e. not using a private car. Just as the survey, in the case of CEFET-MG, was directed to the staff, professors and teachers, while at UFAM the opposite happened. The target audience of the research was the students, since the staff and professors had an exclusive parking lot. However, at UFMG, although the survey was not directed to a specific group, the largest number of responses was from students.

Another aspect in which the cited institutions differ concerns the purpose of implementing Mobility Management measures on the Campus. On CEFET-MG Campus, the carpooling was designed with the purpose of solving the problem of parking overcrowding. However, on UFAM Campus besides improving the mobility, there was also the longing for the appreciation of the campus from the standpoint of recreation and tourism.

On PUCRS Campus, the proposed carpooling would serve a specific audience, students from the evening shift, in the same way, the study focused on the campuses of UFBA tried to solve a specific problem, which was the difficulty of travelling between campuses, which contributed to the increasing number of automobiles. However, the study carried out in the Federal District only intended to characterize the profile of trips produced by and attracted to campi, while in UFMG, the intention was to verify the acceptability of the bicycle not only within the Campus, but also a as a means of transportation to get to it .

The proposed objectives in each Educational Institution, the objectives/topics analyzed and the results/ conclusions reached by the studies are outlined according to **Table 2**.

Table 2: Summary of studies about MM in educational institutions.

Education Institutions	Objectives / Aspects Analyzed
UFBA	Making survey of mobility problems in Campi and user profiles. Analyze the propensity of these use more sustainable means of transport.
UNB and other universities in Brasília	Present a survey of travel patterns in these institutions
UFRJ	Raise the specifics of Campi Fundão Island and evaluate the acceptability of the implementation of some measures of GM with users
UFMG	Evaluate the acceptability of the use of bicycles as their own means of transport to get to university and bike rental system to internal displacement
CEFET-MG	Evaluate the acceptability of system deployment ride scheduled to reduce the demand for parking
UFAM	Analyze the potential implementation of some measures GM, quote, carpooling, encouraging shifts to walking and cycling.
PUCRS	Analyze the impact of the deployment of the ride scheduled in higher education institutions

According to Parra and Portugal (2006) the most widely used techniques for the Mobility Management on college campuses can be systematized as shown in **Table 3**.

Table 3: The most used strategies in the Mobility Management on Campi

Topic	Strategy used on University Campus	
Transportfrom/to Campus	Alternatives to the use of personal car	Increase the supply of transport and improve the existing ones.
		Partnerships with public transport companies to reduce the price of bus fares and to get commercial discounts.
		Unlimited use of subways and buses that serve the campus and increase in integration services.
		Charging or increase in the fee of vehicle parking.
		Motivations for cycling: bike lanes, offering free, locker rooms with showers, parking lots.
		Improvement and increase in pedestrian areas to encourage walking when possible.
		Safety programs for bike riders, walkers and public transportation users.
	Travel Incentive	Implementation of carpooling, vanpooling and carsharing systems.
		Subsidized fees for parking vehicles that carry more people.
		Free parking for carpooling people.
	Alternativestocar use	Alternative schedules on working hours and teleworking for employees.
		Guaranteed trips home to employees.
Community	Awareness	Motivational and educational campaigns targeted to users to encourage behavioral changes.
		Marketing campaignsaboutMobility.
		Environmental educationcampaings.
		Integration and coordination between students, professors and teachers and employees so as to guarantee the success of the actions.
Transportwithinthe Campus	TrafficModeration measures	Speed control of the vehicles to assure safety to pedestrians and bike riders.

Source: Adapted from Parra e Portugal (2006).

6. FINAL CONSIDERATIONS

Considering all the analyzed experiments, it can be concluded that compared to other European countries and to the United States, the Latin American countries and specifically Brazil still are far behind when it comes to Mobility Management in Educational Institutions.

Another important point relates to the specificities of each institution and the importance of planning the implementation of Mobility Management techniques considering each context and its particularities such as location, characteristics of the users' trips, existing infrastructure and the possibility of its construction, the need for mobility existing in each Educational Institutional, due to the large of trips that it generates as well as in the temporal dispersion of the trips.

However, after reviewing the case studies referred here, we can infer that Mobility Management measures have shown good acceptability by the Educational Institutions communities, regardless of the context in which these are embedded. This acceptance by the community that attends the institution is of utmost importance, since transportation planning influences people's lives directly, and therefore the acceptability and understanding of the objectives of the measures implemented are fundamental to the success of any initiative in this direction. Nevertheless, it is pertinent that each institution should be analyzed considering

their specificities. The context in which it operates, the characteristics of the population that will be achieved with the implementation of the measure, their profile, the physical structure of the institution, the configuration of the environment and the impacts that it may cause.

For future research, is indicated consider going into more depth in analyze a specific campus type (e.g. situated in an urban, suburban, rural area, etc.) and going into more detail in evaluating how the campus works and identifying comparable case studies in other cities/countries.

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