# Sustainable Urban Mobility in Medium-Sized Cities. Case Study of the Campus in Caceres

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Sustainable mobility can be defined as a set of transportation patterns that provide citizens with access to services while respecting social equality and economic and environmental sustainability. At the same time, it must be ensured that transport costs, the time invested in travel and the financial expenses involved in transport are kept to a minimum. Since the mid-20th century, mobility in urban settings has featured the mass usage of private vehicles and rising numbers of trips made, as well as an increase in the distances travelled, rendering non-motorised transport methods less and less effective over time. These mobility patterns are the result of an urban model known as city sprawl, which features significant growth and high land consumption.

Furthermore, medium-sized cities have seen the strongest changes in their mobility habits in recent decades: indeed, over the period of the latest censuses published by the Spanish National Statistics Institute (2001 – 2011) they represented 54% of the population growth in Spain. The significant demographic growth was, in most cases, accompanied by a considerable increase in the urban area.

This leads to unsustainable mobility patterns, which are not specific to a certain economic or social sector but rather affect everyone, including sectors that are more sensitive to social and environmental issues such as the university community. In addition, within this context of city sprawl, it must be noted that university campuses often comprise segregated areas in suburban locations that are not easy to access. Such circumstances evidence the need to implement policies that help mitigate the negative effects of mobility, improving accessibility and the quality of life for citizens.

The main purpose of this paper is to develop a methodology for characterising mobility on a university campus so that, by defining the purposes, patterns, and perceptions revealed about mobility, measures can be applied to rationalise the urban transport system. In addition, its specific objectives include analysing the intentions, preferences and reactions of users that travel to the campus on a daily basis by both private vehicle and by public transport, in order to understand the reasons behind their current conduct and the likelihood of success in implementing measures aimed at gradually achieving more sustainable, efficient mobility.

The case study taken as a reference is the university campus in the city of Caceres (population 95,000), given that it is a clear example of segregated suburban space located, as it is, some 4.5 kilometres from the city centre, with connections between the centre and the outskirts of the city being strongly affected by the

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abrupt terrain (the town centre lies at an average altitude of 525 metres, whereas the university campus is at an elevation of 415 metres above sea level).

To achieve the proposed aims, several primary and secondary information sources have been used in the methodological process, depending on the needs of the research. In this regard, a detailed census of the different groups comprising the university community (students, faculty and researchers, administrative and service staff, and others) was drawn up based on information furnished by the University of Extremadura Assessment and Quality Technical Unit. In turn, to ascertain an understanding of the perceptions and to characterise mobility patterns, a declared preference survey was designed and implemented. A total of 371 surveys was taken for an estimated population of 10,600 people. Based on the information gathered in the surveys, a bimodal transport model was created for the purposes of identifying routes travelled in terms of both origins (the users' residence) and destinations (institutions and schools belonging to the University of Extremadura in Caceres). A matrix was generated on the basis of this information, which relates the origins and destinations (O/D) of each person linked to the campus, thus making it possible to estimate the travel flows being studied herein. Finally, the number of vehicles passing the access points to the campus was gauged to validate the survey results.

The findings show that most of the campus users reside in the city of Caceres (89%), travel an average distance of 4.5 kilometres (estimated distance between the place of residence and the workplace), and use an automobile for their daily travel purposes (58%). The average occupancy of the vehicles comes to 1.61 people/vehicle. In addition, these trips are not distributed evenly throughout the day, but rather, the largest influxes take place during the morning hours (60% of the users only go to the campus during the morning shift). In terms of travel times, 75% of the users invest fewer than 20 minutes. In general, someone who works in Caceres devotes 13 minutes on average to travelling from home to the workplace, whereas it takes around 18 minutes to reach the campus.

As for the available parking infrastructure, despite the fact that there is a large area measuring 24,000 square metres, occasional issues have been detected coinciding with the times at which demand is the highest, e.g., during the hours up to mid-day (reaching up to 203% of the total capacity on certain occasions). Faced with this saturated parking infrastructure situation, just 10% of the respondents would be willing to pay to have regulated parking facilities.

As regards the costs related to travelling to the campus, it was found that 68% of public transport users indicate an average monthly expenditure of less than € 30. However, this figure drops to 46% for those who use a private vehicle.

The results obtained from the study on perception indicate that the majority of public transport users believe it to be a sustainable or very sustainable means of transport (76%). A majority considers the private vehicle to be a means of travel that is not very or not at all sustainable compared to other methods they could use (55%). Reasons such as convenience or speed prevail in their decision to choose this means of transport over other, less contaminating, options.

The conclusions found show, firstly, that the methodology used is appropriate as a tool to characterise and assess compulsory mobility linked to an institution that is located in a remote setting, such as a university campus, of an average-sized city like Caceres. Secondly, the findings show an excessive use of private vehicles

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for the purpose of travelling from customary places of residence to the campus, primarily by faculty and researchers, and administrative and service staff.

An analysis of the travel patterns of people who use public transport shows that one third of the neighbourhoods in the city have the nearest stop at a distance of some 1,000 metres, which has an effect on the places of residence for university students during the academic year in Caceres, limiting them to neighbourhoods in the city centre with bus stops nearby and more frequent buses.

Gender and age have proven to be a determining factor in the choice of transport methods. Men use cars more than women, whereas women use collective transport - the bus - more often. In terms of age, more than 80 % of bus users are under the age of 25.

Regarding the perception of mobility, the importance of implementing this kind of analysis has been confirmed, in order to more efficiently evaluate the differing needs and preferences of people in relation to their commutes between their place of residence and place of work or study.

In light of this situation, the need to foster the use of public transport by the university community is clear for a two-fold long-term purpose based on achieving more sustainable mobility that is beneficial not only to the environment but also to citizens.

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