Investigating Mobility Gaps in University Campuses

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Abstract
The objective of the present research is to carry out a gap analysis between current mobility situations and the needs, future plans and priorities regarding a number of thematic areas on the issue of mobility in university campuses. For this purpose, an interview was conducted involving 36 experts from seven Southern European Universities. More specifically, experts from each university were asked to analyse and rate both the current and the desired situation in the campus under their responsibility with focus on the following thematic areas: parking management, soft modes infrastructure, public transport, car related issues, road infrastructure, environment and energy, mobility management, freight infrastructure and management, and Sustainable Urban Mobility Plans. Results indicate the different gaps that exist depending whether the campus is located inside or outside the urban area. More specifically, for campuses located outside urban areas, car-sharing and carpooling systems are missing and are identified as important, together with pedestrian and cycling paths for the mobility inside the campus. On the other hand, the highest gap in campuses located inside urban areas is parking management and the role of ICT tools to support every campus sustainable mobility plan.

Keywords: University Campus, Sustainable Urban Mobility Plan, gap analysis

1 Background and Objectives

University campuses in the MED Area, with a territorial average extension of 430,000 m^2 and an average population of 35,000 students and employees, are historically related to their urban area since many were built close to city center, rather than in the suburbs. A university campus is therefore similar to an urban model and in most cases, it could be used as a test area for mobility policies related to public transport, multimodality or transport restrictions [1].

Universities are a generator and attractor of highly variable demand for travel with significant mobility impact in terms of magnitude and the resulting implications on

the surrounding environment. A university campus brings together groups from different areas, whether to work, study, live, representing different habits and attitudes. The campuses are major centers of home-work/university-home travelers, where many are marked by a strong dependence on individual transport often justified by the inefficiency of the public transport system and the lack of alternative modes that can help contribute an improvement of the situation [2]. University campuses are a microcosmos of the urban landscape and an excellent testbed for implementing and evaluating novel mobility policies regarding public transport and multi-modality. Given this, it is important to apply innovative approaches and policies, particularly in terms of transport, to counter the tendency and common practices of extensive private car use and accept the paradigm change to new forms of mobility [3].

In this context, university campuses should be seen as spaces that require the implementation of sustainable transport policies and, therefore, appropriate mobility management strategies. In an ideal scenario these should also be fully integrated and in accordance with the city's global approach on this matter. On the other hand, these locations, due to their variety of uses and most importantly their typical users, can be extremely important as an example for promoting sustainable transport habits that can be maintained throughout the entire life course. They can also act as good examples for students that in the future will have an active role on institutions responsible for urban mobility management (3).

Longo et al. (4) proposed a framework to assist the university mobility managers with the integrated development of the university campus infrastructures along with the adoption of shared electrical vehicles by the university members. In addition, based on Gori et.al. (5) a classification in mobility solutions is required based on each country specific characteristics. Furthermore, several other studies analyse the effect of different sustainable solutions on university campuses and their integration with the city (6, 7, 8 9, 10)

The first and one of the most important steps on the development of a Sustainable Urban Mobility Plan and more generally on every new attempt is to analyse both the current situation and the future challenges. Within this framework, a key procedure is to conduct a gap analysis, in order to establish specific target objectives by looking at the specific missions stated, strategic goals and improvement objectives (11).

In order to make any improvements in the development of any plan, the first step in the gap analysis is to understand the current situation and to set goals (12). Initially terms have to be defined in order to conduct a gap analysis. Within this framework, several researchers have been implementing assessment tools aimed at investigating the gap that exists between needs and priorities in cities (13,14).

The objective of the present research is the investigation of the gap between the current mobility situation and the needs, future plans and priorities regarding several thematic areas related to the mobility of university campuses. For this purpose, an interview was conducted with 36 experts from seven Southern European Universities. The paper is structured as follows. In the next section, the methodological approach is presented including details regarding the implementation of the survey and the universities that participated. The analysis results are presented in the third section whilst general conclusions are stated alongside proposals for further research.

2 Methodological approach

2.1 Theoretical background

Qualitative survey methods, including interviews, are increasingly being used in research and policy studies to understand traveler perceptions, attitudes and behavior, as a complement to more established quantitative surveys. Qualitative research techniques can be used either as an independent research tool or as a part of a multidisciplinary project in association with more traditional quantitative techniques. In relation to quantitative research, qualitative techniques can be used at different stages as explained below (15):

- Prior to quantification: Qualitative research can be used to explore the range of issues present within a given population, this generally guides the design of subsequent quantification.
- In parallel with quantification: When respondents are completing questionnaires, either self-completed or interviewer-led, there is an option to consider whether to follow these interviews directly with a more open-ended qualitative interview
- Post-quantification: It is also possible to use qualitative research to illuminate the findings, particularly if there is a concern over a particular set of findings.

A main advantage of qualitative data analysis techniques is that they result in a rich and detailed contextual description of the phenomenon under investigation. However, this strength of qualitative data is also a drawback. The output of a qualitative inquiry is fundamentally different in nature from quantitative data. As such, analysis of qualitative information can be a difficult and arduous process (16). The sheer volume of information generated from techniques such as in-depth interviews, focus groups, and participant observation can seem intractable. Findings are often suspected of undue influence by the investigator bias and interpretation. However, proponents argue that qualitative methods can have the same rigor and credibility as quantitative methods if researchers follow a systematic process, paying attention to validity, consistency, and reliability issues during data collection and analysis (17).

2.2 Survey

Within the framework of the present research, an interview has been developed aiming to collect qualitative data (experts' views) of each campus at the local level, concerning mobility to/from and within campus areas, and to investigate the respective gap in the mobility needs. Regarding the sample, a minimum of 3-5 experts per university was set. The ideal mix of participants was described as follows:

- University mobility/planning manager, if such professional figure exists;
- At least 2 technical representatives of local, regional and national public institutions from each partner;
- At least 1 member from Associated Partners, selected by each partner;
- Project Manager of each partner.

Another key element in the interview process were the thematic areas that were identified as key terms for the project. These were parking management, soft modes

infrastructure, public transport, car related issues, road infrastructure, environment and energy, mobility management, freight infrastructure and management, information and communications technology tools, Sustainable Urban Mobility Plans.

Consequently, the interviews were structured in two parts. The objective of the first part was to analyse the current situation in the campus under experts' responsibility regarding each of the thematic areas. Experts were asked to provide all the specific measures, tools and policies that exist and discuss any mobility issues related to the thematic areas both from/to and inside their campus. The second part referred to needs, future plans and priorities, and the experts were requested to describe these for the Campus under their responsibility. The responses of the interviews provide the gap that exist in each of the seven campuses and a list of effective sustainable mobility instruments and policies can be developed for the campus SUMPs. In addition, interviewers were asked to rank (from 1 to 5) the performance of each thematic area.

3 Results

Before the presentation of the results, a summary table is provided to give an overall picture of the universities and campuses that are involved in the project.

Table 1. CAMP sUmp campus characteristics

	University	**Location**	**Area (m^2)**	**Students**	**Personnel**	**Interviews**
1	University of Catanzaro	Outside	260.000	11.000	500	9
2	National Technical University of Athens	Outside	1.000.000	13.500	3.400	8
3	University of Malta	Inside	194.452	11.500	600	2
4	University of Valencia (1 campus)	Outside	1.000.000	10.000	2.000	3
5	University of Valencia (2 campuses)	Inside	400.000	35.000	5.000	3
6	University of Split	Inside	245.000	24.000	1.500	6
7	University of Cyprus	Outside	1.200.000	7.000	1.100	5
8	University of Bologna	Outside	6.570.023	85.000	3.000	9

Table 1 indicates that from the eight campuses (Valencia having two separate campus areas), five were located outside the city while the rest are located inside the city. It should be noted that the overall analysis relies on two parameters. The first concerns the location of the campus as campuses are divided based on their location (inside/outside the city). The second refers to the type of mobility, whether they examined the mobility situation within or outside the campus.

3.1 Campuses located inside urban areas

Figure 1 shows the results of interviews with experts based in universities located inside urban areas. These provide valuable information regarding the mobility status of the thematic areas examined in the study.

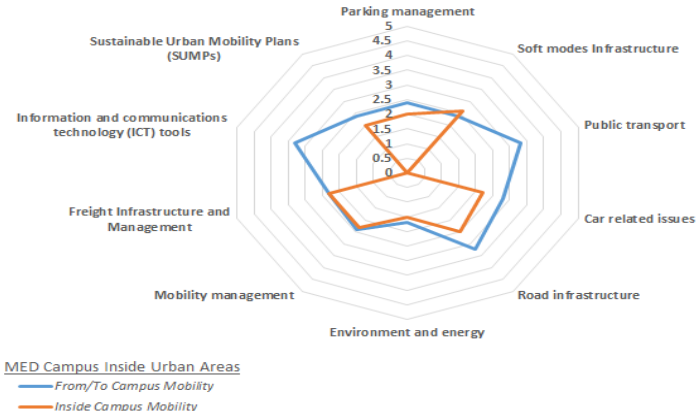

Figure 1. Mobility gaps from/to and inside the campus for campuses inside urban areas

Results indicate several characteristics that distinguish universities whether they are located inside or outside urban areas, as well as the different gaps between the thematic areas examined. Regarding mobility from/to the campus, public transport is considered important considering the strategic place of the campus inside the city and the several ways that can be reached. The other two thematic areas that achieve high score in the analysis are road infrastructure and ICT tools. For both areas, the location of the campus inside the city is an advantage for the implementation and planning of targeted strategies on these topics.

On the other hand, a key gap detected by this analysis identifies environmental and energy issues. Since these campuses are located inside the city, they are challenged to implement strategies for the protection of the environment. Issues that need to be addressed include the use of clean vehicle technologies, on-street electric vehicle charging points (e-mobility) as well as the use of small vehicles for inside campus mobility.

Several interesting conclusions are also raised through the gap analysis regarding the mobility inside the campuses. Campuses located inside urban areas do not have public transport for the mobility inside the campus as buildings are within walking distance and easily connected. For the same reason, ICT tools do not exist on these campuses. On the other hand, road and soft modes infrastructures are the thematic areas that achieve the best scores in the analysis. Within the above areas the improvement of pedestrian networks as well as safety measures at crossings could improve walkability. Similarly, for cycling, measures could include the setting up of cycle rental services, setting up of public bicycle/bike sharing systems as well as the provision of parking areas and facilities for bicycles.

3.2 Campuses located outside or in suburban areas

In Figure 2 the results of interviews with experts based in Universities located outside urban areas are presented.

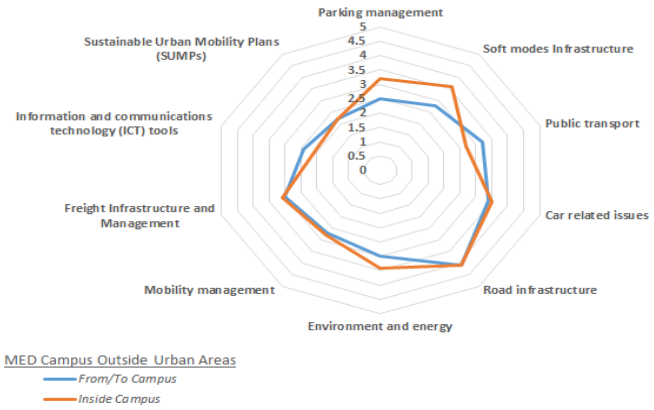

Figure 2. Mobility gaps from / to and inside the campus for campuses outside urban areas.

The overall picture of the examined thematic areas for campuses outside urban areas are very similar for both the mobility within and outside the campus area. This consists a first very interesting difference detected by the gap analysis between the universities located inside and outside urban areas.

Any infrastructure related to road transport is the best performing area from the examined themes. This can be explained by the fact that campuses located outside urban areas are relatively new, with high quality road infrastructure leading to them. Measures that can further improve this area are mentioned for improved lighting conditions inside campus, pavement maintenance, new infrastructure for disabled access, as well as signage and road markings.

Regarding public transport, the gap analysis showed how several measures and policies should be implemented in order to decrease the gap between current and desired mobility. Indicative measures include the improvement of density and extent of public transport services, actions to improve comfort (stops, stations, and vehicles), actions to improve security (e.g. camera surveillance), ICT tools to improve information to passengers, actions to improve the ticketing systems, actions to implement Intelligent Transport Systems (ITS) as well as to increase frequencies. Mobility management is another thematic area, detected as a gap in the current situation. Measures to decrease this gap include information and advice about travel options to travelers based on ICT tools, setting up of a mobility center in the University, awareness raising activities to promote and encourage sustainable mobility as well as promotion of travel plans for the Regions.

Finally, the lowest score in both types of mobility outside and inside the campus areas are the Sustainable Urban Mobility Plans, which are seen as very important

especially for universities located outside urban areas. In general, a Sustainable Urban Mobility Plan should provide a strategy to enhance the quality, security, integration and accessibility of public transport services, covering infrastructure, rolling stock, and services. A main objective of the SUMP is to raise public awareness of sustainable transport options in order to improve take-up of public transport, car sharing, cycling and walking as positive alternatives to single occupancy car use.

4 Conclusions

The innovative aspects of the present research consist both in the methodological approach as well as the key findings. More specifically, a key methodological innovation of the present research is the fact that 36 expert interviews were collected from seven Southern European Universities. The second innovative aspect concerns the key results of the present research categorized into four different groups. More specifically results were separated depending on whether the universities were located inside or outside urban areas. Furthermore, mobility gaps were defined both for mobility within and outside the campus providing useful multi-level results for the examined case studies.

Results indicate several characteristics that distinguish Universities whether they are located inside or outside urban areas, as well as the different gaps between the thematic areas examined. For campuses located inside the city, public transport is considered important given the strategic location of the campus and the several ways that they can be reached. The other two thematic areas that achieved high scores in the analysis are road infrastructure and ICT tools. For both areas, the location of the campus inside the city is an advantage for implementation and planning of targeted strategies on these topics. On the other hand, a key gap detected by the analysis, is the impact on the environment and energy issues.

Focusing on campuses located outside the city, road infrastructure, any infrastructure related to road transport, is the best performing thematic area. With regard to public transport, the gap analysis proved that several measures and policies should be implemented to decrease the gap between the current and desired mobilities. Indicative measures include the improvement of density and extent of public transport services, actions to improve comfort and security. Finally, mobility management is identified as another thematic area which is required to achieve desired mobility levels.

In the next step of the present research, a questionnaire can be developed aiming to extract quantitative data from the case studies. More specifically, by supplementing experts' views, several interesting conclusions can be extracted through a questionnaire to students, researchers and faculty members of the respective campuses.

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