

MOBILITY TO THE UNIVERSITY CAMPUSES OF THE COMMUNITY OF MADRID: DIAGNOSIS AND BASES FOR A SUSTAINABILITY STRATEGY

Luisa Fernanda Balsero Martínez

PhD. Candidate, TRANSyT-UPM, Spain

Karim Lamarty Belica

Master candidate, TRANSyT-UPM, Spain

Andrés Monzón de Cáceres

Prof., Transport Eng., Urban and Regional Planning-UPM, Spain

ABSTRACT

The movements to the university campuses bring a challenge to the sustainability and public transportation. Taking into account the EDM2018 (home mobility survey of the Community of Madrid) an analysis of university mobility has been made in order to define global and specific strategies for this segment of recurring trips.

The study perform, divides the survey data according to different type of users: students, workers (PAS) and teachers/researchers (PDI). Each of these groups have different socio-economic profiles, work patterns and availability of their own vehicle, which conditions their daily mobility. Second, the different mobility patterns of the 14 Campuses of the 6 public universities in the region are compared. The results are clearly influenced by location variables (urban, metropolitan, isolated) and their accessibility by public transport.

Therefore, a multiple causal relationship can be established between the above factors, which determine the modal distribution for each campus and each group. The variations are important, going from 78% of trips by public transportation made by students in urban campuses to 14% of trips by public transportation made by workers in isolated fields.

The analysis methodology contrasts the previous results, based on the data obtained from the EDM2018 with the level of infrastructure and transport offer: car parks, entrances, railway stations and bus stops, and their accessibility to the campus.

These analyzes make it possible to propose a series of recommendations to reduce car use and promote the use of collective transport.

All of this will be part of the diagnosis for the development of Sustainable University Mobility Plans, which will be the second phase of this work.

1. INTRODUCTION AND OBJECTIVES

1.1 Issue

There is a big problem with pollution in the city of Madrid. We need to promote sustainable mobility to give a solution to this issue. Nowadays there is talk of using active modes of transport such as bicycles, electric vehicles, walking... but first it is necessary to facilitate their use and make people aware so that they choose to use them.

1.2 Objectives

The main objective of this research is to reduce the CO₂ emissions produced by motor vehicles and improve the mobility of the city, in this case of the university community.

1.3 Structure of paper

The structure of the paper is the following:

First, it will show an analysis of the existing studies that have been carried out on sustainable university mobility will be shown, highlighting proposed solutions and problems that remain to be solved. For this, the mobility of the public universities of Madrid will be taken as a case study.

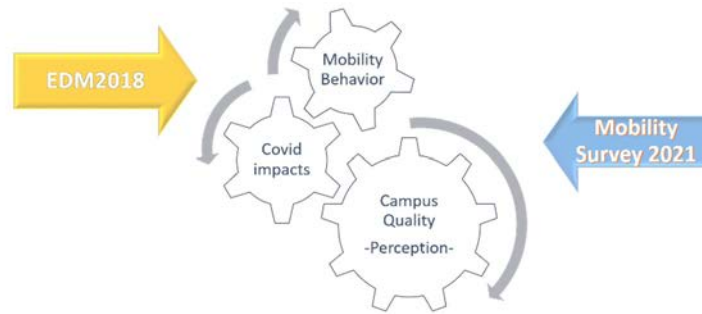
After it will do a recompilation of mobility data with a mobility survey ad hoc EDM2018, where it will obtain the mobility patterns of university users and it will do a comparative analysis with the mobility survey 2021 that was created for this research aimed at students, teachers, administrators, and providers. With the data obtained from the survey 2021, it will do a statistic analysis to identify mobility patterns and to define key factors improving sustainable mobility, in addition to being able to appreciate the incidence of COVID-19.

2. BACKGROUND

2.1 State of the art (key papers <12)

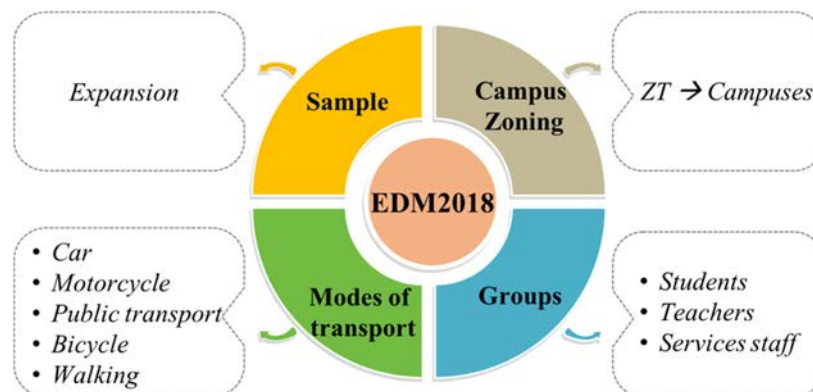
The published literature on sustainable transport is extensive, although it focuses mainly on car use, its impacts, and infrastructure (Balsas, 2003).

3. METHODOLOGY



3.1. Mobility survey ad hoc EDM2018

The mobility survey ad hoc EDM2018 was done by Regional transport consortium of the Community of Madrid to study the mobility general of population of Madrid. This survey was done in person, between February 13 and June 12, 2018 in the Community of Madrid, grouping the areas where the surveys were conducted as transportation areas. For use this data, it has been filtered by age, degree, transportation areas that coincide with our study areas, in this case university campuses and reason for the trip.



The population of the university is made up of students, teachers and service staff that have been identified with the following characteristics:

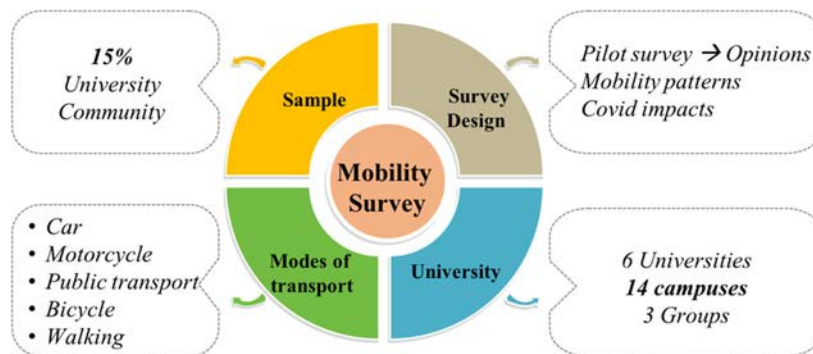
- Students: over 18 years old, with professional or university training, studying or studying and working, study trips.
- Teachers: over 30 years old, with high school studies and/or professional training, public sector employees, work trips.
- Service staff: over 20 years old, public or private sector employees, work trips.

Once the groups have been made with the filters described, the number of trips made by each group is obtained and with this the modes of transport used are classified with the information that EDM2018 provides per trip.

Based on these data, an analysis of trips to university campuses has been made.

3.2. Mobility survey for the university community 2021 (App: survey monkey)

The mobility survey for the sustainable university community 2021 was designed based on the detailed study of the mobility of the university campuses of the 6 public universities of the Community of Madrid in an application called Survey Monkey.



This survey is aimed at students (over 18 years old, studying or studying and working), teachers (over 30 years old, public sector employees) and service staff (over 20 years old, public or private sector employees).

3.2.1 Pilot for students, research teaching staff, and administration and services staff

To prepare it, first of all, a series of pilot surveys were launched, a total of three per group at each campus, with a total of 135 responses throughout the university community. This pilot survey was distributed as follows: three student surveys, two being undergraduate and one master's degree; another three to professors (one to a non-permanent professor and two to permanent professors); and three more to service personnel, two under 30 years old, another over 30 years old.

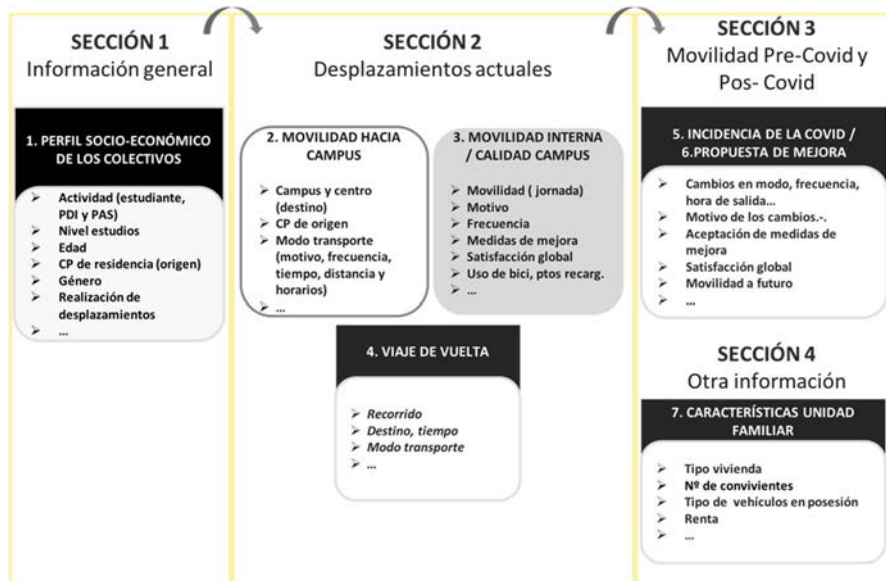
They were able to draw conclusions about the perception of those surveyed with the survey and the aspects to improve.

3.2.2 General survey students, research teaching staff, and administration and services staff (launch communication campaign with posters, screens, complaints management, and recruitment of non-institutional staff with cards)

The general survey consisted of 4 sections, section 1 of general information, section 2 of current trips (including the mode of transport, frequency, origin of the trip, the distance traveled, the trips within the campus and the trip of return), section 3 on pre-Covid and post-Covid mobility (it asks about the perception of quality in their mobility to the campus) and section 4 of other information (where data on the family unit were asked).

For the launch of this survey, a communication campaign was carried out through physical posters and on screens in the buildings of the study universities until March 26, 2021.

During those weeks, an exhaustive control of incidents with the survey was maintained through social networks and email



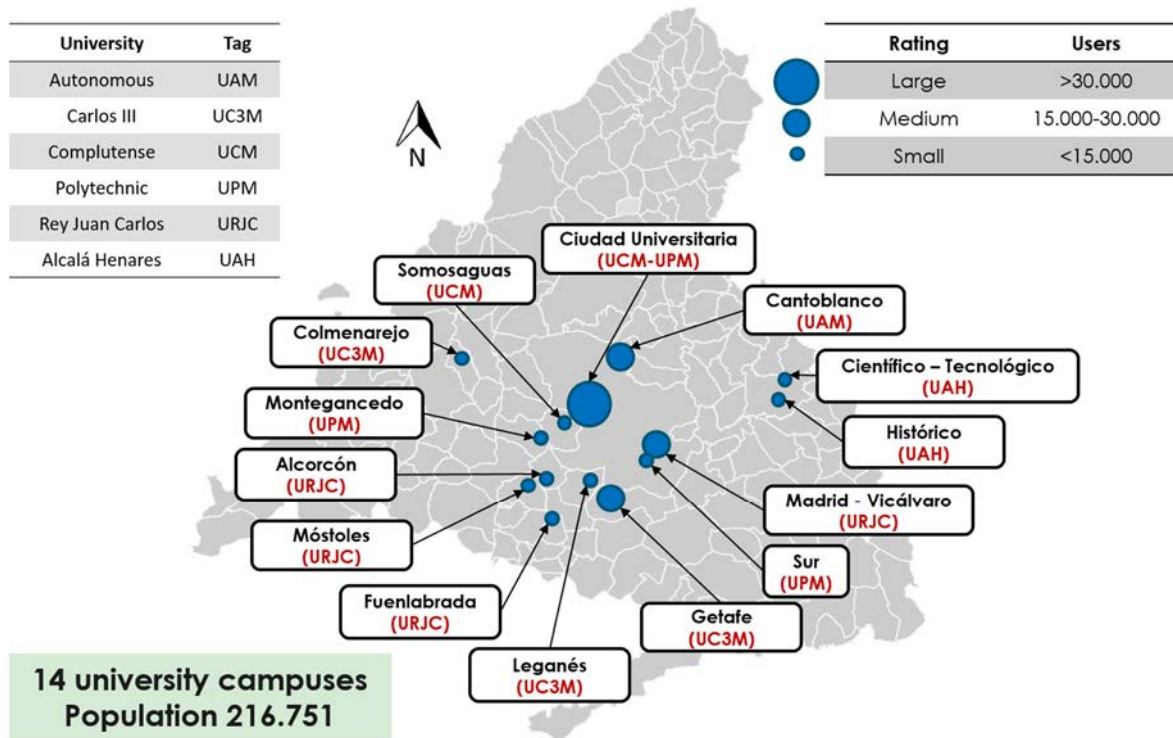
The external contracted service personnel also had access to this survey through cards containing the QR and the survey link, which were sent to them through the management of each university.

4. CASE STUDY

4.1 CAM (public universities of the Community of Madrid)

The objective of the community of Madrid is to acquire a more sustainable mobility in the city and for this purpose a pilot scenario has been created which is the university community, where the main problems in mobility will be collected on a small scale, the main problems in mobility will be determined. majority mobility patterns and a series of recommendations will be provided that will be carried out through the drafting of sustainable university mobility plans that, once completed, can be extrapolated to larger scales, such as the city of Madrid and other cities with similar characteristics.

the universities that have participated in the study are the 6 public universities of the Community of Madrid and the campuses universities study are the following:



There are a total of 14 university campuses, the university campus being shared by the UPM and the UCM.

5. RESULTS

When analyzing the results, this information has been divided into four criteria:

- Socioeconomical
- Mobility patterns
- Impacts by Covid
- Perception of mobility and future

5.1 Descriptive analysis (statistic analysis)

The statistical analysis includes the following variables:

<i>Variable</i>	<i>UPM</i>	<i>UCM</i>	<i>UAM</i>	<i>UAH</i>	<i>UC3M</i>	<i>URJC</i>
1. Activity						
<i>Students</i>	72%	70%	67%	81%	85%	88%
<i>Teachers</i>	16%	19%	20%	13%	8%	10%
<i>Service Staff</i>	12%	11%	13%	6%	7%	3%
2. Studies						
<i>School</i>	56%	53%	48%	66%	66%	65%
<i>College</i>	6%	7%	4%	8%	10%	11%
<i>Degree</i>	15%	15%	17%	10%	13%	11%
<i>Master</i>	10%	9%	13%	4%	6%	5%
<i>Doctorate</i>	14%	16%	18%	12%	5%	8%
3. Gender						
<i>Man</i>	53%	33%	34%	31%	43%	31%
<i>Woman</i>	45%	65%	64%	67%	56%	68%
<i>I prefer not to specify</i>	2%	2%	2%	1%	1%	1%
4. Monthly income						
<i>1000 – 2500€</i>	44%	48%	44%	51%	40%	55%
<i>2500-5000€</i>	38%	34%	37%	34%	37%	27%
<i>> 5000€</i>	9%	7%	8%	4%	13%	5%
<i>< 1000€</i>	9%	12%	10%	11%	11%	13%
5. Age						
<i>Minimum</i>	18	18	18	18	18	18
<i>Half</i>	35	35	35	29	27	28

Table 1. Socioeconomic characteristics variables

5.2 Mobility patterns

The following variables are used to determine mobility patterns:

<i>Variable</i>	<i>UPM</i>	<i>UCM</i>	<i>UAM</i>	<i>UAH</i>	<i>UC3M</i>	<i>URJC</i>
1. Current displacements						
<i>Yes, some day a week</i>	37%	26%	41%	47%	63%	32%
<i>Yes, most of the days</i>	36%	47%	39%	36%	29%	20%
<i>Yes, but less than 1 days a week</i>	27%	19%	19%	17%	8%	48%
2. Transport mode						
<i>Driver car</i>	26%	26%	30%	27%	28%	31%
<i>Accompanying car</i>	3%	2%	3%	3%	3%	3%
<i>Motorcycle</i>	2%	0%	1%	1%	0%	1%
<i>Public transport</i>	59%	65%	63%	58%	52%	61%
<i>Bicycle</i>	2%	1%	1%	1%	0%	0%
<i>Walking</i>	7%	5%	2%	10%	15%	3%
<i>Others</i>	1%	1%	0%	1%	1%	0%
3. Time travel						
<i>0-15min</i>	11%	9%	15%	15%	19%	14%
<i>15-30min</i>	34%	29%	25%	25%	30%	30%
<i>30-60min</i>	37%	41%	38%	29%	33%	34%
<i>>60min</i>	18%	21%	23%	32%	18%	22%
4. Satisfaction	1--6					
<i>Half</i>	4,108	4,058	4,145	3,614	4,082	3,995
5. Campus stay						
<i>Tomorrow</i>	35%	36%	36%	29%	24%	36%
<i>Afternoon</i>	15%	20%	17%	23%	25%	29%
<i>All day</i>	12%	12%	15%	11%	9%	5%
<i>Night</i>	0%	0%	0%	0%	1%	0%
<i>It varies according to the days</i>	38%	32%	32%	38%	41%	29%
6. Moving frequency on campus						
<i>Daily</i>	23%	30%	26%	20%	18%	16%
<i>2 times a week</i>	30%	27%	34%	46%	64%	26%
<i>Occasionally</i>	35%	36%	33%	29%	14%	54%
<i>Never</i>	11%	7%	6%	5%	4%	4%

Table 2. Mobility characteristics variables

5.2.1. Qualitative variables by group

Chart 1. Group mobility – UCM -

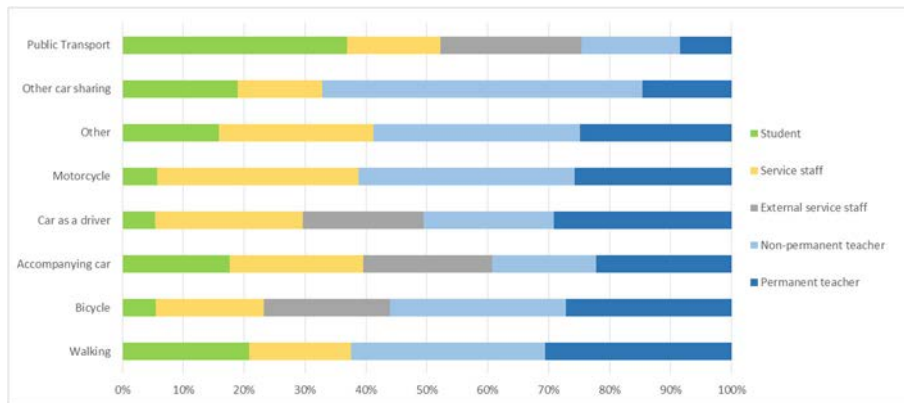


Chart 2. Group mobility – UC3M -

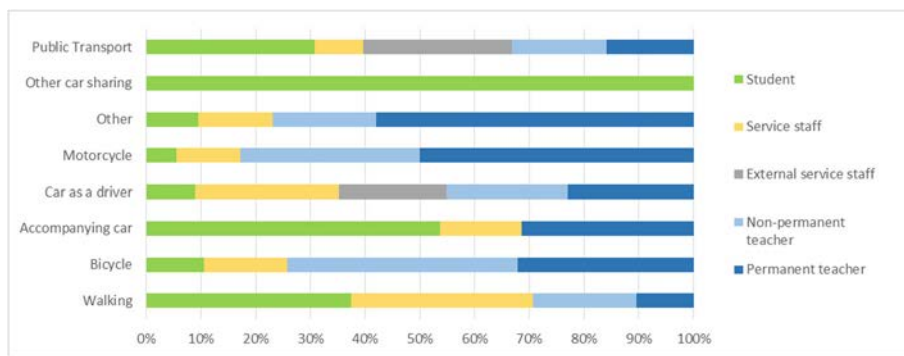


Chart 3. Group mobility – URJC -

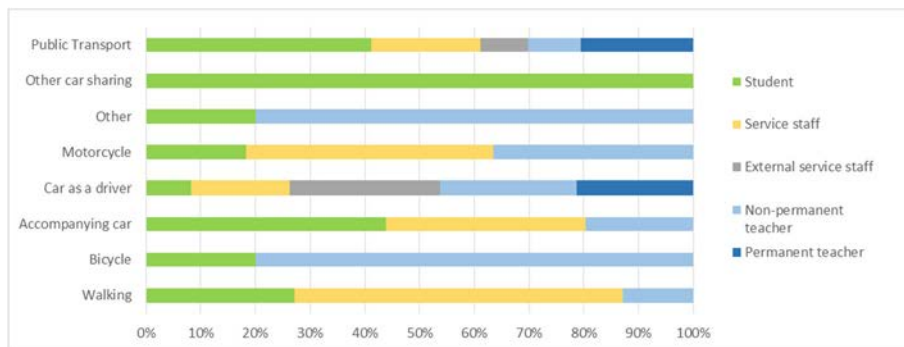


Chart 4. Group mobility – UPM -

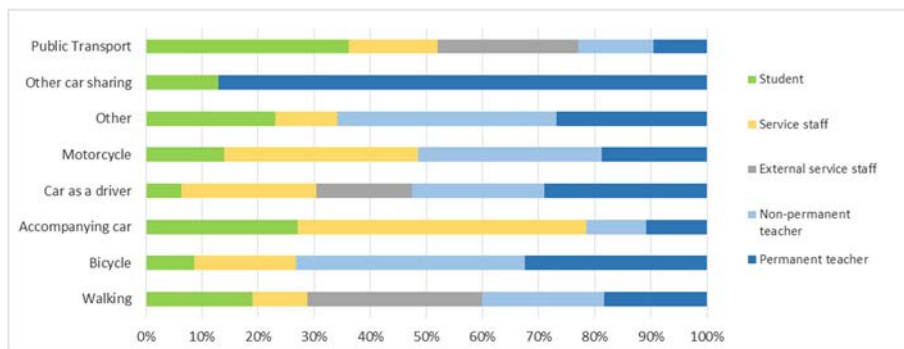


Chart 5. Group mobility – UAM -

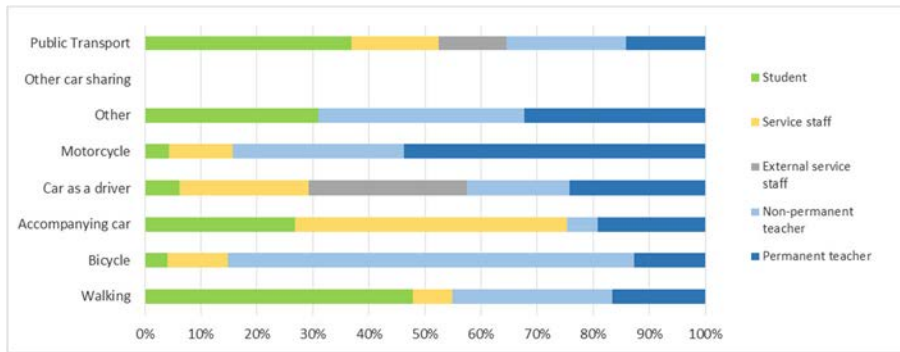
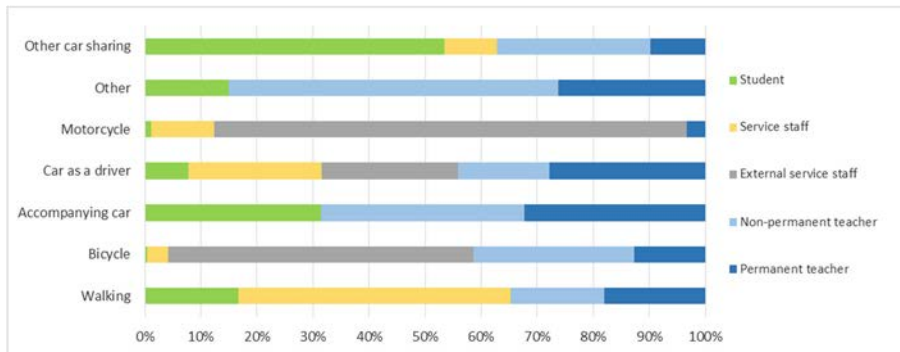


Chart 6. Group mobility – UAH -



5.2.2. Age mobility variables

Chart 7. Mobility & Year - UPM -

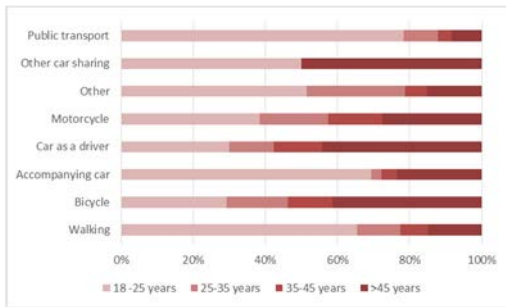


Chart 8. Mobility & Year - UCM -

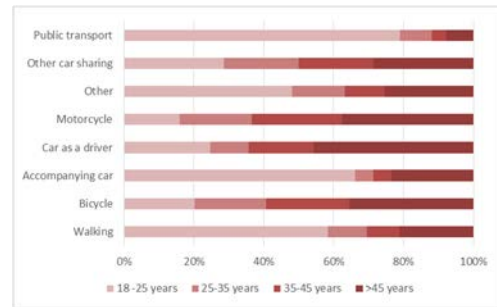


Chart 9. Mobility & Year - UAH -

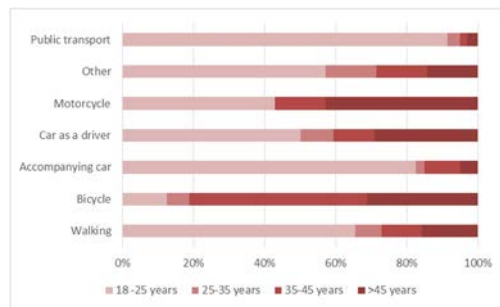


Chart 10. Mobility & Year - UAM -

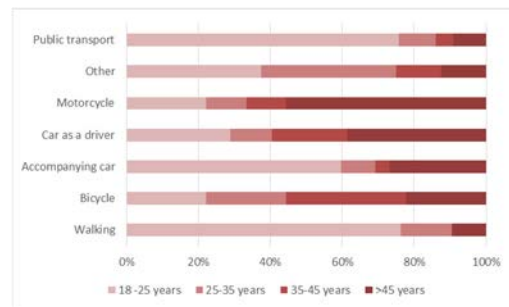


Chart 11. Mobility & Year - UC3M -

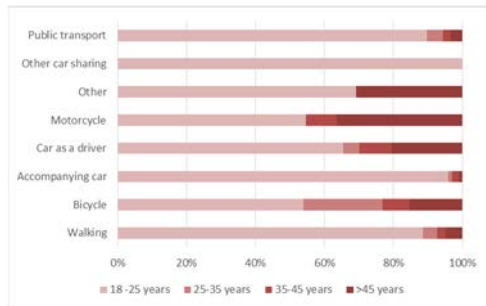
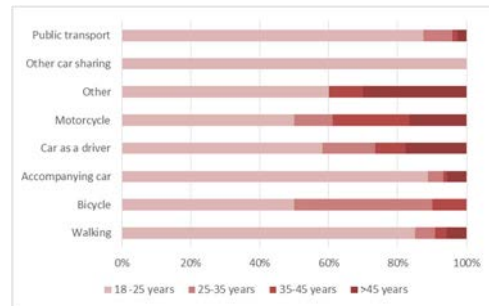


Chart 12. Mobility & Year - URJC -



5.2.3. Income mobility variables

Chart 13. Mobility & Income - UPM -

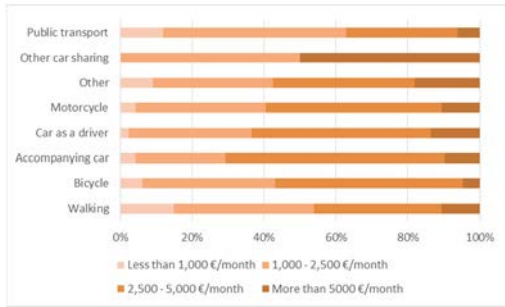


Chart 14. Mobility & Income - UCM -



Chart 15. Mobility & Income - UAH -

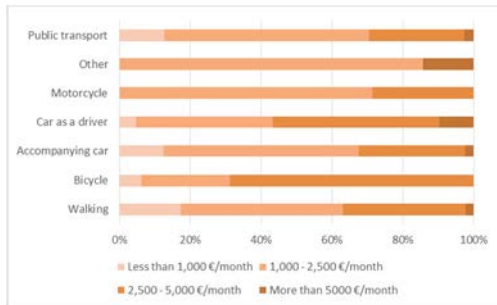


Chart 16. Mobility & Income - UAM -

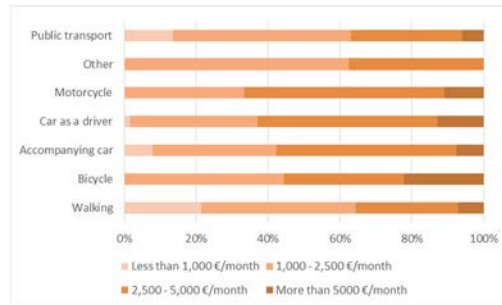


Chart 17. Mobility & Income - UC3M -

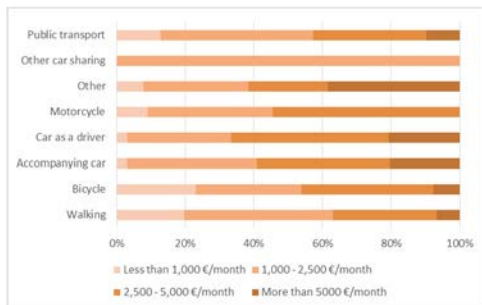
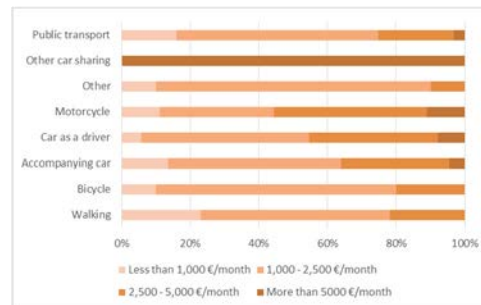


Chart 18. Mobility & Income - URJC -

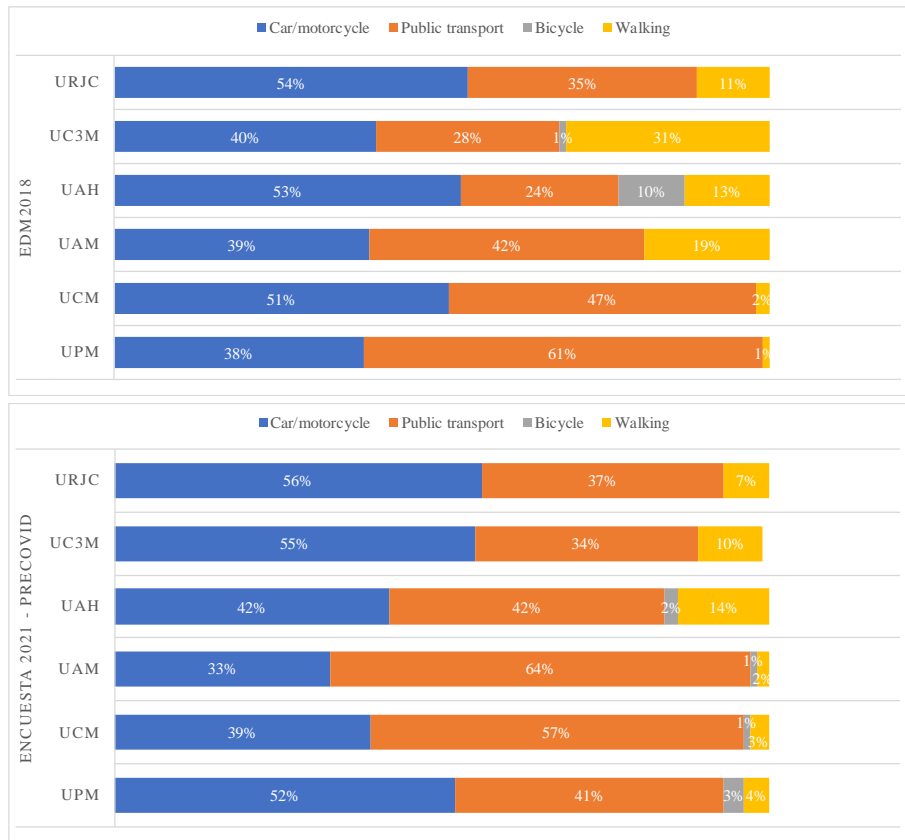


5.3. Quality of service environment

In this section a comparison will be made between the 2018 mobility survey and the 2021 mobility survey in terms of modal split, and the impact of Covid on modal choice and users' perception of their mobility and how they think it will be in the future will be analysed.

5.3.1. EDM2018 & Mobility Survey 2021

Comparison between the results of the edm2018 and those of the mobility survey 2021.



5.3.2. Impact of COVID-19 on mobility

Chart 19. Impact Covid - UPM -

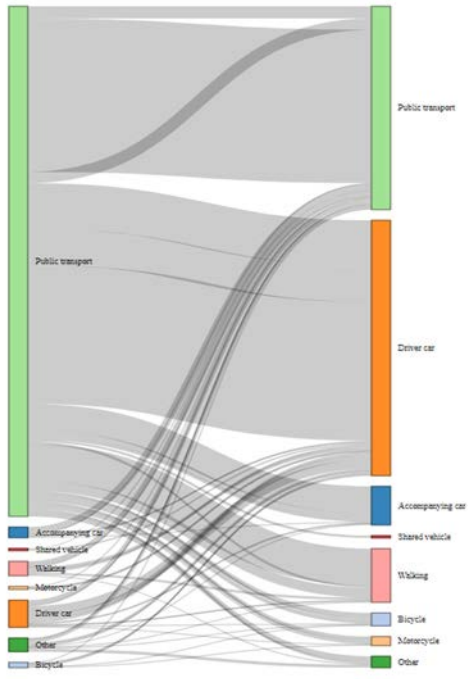


Chart 20. Impact Covid - UAM -

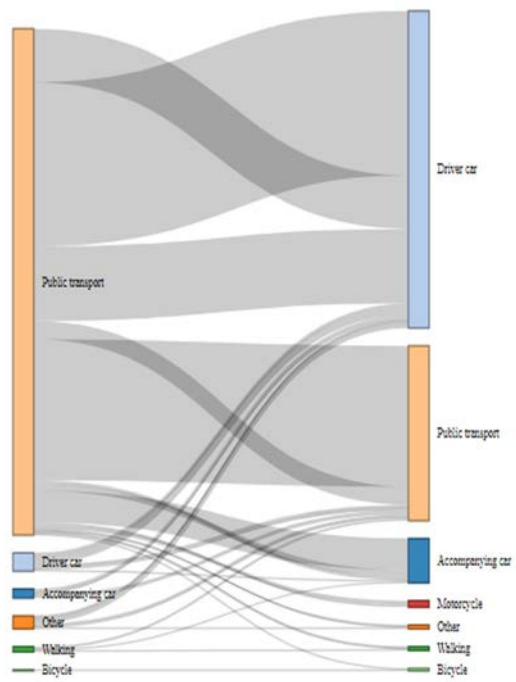


Chart 21. Impact Covid - UCM -

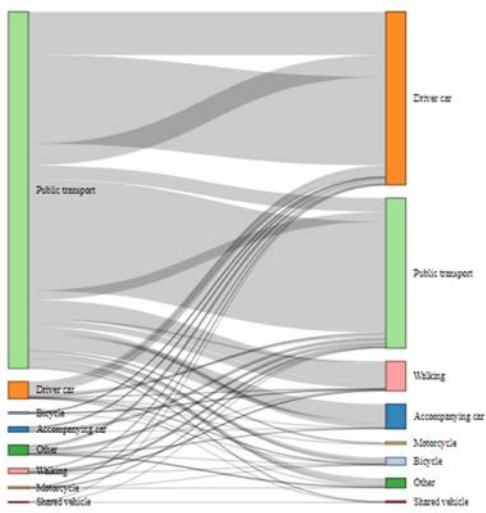


Chart 22. Impact Covid - UAH -

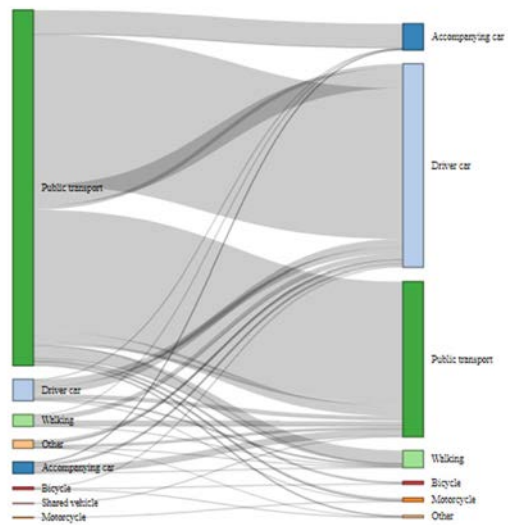


Chart 23. Impact Covid - UC3M -

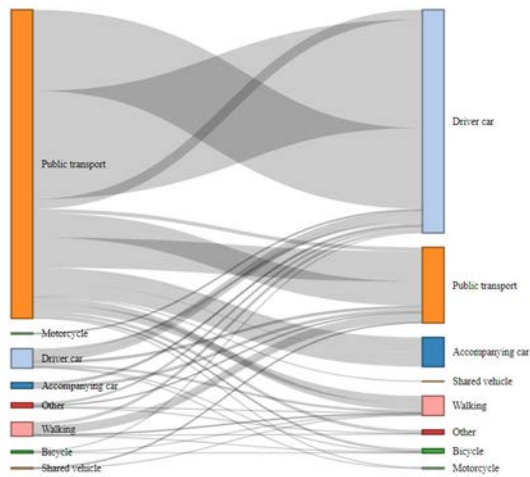
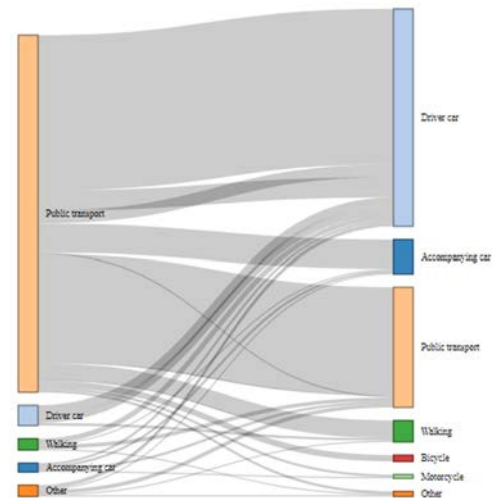


Chart 24. Impact Covid - UC3M -



5.3.3. Perception of mobility and future

Criteria	Variables	UPM	UCM	UAM	UAH	UC3M	URJC
Preferences and satisfaction	1. Future mobility (1-6)						
	more trips by public transport	4.28	4.40	4.52	4.18	4.22	4.43
	More bike trips	3.42	3.52	3.40	3.45	3.19	3.39
	More car travel	2.55	2.53	2.52	2.94	2.82	3.06
	I will share travel	2.22	2.16	2.11	2.15	2.18	2.30
	Use of shared modes	2.95	3.24	3.26	3.79	3.52	3.51
	I will reduce commuting	2.08	2.05	2.03	2.06	1.98	2.25
	I will work remotely	2.36	2.17	2.25	2.06	2.27	2.40
	2. Satisfaction (1-6)						
	General	4,11	4,06	4,15	3,61	4,08	4,00
	2.1. Groups						
	Students	3.99	3.91	3.97	3.43	4	3.90
	Service staff	4.20	4.26	4.60	4.5	4.40	4.45
	Teachers	4.35	4.42	4.45	4.1	4.35	4.82
	2.2. Gender						
	Mas	4.17	4.16	4.26	3.83	4.08	4.11
	Woman	4.09	4.02	4.09	3.51	4.08	3.94
	Unspecified	3.61	3.78	4	3.79	3.87	4.08
	2.3. Travel time						
	0-15min	5.03	5.05	5.27	4.95	5.36	5.03
	15-30min	4.62	4.59	4.61	4.38	4.54	4.56
	30-60min	3.97	3.94	3.99	346	3.69	3.80
	>60min	2.95	3.10	3.14	2.52	2.72	2.89

3. Assessment of the transport service (1-6)						
Access by car	4.86	4.73	4.97	4.38	4.67	4.99
Access by public transport	4.60	4.82	4.74	3.84	4.43	4.85
Access by bicycle	3.99	4.23	3.9	3.84	3.83	4.05
Security in access and parking	4.26	4.21	4.65	3.98	4.42	4.33
4. Improvement measures (1-6)						
Car access restriction	3.01	3.24	2.91	2.99	3.34	3.05
Incentivise car sharing	3.96	3.90	4.33	4.19	4.24	4.24
Increase frequency of public transport	4.96	5.17	5.36	5.40	5.09	4.96
5. Mobility relevant to university choice (%)						
Yes	37	52	40	52	39	54
No	63	48	60	48	61	46
6. Use electric vehicle if reserved spaces are available (%)						
Yes	43	77	41	38	40	45
No	57	23	59	62	60	55
7. Carpooling with others (%)						
Yes	68	70	72	70	72	72
Already carpooling	6	6	6	10	9	7
No	26	23	22	20	19	21

6. CONCLUSIONS AND RECOMMENDATION

Recommendations based on the characteristics of the campus, where to decide on which campus it would be appropriate to:

- Restrict the access and circulation of private vehicles.
- Promote the electric vehicle, placing recharging points or excluding them from the restrictions of the private vehicle.
- Facilitate the use of the bicycle, or active modes by building more infrastructure or improving the existing one.
- Encouraging the use of dissuasive car parks and the use of shared vehicles.
- Making study and work hours more flexible to reduce the demand curve in public transport at rush hour.

6.1. Key factors improving sustainable mobility (influencing variable in decision making)

The key factors that enhance mobility to universities are: the income of each group, the location and accessibility of the universities, the existing facilities for carpooling.

This analysis shows that it is key to promoting sustainable mobility to know the socio-economic characteristics of university users, which will facilitate access to new, more sustainable modes of transport. The trend and acceptance of the initiatives shown towards the use of bicycles is quite acceptable, which encourages us to continue along this path.

ACKNOWLEDGMENTS

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