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Consultancy, Advice and Specialized Research on Active Mobility with Two-Person Electric Vehicles, As A Carsharing and Micro-Mobility Strategy in Cuenca

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The Study Advice and specialized research on active mobility with two-person electric vehicles, as a Carsharing and micromobility strategy in Cuenca, is the instrument that will analyze the needs of alternative transport in the city of Cuenca through the application of an Origin-Destination matrix, which will provide the information for the analysis of the two-person electric vehicle as a possible alternative means of transport. In addition, some parameters will be evaluated, such as: calculation of demand, model to be implemented, sources of income. Among the main findings of this research, it is found that, in the face of the implementation of the proposed model, the behavior of demand in the first months should be analyzed, and if possible, a prior expansion plan should be had both in number of units, as well as in number of stations and areas of scope.

Keywords: Active mobility, Electric vehicles, Carsharing, Micro-mobility.

1. Introduction

The concept of carsharing is apparently new, at least in the South American region, where academic works have begun to analyze this type of mobility in recent years. The academic literature worldwide mentions that the analysis of carsharing has been taking place for approximately 20 years, however, year after year, a notable growth in scientific production can be observed. In the same way, the media (press) progressively give greater notoriety to carsharing as a micromobility strategy. A brief review of digital repositories shows an 800% increase in the number of publications referring to carsharing, between 2000 and 2020; However, of all the publications, most of them correspond to technical issues of operation of the units and the system, while only 18% analyze the carsharing alternative from an economic and business point of view, studying, among other aspects, the sustainability and acceptance of the system in the different markets.

In the case of Ecuador, there are no studies on carsharing, however, in Colombia and Peru, the closest countries, some undergraduate or postgraduate degree works have been found that analyze this operation. Likewise, in Europe it has been possible to find works that show the success of this mobility strategy.

Samar (2018) identifies carsharing as carpooling for "round trip" journeys, which allows users to pick up and return a carpool at the same station from which it departed. Users access this network or system through some mechanism established for this purpose, prior to which they should register in a system or application, paying some value; Subsequently, the payment is made in a fixed way for a limit of kilometers and/or travel time, which once exceeded, a rate will be established based on the time and distance traveled extra. In recent years, according to Samar (2018), new models have been introduced to the market, such as an AB model, which is a much more flexible option, where users can pick up a vehicle in a place and leave it in a different designated parking place and therefore closer to its final destination. so that the initial concept of "round trip" is no longer used.

This model has been successful mainly in spaces such as airports, terminals or train stations. It is also successful when implementing a carsharing service electric because it allows users to park vehicles at charging stations at the end of their journeys. Finally, another of the successful models corresponds to a free float system, which is operating in at least 50 major cities around the world, including: Berlin, Vancouver, Milan, Seattle, and Hamburg. The free-float system has the advantage that instead of returning the car to a fixed parking spot, members can end their trips anywhere within a designated local area.

1.1 Carsharing Business Models

Car-sharing business models are all about access and not ownership. Instead of buying a vehicle and owning it, people become members of a club or group that gives them access to a vehicle, according to the availability of the area in which it is located, and for which it establishes a reference price, either by time or kilometer.

Samar (2018) identifies that there are four ways to build a car-sharing business model:

- B2C (Business to Consumer), corresponds to the business model in which the company provides the service directly to the consumer.

- B2B (Business to Business), refers to services that are provided directly between companies. This includes the free-floating models, the AB model and the electric carsharing.

The free fleet model refers to the ease of taking the vehicle anywhere and parking it in the same way anywhere, so that access to the service is facilitated, since the user parks near his destination. The AB model is relatively similar, however, the user must park in stations established for this purpose, created by the same company, which sometimes makes it difficult perhaps because of the distance when not finding a nearby station to park. This type of model is more attractive for transfer to airports, terminals, train stations, or similar. Finally, electric carsharing is very similar to the AB model, however, in the former the vehicle is parked at an electric charging station.

- P2P (peer to peer) refers to services provided between people.

- Non-profit.

For the car-sharing model to be a success, there has to be a parking agreement that supports the business model, backed by a competent authority, for example, in Germany there has been a law for car-sharing throughout the country since 2017, a situation that benefits all carsharing companies in that country, and facilitates the implementation of a free-floating model. Or Vancouver that has created a special parking permit that makes it easier for carsharing units to park in any residential area. Which is why these 2 cities mentioned are the pioneers in the establishment of carsharing through a free fleet model. The regulation must allow vehicles to park anywhere in this case without generating a contravention, so the implementation of this type of alternative must be a joint proposal or at least with the endorsement of the regulatory entity.

1.2 Advantages of Carsharing

Carsharing has a number of advantages, which is why it has many success stories worldwide, among the main advantages are:

- Sustainable mobility, which refers to the fact that this alternative is a sustainable formula that reduces carbon dioxide emissions, as well as decongesting traffic. Being able to share a vehicle using it only when it is really necessary means fuel savings and a reduction in CO2 emissions.

- Cost, carsharing reduces vehicle rental costs by more than 30%. This cost reduction lies in the low rates established by the companies.

- Management, carsharing is usually accompanied by a special application for management, facilitating the monitoring of the vehicle's one-off rental.

- Investment, considering the main problems of liquidity and indebtedness of people, carsharing is presented as one of the best alternatives, because it gives people the possibility of moving in independent vehicles, to the place they want without the need to have their own vehicle and all the expenses that this would generate, In this way, the debt of buying a traditional vehicle is avoided.

- Flexibility, the fact of having a shared vehicle, provides the option to change the vehicle, the number of times you consider it pertinent or want to do so, so you will always have a new, updated vehicle, additionally any problem related to the vehicle, will be assumed by the carsharing operating company, so the user will not worry about that type of inconvenience.

2. Objectives

2.1 General objective

Prepare and present a study that allows to know the generating and attractant areas of the trips that are generated in the city of Cuenca, which will allow analyzing the implementation of Carsharing as a means of micro-mobility transport in the city, as well as the analysis of the costs, location, supply and demand of this type of transport, focusing on the electric two-person car.

2.2 Specific objectives

- Design the Origin-Destination Survey (EOD)

- Obtain the origin-destination matrix using the Gravitational Model.
- Locate vehicle parking areas (Geo-positioning of stations).
- Locate charging stations, charging points for vehicles.

3. Methodology

3.1 Activities

To achieve the objectives of the study, the collection of information, its processing and the generation of conclusions will be carried out through the use of various techniques or processes, the same that are detailed below, for each of the products that will be obtained:

3.1.1 Documentary research on the different mobility models

A brief documentary research will be carried out on the different models of shared mobility existing today, through the review of current scientific and non-scientific literature in repositories and databases; as well as the review of existing planning instruments that in principle have application in Cuenca, in Ecuador and internationally. Background of Mobility in Cuenca.

A review will be carried out based on secondary information on mobility in Cuenca.

3.1.2 Obtain an origin-destination matrix with different gravitational or other models.

Origin-Destination Surveys (DOEs) are a source of information on everyday spatial mobility; They collect data on the volume and direction of daily population flows and also provide a detailed picture of travel patterns (modes of transport, schedules, travel purposes, etc.). These studies generate useful data for the planning of road infrastructure, the relationship between urban structure and displacement, as well as for the analysis of the links between sociodemographic characteristics and habitual mobility.

The design of the survey must include the registration of information that allows to know the daily mobility of the inhabitants of the city of Cuenca and the characteristics of the trips they make, for this the following fields will be considered:

- Number of trips generated in Cuenca with respect to micro-mobility.
- Population that travels on the indicated days.
- Modes of transportation used to reach the final destination of the trip (including walking).
- Hours of greatest influx of trips.
- Reasons, duration, means of transportation used, time and cost of transportation.

It is important to mention that, due to the scope of the consultancy, the O.D. parent company will be mainly focused on potential users of the Carsharing service, especially associated with Micromobility.

In general, the use of private cars is distributed in a similar way throughout the city, with the

exception of the Historic Center and the northern sector of Cuenca, where low values are observed: in the Yanuncay sector, high values of car use are concentrated. The use of the bus as the main means of transport presents spatial conglomerates of low values in the Historic Center. High values are mainly concentrated on the outskirts of the city, essentially in the Industrial Park. Although few people use bicycles as their main means of transportation, bicycle users are located around Yanuncay, El Ejido, Control Sur, and Pumapungo (PMEP Cuenca, 2015).

Pedestrians, like bus users, present statistically significant spatial patterns, most pedestrians reside in the Historic Center and the number decreases towards the outskirts of the city. The percentage of motorcyclists and taxi users as the first option of mobility is low and does not allow spatial patterns to be identified. The means of transport used can be explained in part by the distance that each area has from the city center, areas near the center have more pedestrians; while the furthest ones have more use of the bus.

Graph 1 Modes of transport differentiated by microzones.

Source: PMEP, 2015

When visualizing the results for the spatial units proposed by the PMEP: Macrozones and microzones, we compare the difference between trips generated Vs trips received. The circles on the map show this difference: Blue circle indicates that the area is a driver of trips, and a red circle indicates that the area is a recipient of trips. The size of the circle indicates how strongly these values are expressed. In this way, we appreciate the prevalence of the Historic Center as the main destination for trips in Cuenca. It is observed that the universities of Cuenca are also important travel attraction, as well as the shopping centers, mainly El Arenal.

3.1.3 Definition of population (universe)

The Population (quantity represented in the formulas as N), is the total set of elements from which the sample can be selected and is made up of elements called sampling units or sample units, with a certain location in space and time. The sampling units can be individuals, families, universities, groups of students, teachers, etc. A relevant aspect in the research methodology is the estimation or calculation of the number of participants that should be included in a study,

therefore, defining the universe in which the intervention is going to be carried out is essential.

In the section on "Attitudes towards mobility change" developed in the Cuenca PMEP prepared in 2015, it is established that 72% of respondents would be willing to participate in a car-sharing system.

According to INEC, for the year 2010 the population of the city of Cuenca was 331,888 inhabitants and the projection for the year 2022 is 417,461 inhabitants.

Taking into account the percentage of people willing to use carpooling, in principle there would be a universe of 300,572 inhabitants.

3.1.4 Sample Calculation

A sample (quantity represented in the formulas as n) is nothing more than a subset of the population that is obtained by a sampling process or strategy.

The fundamental objective for selecting a sample is to make statistical inferences (estimates of one or more parameters about a population of interest). This population is the one to be investigated and is called the population of interest, target, object or target. For extrapolation (statistical inference) to be valid, the sample must be representative, and alludes to the fact that the sample estimator of the variables of interest must have a distribution similar to those of the population from which it comes.

To calculate the sample of a finite population, the following formula will be used:

$$n = \frac{z^2 * p * q * N}{e^2 * (N-1) + (z^2 * p * q)}$$

n = sample for surveys.

N = Total population of inhabitants of the canton of Cuenca, over 18 years of age.

z = 95% Confidence Level = 1.96.

e = maximum allowed error 5.00 % p = probability of success.

q = probability of failure.

The calculation gives us a sample of 384 OD surveys.

For the present study, the surveys will be applied for a full week (Monday to Sunday), considering that the commercial day or main fair in Cuenca is Wednesday, however, there are small markets and fairs (cattle fair that takes place on Thursdays), in different areas of Cuenca that open indistinctly different days of the week that could also influence the need for transportation of citizens and that would be interesting to analyze.

3.1.5 Apply the O-D Survey.

Once the sample size and the areas where the O-D Surveys will be applied have been established, the team of interviewers is selected to instruct them to carry out the data collection. The travel of the interviewing teams will be organized. Follow-up will be carried out during the application of surveys and once the surveys have been applied, they will be delivered for processing. In this study, the interviews will be applied according to the zoning of the city of

Cuenca.

3.1.6 Generation and attraction of trips in the City of Cuenca

This stage of the study focuses on the number of trips an area can generate and the number of trips it can attract through travel generation and attraction factors. The application of the surveys in each of the areas was carried out with total randomness for a full week and the total number of samples was distributed for the 7 days during which the data were collected.

Schedules were set up for the collection of information, trying to cover the largest number of areas for the application of the surveys.

4. Results

4.1 EOD Origin-Destination Survey

The Origin-Destination Survey for the collection of information can be visualized in the Graph 2 Graph 3 Graph 4 record the data obtained from the Origin-Destination Surveys, applied to the sample.

DATOS

NOMBRE ENTREVISTADO _____ EDAD: _____ GÉNERO: M □ F □

POSEE LICENCIA DE CONDUCIR: SI □ NO □ TIPO LICENCIA: _____

POSEE VEHÍCULO PROPIO

	BICICLETA	VEHÍCULO	MOTO	OTROS (Especifique)
				
CANTIDAD				

FECHA: DIA:_____ MES:_____

DIA DE LA SEMANA: Lunes □ Martes □ Miércoles □ Jueves □ Viernes □ Sábado □ Domingo □

ENTREVISTADOR _____

LUGAR TOMA DATOS: _____

1- ORIGEN DEL VIAJE

1,1- A que hora inició el viaje?

HORAS	MINUTOS

1,2- En qué lugar inició el viaje?

Nombre del lugar o referencia _____

Calle _____

Entre que calles _____

Parroquia _____

1,3- Qué tipo de lugar es el origen de su viaje?

Casa	Oficina / Taller	Colegio / Universidad	Mercados / Comercios	Centro Cultural/ Áreas Recreativas	Hospitales / Clínicas / Laboratorios	Otros (especifique)
						

Figure 2. EOD Origin-Destination Survey.

Source: Author

2,- MODO DE TRANSPORTE

2,1- Qué transporte tomó para realizar este recorrido? Marque los transportes que utilizó, numérelos en el orden que los usó y registre el tiempo en cada uno de ellos.

	BUS	TAXI	TRANVÍA	BICICLETA PUBLICA	BICICLETA	VEHÍCULO	MOTO	A PIE	OTROS (Especifique)
									
2,2,-Orden en que los usó									
2,3- Tiempo de viaje (horas y minutos)									
2,4- Cuanto gastó?									

2,5- En caso de haber marcado TAXI. Indique el tipo de taxi.
1. Solicitado por aplicación de internet ☐
2. Sitio, calle u otro ☐

2,6- En caso de haber marcado VEHÍCULO/MOTO
Condujo
SI ☐
NO ☐ PASE AL 3,1

2,7- Numero de personas en el vehículo

2,8- Dónde se estacionó?

2,9- Cuánto pagó en total por parqueo?
$

2,10- Usted paga ese valor de parqueo por (marque)
Hora ☐
Día ☐
Semana ☐
Quincena ☐
Mes ☐

Figure 3. EOD Origin-Destination Survey.

Source: Author

3,- PARADAS INTERMEDIAS

3,1- Durante su viaje. Cuántas paradas intermedias hizo menores a 10minutos y sin pago adicional por transporte?
Registre con números

Con "00" pase a 4,1

3,2- Las paradas intermedias fueron para?

Llevar o recoger a alguien	Ir a la gasolinera	Ir a un cajero	Hacer una compra rápida	Otros (especifique)
				

4,- DESTINO DEL VIAJE

4,1- A qué hora llegó o estima llegar?

HORAS	MINUTOS

4,2- En qué lugar terminó el viaje?
Nombre del lugar o referencia
Calle
Entre que calles
Parroquia

4,3- Qué tipo de lugar es el destino de su viaje

Casa	Oficina / Taller	Colegio / Universidad	Mercados / Comercios	Centro Cultural/ Areas Recreativas	Hospitales / Clínicas / Laboratorios	Otros (especifique)
						

4,4- Cuál es el motivo/propósito del viaje?

Trabajar	Estudiar	Ir de Compras	Recreación / deportes	Llevar o recoger a alguien	Ir al hospital/ clínica	Otros (especifique)
						

Figure 4. EOD Origin-Destination Survey.

Source: Author

Table 1 and Graph 5 show the total number of surveys that were applied in each control zone described above; Also in this same graph, you can see the bar scheme of this table, in order to be able to better visualize the established distribution.

Table 1. Points where the Origin-Destination EOD Surveys were applied.

Sectors	Percentage
South Control	7%
Free Fair	6%
August 10 Market	9%
February 27 Market	9%
9 de Octubre Market	6%
Calderón Park	8%
Iberia Park	7%
Industrial park	7%
Paradise Park/Regional Hospital	6%
Land terminal	8%
UDA	4%
Catholic University Basilica	6%
University of Cuenca	5%
University of Cuenca Balzay	5%
UPS	7%
Total	100%

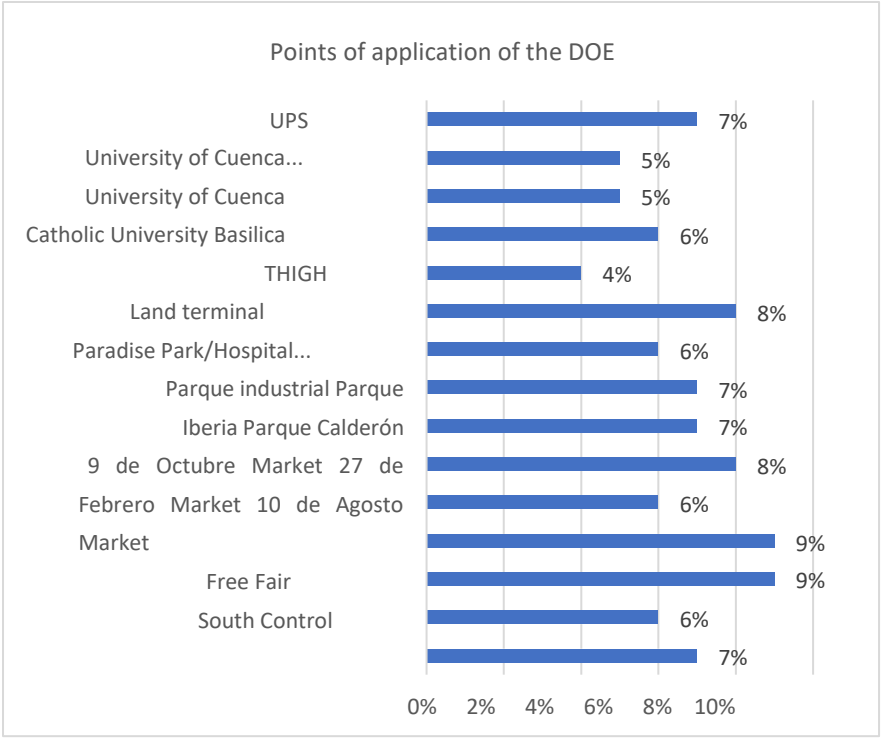


Figure 5. Points of application of the EOD Origin Destination Surveys

Source: Author

It can also be observed that in the selected sectors an attempt has been made to achieve a more homogeneous distribution, with the respective differentiations based on a greater influx of people in each of the sectors. The established places were methodologically determined in a strategic way, designed according to the travel destinations maintained by the citizens who would be potential users of the service, as well as according to the field of action of the service.

4.1.1 Age range of the individuals surveyed

Table 2 and Graph 6 show the distribution by age range of the individuals surveyed.

Table 2. Sample Age Range

Age Range	Quantity
18-30	43%
31-40	30%
41-50	21%
51-65	6%

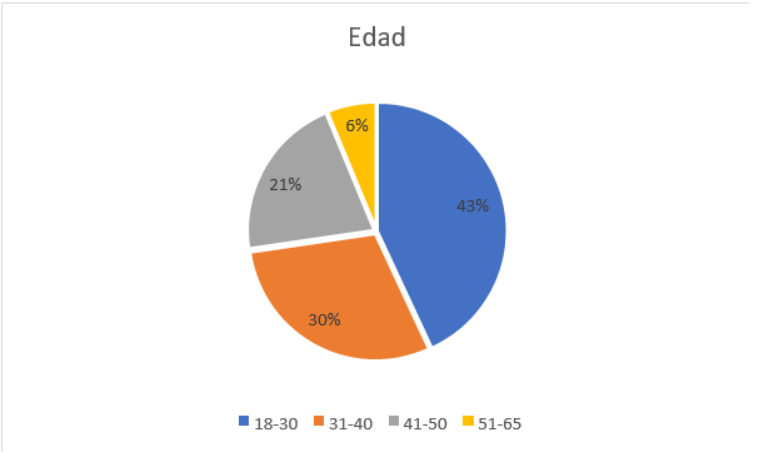


Figure 6. Age range of the sample

Source: Author

According to the graph, it can be seen that approximately 73% of the population is in the range of 18 to 40 years old, which is considered as an economically active population, and therefore, this would become the population that makes the highest number of trips within the city of Cuenca.

4.1.2 Gender identification of the interviewed individuals

Table 3 and Graph 7 show the gender classification of the people surveyed.

Table 3. Identification of the gender of the individuals surveyed.

Gender	Quantity
Men	55 %
Women	45 %
Other	0%

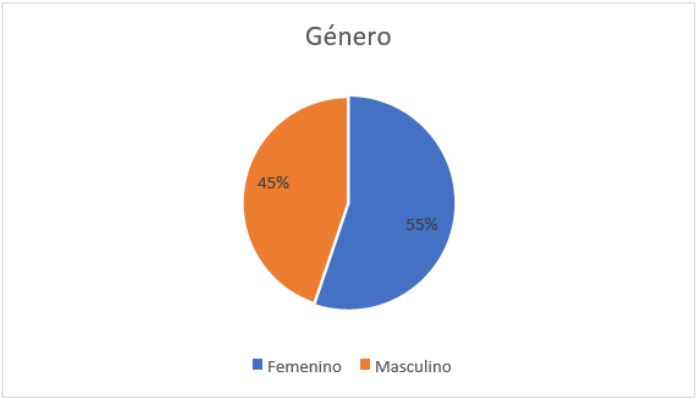


Figure 7. Identification of the gender of the individuals surveyed.

Source: Author

Of those surveyed, a higher percentage (55%) is represented by the female gender, which is normal, since statistically in the city of Cuenca and in the country there is a greater number of women than men.

4.1.3 Type and place of origin of your trip

Table 4 and Graph 8 show the type of place where the trips begin.

Table 4. Place of origin of your trip

Type of Place	Quantity
House	68,3%
Office / Workshop	7%
College/University	4,1%
Markets / Shops	11,9%
Cultural Center/ Recreational Areas	3,9%
Hospitals / Clinics / Laboratories	0,5%
Other (please specify)	4,3%

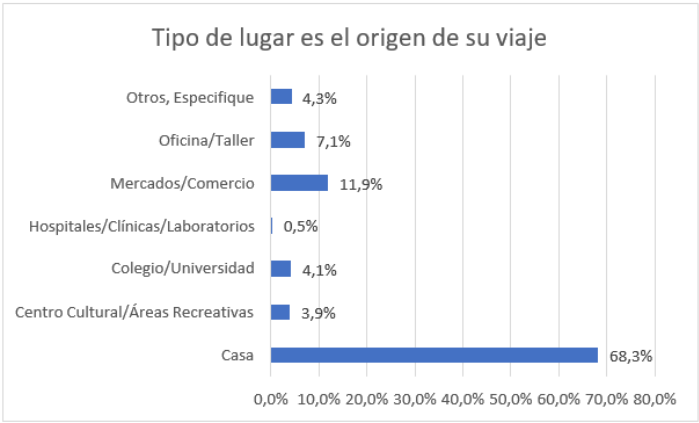


Figure 8. Place of origin of your trip Source (Author, 2022)

In relation to the origin of travel, 68% of those surveyed state that their place of origin is the house or homes, followed by market or commerce and office or workshop, the lowest percentage is represented by hospitals, clinics and laboratories.

4.1.4 Mode of transport used

Table 5 and Graph 9 show the frequency of use by mode of transport used to make a trip.

Table 5. Mode of transport used

Mode of transport	Quantity
BUS	37%
TAXI	7%
TRAM	3%
PUBLIC BICYCLE	0%
BICYCLE	2%
VEHICLE	16%
MOTORBIKE	3%
ON FOOT	31%
OTHER (Specify)	1%

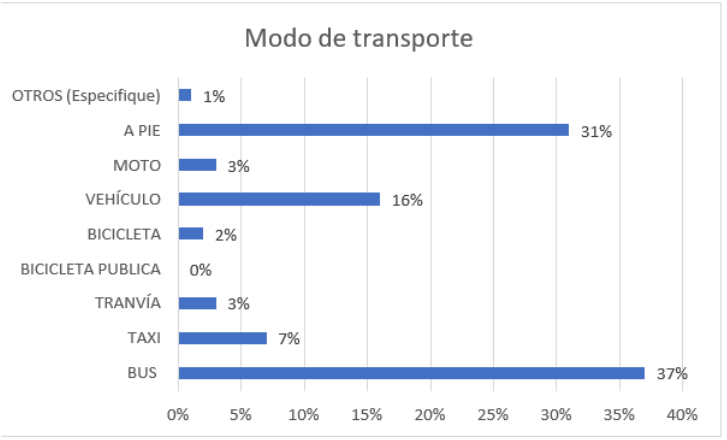


Figure 9. Mode of transport used. Source (Author, 2022)

Regarding the mode of transportation, to a greater extent people use the bus (37%), as well as decide to walk (31%) to get to their destinations, this because the city is accessible to move on foot. Within "other means of transport" are cataloged the Scooters.

4.1.5 Type of duty station

Table 6 and Graph 10 show the type of place that represents the destination of the trips.

Table 6. Type of duty station

Type of Place	Quantity
House	10%
Office / Workshop	17%
College/University	17%
Markets / Shops	33%
Cultural Center/ Recreational Areas	10%
Hospitals / Clinics / Laboratories	1%
Other (please specify)	12%

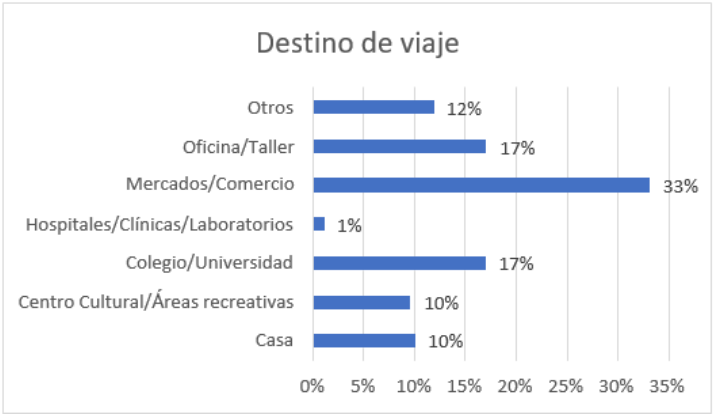


Figure 10. Type of duty station. Source, (Author, 2022)

Regarding the destination, travel to markets or shops predominates (33%), followed by the office/workshop (17%) and school/universities (17%), which indicates that the activities of the respondents are focused on these three activities.

4.1.6 Reason for travel

Table 7 and Graph 11 show the reasons why the people surveyed make their trips.

Table 7. Reason for the trip.

Reason for Travel	Quantity
Work	51%
Study	17%
Shopping	11%
Recreation / Sports	10%
Driving or picking someone up	5%
Ir al hospital/ clìnica	1%
Other (please specify)	5%

Figure 11. Reason for the trip. Author Source, 2022

In accordance with the destination, 51% of those surveyed make their trips for work purposes, followed by studies, a small group makes trips to clinics or hospitals.

4.1.7 Average travel time by mode of transport.

Table 8 and Graph 12 detail the average time per trip used to make a trip.

Table 8. Average travel time by mode of transport.

Mode of transport	Minimal	Maximum	Media	Standard deviation
Taxi	0:05	7:00	0:25	1:05
Private Bike	0:05	2:00	0:28	0:31
Vehicle	0:05	1:30	0:25	0:18
Other	1:00	1:00	1:00	
Motorcycle	0:05	0:35	0:19	0:09
Bus	0:05	1:30	0:28	4:33
Walking	0:01	5:00	0:15	0:27
Tram	0:07	0:40	0:18	2:30

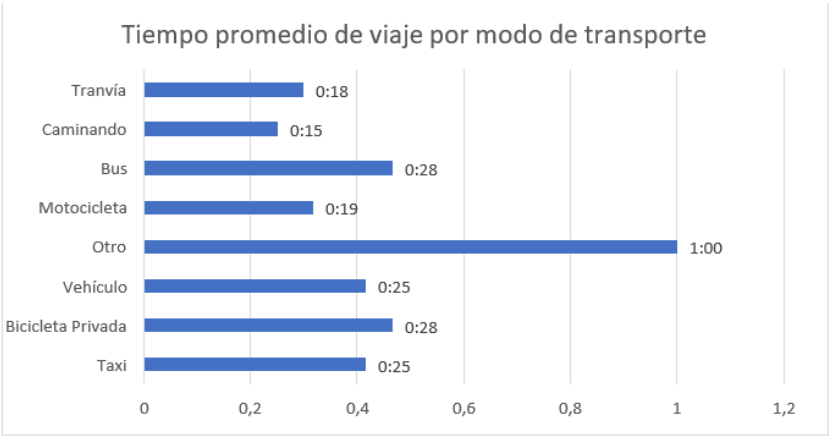


Figure 12. Average travel time by mode of transportation.

4.1.8 Identification of macrozones

The sectorization of the city for the determination of the Macrozones was carried out according to the parishes of Cuenca, both urban and rural, as can be seen in Graph 13.

Figure 13. Macro-areas of the city of Cuenca

Source: Own elaboration

4.1.9 Travel-generating areas

Once the EOD has been applied, the areas that generate trips are identified, where it is identified that the sector with the highest generation of trips is Yanuncay, followed by the Huayna Capac sector, this can be seen in Graph 14.

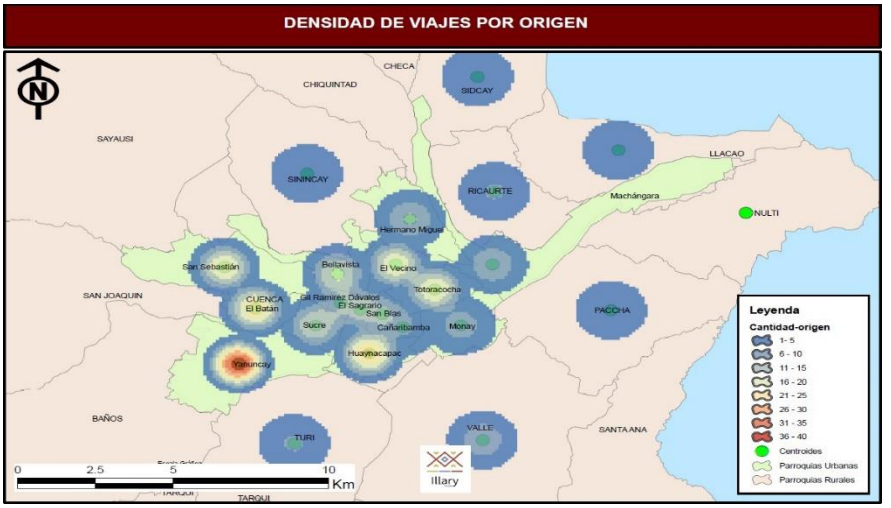


Figure 14. Travel density by origin

Source: Own elaboration

4.1.10 Travel attraction zones

Once the EOD has been applied, the travel attraction areas are identified, where it is identified that the sector with the highest generation of trips is the Historic Center, followed by the Huayna Cápac and Batán sectors, this can be seen in Graph 14

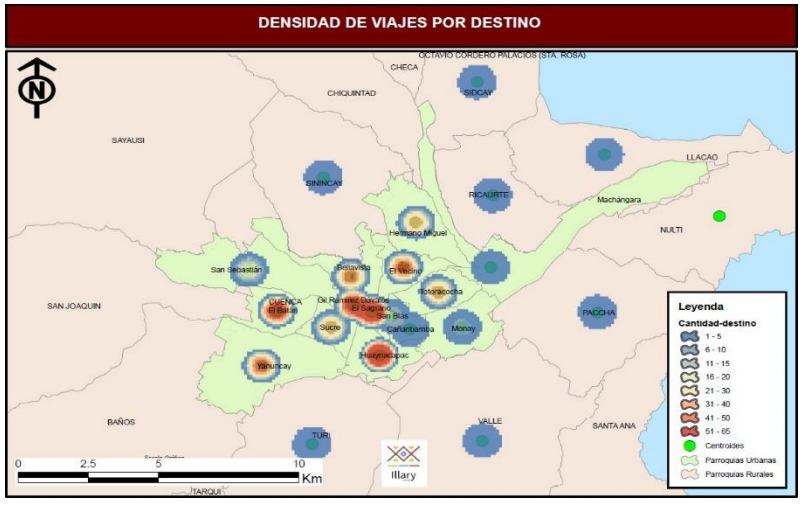


Figure 15. Travel density by destination

Source: Own elaboration

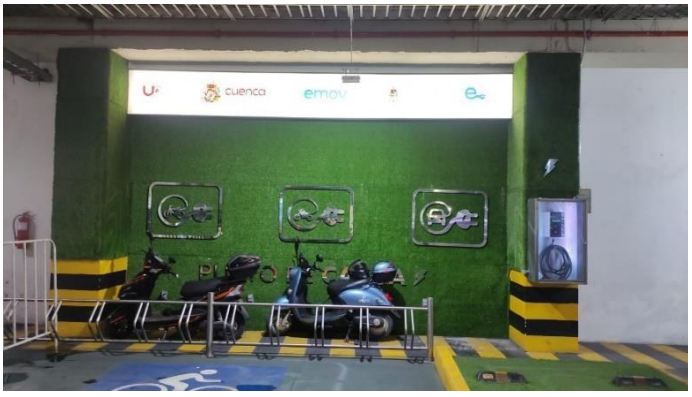
4.2 Charging stations, geospatial location of charging points and parking lots for electric two-person vehicles.

4.2.1 Cadastre of the charging stations of the city of Cuenca.

A tour was carried out in all the places, where it is public knowledge that there is a charging point or charging station in the city of Cuenca.

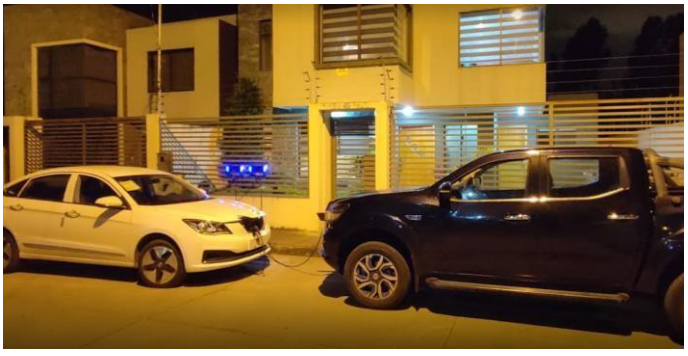
In the field survey, the existence of 5 charging points or charging stations could be verified.

1. Charging station located in the underground public parking lot of Parque de la Madre, this is for public use, it operates with the hours of operation of the parking lot that currently operates from 6:00 a.m. to 10:00 p.m.



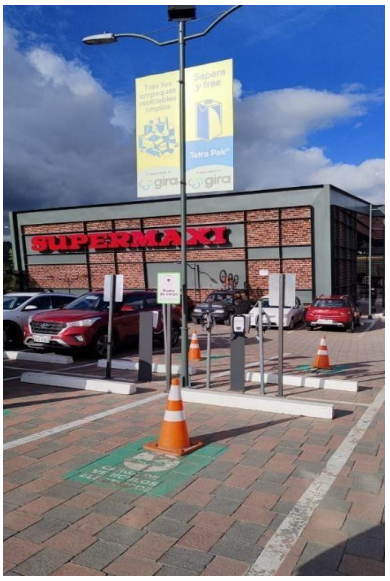
Photograph 1 Parque de la Madre Charging Station. Source: Author.

2. Electromobility & Energy charging station, located in Ricaurte. a company dedicated to the advice and provision of equipment and implements or acquisition of electric vehicles, which provide the charging service in prior coordination with the dealerships with which they work, which makes it a private charging station.



Photograph 2 Mobility & Energy Charging Station. Source: Maps,2022

3. Charging Station or Charging Point located in the Plaza del Supermaxi in the Challuabamba Sector, which is for the exclusive use of users of the parking lot of the Plaza where there are some commercial premises and bank ATMs. Its use can be done during the service hours of the Plaza.



Photograph 3 Supermaxi charging station or charging point in the Challuabamba sector.

4. Charging station or Charging point Salesian Polytechnic University UPS. This charging station is for the exclusive use of those who work or study at the University, since they are installed within the infrastructure of the institution where access is restricted. In this charging station you can see the use of renewable energy since they use solar panels.

Photo 4 Charging station / UPS charging point. Source: Author

5. Charging station located in the Central South Electric Company. This charging station is for public use, the hours of operation correspond to the service hours of the South Center that works from Monday to Friday from 7:30 a.m. to 5:30 p.m.

Photograph 5 South Central Charging Station. Source: Author

4.3 Presentation of the Carsharing model

Carsharing has a number of advantages, which is why it has many success stories worldwide, among the main advantages are:

-Sustainable mobility, which refers to the fact that this alternative is a sustainable formula that reduces carbon dioxide emissions, as well as decongesting traffic. Being able to share a vehicle using it only when it is really necessary means fuel savings and a reduction in CO2 emissions.

-Cost, carsharing reduces vehicle rental costs by more than 30%. This cost reduction lies in the low rates established by the companies.

-Management, carsharing is usually accompanied by a special application for management, making it easier to monitor the one-off rental of the vehicle.

-Investment, considering the main problems of liquidity and indebtedness of people, carsharing is presented as one of the best alternatives, because it gives people the possibility of moving in independent vehicles, to the place they want without the need to have their own vehicle and all the expenses that this would generate. In this way, the debt of buying a traditional vehicle is avoided.

-Flexibility, the fact of having a shared vehicle, provides the option to change the vehicle, the number of times you consider it pertinent or wish to do so, so you will always have a new, updated vehicle, additionally any problem related to the vehicle, will be assumed by the carsharing operating company, so the user will not worry about that type of inconvenience.

4.3.1 Determination of demand and supply

To determine the demand, a survey of 500 individuals conducted virtually is taken as the main source of information. The sample size has been determined by the contracting company based on non-probabilistic sampling, so it has been disseminated through the snowball methodology, that is, each contact generates replicability among its contacts.

The survey looks at demographic variables, as well as perception variables to determine the interest and probability of using the carsharing service. Of all the variables, three variables

that characterize it are considered for the determination of demand:

- Willingness to use the service

- Frequency of use of the service

- Interest in use

Once the percentages of each variable have been determined, a proration will be made based on the number of trips determined in the Mobility and Public Spaces Plan of the canton of Cuenca, which determines that the urban mobility of the canton is approximately

600,000 trips to and from the city, of which 69% correspond to motorized trips. For this purpose, trips only to the destination will be considered.

In addition, a proration of the representativeness of the percentage of the surveyed population will be carried out, thus determining a weighted demand for motorized trips through carsharing by service station.

$$\text{Daily trips} = \text{Trips by station} * \text{numberof stations}$$

To avoid a problem of bias in the survey, due to the lack of knowledge of the terminology, an explanatory note was added at the beginning of the survey to solve any inconvenience.

To determine the supply of vehicles, the number of trips determined in the demand per service station is considered, in addition, based on the analysis of the location of charging stations, the calculation of total daily trips is made through the product of trips per station, by number of stations. The number of daily trips is divided by the hours of operation of the service, which depending on the public transport system of the canton of Cuenca, is 16 hours. In this way, the number of trips per hour will be determined, which must be divided by the number of stations, clearly identifying the number of units per station that must be offered.

For the projection of demand, the population growth rate has been considered, which has been calculated based on the growth rate of the population of the canton of Cuenca, using data taken from the projections made by the INEC. Table 8 details the projected growth rates for the next 20 years, from 2022 to 2042, which average is 1.034%.

Table 8 Percentage of population growth. Source: INEC

Year	Annual growth rate
2022	1,07%
2023	1,06%
2024	1,04%
2025	1,03%
2026	1,02%
2027	1,01%
2028	1,00%
2029	0,99%
2030	0,98%
2031	0,97%
2032	0,96%
2033	0,95%
2034	0,95%
2035	0,94%
2036	0,93%
2037	0,92%
2038	0,91%

2039	0,90%
2040	0,89%
2041	0,89%
2042	0,88%
Average	1,034%

Once the adjusted growth rate is available, the projection of passenger demand for 20 years has been made, as can be seen in Table 8.

The demand has been calculated based on virtual surveys carried out on the population of the Cuenca canton, through a non-probabilistic sampling. 500 surveys have been carried out, from which it has been possible to determine that there is 7.8% of the population that would be willing and very interested in using this mobility alternative and that they would do so on a daily basis, as shown in table 9.

Table 9. Frequency of use according to interest. Source: Survey 2022, Consulting Team

Interest in use Frequency of use	Very interested	Quite interested	Somewhat interested	Not very interested
Everyday	7,80%	2,80%	2,80%	1,60%
3 to 2 times a week	7,70%	7,20%	3,80%	0,40%
Weekly	4,40%	3,00%	2,40%	0,40%
3 to 2 times per month	0,80%	1,80%	2,00%	0,40%
Never	0,80%	0,40%	0,20%	0,00%

This percentage has made it possible to determine the demand, also considering the number of trips made by the urban population of Cuenca, which is 600,000, in accordance with the 2015 Mobility and Public Spaces Plan; However, it should be noted that these trips correspond to origin and destination, so they have been divided, and only destination trips have been considered, which would correspond to 300,000 trips. The same PMEP (2015) considers that of these trips, 69% are motorized, a field of action in which the carsharing system is included. To adjust the value of demand to reality, an expansion factor has been determined, which is obtained from:

$$Fe = \frac{m}{P}$$

Where:

Fe = Expansion factor m = Sample

M= sample

P = Population

Projected 5-year demand

Table 10 5-year demand projection

YEARS	2022	2023	2024	2025	2026	2027
DAILY PASSENGER DEMAND	81	82	83	84	84	85
Average Day Trips	81	82	83	84	84	85
Average Trips Month	2268	2.291	2.315	2.339	2.363	2.388
Year trips	27216	27.497	27.782	28.069	28.359	28.652
ANNUAL PASSENGER DEMAND WITH	27216	27.497	27.782	28.069	28.359	28.652

SINGLE RATE

Based on the calculated demand, a projection of the supply has been made that would cover this demand, for which the establishment of three service stations has been considered, where the charging stations (electric charging stations) would also be located. In this way, the number of daily trips has been divided, for the hours that each unit will work, which correspond to the range of the public transport service, that is, 16 hours, thus obtaining a number of 5,025 trips per hour, which distributed among the 3 stations show the need for at least 2 vehicles per station. So the offer of this service will be 6 vehicles in general, that is, 2 per service station, this information is the basis on which the cost structure has been defined.

4.3.2 Business Model Identification

To identify the business model that the EMOV should opt for the implementation of a carsharing system, it must initially consider which model it would correspond to and once that has been identified, determine the potential of the market size, as follows:

-For the free-fleet car-sharing business model, it mainly targets densely populated cities, with a denser demographic, however, the initial investment is extensive, so a minimum of 50 vehicles is recommended. Free-floating models have been most successful in cities with 500,000 or more inhabitants and a population density of at least 1,500 people per square kilometer.

-The station-based model and AB car-sharing can access the same markets, but also smaller ones, such as cities with fewer than 100,000 inhabitants.

-"Round trip" type model, where the user must pick up the vehicle at a certain station and return it at it according to a previously reserved time of use.

-"Round trip" type model, where the user must pick up the vehicle at a certain station and return it at it according to a previously reserved time of use.

4.3.3 Value Proposition

A company's value proposition is the set of benefits or values that it intends to deliver to consumers to satisfy their needs, that is, a company's value proposition is the idea by which one or another company distinguishes itself in front of the customer, making them opt for its products or services.

Value creation is one of the fundamental pillars in business strategy, considering that, in the ability to offer products and services that are more valuable to others, the test, use and preference of them lies in the long term. When an organization provides useful products and services for others, demand is activated and the business grows.

The value proposition of the CANVAS model is the central module, since the value proposition is the factor that makes a customer choose one company or another.

The value proposition corresponds to a series of advantages perceived by the customer in the product or service offered by a company over similar products or services offered within the same industry, these advantages can be disruptive in some cases, while in other cases they will only be small changes.

4.3.4 Sources of income

Revenue is an increase in the company's assets from its profit-oriented activities that result in positive cash flows. It should be taken into account that there are sources from which the income received by companies comes, so from the accounting point of view, income can be classified into operational and non-operational, where operational income is those that are obtained as a result of the activities for which the business was created; while non-operational activities are those obtained from activities not related to the line of business.

In this particular case, operating revenues are expressed as a function of the revenue stream determined by the demand and tariff previously calculated. In addition, an additional income from advertising has been included or incorporated in one of the scenarios that demonstrates the significant impact of this type of non-operating income on economic activity. The calculation of the tariff as expressed in previous lines has been calculated in such a way as to cover and recover the investment, as well as to provide coverage with operating costs.

5. Conclusions and recommendations

-Depending on the type of business, the implementation of an AB model is suggested, that is, pick-up and delivery at any station belonging to the service.

-As a recommendation, it is suggested to choose to enable the charging points of the Parque de La Madre, the Electric Company and even private shopping centers, which facilitate the charging of the vehicle if necessary.

-It is suggested to make every possible effort to include advertising in the units, as the impact of this decision on rates has been appreciated. In the event that advertising is not included in them, and is not charged for it, the final rate for the user could be too high, which would cause people not to use the service. The more income alternatives there are, the more affordable rates are guaranteed to all types of people.

-Intensive socialization and dissemination campaigns are recommended prior to the start of operations of the project and once it is in operation, so that the majority of the population is aware of it, as well as all kinds of strategies such as promotions and/or discounts should be used to attract as many users as possible.

-The authorization for the use of the public spaces in which the service and charging stations will be installed must be obtained with the competent authority (Municipality of Cuenca). It is suggested that they be outdoors so that no additional costs are required from people to take care of and protect the vehicles. However, the expense in geopositioning and insurance should be mandatory, even the possibility that the application created for this purpose has the facility to execute controls inside the vehicle for any eventuality should be analyzed.

-The application that is designed for the carsharing service must be highly intuitive, so that it facilitates its use and does not complicate it, preventing people from feeling comfortable using it.

-The Cantonal Council could also support this initiative through the establishment of ordinances that encourage sustainable mobility.

-The behavior of demand should be analyzed in the first months, and if possible, a prior expansion plan should be in place both in terms of the number of units and the number of stations and areas of reach.

-Regulations must be designed to regulate the use of carsharing, establishing obligations and rights of each of the parties and identifying the treatment of possible eventualities.

-Finally, it is necessary to indicate that the carsharing service is a solid proposal with several strengths and opportunities that can be taken advantage of, however, the cultural theme of the city rooted in a feeling of ownership, tradition and ignorance can cause rejection in new and innovative proposals, so socialization processes are indispensable. Additionally, the initial proposal must have clear guidelines for the growth of the project in case it is successful so as not to stop operations, or provide a bad service due to lack of units. The

The urban sector of the city in size and population has ideal characteristics to include this service as an alternative to mobility systems, integrate it into the Integrated Transport System, even use the same form of payment and respond to the problem of traffic and environmental pollution.

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