CARSHARING FOR TOURISTS

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1. Introduction

Carsharing[1] is a model of car rental where a person rent a car for a short period of time, often by the hour. Cars are rented by an organization, such as a commercial business, a public agency or a cooperative.

Historically, carsharing has started in Zurich, Switzerland, in 1948 by a community of people who thought that a car should not be a private but a "common" good to be shared with others and owned by the community, both for moral and economic reasons. Nowadays, even in Switzerland, this "radical" spirit is much weaker and carsharing is a commercial enterprise, run by private or public organizations (the former are more common in North America, the latter in Europe, as one would expect) with the help of sophisticated technological booking and charging systems.

In the UK the term "carsharing" is often known as "car clubs", whereas the term "carsharing" is also used for carpooling or ride-sharing. However, strictly speaking, the terms "carpooling" or "ride-sharing" refers to the shared use of a private car for a specific journey, in particular for commuting to work, by people who travel together to save on fuel costs. The term "car club" in the U.S. refers instead to a club of car hobbyists. Since, the term carsharing is internationally gradually gaining currency, it will be used throughout the paper.

It is also worth underlining that carsharing is different from traditional car rental service. The difference lies in its historical background and motivations and as well as in its organization. As for the motivations, carsharing is often motivated by social and environmental aims, as it will be discussed below, such as reducing car traffic, improving the modal split, reducing parking space needs, improving environmental quality while preserving flexibility and accessibility.

With regards to the organizational aspects, carsharing differs from car rental since:

[1] The term carsharing (earlier often written as two separate words, and still today occasionally hyphenated) is now the widely accepted international term.

- Users are members of a club and have been pre-approved to be admitted to the program;
- Reservation, pickup, and return is self-service;
- Vehicle locations are distributed throughout the service area, and often located for access by public transport;
- Carsharing time window is 24h a day and is not limited to office hours;
- Vehicles can be rented by the minute and by the hour, not only by the day as with the rent service;
- Insurance and fuel costs are always included in the rates;
- Vehicles are not always serviced after each use, although certain programs such as Car2Go (Vancouver, Canada) continuously clean and fuel their fleet.

The literature on carsharing is growing rapidly. Some of it tracks the growth and expansion of carsharing (Shaheen et al. 1998, 2006, 2009; Shaheen and Cohen 2007). Other research focuses on administrative or logistical aspects of running a carsharing organization (Kek et al. 2009; Fan et al. 2008; Shaheen et al. 2003; Barth et al. 2003; Barth and Shaheen 2002). A number of important contribution study the actual usage of the carsharing vehicles (Morency et al. 2008) and how the adoption of carsharing impacts VKT and vehicle ownership (Cervero et al. 2007; Lane 2005; Cervero and Tsai 2004; Cervero 2003). It is generally concluded that carsharing organizations provide a net reduction in VKT (Shaheen et al. 2006).

A further stream of research has performed with a detailed demographic analyses of those who have chosen to join a carsharing service (Millard-ball et al. 2005, Burkhardt and Millard-Ball 2006). It is found that the propensity to use carsharing is higher in urban residential locations, with people typically in their 30s and 40s, belonging to smaller households, with an high educational attainment, who have a concern for environment, and are willing to be an ‘‘early adopter’’.

Other studies have investigated the familiarity with the concept of carsharing and the willingness to accept it (Nobis 2006; Loose et al. 2006) with the aim of providing carsharing agencies with attractive fare structures, of understanding effective advertising strategies, and of determining the best neighborhoods to locate their carsharing vehicles (Celsor and Millard-Ball 2007).

With regards to the market potential of carsharing from the current niche market to a much larger market, some discussion has been taking place. The carsharing companies include in their promotional website a section, and sometimes also a software, that estimate the potential cost savings that one can achieve through carsharing based on the annual kilometers travelled (City Carshare 2010; Zipcar 2010, ICS[2]). The ability of carsharing of providing financial cost savings is thought

[2] http://www.icscarsharing.it/

of as a decisive factor. However, although financial savings could be an interesting starting point, forecasting the potential demand for car sharing requires a much deeper understanding of which factors enter the decision making process between carsharing and car ownership and how these can be applied to a specific area, with specific travel patterns, traffic conditions, traffic regulations and public transport supply.

In the scientific literature, an interesting application is provided by Schuster et al. (2005) who developed a complex simulation model that uses recorded travel patterns to predict the adoption of carsharing in Baltimore. They assumed the adoption of the Flexcar program in use in March 2004 in the nearby Washington, D.C., metropolitan area. It consists in an annual membership fee of $25, an hourly rate of $9, and a mileage fee of $0.35. They estimate that carsharing would be chosen 1,474 out of 35,500 trials, or 4.15 ± 0.10% of the time. Such values would drop to 3.69 ± 0.09%, when it is taken into account that some people love expensive and prestige vehicles. Since such values are comparable to the area transit mode share, which was 5.7%, they conclude that carsharing may prove a useful part of an integrated strategy to reduce the negative effects of auto dependence.

Catalano et al. (2008) present a carsharing demand estimation for urban transport using stated preference techniques for the Italian city of Palermo. Estimating a nested logit model, they predict for carsharing a traffic share between 5-10%, compared to about 40% for the private car and about 30% for public transport.

Ciari et al. (2009) discuss how a carsharing scheme should look like in order to grow from the current niche market to a large-scale scheme (defined as at least 5% of the relevant global fleet). They argue that such a scheme should be based on concepts such as the capillarity of the system, its flexibility and its integration with other urban mobility systems. They also stress the need for a methodology allowing a realistical assessement of the carsharing market potential and suggest that the adoption of an agent based approach. As a framework to model such a large scale carsharing scheme they proposed to use MATSim-T, an existing agent based traffic micro-simulation tool (Ciari, 2010).

Ducan (2010) seeks to quantify the market potential of carsharing in the San Francisco Bay Area, defined as its ability to provide cost savings to those who adopt it in contrast to vehicle ownership. The result is that a significant number (approximately more than a million people) of the Bay Area households own a vehicle with a usage pattern that carsharing could accommodate at a lower cost. Such number is still a minority of the total number of car users in the Bay Area, but much larger than the current number of carsharing member across the entire U.S.

Despite these optimistic forecasts, the actual size of the carsharing market is still quite small, although it shows huge growth rates.

Mastretta and Burlando (2007) report that in 2006 worldwide the total number of vehicles available for carsharing was equal to 11,696, two thirds of them located in Europe. The total number of carsharing members was equal to 347,910, with a ratio of 1 vehicle for every 30 members. More recent estimates (Shaheen et al. 2009), report that, in July 2008, the North American carsharing market had grown to 33 operators with 318,838 members and 7,505 vehicles collectively, that represents a threefold increase in membership and twofold increase in vehicles. Mobility, the Swiss carsharing organization, states to have 2,600 vehicles in 1,300 locations in Switzerland. In Italy, ICS reports to have in September 2011, 599 vehicles in 404 parking places and 17,925 members, located in 12 Italian cities.

Although the growth rate is impressive, the absolute size of the market is insignificant compared to the number of car circulating worldwide: consequently, carsharing is still a niche market. Moreover, in the assessment of the carsharing demand evolution is important to consider also the size of the supply of carsharing. There exist areas of great potential development of carsharing services but actually with a limited range of services (e.g., Rome) (ICS 2005). Furthermore, barriers to carsharing market entry are consistent around the world.

However, there is a great deal of discussion on the potential of carsharing, which is described as an important innovation for mobility.

In the literature on carsharing various potential market segments have been identified and targeted such as residential neighborhoods, business communities, college students and low-income families (Shaheen et al. 2009), to this list we add tourists. Tourists represent an interesting target group because they visit locations, to be preserved from an environmental point of view, which are far away from their hometown, often leaving their private car at home or without having the possibility of bringing their private car (when the location is too far away or in a different continent). However, they have stringent mobility needs: they often wish to visit as many locations as possible in as little time as possible in order to maximize the benefits of traveling. When the sites to visit are far apart and public transportation is not available with the necessary frequency and flexibility, the use of a car is very convenient.

When a tourist does not drive by his\her private car to the tourist destination, a car may be available as a taxi with a local taxi driver (in some cases rented even for an entire day), or via a car rental service, to be picked up at the airport or at the train station. The availability of a carsharing service is an additional possibility. It can compete with the previous ones in terms of costs and flexibility depending on its cost structure and service organization and on the tourists' needs and characteristics, as we will discuss below.

A further aspect which needs to be stressed is that the existence of a carsharing service may be beneficial not only from the private point of view of the tourist but also from the one of the tourist location. As locations compete among each other to attract tourists, the availability of a carsharing services could enhance the attractiveness of a location. Tourists know that a wide array of mobility options are at their disposal and that the accessibility of all interesting sites is guaranteed with an effective mean of transportation. This may even influence their choice on how to reach a location. If a carsharing service is available at the destination, driving their private car might be a discarded option in favor of flying or of riding a train, enhancing the environmental sustainability of the trip from the tourist home-town to their destination.

Even more interestingly, if the tourist destination is environmentally sensitive, the carsharing services might consist in low- or zero-emission vehicles such as an electric car which provides very limited noise and zero pollution emissions when the car is used. In turn, ”green” cars might strengthen the attractiveness of the destination and can be used as a marketing tool to signal a special attention to tourism sustainability. Mountain areas, parks or islands might even take a stronger stance and prohibit the use of private cars unless they are not up to certain environmental standards.

This paper presents a simulation model to predict potential carsharing demand for tourists. This model is based not only on transport characteristics but also on tourist and destination issues and mobility pattern. With reference to the transport related characteristics we consider both the transport mode to arrive in the location and that used at the destination to visit touristic places. The framework of our model is adaptable to different size of the study area (city, region and island).

The data are taken from the literature and adapted to Italy.

This paper is organized as follow. After an introduction a synthetic list of international experiences on carsharing for tourists are reported in section 2. Section 3 and 4 report respectively our simulation model’s framework and application, highlighting basic assumptions and results. Section 5 concludes the paper.

2. Carsharing for tourists: some examples

Carsharing services aimed at tourists are already a reality in many places. A simple Google search conducted in June 2012 revealed these examples:

- Green car-sharing by the hour at Hawaii hotels[3];Car Sharing - Official website Milan Tourism[4];
- Car Sharing Vancouver for tourists[5];
- Plan your route/ Car hire & CarSharing, Chur Tourismus, Hotel[6];
- Mobility - Car sharing - Themes - Nyon Region Tourism[7];
- Travelling & Car Sharing Llanarmon[8].

These examples prove that carsharing might be a useful addition to the services provided to tourist and a factor of attractiveness for the hotels or tourist locations that offer these services. But will the service be used? By how many and by which tourists? And what is their willingness to pay for the service? How should the service and the tariff structure be designed in order to be successful? Is the service going to be economically sustainable from a private and a social point of view?

In order to answer these questions and to advise private firms or public agencies on whether and how to organize the service, we believe that a simulation model might be a useful tool. Therefore, such a model and some numerical simulations will be presented below.

3. A simulation model

A simple simulation model to estimate the potential demand for a carsharing service by tourists is illustrated in Figure 1.

The model is made up of three components.

The first component contains the socio-economic and context variable, such as the ones capturing:

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[3] www.springwise.com/tourism_travel/greencarhawaii/ - United States 30th August 2010 in Automotive, Tourism & Travel. Hotels and car-sharing are a natural fit.

[4] www.turismo.milano.it. A Car Sharing service, managed by several companies operating in Milan, is available. This is an innovative service that allows you to choose your vehicle.

[5] Vancouver Tourist. www.vancouvertourist.com/content/car-sharing-vancouver - Vancouver has 3 car sharing companies called car2go, ZipCar and Modo.

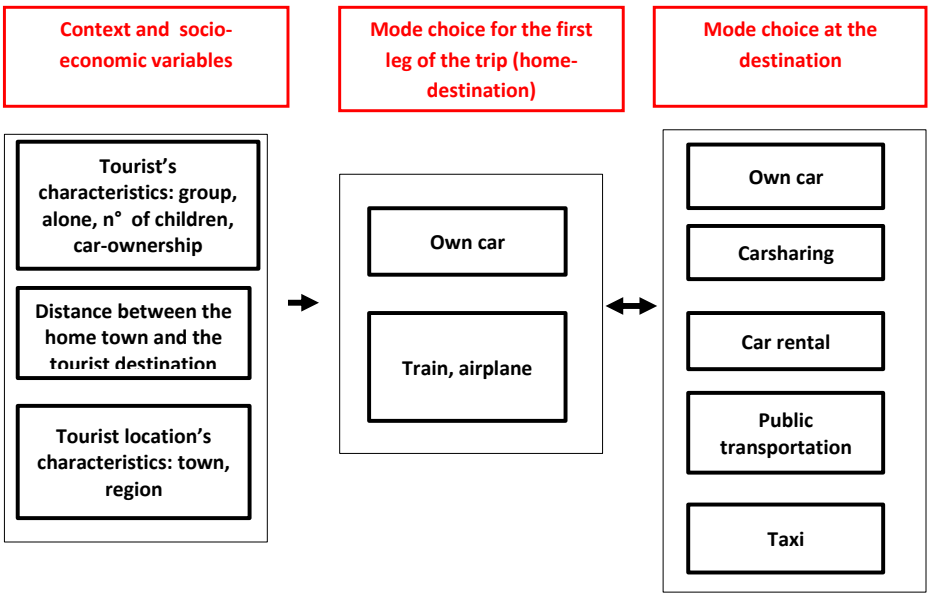
[6] www.churtourismus.ch/en/.../plan-your-route-car-hire-carsharing/ - CarSharing with Mobility is the clever way to be mobile. Mobility has 2300 vehicles at your disposal at 1150 stations throughout Switzerland. 24 hours a day.

[7] www.nyon-tourisme.ch › Home › Topics - Car sharing is the clever way to be mobile. Whenever you want – without the commitments that owning your own car entails. Mobility has 2'500 vehicles waiting

[8] www.llanarmon.com/en/tourism-and.../travelling-car-sharing/ Home Tourism & Business Here. Travelling & Car Sharing.

- The socio-economic characteristics of the tourists: age, income, number of people travelling together, number of children travelling, and so on;
- The variables describing the trip that needs to be made between the town of residence and the tourist destination: distance, geographical characteristics (intra-continental, inter-continental, island), means of transport available, and so on;
- The characteristics of the tourist destination: city, countryside, number of locations worth-visiting, means of transport available, and so on.

Figure 1 – *Flow chart of the simulation model*



The second component describes the transport choices available for the trip from the hometown to the tourist destination, that is the modes of transport available and their cost and time characteristics. We include also the car, assuming that the distance and geographical characteristic of the trip make it possible.

The third component describes the transport choices available at the tourist destination to visit the various tourist sites of interest, that is the modes of transport available and their cost and time characteristics. The private car, the taxi, carsharing, car rental and public transport are assumed available. We exclude bike and walking due their marginal role.

The next paragraph will present a numerical simulation assuming different parameters and specifications for the total transport cost functions depending on the transport mode chosen for the home-destination trip and for the trips on the tourist site.

4. A numerical simulation

4.1. Assumptions

Let us assume that the socio-economic and context variables are the following.

- Distance between home and tourist destination: 500 km, 1000 km, which could be travelled also by car;
- Type of destination: City, Region. The City is a metropolitan area with sites of interest spread in many urban and suburban locations (e.g., Rome). The Region (e.g., Sicily) contains several sites of interest at reasonable distance from the hotel where the tourists are lodged;
- Car ownership: Yes, No. The tourist may or may not own a private car.
- Number of people traveling: 1 (single), 3 (family).

Mobility at destination

Let us also assume the following holiday characteristics and mobility patterns at the tourist destination.

- Length of the holiday: 1 week;
- N ° of days: 5;
- Number of visits during the week: 7;
- Distance in km from the hotel to sites visited: 2 km (in City), 30 km (in Region);
- Number of days of use of car rental during the week: 5;
- Time needed for a visit: 4 h (in City), 6 h (in Region).

We provide now the list of the formulas used in the model and of the parameters' values assumed. The latter are as realistic as possible, considering the May 2012 prices in Italy. Whenever there is uncertainty or we wanted to perform sensitivity analysis a stochastic value is assumed and provided.

Route from home to destination

Auto costs = auto monetary cost + auto travel time cost
auto monetary cost = cost of petrol per km * km driven
cost of petrol = 0.2 €/km
cost of travel time = travel time in hours * value of travel time
travel time in hours = 4 (for 500 km), 8 (for 1000 km)
Value of time: 5 €/h (normally distributed with standard deviation equal to 1).

This value is based on the empirical literature which suggests a 20€/h value for the commuting trips. Since during holidays, there is less time pressure and tourists might benefit for the travelling activity itself, we assumed the 5 €/h value to be reasonable. Since relevant uncertainties, do exist and since the value of time might differ among tourist, a normal distribution of the value of time is assume with a standard deviation equal to 1. Similar stochastic values are assumed below when uncertainties exist and where sensitivity analysis for the variable is of interest.

Train costs = train monetary cost + train time cost

train monetary cost = train cost per km * km traveled by train
Train ticket = 0.1 €/km
train time cost = travel time in hours * value of time
travel time in hours = 5 (for 500 km), 10 (for 1000 km)

Air costs = air monetary cost + air time cost

air monetary cost = monetary cost of air ticket
monetary cost of ticket = 300 € (for 500 km), 350 € (for 1000 km)
air cost of the time = air travel time in hours * value of time
air travel time in hours = 3 (for 500 km), 4 (for 1000 km)

Carsharing

Total cost of carsharing = membership cost + journey cost + hourly cost + time cost to reach the carsharing pod
Membership cost = 5 €/week
journey cost = cost per kilometer*distance driven

Cost per km = 0.28 €/km (normally distributed with standard deviation equal to 0.05)
cost per hour = 0.375 €/h (normally distributed with standard deviation equal to 0.1)
time cost to reach the carsharing pod= time to reach the carsharing pod*value of time
time to reach the carsharing pod = 0.2 h

Private car

Total cost of private car use = fuel cost + private car parking costs
private car parking costs = hourly parking cost *parking time
hourly parking cost = 1 €/ h

Public transport

Total cost of public transport = ticket cost + cost of the extra-ticket waiting time at stops
Tickets cost € = 1.5 (in town), 3 € (in region)
cost of the extra-ticket waiting time at stops = extra waiting time at bus stops * value of time
extra waiting time at stops = 0.8 h (in City), 3 h (in Region) (normally distributed with standard deviation equal to 0.1)

Car rental

Total cost of car rental = Daily cost of car rental + fuel cost
daily cost of car rental = 47 €
Taxi
Total cost of taxi = Fixed rate + taxi cost per km
Fixed rate = 3.2 €
Cost per km = 1.03 €

4.2. Results

By running 100,000 simulations for the stochastic normally distributed variables and with the above reported parameters one gets the results illustrated in Table 1.

Table 1 – *Mode choice probability (percentages) for the first part of the trip (hometown-tourist destination) and for the mobility at the destination, based on 100,000 simulative runs.*
Note: C=City, R=Region, CS=Carsharing, PT=Public transport, CR=Car rental

Distance	Desti-nation	Auto Own.	N° pers.	Car only	Train + CS	Train + PT	Train + CR	Trai + taxi	Air + CS	Air + PT	Air + CR	Air + taxi
500	C	SI	1	0	99	1	0	0	0	0	0	0
500	R	SI	1	0	26	74	0	0	0	0	0	0
1000	C	SI	1	0	99	1	0	0	0	0	0	0
1000	R	SI	1	0	26	74	0	0	0	0	0	0
500	C	SI	3	100	0	0	0	0	0	0	0	0
500	R	SI	3	100	0	0	0	0	0	0	0	0
1000	C	SI	3	100	0	0	0	0	0	0	0	0
1000	R	SI	3	100	0	0	0	0	0	0	0	0
500	C	NO	1	0	99	1	0	0	0	0	0	0
500	R	NO	1	0	26	74	0	0	0	0	0	0
1000	C	NO	1	0	99	1	0	0	0	0	0	0
1000	R	NO	1	0	26	74	0	0	0	0	0	0
500	C	NO	3	0	99	1	0	0	0	0	0	0
500	R	NO	3	0	26	74	0	0	0	0	0	0
1000	C	NO	3	0	99	1	0	0	0	0	0	0
1000	R	NO	3	0	26	74	0	0	0	0	0	0

The following comments are in order.

If, as assumed, it is feasible to bring one's own private car at the tourist destination (provided one is an car owner), the use of the private car for all trips appears to be the best choice when a group of 3 persons travel together, both when the tourist destination is 500 or 1000 km away from the hometown, since the monetary cost component of travelling by train and airplane more than offset the

value of the longer time component of travelling by car. The opposite is true when one person travels on his\her own.

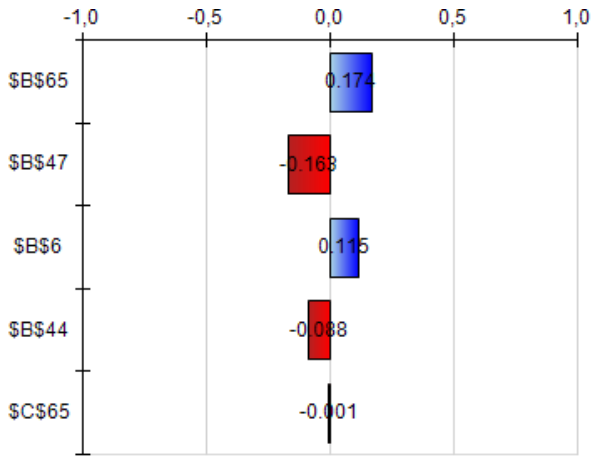
Quite surprisingly, carsharing appears to be 99% of the times the best choice when the tourist destination is a City, whereas only 26% of the times when the tourist destination is a Region. The reason has to do with the assumed carsharing cost structure. In a city, the trips are shorter, hence the distance and use costs are lower than the public transport costs, the latter suffering not so much from the ticket cost but from the extra-time assumed to be needed because of the its insufficient frequency and accessibility relative to carsharing. In a Region, on the contrary, the cost of the longer trips proved to be so expensive to counterbalance the frequency and accessibility insufficiencies of public transport.

Taxi and car rental appeared to be in all examined circumstance inferior choices.

Similarly, for the first leg, given the high cost of the air ticket for domestic flight, air is never the chosen alternative.

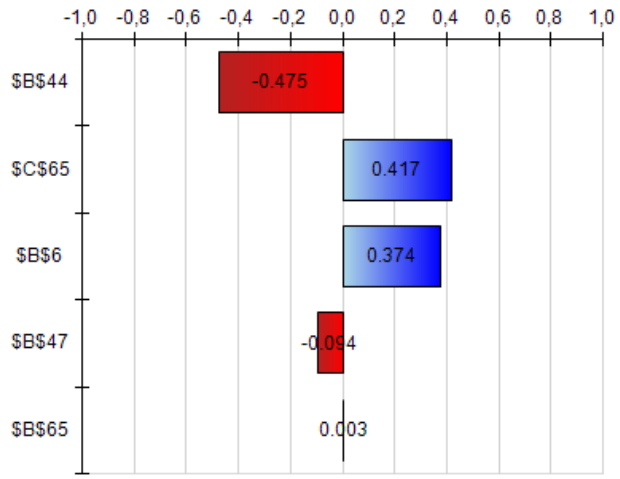
It is also of interest to perform a sensitivity analysis of the estimates provided in order to appreciate how the results depend on the various variables. Two interesting results are reported below.

Figure 2 - *Dependent variable: the probability of choosing the combination Train + Carsharing, when the tourist area is a City, 5oo km away from hometown.*



Notes:_Independent variables by correlation importance: B65 – Public transport-extra-time in a city, B47 – Carsharing-hourly cost, B6 – Value of time, B44 – Carsharing-distance cost per km, C65 – Public transport-extra-time in a region.

Figure 3 - *Dependent variable: the probability of choosing the combination Train + Carsharing, when the tourist area is a Region, 5oo km away from hometown*.



Notes: Independent variables by correlation importance: B44 – Carsharing-distance cost per km, C65 – Public transport-extra-time in a region, B6 – Value of time, B47 – Carsharing-hourly cost, B65 – Public transport-extra-time in a city.

In Figure 2, the dependent variable is the probability of choosing the combination Train + Carsharing, when the tourist area is a City, 500 km away from hometown. Keeping all variable constant and changing one at the time the variables assumed stochastic, Figure 2 reports the correlation between the dependent and independent variable. Both the sign and the size is of interest. The stochastic variable coded B65 – Public transport-extra-time in a city results negative (as expected) correlated with the highest correlation level, followed by the variables B47 – Carsharing-hourly cost, B6 – Value of time, B44 – Carsharing-distance cost per km, C65 – Public transport-extra-time in a region.

On the contrary, in Figure 3, the dependent variable is the probability of choosing the combination Train + Carsharing, when the tourist area is a Region, 5oo km away from hometown. The stochastic variable coded B44 – Carsharing-distance cost per km results negative (as expected) correlated with the highest correlation level, C65 – Public transport-extra-time in a region, B6 – Value of time, B47 – Carsharing-hourly cost, B65 – Public transport-extra-time in a city.

The less predictable result is the one relative to the value of time: the higher the more likely the tourist would use carsharing. Most probably, high income, busy tourists are the most likely users and benefiters of a carsharing service. Unfortunately, time pressure seems to be a feature of modern tourism.

5. Conclusions and future research

The paper discussed the possibility of introducing a carsharing service in a tourist area to enhance the mobility alternatives available to tourists, to improve the accessibility to the sites of interest, to increase the location attractiveness and, in some instances, to preserve the quality of the environment. We showed that such a possibility is already implemented in some locations.

In order to evaluate the potential demand and the economic sustainability of such a service, which could be implemented both by private and public organizations, a simulation model might be useful since it allows to design the service with the most convenient tariff and organizational structure.

A generic simulation model is then presented and parameterized with data relative to Italy and some results are derived. As the model is not specific to a city or a region, the results present no level of generality. However, the model implementation and the numerical simulations performed in this paper allowed us to structure the problem and to test which variables mostly affect the potential demand for carsharing by tourists.

For a full implementation of the model, we feel that the following steps would be needed:

- enhance the model with additional quantitative and qualitative variables (the latter estimated in monetary terms);
- describe with greater detail and differentiation the socio-economic and context variables;
- apply the model to a specific case study;
- fit the continuous or discrete stochastic variables with values coherent with the specific case study.

The above steps would allow developing a useful decision support system for private or public decision makers. With this more sophisticate framework then we could explore policy options through simulations in order to promote the most efficient and useful (mixed) mode of transport A plan of specific public policies are essential to support the creation and implementation of a new and more sustainable transport system. In this context, policy-makers play a crucial role. It is necessary to develop all these aspects together.

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SUMMARY

Carsharing for tourists

The paper discusses the possibility of introducing a carsharing service in a tourist area to enhance the mobility alternatives available to tourists, improve the accessibility to the tourist sites, increase the location attractiveness and, in some instances, preserve the quality of the environment. Such a possibility is already implemented in some locations. In order to evaluate the potential demand and the economic sustainability of such a service, which could be implemented both by private and public organization, a simulation model is presented and parameterized with data relative to Italy. The model allows testing which tariff and organizational structure is more convenient.

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