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Electric car sharing model for tourism in Asti

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The following work has been developed as Master's thesis in partial fulfilment of the requirements for the degree of Master in Engineering and Management at Politecnico di Torino. The author expresses his availability for further clarification of the topics here presented.

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Abstract

With the arrival of enhanced battery powered vehicle technology which has reduced the cost of electric cars, many modern cities have provided their citizens with a new mobility solution: electric car sharing. The study is based on finding a suitable model for electric car sharing system for the city of Asti along the routes of UNESCO heritage sites, namely the Vineyard Landscape of Piedmont: Langhe Roero and Monferrato. The study starts by defining the components of various business models for a car sharing system. Then the focus shifts to electric car sharing system where not many literature or applications are present as compared to traditional car sharing. A dataset was created by taking one operator from each country in Europe where the electric car sharing system is available. The use taxonomy development approach by using the VISOR framework helped to identify clusters of business models which were similar. The dimensions of clusters which were the closest to our need helped us shortlist the operators which worked in similar condition to our problem. Their business model was taken up as a base and accordingly revised to suit all our needs which are described in the beginning of second chapter.

Chapter 1 Introduction

Major changes around the world which are taking place are strictly related to mobility. It plays a crucial role in every city and the concept can be defined as “the movement of individual or groups from place to place”. Mobility has allowed urban centres to develop in the last fifty years, for example, motivating people to use public transport or private vehicles, from their houses to workplaces, visiting family and friends, but it has also enabled us to perform lot of other essential activities, such as the delivery of essential goods.

The abovementioned evidences highlight the importance mobility has in our day to day life, representing the lifeline of our society. Since it is also a critical factor for the countries’ economy, more and more opportunities are developing in order to make the system more innovative, efficient and flexible since it is going through a period of radical changes and business models.

A study conducted by McKinsey & Company about the future of mobility reports that this process of changing is led by a lot of features. Some of them refer to macroeconomic trends and the urbanization, others are related to ancillary mobility services, such as the connectivity and Internet of Things (IoT) and other aspects of the core of mobility, including the autonomous driving, vehicle electrification and the shared mobility.

Electrification of Vehicles

The electrification of vehicle is the major aspect which will push the mobility towards a period of changing where people will move and satisfy their needs of mobility in a completely new way. This up and coming model can be referred with he term “electric mobility”.

Before discussing any further, electric mobility relates to electrification of the automotive powertrain. For clarification EVs (electric vehicles) will be referred as all vehicles for which an electric motor is the primary source of propulsion. This category includes plug-in hybrid electric vehicles (or PHEVs), range extended electric vehicles (REEVs), battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs). We are not considering HEV or hybrid electric vehicles in this study. [1]

The Electric Mobility (or E- Mobility, for short) is one of the most discussed key word in the present period and its going to radically change not only the main actors of the mobility industry (for example the automotive companies) but most importantly the “life style” of the population of most developed countries which will welcome this paradigm change in personal vehicles.

The aim is to understand what the future of the E-Mobility and what main factors could be involved are crucial to evaluate in this process which affects the development of the electrical model.

Even though the electrification of motor vehicles is a recurring theme in the history of automotive industry, some changes in the recent years have paved the way towards a future characterized by a more sustainable mobility in this context.

These factors are coming from various sectors and actors and have different natures. For the same reason, in order to include in the assessment not only the “core” mobility trends but also the ones related to the social, cultural and economic sphere, it is important to enlarge our perspective. Evaluation of these aspects through an integrated perspective which enables to consider their mutual and reinforcing effects is also important. It is only through this method that we will examine in proper fashion the potential coming from the implementation of E-Mobility and its future role.

Starting from the larger picture before us, the main push towards this change is definitely related to increasing prices of fossil-based fuels (for example petrol and diesel) and their scarcity. These obstacles can be overcome by research for new technologies. Oil industry is responding to the gradual decrease in the demand for fossil fuels by changing their development strategies due to diffusion of electric vehicles. 54% of the oil produced globally is intended to be used for automotive application (mobilitàelettrica.it). Hence oil industry is looking for new economically viable solution which can satisfy the expected increase in the demand of electricity.

The oil "giants" of the industry are not actually opposing to this shift in course, but rather they are embracing it to participate in this transformation. This act can be supported by production from renewable sources of energy. In 2016, Eni had announced a strategic plan worth 230 million euros for constructing a large photovoltaic power plant (wired.it) and also giant Royal Dutch Shell has completed relevant strategic acquisitions in the renewable energy sector by investing in Dutch Wind Offshore (lifegate.it)

Shifting towards renewable energy will allow us to meet the increasing demand for electricity in a more cost efficient and sustainable manner and hence lowering the amount of greenhouse gas emissions.

Environment sustainability

The era of the E-Mobility has been given a great boost by the fact that the reduction of the carbo intensity is also an important factor thus pushing the need for "green and clean" mobility at the top of various Governments' priorities. If we look at the level of emissions registered in the recent years, the importance of more environmental sustainability by the governments can be justified.

What concerns many metropolitan areas, during recent years, is the witnessing of an increase in the level of amount of green house gases released in the atmosphere. This has obviously had a consequent impact on the air quality and liveability.

23% of the CO2 emissions comes from the transportation sector. This evidence has led governments to put in place norms to substantially reduce emissions from private and commercial vehicles in order to comply with regulations set by the European Union (which

states to reduce at least 20% of green house gases by 2020, with respect to emissions registered in 1990.

A better quality of life is ensured by development of new policies concerning the environmental issues, but it can only be achieved with development of new technologies. Policy makers are putting immense pressure on the automotive industry to be complaint with the regulatory framework, but also to keep up with demand of the consumer for a more efficient and environmentally friendly mobility.

Innovation research of the propulsion technology for vehicles characterises the technological trajectory undertaken by most companies of the automotive industry. These companies are heavily investing in R&D activities aiming to develop alternate more efficient form of propulsion which is also less polluting when compared with traditional internal combustion engine.

E-mobility is increasingly seen as one of the most promising policy to be implemented. This is relevant by the steps made in this direction by the automotive operators. More importantly, not just the automotive operators, but also other players primarily involved in the ICT sector are coming into this market thanks to the arrival of electric mobility

Europe as the stage for EVs

For the first time, in 2017, new electric vehicles (EVs) surpassed a million units [2]. Under the current growth rate trajectory, EV producers could almost increase that number four folds by 2020, moving around 4.5 million units, which would be 5% of the global light vehicle market.

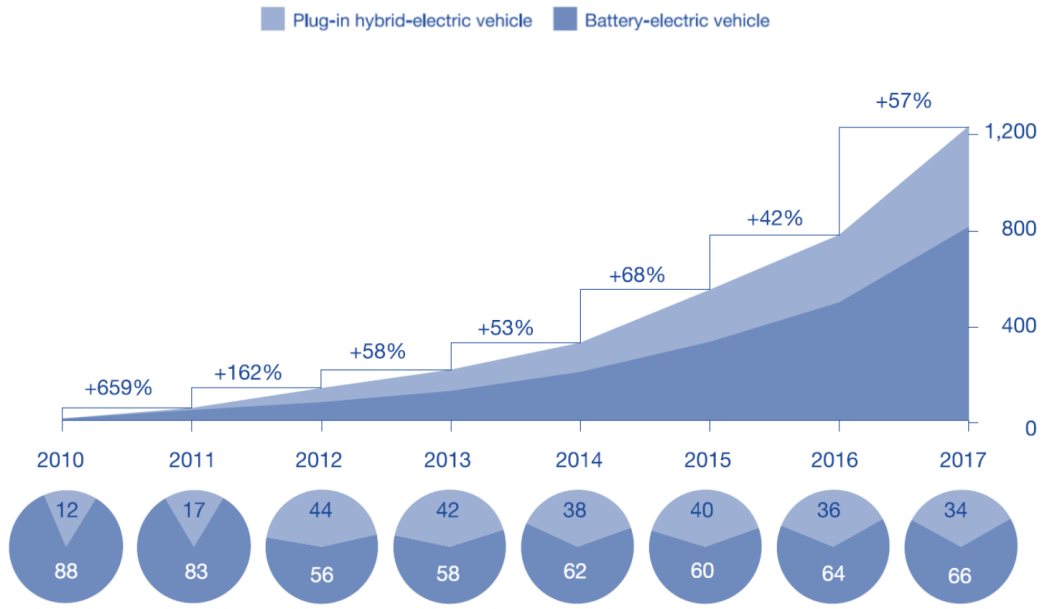


Figure 1 Global Electric vehicle sales 2010-17 (in thousands), compound annual growth rate

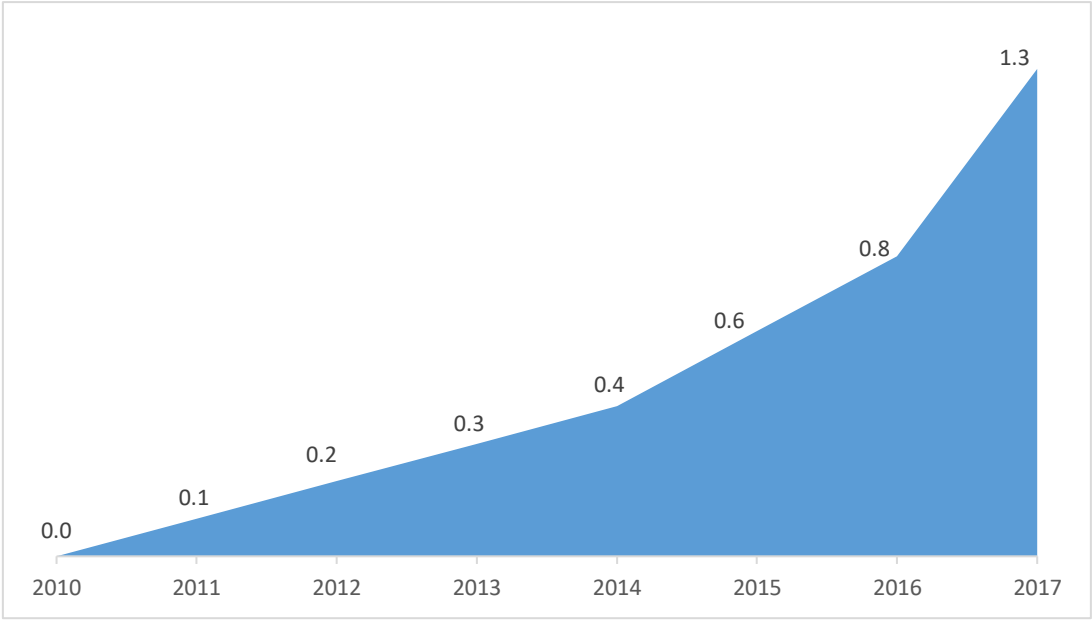


Figure 2 Global electric vehicle sales, 2010-17, % share of all vehicles

66% of the global EV market is currently made of pure electric vehicles (BEVs). Sales of BEVs are growing at a faster rate than those of plug-in hybrid vehicles (PHEV). However, all markets have a very diverse powertrain preference which are influenced by customer choice, regulatory actions and the availability of specific models.

EV market in Europe grew by nearly 40% from 2016 to 2017, albeit from a small sales base. Increasing interest of customers in EVs and headwinds for diesel technology were

few of the factors which contributed. EV market in Germany more than doubled. Germany is now the second largest EV market, first spot held by Norway.

Europe's market underlined regional growth trajectory, excluding Netherlands where an incentive shift from PHEV's to BEV's led to a significant drop in overall EV sales. Sales-penetration rate for EV in Norway reached 32% in 2017, by end of the year, every second car sold there was an EV. Norway largely alone stands as real-world example of future EV sales proportions due to its mass market embrace of electric vehicles that developed markets could experience over the next 5 to 10 years.

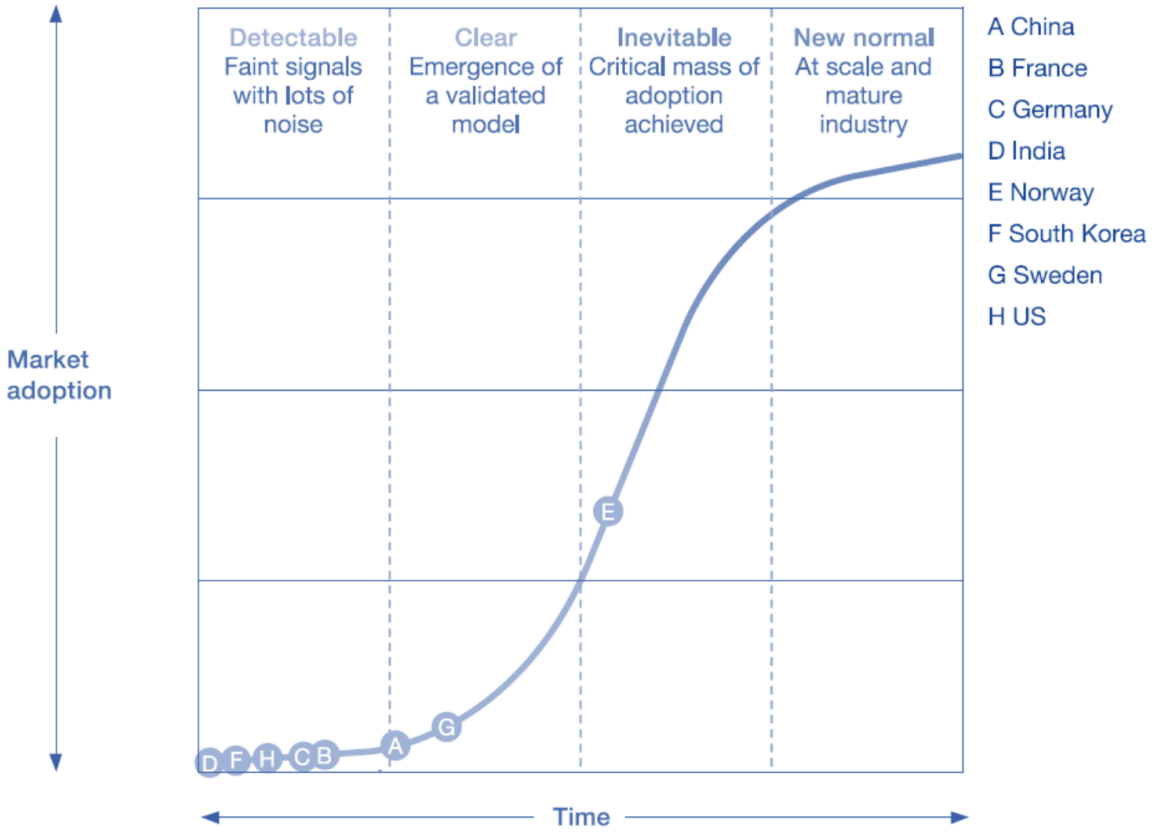


Figure 3 4 stages of disruptive trend-focus on electric vehicle market adoption

Figure 2 shows the 4 stages of disruptive trends. Norway is clearly ahead of other countries since it has reached the critical mass of EVs- the EV disruption is inevitable. Except Sweden and China (which have already reached the second: while EVs emerge as a validated model, disruption is clearer), most other countries are in the first stage.

Smart mobility

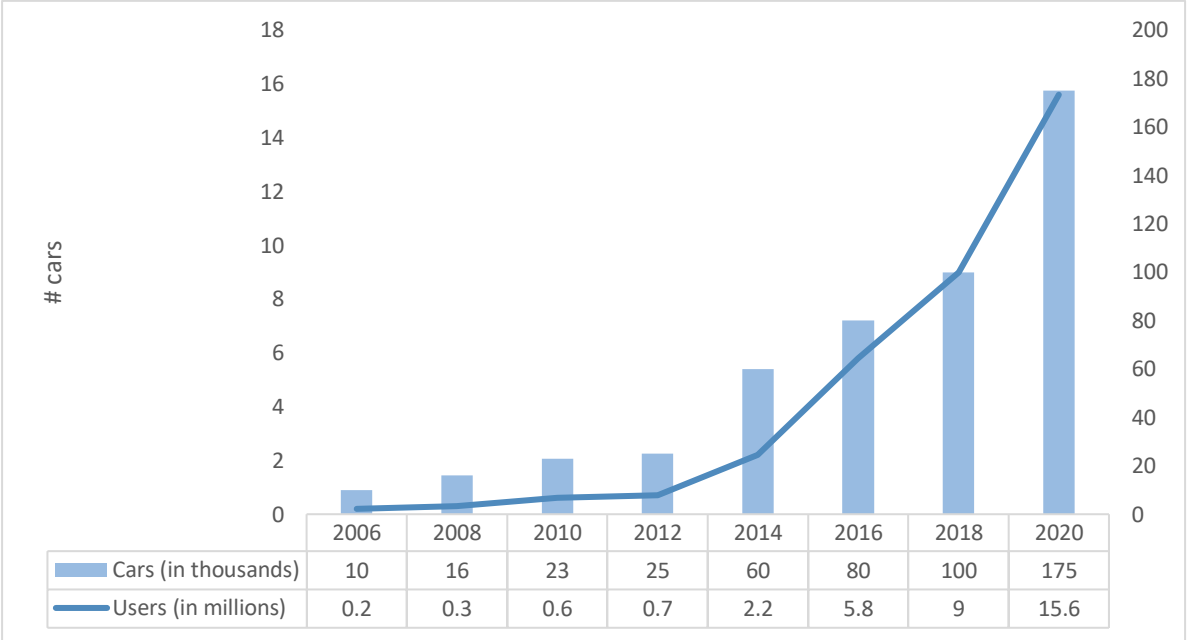
Car sharing and e-hailing are few of the examples from range of alternative models for vehicle ownership and usage. Even though the fraction of passenger miles travelled is very small using these services in present day but many customer surveys have shown that 67% of car owners plan to increase their use of car sharing within next two years. Developing business models and technology is the key to further penetration of all these trends that allow companies to capitalize on them. In order to benefit in the new mobility landscape, the industry players (traditional automotive companies and new entrants alike) must identify and secure those technological resources. Instead of acquiring single products or services, industry players need to think about sourcing underlying technologies. [3]

Car Sharing in Europe

Future of mobility is spreading widely all over the globe, but the development is still in its initial stage and has not reached its peak by a huge margin. The sharing economy is approaching while disruptive technologies inspire the emergence of new business models and the set course for a new era of future mobility. Car sharing is an important aspect of this, and the market has committed to offering personal convenience and social improvement.

A recent study [4] highlighted the fact that millennials (those born between 1977 and 1994) desire connectivity and convenience and can choose between an ever-increasing range of transportation types apart from vehicle ownership, for getting from point A to point B. This 2 billion strong consumer segment is the most influential since the Baby Boomers (born between 1940 and 1964). Young adults are shaping an industry by their emerging mobility patterns which on demand service providers like Car2Go and Uber have experienced, and are still experiencing, significant growth and are undoubtedly among the defining factors of our future mobility as well as digital age. These providers are seamless connecting either drivers to passengers (taxi, carpooling) or passengers to cars (car sharing) and changing the way individuals move. The latter is made possible by technology and covers specific segments in the overall mobility market by offering number of solutions in terms of transport modes, from ever-changing one-way journeys to planned weekend round trips.

Car sharing encompasses the advantages of automobility to individuals without them having to go trough the hassle by bearing the cost and effort of a car ownership.



	2006	2008	2010	2012	2014	2016	2018	2020
Cars (in thousands)	10	16	23	25	60	80	100	175
Users (in millions)	0.2	0.3	0.6	0.7	2.2	5.8	9	15.6

Table 1 Car sharing market development Europe (2006-2020)

Car sharing as uninterruptedly experienced double-digit growth over past few years, especially in bigger cities where more and more people opting on passing the costs of vehicle ownership. The immediate advantages to this scenario are reduced traffic congestion and environmental benefits. Though this phenomenon started in United States, the sector has become a global spectacle, and Europe now represents 50% of worldwide car sharing market with 5.8 million users and 68,000 cars in 2016. A global compound annual growth rate of 32% is expected by 2020. Big well-known providers (for example Car2Go and DriveNow) are already well established all across major cities in Europe, the US and Asia. On the other hand, smaller cities and regional areas are being taken cared by more regional providers which provides a considerable room for market growth. Experts believe a potential decline by more than half a million cars by 2021, due to the strong presence of car sharing providers. This development is a global phenomenon, but it varies between countries. Germany is the biggest car sharing market in Europe by a huge margin. Growth has accelerated since 2012 (0.26 million users) and is expected to have 3.1 million users by 2020.

The important position of car sharing in respect to other mobility services can be described by the broad range of individual car sharing business models that have appeared over time.

They address different customer experiences at different price points. Other than price, mobility can be classified by the flexibility presented to customer as well as the distance covered, which also takes into the account the difference in usage from urban to regional (see Figure 4).

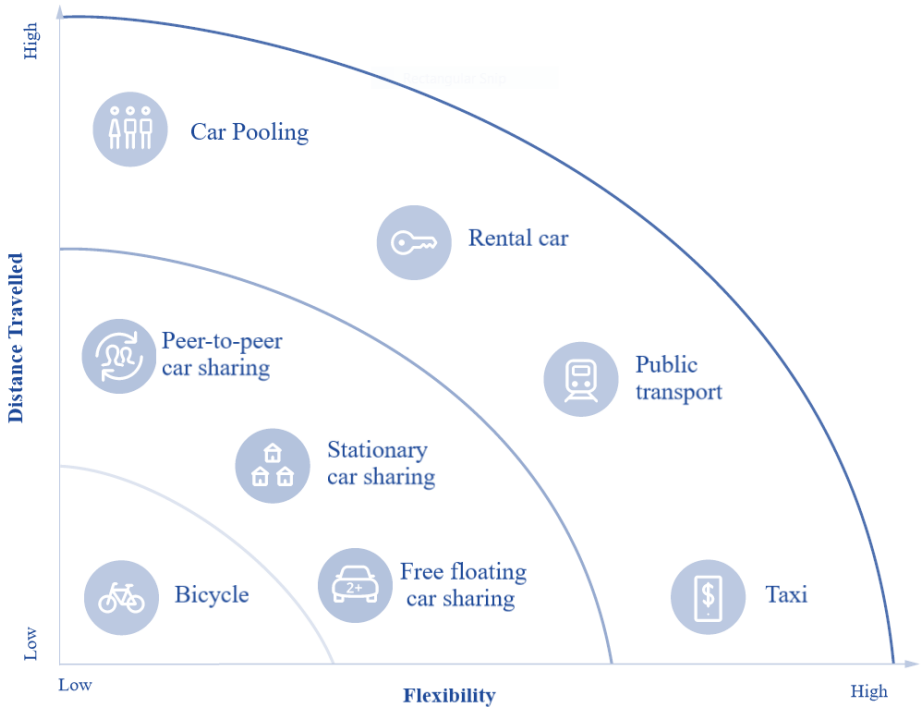


Figure 4 Classification of car sharing among existing mobility concepts

Car sharing models can be categorized into two traditional car sharing models: free floating and stationary B2C and B2B car sharing and cater for specific needs. While free floating models deliver higher flexibility and compete with taxi services such as Uber and mytaxi, stationary models used for lengthier journeys and lean towards to substitute rental cars or car ownership. Furthermore, corporate car sharing users are becoming an unavoidable source of supplementary business for stationary car sharing providers. B2B car sharing is achieved as a closed system in which employees can use vehicles on a sharing basis and is solid substitute for a corporate to operating their personal fleet. The traditional free floating and stationary methods are well established in countries such as Germany and Italy, while for example in France an alternative model is very common: peer to peer (P2P). Customers in this model offer their own car for rental by private users through a platform. P2P offers a transportation method for extended distances as compared to “old-style” car sharing and parallels more to an alternative to short term car rental or carpooling. [5]

Various car sharing business models

Car sharing is a very broad term and a diversity with respect to the different business models is compulsory. They range from free floating to stationary and P2P car sharing. Some providers offer both free floating and stationary, as we will see later in this report, thereby offering the best of both worlds to their customers. Generally, these three business models (free floating, stationary, combination) an cater to either B2C or B2B. Furthermore, additional progress can be detected in the car sharing market but will not be the focus of this study. O2O platforms consolidate offerings by providing a link between online and offline, which enhances convenience and comparability for users.

Each approach displays particular characteristics when it comes to product offering, pricing, pickup and return, cooperation, as well as ownership structure. While business model features may vary, car sharing providers can guarantee positive prospects for success by meeting general success factrs, for example, high availability network coverage, transparent and flexible pricing, and also variety of fleet offer individuals according to their use cases. Also, Providers and investors need to know the unique selling point of each business model.[5]

Business Model features

Usage area of vehicle			Vehicle Type			Pricing			Parking Co-operations		
FF	S	P2P	FF	S	P2P	FF	S	P2P	FF	S	P2P
City center			Small/city cars			By time			Parking permits		
✓		✓	✓		✓	✓			✓		
Broader city areas			Compact cars			By distance			Commercial		
✓	✓	✓	✓	✓	✓		✓			✓	
Regional			SUV&MPVs			Fixed Prices			Private		
	✓	✓		✓	✓	✓		✓			✓

Table 2 High level classification of distinct business model features

FF = Free Floating | S = Stationary | P2P= Peer to Peer ✓=Applicable

Free floating car sharing

The fact that most free floating providers have been in the market for less than five years highlights that this approach is still new, nevertheless this market is booming. Free floating allows customers to pickup and drop vehicle anywhere within a prescribed area, this

highlights the main advantage of this system: flexibility. Free floating cars are mainly used for short trips (shopping or other leisure) in city areas as alternative to taxis. Usually in Germany providers experience high turnover rate of 125 people per car which show profitable operation despite low utilization. Compared to stationary car sharing, free floating system has higher prices that are often based on time only, and in particular become more expensive in case of traffic jams in city areas. Given that most free floating services are mainly operating in city centers, providers usually offers small to medium sized cars (eg. Smart, Mini, Leaf) which also ensures relatively easy parking. for users. The flexible parking system requires operators to have a understanding with local authority in order to avoid parking limitations. In 2014, car2go stopped operation in London because they could not secure parking permits in all of London's residential areas.

In order to be successful, free floating providers need to consider the following success factors:

- Location: high population density to attract enough customer per car
- Pricing: based on time, mostly per minute not on distance
- Cooperation: local authorities have to grant parking space/permits
- Convenience: constant availability of (small) cars that fit needs in city area

Stationary car sharing

Stationary car sharing on the other hand has been around for a longer time (20 years). While free floating emphasizes flexible one way trips, stationary car sharing has fixed stations and usually provide only round trips with the start and end points being the same. This is more useful for longer trips and will most probably replace rental cars or ownership of second car. Even though they lack flexibility in this system they have the upper hand in terms of fleet variety which suits every need. They are situated near small to medium sized cities and rural regions.Utilization is higher due to longer drives and well planned car utilization, while turnover is lower than free floating (45 users per car, Germany)

Stationary providers are often locally organized and do not operate on large global level. Many stationary providers are backed by public funding or private investors, rather than OEMs or car rental business. Success is often attached to regional particularities that are based on strong local market knowledge and an understanding of customer needs. They

often rely heavily on cooperation with other providers to expand their network and for instance also extend their offerings to free floating.

In order to be successful, stationary providers need to consider the following success factors:

- Location: smaller and medium sized cities, rural areas
- Availability: large network of station including at central hubs (eg. Train stations)
- Pricing: based on distance or hourly rates
- Fleet variety for different purposes

Peer to Peer car sharing

Initially only a niche market, P2P car sharing is on the rise. While vehicles for free floating and stationary cars sharing are made available by providers, P2P car sharing offers vehicles belonging to private individuals to specific user community. Players provide a platform to handle the transaction, offer insurance, and equip the car with telematics devices to ensure easy access. The car needs to be returned to the pick-up area after use, and this can only be used for round trips. Given the decentralized fleet, customers have more variety in terms of brands and models. Pricing (eg drivy in Paris) is based on a daily tariff and provides a good alternative to stationary car sharing or rental cars.

The P2P market is relatively dynamic, with new players emergin frequently and with respect to investment activities by financial investors. For instance, drivy have been backed by venture capital funds over the course of various financing rounds. While free floating and stationary car sharing can show global players, most P2P providers operate in only country e.g. drivy in France, Turo in the US etc.

In order to be successful, P2P providers need to consider following success factors:

- **Technology:** state of the art platform and telematics to ensure ease of use
- **Availability:** large and diverse network to ensure best fit for customers everywhere
- **Insurance:** good insurance policy for car owners to answer concerns about lending
- **Community:** establishment of trust between driver and lender

Chapter 2 The project in Asti

Aim of the study

The main goal of this project report will to define a flexible electric car sharing model which will be put in place in the province of Asti, in the region of Piedmont in northern Italy. It is expected that the reach of this system covers most of the UNESCO heritage sites in and around the town as it is mainly being put in place for the tourists which come to take in the cultural, heritage, architectural and gastronomic experiences. [6] The model should be able to define:

- the number of vehicles
- their usage
- type of roads the vehicle will be used on
- Destination covered by the route
- Which type of charging platform to use (for example: fixed station charging or battery swapping)

The model will primarily be dependent on the number of incoming tourists to the region which will help in deciding how many cars to use; what type of vehicle to use; what should be the range of the vehicle; where to allocate places to charge (or swap batteries); in what other ways can these vehicles be used. By the end of this report, a simulation should be in place to make it possible to compute the above-mentioned parameters. We should also define how the project can be further expanded and improved in future. We shall start by studying the region and the flow of tourist. Then compare the other electric car sharing

models already put in place in Europe in major cities. Then find statistical description of the data collected for different countries with electric car sharing programs. Then ensure the model which we create complies with the already existing models in Europe. The important aspect would be to characterise and prioritise what parameters of existing models to be taken into consideration when evaluating their features. Also, while defining the route we should make sure it covers interesting commercial activities (UNESCO sites, retail outlets, merchandise stores, vineyards etc.). We should be aware that seasons will play an important part as well while defining the model hence the route should be flexible as not all activities can be done throughout the year. This will further help us in deciding if fixed charging stations are a feasible option since we need least number of non-operating charging stations in off season.

Geography

Situated in the centre of Piedmont and bordering Liguria in the south, Asti is transversed by the Tanaro River and is mostly hilly territory. This area is a wine producer and the home of Asti Spumante DOCG, renowned and exported all around the globe.

Mediterranean Sea is in the proximity and moderates the continental climate of Asti. Compared to Turin, winters are warmer and summers cooler. Spring and autumn experience the most rain falls while during hottest months rain is less common but stronger when it does occur within thunderstorms. The town of Asti is prone to fog during the months of November and December, which is uncommon in the areas that surround it at higher altitude. [7]

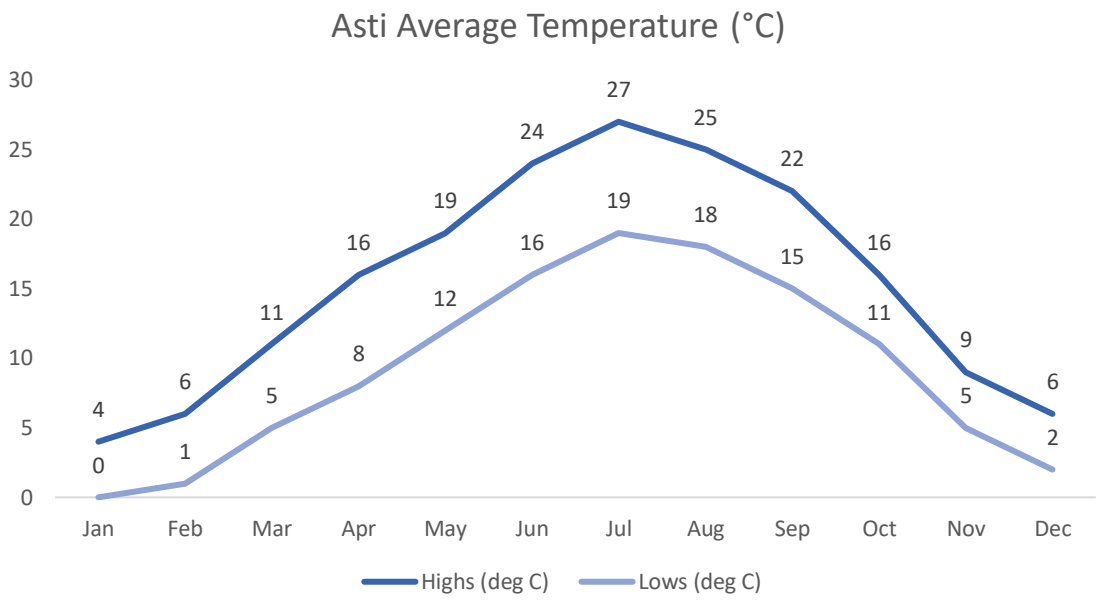


Figure 5 Average Temperature for Asti over a year [8]

Figure 6 Location of Asti in Piedmont

Points of interest in Asti

The commune and city of Asti is in the Piedmont region; it is the capital of Asti Province and considered the modern capital of Monferrato, wine district. The city's many palaces; mansions and monuments include the remains of ancient Roman and medieval walls. Surviving towers in the "city of 100 towers" include the Tower of the Comentini; Torre Troyana; Rossa di San Secondo and Torre de Regibus.

The Cathedral of Santa Maria Assunta is a 13th century Romanesque-style Duomo and one of the largest in Piedmont. It holds 18th century frescoes; 15th century silverware and altarpieces by Gandolfino d'Asti. See the Collegiata di San Secondo with a polyptych by d'Asti and a 6th century crypt. The Palazzo Civico; Santa Maria Nuova; Sant'Anastasio; Santa Caterina; San Pietro in Consavia and the 12th century Baptistery of San Pietro are all top attractions. See the spectacular Palazzo Mazzetti. The city's Jewish community dates back to 812 and you can visit the synagogue and Jewish Museum. Palio Asti is a huge celebration with a 2,000 people costumed parade; horse-back competitions and street parties. The Festival of Festivals is held a week prior to the Palio and entails a traditional local food festival with delicacies like local white truffles.

- **Asti Cathedral**

  Asti cathedra is devoted to the Assumption of Virgin Mary and to Saint Gotthard. It is the pontifical bench of the Diocese of Asti and is a Roman catholic church. At 82 meters long and 24 meter high and 24 meters wide, it is one of the largest churches in piedmont, the highest example of gothic architecture of the area and among the best example of Lombard Romanesque situated in northern Italy.

- **Palazzo Ottolenghi**

  Palazzo Ottolenghi is a Asti palace. It is one of the finest baroque buildings in the city, situated in corso Alfieri, in the district headquarters Cathedral also of the Risorgimento Museum.

- **Palazzo Mazzetti**

The Mazzetti Palace is a baroque palace in Asti, overlooking Contrada Maestra (today Corso Alfieri). It is the seat of the Civic Art Gallery of Asti.

- **Torre Rossa**

The Red Tower of San Secondo is a Romanesque tower of Asti. It tells the legend that the tower was the last prison of the patron saint of the city (San Secondo) before his martyrdom. Its name may derive from the same color of the tower or by the family De Rubeis, who seems to possess their homes in the immediate vicinity.

- **Collegiata di San Secondo**

The collegiate church of San Secondo is the oldest catholic church in Asti. It I situated in the heart of the city adjacent to the town hall and overlooking the main square. It is dedicated to San Secondo, the patron of the city, and hence was built on the site of his martyrdom and burial according to the tradition.

- **Torre Comentina**

The Comentina Tower is a tower of Asti, located in Piazza Roma, corner of Corso Alfieri, in Rione San Martino-San Rocco. With the clock tower, it is the only towers in the city arrive intact to this day.

- **Museo del Risargimento**

The Museo del Risorgimento is an exhibition space located in Asti at Ottolenghi palace. It is dedicated to the Risorgimento and contains artifacts that date back from 1797 (year of the proclamation of the Republic Astese) to 1870 (fall of Rome). Complete collections testimonies of the First and Second World War.

- **Museo deocesano San Giovanni**

The Diocesan Museum of Asti is a museum, open to the public in 2010 with the intent to preserve the artistic heritage of the Diocese of Asti. Situated in the classroom of the former church of St. John, in the broader complex of Santa Maria Assunta Cathedral,

the museum is still being completed. The exhibition spaces are periodically used for temporary exhibitions.

- **Torre de Regibus**

De La Torre Regibus is a tower of the city of Asti. It is situated at the confluence between Via Roero and course Alfieri, a few hundred meters from Piazza San Martino.

UNESCO heritage sites

Vineyard Landscape of Piedmont: Langhe Roero and Monferrato

Five different wine growing areas with outstanding landscape and the Castle of Cavour are covered in this area. These are historically simportant names for both development of wine yard and Italian history. The region is located in the south prt of Piedmont, sandwiched between the Po River and the Ligurian Apennines. It covers the whole range of technical and economic processes relating to the wine making and its growing that has described this region for hundreds of years. Since 5th century BC, wine pollen has been found in this region, during this period, Piedmont was the central point for contact and trade between the Etruscans and the Celts. Their language was of importance and is still felt in the winemaking dictionary and have found a place in the local dialect. Pliny the Elder, during the roman empire, mentioned region of Piedmont as the most favourable for growing wines in ancient Italy.

The world heritage committee provides the following reason to include Langhe, Roero and Monferrato in World Heritage List

a) “The cultural landscapes of the Piedmont vineyards provide outstanding living testimony to winegrowing and winemaking traditions that stem from a long history, and that have been continuously improved and adapted up to the present day. They bear witness to an extremely comprehensive social, rural and urban realm, and to sustainable economic structures. They include a multitude of harmonious built elements that bear witness to its history and its professional practices.”
b) “he vineyards of Langhe-Roero and Monferrato constitute an outstanding example of man’s interaction with his natural environment. Following a long and slow

evolution of winegrowing expertise, the best possible adaptation of grape varieties to land with specific soil and climatic components has been carried out, which in itself is related to winemaking expertise, thereby becoming an international benchmark. The winegrowing landscape also expresses great aesthetic qualities, making it into an archetype of European vineyards." [9]

ID	Name & Location	Coordinates	Property	Buffer Zone
1390rev-001	Langa of Barolo	N44 36 31 E7 57 49	3,051 ha	
1390rev-002	Grinzane Cavour Castle	N44 39 7 E7 59 39	7 ha	
1390rev-003	Hills of Barbaresco	N44 43 14 E8 5 15	891 ha	
1390rev-004	Nizza Monferrato and Barbera	N44 47 47 E8 18 18	2,307 ha	
1390rev-005	Canelli and Asti Spumante	N44 44 17 E8 14 59	1,971 ha	
1390rev-006	Monferrato of the Inferot	N45 3 3 E8 23 23	2,561 ha	16,943 ha

Table 3 List of World Heritage Sites in region of Asti

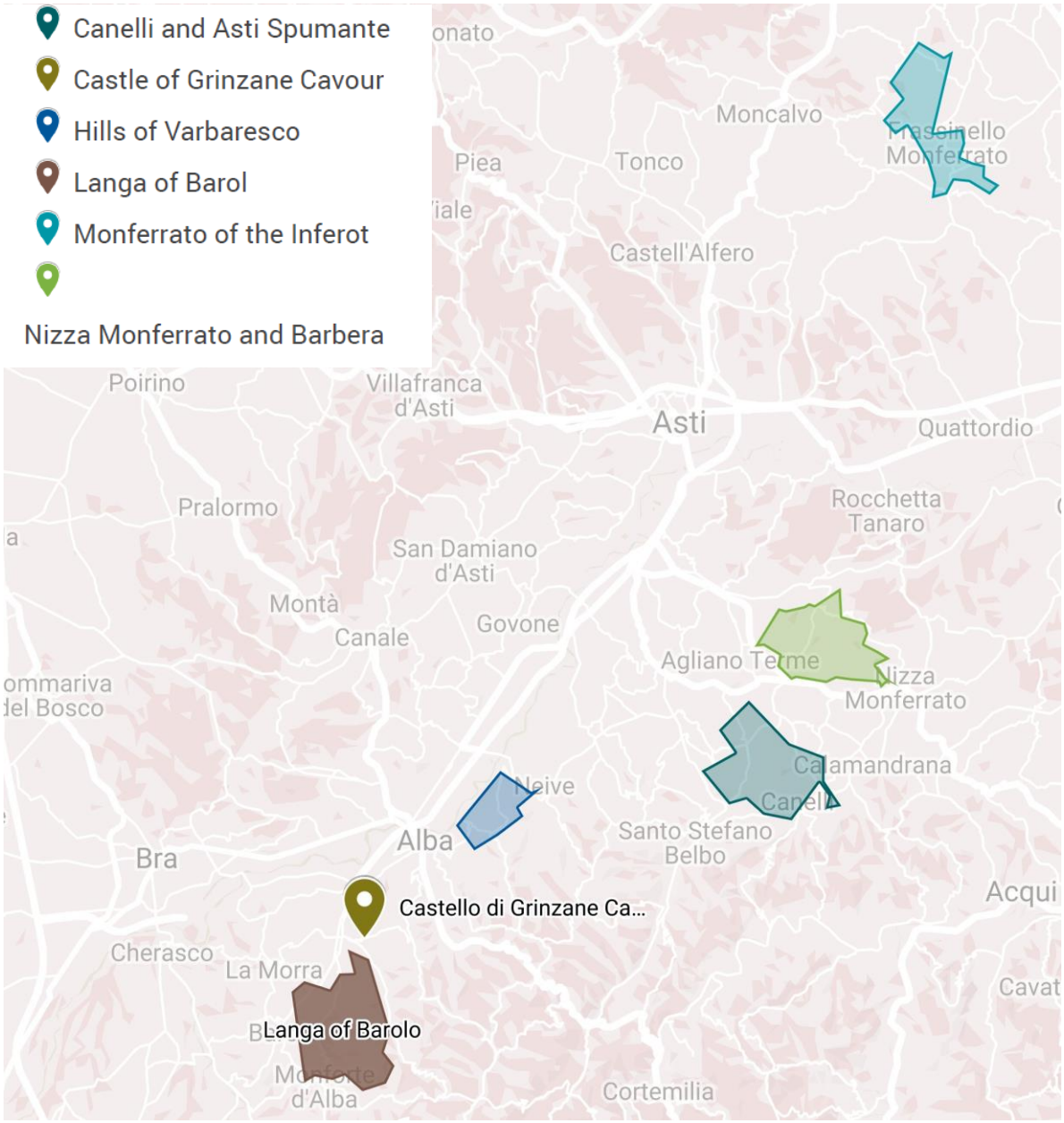


Figure 7 UNESCO Heritage sites near Asti

Tourist influx

Data released by the National Institute of Statistics shows the tourist flow and their features in 2016 from the point of view of supply and demand side.

403 million nights were spent in tourist accommodation establishments in 2016 (an increase of 2.6% from 2015) and arrivals were 117 million (an increase of 3.1% from 2015)

Average length of stay in hotels and similar establishments was 2.97 nights with about 90.3 million arrivals (increase of 1.4% from 2015) and 267.7 million nights spend (increase of 1.8% from 2015) in total.

Arrivals increased by 9.5% in other collective accommodation establishments bringing the total number upto 26.7 million. Number of nights spent in such establishments increased by 4.2% (total nights spent 135.3 million), hence reducing the average length of stay by 0.26 nights.

The total number of nights spent by non-residents was 199.4 million and those by the residents was 203.5 million (respectively an increase of 3.5% and 1.6% when compared with 2015)

40.3% of total nights spent, in 2016, was focused in only 50 Italian municipalities. Rome being the top destination with more than 25 million of nights spent (6.3% of whole country), followed by Milan (2.7%) and Venice (2.6%).

86% of the trips made in 2016 by the residents in Italy in collective tourist accommodation establishments of the country were for holiday purposes (increase of 19.6% over 2015). As oppose to business trips, which made up 14% of trips, a dip by 4%.

Study shows that 76% of the overnight stays were booked directly by the residents, an increment of 33% of holidays and 12.8% of business trips when compared with 2015. Approximately 15% of departures had taken place without any booking (decrease of 26% over 2015). More than half the trips were booked over the internet (54.5%). 57% percent of holiday trips were booked over the internet.

Italian residents spent an average of 369 euros per trip and 82 euros per night in 2016. Both these figures stayed the same over the three-year period from 2014 to 2016.

Influx of German tourists was the highest, around 14% of total nights spent, followed by French and US residents (having a lower share of about 3% each).

Italy came third country of destination in Europe, in 2016, after France and Spain, for number of nights spent. Germany, France, Spain and Italy together registered 57.4% of total nights spent in EU28. [10]

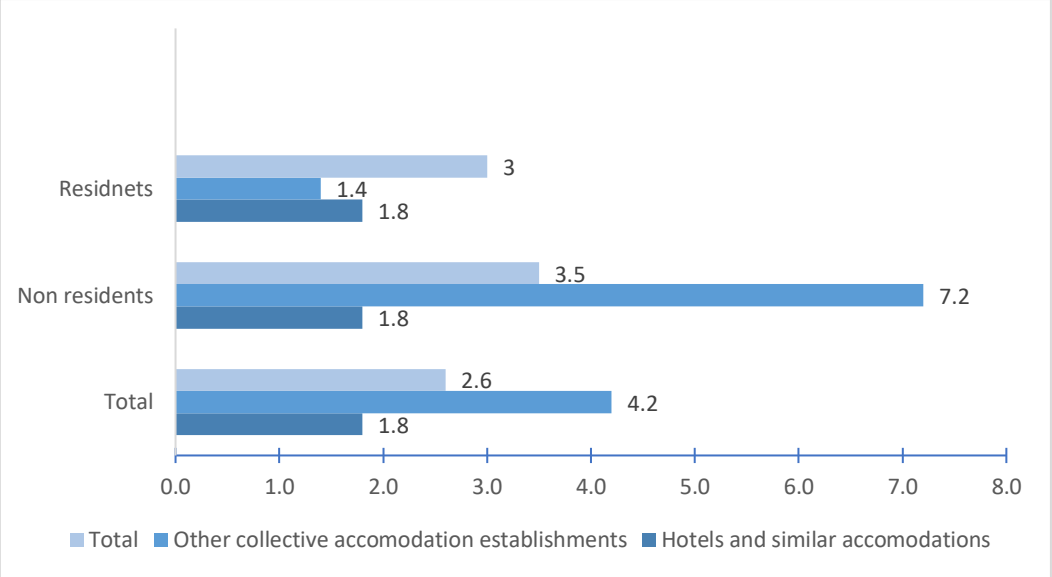


Figure 8 Nights spent by type of accommodation and residence. Years 2015 and 2016 % change

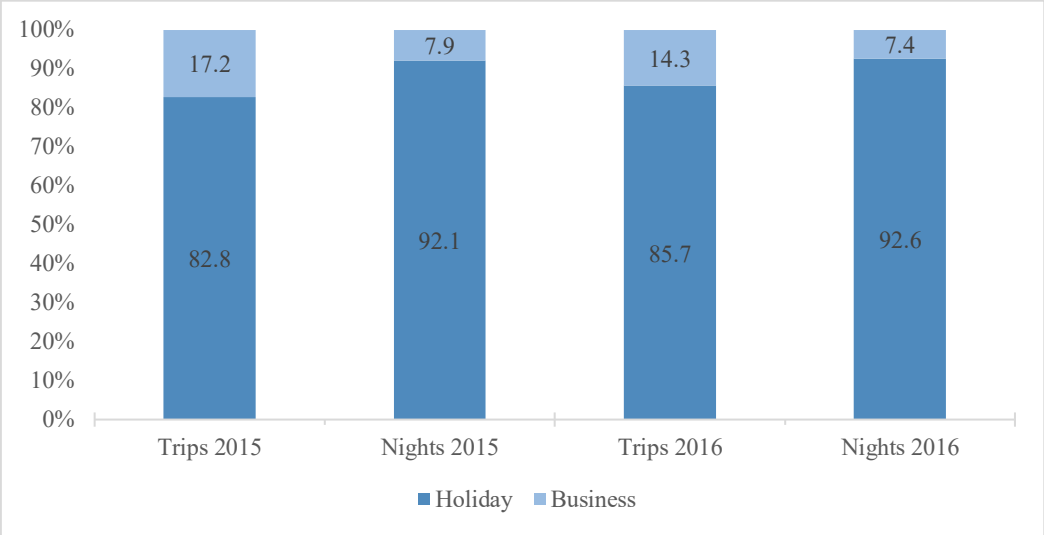


Figure 9 Trips and Nights spent in Tourist accommodation establishments by type of trip. Years 2015 and 2016 % change

	Hotels and similar accommodation		**Other collective accommodation establishments**		**Total tourism accommodation establishments**	
	2015	2016	2015	2016	2015	2016
Arrivals	89,019,596	90,256,224	24,372,541	26,688,019	113,392,137	116,944,243
Nights spent	263,009,954	267,675,213	129,864,116	135,286,900	392,874,070	402,962,113
Average length of stay	2.95	2.97	5.33	5.07	3.46	3.45

Table 4 Arrivals, nights spent and average lenght of stay by the type of accommodation. years 2015-2016, absolute values

	% changes 2016/2015 Hotels and similar accommodation	% changes 2016/2015 Other collective accommodation establishments	% changes 2016/2015 Total tourism accommodation establishments
Arrivals	1.4	9.5	3.1
Nights spent	1.8	4.2	2.6
Average length of stay	0.02	-0.26	-0.01

Table 5 Arrivals, nights spent and average length of stay by the type of accommodation, years 2015-2016, % changes

The numbers changed in the 2018 when the overnight stays made by residents creased from 19.5% in 2017 to 78.940 million. The average duration of nights spent reduced to 5.5 corresponding to 432 million nights. For three years in a row, long holidays showed a positive trend which showed an increase of 12.7 percent from past year. Short holidays increased by 19.6 percent and business trips increased by 57.7 percent. Main means of transport was a car (59.2 percent of trips) especially for short holidays. Use of Airplanes and trains reduced.

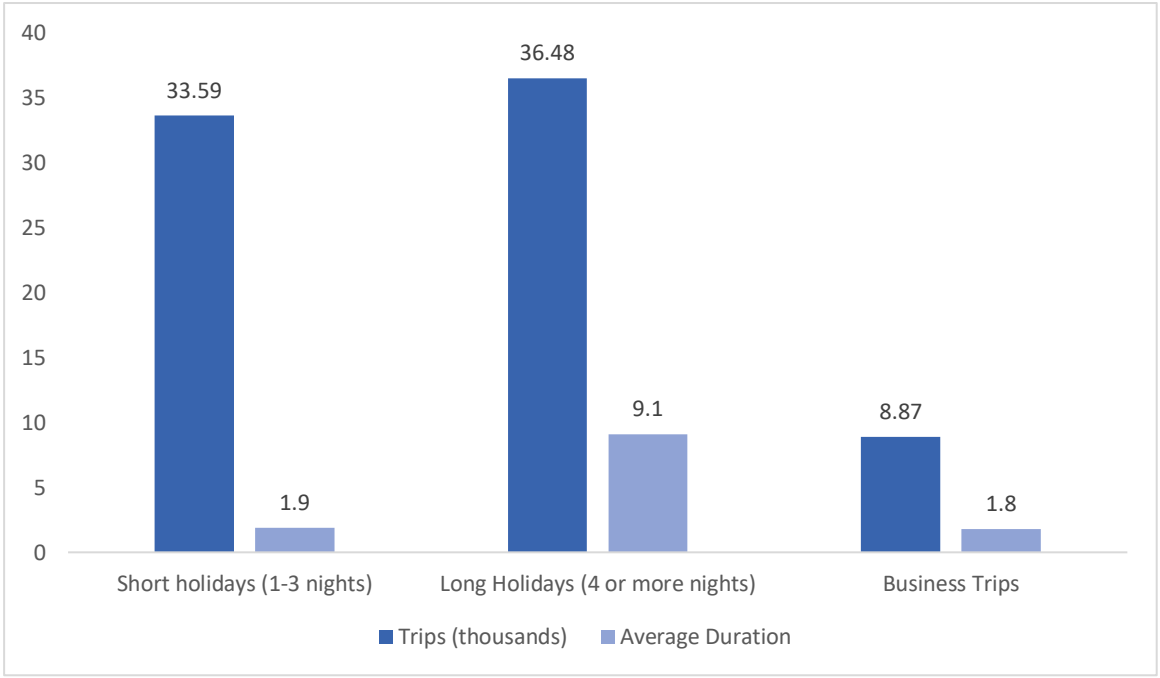


Figure 10 Trips and Average duration by type of trip. Year 2018

Chapter 3 Creating the model

Nearly all existing carsharing programs and businesses manage their services and operations manually. Customer makes a vehicle reservation beforehand with a human operator, obtain their vehicle key through a self-service, manually controlled key locker, and record their own mileage and usage data on forms that are stored in the vehicles, key lockers, or both. As carsharing programs expand beyond 100 vehicles, manually operated systems become expensive and inconvenient, raising issues like mistakes in reservations and billing, and susceptible to vandalism and theft. [11]

Since then, these problems in carsharing have mostly disappeared because digital technologies have automated the manual steps and allowed the innovation of completely new business models. This encouraging role of digital technologies can also be observed in other segments of the sharing economy that have long been in existence but only recently experienced digital technology-enabled business model innovations, including peer-to-peer (P2P) accommodation, crowdsourcing, and crowdfunding.

Methodology

Only handful of studies have been made to draw a comparison of different car sharing companies which focus solely on electric cars despite the fact there are already extensive studies regarding potential impact of car sharing. To be more precise, there aren't many research present which compares the coexistence of different elect car sharing companies in the same geographical boundary and how they can exist while maintaining competition given the fact that this is becoming more and more common as electric car sharing market

grows and new player enters the market. Defining the methodology is very important. On one hand, the exclusivity of the electric car sharing services compels to consider the methods presented in the literature for new entrants [12]. On the other hand these methods should be reproducible, repeatable and adaptable for existing organizations. Thus taxonomies were created to initiate the process. From the review of literature material about developing taxonomy, following three phases were adopted. [13]

	Phase 1: **Set up database**	**Phase 2:** **Develop taxonomy**	**Phase 3:** **Perform cluster analysis**
Steps	• Search for electric car sharing operators and store information in database • Filter for defunct operators • Pre-classify operators • Request additional information where necessary	• Define meta characteristics for the taxonomy • Run through several iterations of taxonomy until all ending conditions are fulfilled	• Identify a useful number of clusters • Specify the companies belonging to each cluster
Methods	Literature review, desk research	Taxonomy development	Combinations of different clustering algorithms
Source	Electric car sharing literature, car sharing blogs, Wikipedia, practice reports, emails	Carsharing literature (for theoretical concepts), carsharing database for empirical data	Electric car sharing business model taxonomy
Results	Database with 16 independent car sharing organizations	Taxonomy of carsharing business models with 7 dimensions	Three empirically derived carsharing model archetypes

Table 6 Research phase for taxonomy

We specifically employed the Nickerson taxonomy development method and applied empirical clustering method to identify the archetypes. A thorough review of literature about business model showed that the VISOR framework will be best suited. It emphasizes the importance of customer interaction, the main role of digital platform, and the requirement to organize a complex ecosystem by segregating business models into five components, value proposition, interface, service platform, organizing model and revenue model. [14]

Visor Framework

Even though there is a lot to study about the values of business model, astonishingly, very little methodically sourced and agreed upon literature is present regarding what are the business needs in academic, consulting and corporate sectors. It is critical to find usable and reliable business models in a market where there are new products and services, new platforms and latest Information Technology based delivery platforms. This is the similar case in electric car sharing industry. Hence it is very important to better understand and define various parts of business model and their interactions in order to be capable of

i Having an intelligent conversation by using a common language
ii Examine the viability of new business propositions by using the framework
iii Get to know the various elements that have to be in order for a business model to be successful [15]

Value

Value Proposition for Targeted Customer Segment: This proposal usually goes hand in hand by a good back story about why a particular customer base would give importance to an organization's products and services and be ready to pay a premium price for them.

Interface

Interface Experience: The ease of use, simplicity, convenience and positive energy that a user interface experience generates heavily predict the success of delivery of a product. An outstanding value proposal with a poorly formed user interface experience cannot thrive and a similarly amazing user interface can hugely alter the value proposition.

Service Platform

Service Platforms to Enable Delivery: In order to deliver the product and services, and also to enhance the value proposition, an IT platform is required that enables, shapes and supports the business processes and relationships.

Organizing Model

Organizing Model for Processes and Relationships: These models define how a set of enterprises, will manage business procedures, value chains and continue to form relationships, to effectively and efficiently deliver products and services.

Revenue/Cost sharing

Revenue/Cost Model Calculations for All Partners: In an appropriate business model, the combination of value proposal, the method in which products and services are delivers, and the investment in IT platforms are such that income exceeds expenditure. If there are many organizations in partnership, then the revenue agreement should be profitable to all the partners. Lastle, the hazard of errors in forecasted profits and costs should be controllable and the revenue/cost margin strong.

VISOR defines the sustainable capability of a business model. 16 individual cases were conducted with diverse organisations in the electric car sharing sector. The 16 cases discussed dealt with B2C business model and the primary data was collected via literature review, desk research, supplemented by an extensive range of secondary data. A cross-case comparative data analysis was used to review the patterns of different viable business components across the 16 cases and, finally, the findings and conclusions of the study are presented. [16]

Phase 1: Set up Database

The primary aim of the this phase was to create a database of electric carsharing operators that were operational in month of September 2018. We proceeded by combining a variety of sources to assemble a complete picture of European electric car sharing operators. One operator was chosen from each biggest country where electric car sharing is available to get a better idea of the whole picture. We studied all articles from the literature review and searched the database of the Carsharing Association (CSA) and Wikipedia. Operators which were about to get shut down were filtered out. Also the operators which did not have an English homepage was rejected from the study.

Country	Company	City Based	Type of Vehicle	No. Of Passengers	No. of Vehicle in Fleet	No. of Customers	Membership Cost	1st Hour Rate	Subsequent Hourly rate
Belgium	Zen Car	Brussels	Renault Zoe	5	86	4000	10€	9€	9€
Czech Republic	Car4Way	Prague	Skoda Citigo	4	69	3000	€38.5	€14	4€
Finland	Ekorent	Helsinki	Nissan Leaf	4	13	500	€12	7€	7€
France	Drivy	Paris	P2P model				free	5-30€	varies
Hungary	GreenGo	Budapest	Volkswagen e-UP	4	184	1346	€16	€12	€12
Ireland	GoCar	Dublin	BMW i3	4	11	500	€0	€12	€12
Italy	Share'nGo	Milan	Custom Microcar	2	650	9000	€0	€16.8	€16.8
Luxembourg	Carloh	Luxembourg city	Renault Zoe	5	3	40	€30	€2.5	€2.5
Netherlands	Car2Go	Amsterdam	Smart	2	250	4000	€9	€18.6	€18.6
Poland	Vozilla	Warsaw	Nissan Leaf	4	15	600	€0	€14	€14
Portugal	Emov	Lisbon	Citroen C-Zero	5	150	1200	€0	€12.6	€12.6
Romania	BCR eGO	Bucharest	BMW i3	4	20	750	Na	Na	na
Spain	ZITY	Madrid	Renault Zoe	5	150	2000	€0	€15.6	€15.6
Switzerland	ENUU	Biel	LEV	1	25	500	€0	€0	€0
Sweden	MoveAbout	Stockholm	Nissan Leaf	4	60	2500	€12.3	€7.73	€7.73
UK	eCar	London	Renault Zoe	4	800	10000	€57	€6.33	€6.33

Table 7 Database for electric car sharing services in Europe

- Zen Car, Belgium, Station based charging. Reserved through mobile app and provide loop service only, which means the car must be returned from the same charging station it was picked up from.
- Car4Way, Prague, Station based charging. Reserved through mobile app and can be parked on any charging station in the city.
- Ekorent, Helsinki, Free floating parking system. Reserved through an app and charged hourly with unlimited kilometres.
- Drivy, Paris, P2P car sharing system. Reservation made through app and vehicle dropped back at the pickup point. Community driven service hence not all vehicles are electric. one
- GreenGo, Budapest, Free floating electric car sharing system. Reserved through mobile app and charged on per minute basis

- GoCar, Dublin, Loop service only, car to be returned back to the pickup point. Reservation made through an app.
- Share'nGo, Milan, Free floating service, reserved through an app. Free parking and entrance to all the zones of Milan.
- Carloh, Luxemberg, Station based parking, reservation done through an app
- Car2Go, Amsterdam, Free floating parking, reservation done through an app
- Vozilla, Warsaw, Free floating system, reservation made through an app
- Emov, Lisbon free floating system, reservation made through an app
- BCR eGo, Bucharest, Free floating system reservation made through the app but the service is only available exclusively to customers of BCR (Banca Comerciala Romana)
- ZITY, Madrid, Station based parking, reservation made through an app
- ENUU, Biel, Free floating service, reservation made through an app. A light electric vehicle (LEV) is used which seats single person. First three rides of the day are free of charge and there is no registration fee as well.
- MoveAbout, Stockholm, Station based system. Reservation made online through their website
- eCar, London, Free floating system, reservation made through an app

Phase 2: Develop Taxonomy

The main objective of this phase is to methodically develop a taxonomy of electric carsharing business model that will contain the most crucial dimensions through with the business models of different operators differ. This is also called taxonomy development method. The method is very thorough as is clearly states the important steps and ending condition. It has been tried and tested through number of applications [17]. Also, this method utilises the use of combinations of theoretical knowledge and experimental results, making it very useful for our case. Even thought the present electric car sharing business models are different (see table below "Proposed taxonomy dimensions.") the complete data set of worldwide electric car sharing operators developed in previous phase can reveal extra dimensions.

Author	Proposed archetypes	Proposed taxonomy dimensions
Alfian et al 2014 [18]	• 36 logical dimensions from a combination of taxonomy dimensions	• Returning time: specified vs open ended • Destination service: roundtrip vs one-way vs undeclared • Relocation technique: static inventory balancing vs static shortest time vs rebalancing
Barth and Shaheen 2002 [19]	• Neighbourhood carsharing • Station cars • Multimodal shared use vehicles • Hybrid models	• Linkages with other travel modes • Size of target area and target group served • Organization, services offered, business models • Vehicles • Customer service • Technological sophistication • Sources of support
Cohen and Kietzman 2014 [20]	• B2C point to point • B2C roundtrip • Non-profit/cooperative • P2P	• Value proposition • Supply chain • Customer interface • Financial Model
Shaheen and Cohen 2013 [21]	• Neighbourhood residential • Business • College/ university • Government and institutional fleets • Public transit • One way • Personal vehicle sharing • Vacation/resort	• Market segments • Parking • Vehicle and fuels • Insurance • Technology

Table 8 Literature classifying car sharing business model

Taxonomy development process proceeds in several steps. Firstly, the meta characteristic is defined., which guides the progress of the dimensions. Second, the terminal condition must be stated. Third, the method permits for iteration through two separate cycles. One cycle is empirical to conceptual, which means subset of the objects to be classified must be assessed for mutual characteristics and dimensions which are then included to the classification. The other cycle is conceptual to empirical, which means that the dimensions

and characteristics could be a derivative from the literature but must be assessed by real world examples subsequently. Lastly, the procedure ends when the ending conditions are met.

For this project, meta characteristics were defined as the components of the carsharing business model. All dimensions must be derivative of this meta characteristics and help in defining the structural diversity of various electric carsharing business models. It was found that the above mentioned VISOR concept to be a convincing basis for guiding this process. Hence each dimension must be related to one of the VISOR's five components. After this, iterations were run until all carsharing operators from the dataset were segregated and the ending conditions were met. [22]

Firstly, the conceptual to empirical iteration was adopted and we integrated the taxonomy dimensions identified during the literature review. During this we added 6 dimensions namely number of passengers a car can hold, how big the fleet size, number of existing customers, membership cost, rate for the first hour and rate for the subsequent hour. The subsequent iterations were empirical to conceptual and resulted in the successful segregation of all carsharing operators in the dataset. It is to be noted that all these iterations led to addition of three further dimensions along which the operators differed: booking platform and service type (floating or stationary) and billing method (per km, hourly or per minute). Finally, all operators from the dataset were segregated and all objective and subjective terminal conditions were completed hence ending the iterations.

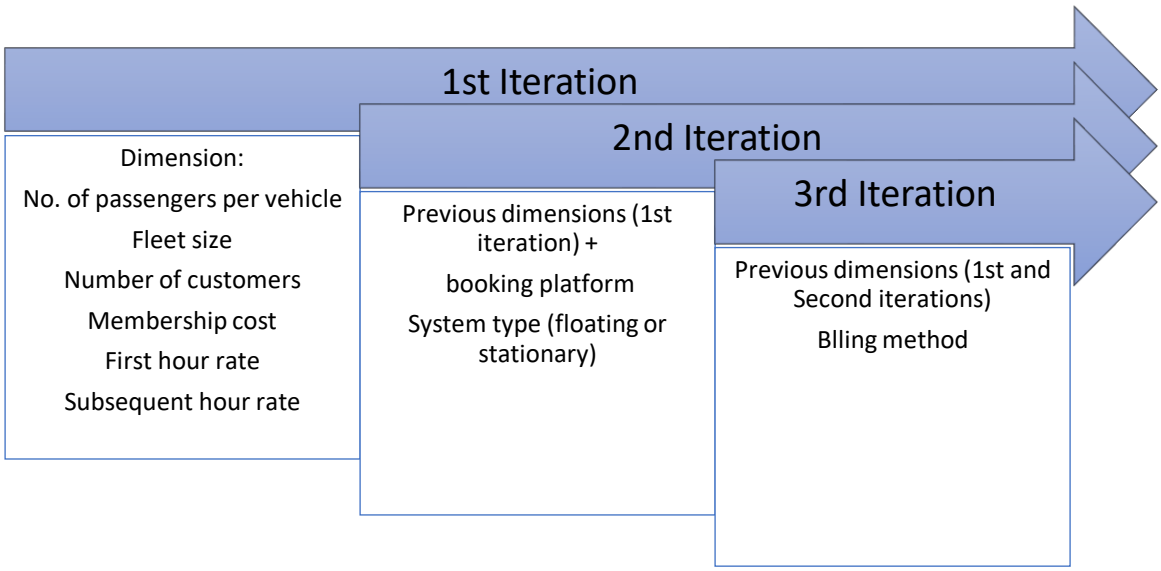


Figure 11 Development of Dimensions for the Carsharing Business Model

Phase 3 Performing Cluster analysis

This third phase of performing cluster analysis will address the empirical identification of electric car sharing archetypes from the taxonomy by performing cluster analysis. The main aim of cluster analysis is to define groups of objects where objects in the same group are as similarly defined as possible and objects in different groups are as divergent as possible. The most difficult challenge in this phase to decide the number of clusters. The best method is to make clusters using eye balling since we do not have a huge data set. After this, the clusters should be further specified using repetitive partition procedure.

The process can be repeated for a huge dataset using Ward's method. [23]. Then the suitable number of clusters are found out using the descriptive data on the iterations, usually the dendrogram, the scree plot (by using the elbow rule), and the distance between coefficients. Then the statistics will indicate the number of clusters that are most useful.

Ward's Method

Ward's Method (called Minimum variance method or Ward's Minimum Clustering Method) is useful in the sectors like linguistics and is a substitute to single link clustering. It is useful because it creates small, equal sized clusters.

Even though the clustering method are less computationally intensive as compared to other methods. The limitation is that this commonly leads to less than optimal clusters. However, the clusters obtained are usually satisfactory for most purposes.

At the beginning, Ward's method contains n clusters, each containing a single object. These clusters are combined until there is only one single cluster. At each step, the process makes a new cluster that minimizes variance, which is calculated by an index called E.

At each step, following calculations are made

i Find mean of each cluster
ii Calculate the difference between each object in one cluster and the cluster's mean
iii Square the difference
iv Sum the squared value
v Sum all the squared value from all clusters

Hence at each step, all combination of clusters must be considered. Since the datasets have a combination of data points, like in our case, it makes a computer a necessity because computation cannot be done by hand. [24]

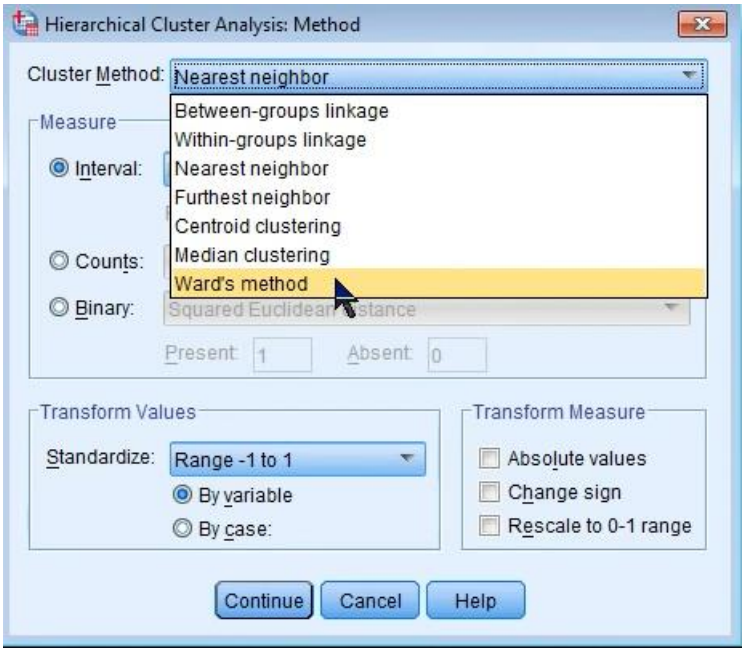


Figure 12 Ward's Method SPSS selection window

Chapter 4 Conclusion and results

Database

The 16 carsharing operators we selected for our database are from Europe including Ireland, United Kingdom and Romania. They were pre-categorized into car sharing business models archetypes. The operators could be classified as follows: 13 one ways, 8 with 4 passengers capacity vehicles, 6 dedicated stations, 6 vehicle charging done by customer, 11 with one time membership cost.

Country	**Company**	**Destination**	**No. Passengers**	**parking** infrastructure	**vehicle charging**	**membership cost**
Belgium	Zen Car	roundtrip	more than 4	dedicated stations	charged by customer	one time
Czech Republic	Car4Way	one way	4	dedicated stations	charged by customer	annually
Finland	Ekorent	one way	4	free floating	charged by operator	one time
France	Drivy	roundtrip	4	free floating	charged by customer	Annually
Hungary	GreenGo	one-way	4	free floating	charged by customer	one time
Ireland	GoCar	roundtrip	4	dedicated stations	charged by customer	one time
Italy	Share'nGo	one-way	less than 4	free floating	charged by customer	one time
Luxembourg	Carloh	one-way	more than 4	dedicated stations	charged by operator	one time
Netherlands	Car2Go	one-way	less than 4	free floating	charged by customer	Monthly
Poland	Vozilla	one-way	4	free floating	charged by customer	one time

Portugal	Emov	one-way	more than 4	free floating	charged by customer	one time
Romania	BCR eGO	one-way	4	free floating	charged by customer	one time
Spain	ZITY	one-way	more than 4	dedicated stations	charged by operator	one time
Switzerland	ENUU	one-way	less than 4	free floating	charged by customer	one time
Sweden	MoveAbout	one-way	4	dedicated stations	charged by operator	Monthly
UK	eCar	one-way	4	free floating	charged by operator	Monthly

Table 9 Classification of business models

Taxonomy

The described taxonomy contains 15 dimensions which in turn contains two to five characteristics. There is a one to one relation between each of the 16 electric carsharing operators and characteristics It should be noted that the taxonomy contains only the most important dimension through which the operators differ., hence the components of business model that are identical to all operators are either not listed or shall be considered omitted from the list. For example, the booing platform for all operators under the study is through a dedicated mobile application. The dimensions were discussed along the VISOR framework's five components as they were assigned to the respective components.

	Dimensions	Characteristics		
Value proposition	Destination	roundtrip,	one way,	roundtrip with option for one way
	No. of passengers per vehicle	less than 4,	4,	more than 4
	number of customers	less than 1000,		more than 1000
	minimum duration	at least 24hours,	hourly,	by the minute
	Vehicle type	identical/similar vehicle,		different vehicle
	additional benefits	free/discounted parking,		no benefits
Interface	vehicle booking	reservation and instant access,	instant access fixed return time,	fixed return and open ended time
	vehicle access	manual key handover,	lock box for key,	Automatic

Service platform	booking platform	proprietary application,				Website			
	parking infrastructure	dedicated stations,		street parking,		private homes			
organizing model	vehicle ownership	operator owned,				private owned (customer)			
	vehicle maintenance	maintained by operator,				maintained by friver			
	vehicle chargin	charged by operator,				charged by driver			
Revenue model	membership cost	0,		one time,		monthly,	Annual		
	first hour rate	fixed less,		fixed more,		Constant			
	subsequent hour rate	less than first,		more than first,		Constant			
	price structure	by duration,				combinaiont of duration and time			
	transaction based revenue	service fee (including insurance),				comission and/or insurance			
	continuous revenue	membership fee,	service fee,	subsidies,		advertiding,	Combination		
	organizational ownership	private,				Cooperative			

Table 10 Taxonomy of Carsharing Business Model

Value Proposition

Destination: What kind of journey options do these operators offer? Some operators only offer roundtrip service i.e. the vehicle is needed to be dropped off at the pickup location. Some offer point to point service or one way service where the above mentioned requirement is not an obligation.

Number of passengers per vehicle: Usually the tourists coming to this area are couples or families with three or four members. Hence this was an important dimension to determine the type of vehicle to be used. Some operators offer 4 vehicles with four passengers such as Nissan Leaf or VW up!. Other offer bigger vehicles like Renault Zoe and also smaller ones like Smart.

Number of customers: Depending on the area and need of the citizens or tourists, this dimension will indicate how many vehicles to put in the system and how to vary it according to the changing influx of tourists

Minimum duration: What is the least amount the vehicle can be used by the customer? The range of minimum required booking time is from a minute to an hour or to a whole day depending on the service type available and use case scenario.

Vehicle type: What type of electric vehicles are provided by the operator? While some operator only provide one kind of vehicle some has a fleet of different model available to customers depending on budget and requirement.

Additional benefits: What benefits are available to customer? These could include discounted or free parking in the city centre to free charging options.

Interface

Vehicle Booking: When the vehicle should be booked or returned? Some operators ask in advance the schedule of pick up and return of vehicle. Some ask for the duration of how long the vehicle will be used. Some can be booked instantaneously with open ended return time.

Vehicle Access: How the vehicle will be accessed or opened by the customer? Some operators still depend on manual handing over of the key while some have lock box approach where the customer can collect the key of the vehicle by showing access pass. While some operators have gone fully automated by using smartcard or smartphones as key for the vehicle.

Service Platform

Booking platform: How will the customer book a vehicle for the said customer? Is there any specific application for mobile operating systems or does the customer have to call the operator or does she have to book it through the operator's website.

Parking infrastructure: Where are the vehicles parked? Are they free floating service providers or are there dedicated station where the vehicle is to be parked? If dedicated stations, where are they located? Near the airport? Train stations? Residential localities ?

Organizing Model

Vehicle Ownership: Who is the actual owner of the vehicle? In our database, the ownership differs from operators to customers.

Vehicle Maintenance: Who is responsible for maintenance of the car? Jobs such as repair, inspections and tire changes are conducted by either operator or customer.

Vehicle Charging: Who is responsible for vehicle refuelling, is it the operator or the customer?

Revenue Model

Membership cost: How much is the membership cost and how long does the membership last? Some operators only charge their customer once and membership lasts indefinitely. While other operators ask for membership on a recurring basis which can either be monthly or annual.

First hour rate: How much does it cost to the customer to use the vehicle either for the first hour or for the first kilometre. Usually it is more or less depending on the situation and service offered in order to push the customer to use the vehicle either for long or short duration.

Subsequent hour rate: This usually differs from the first hour rate and is usually lower to convince the customer to use the service for more than the first hour or for longer distance.

Price structure: How are the price calculated? Is it based on time, distance or combination of both?

Transaction based revenue: How does the operator earn its income from each transaction? The transaction is completed when the customer leaves the vehicle by giving it back to the operator or enabling other customers to use it. Is it through any service fee or commission which the operator might pay to a third party?

Continuous revenue: Apart from transaction-based revenue what other income does the operator have. These continuous revenues can come from membership fees, advertisement,

subsidies, leasing of technology or combination of these. It is also possible that the operator does not have any continuous revenue and rely solely on the transaction-based revenues.

Organizational ownership: The operators are usually owned by private companies or cooperation of private and public bodies and is available to be used by everyone who is a member.

Cluster Analysis

The three clusters identified cover between 3 and 6 out of the 16 operators from the dataset. Each cluster has a different characteristic of electric car sharing business model taxonomy. Each cluster also has a different centres along the dimensions and characteristics. These characteristic are collectively exhaustive and mutually exclusive. Following are the clusters described in greater detail by defining the most typical characteristic and providing illustrative examples.

Cluster Analysis (Segmentation) Output

This is an output worksheet only - please do NOT enter any data - use the input data sheet only

For more assistance, please review the "How to interpret" worksheet

Output for ONE Cluster/Segment

Mean/Centroid	*Destination*	*No. Of Passengers*	*Parking Infrastructure*	*0*	*0*	*0*	*0*	*0*
AVERAGE	0.19	3.81	0.63					
Respondents	**Number**	**%**	**SSE/Segment**					
Segment 1	16	100.0%	26.6	**SSE Total**	**26.6**			
TOTAL	16	100.0%						

Output for TWO Clusters/Segments

Mean/Centroid	*Destination*	*No. Of Passengers*	*Parking Infrastructure*	*0*	*0*	*0*	*0*	*0*
Segment 1	0.33	4.50	0.00					
Segment 2	0.10	3.40	1.00					
AVERAGE	0.19	3.81	0.63					
Respondents	**Number**	**%**	**SSE/Segment**					
Segment 1	6	37.5%	2.8	**SSE Total**	**18.1**			
Segment 2	10	62.5%	15.3					
TOTAL	16	100.0%						

Output for THREE Clusters/Segments

Mean/Centroid	*Destination*	*No. Of Passengers*	*Parking Infrastructure*	*0*	*0*	*0*	*0*	*0*
Segment 1	0.00	4.50	0.00					
Segment 2	0.00	3.33	1.00					
Segment 3	1.00	4.33	0.33					
AVERAGE	0.19	3.81	0.63					
Respondents	**Number**	**%**	**SSE/Segment**					
Segment 1	4	25.0%	1.0					
Segment 2	9	56.3%	14.0	**SSE Total**	**16.3**			
Segment 3	3	18.8%	1.3					
TOTAL	16	100.0%						

Output for FOUR Clusters/Segments

Mean/Centroid	*Destination*	*No. Of Passengers*	*Parking Infrastructure*	*0*	*0*	*0*	*0*	*0*
Segment 1	0.00	1.67	1.00					
Segment 2	0.00	4.17	1.00					
Segment 3	0.00	4.50	0.00					
Segment 4	1.00	4.33	0.33					
AVERAGE	0.19	3.81	0.63					
Respondents	**Number**	**%**	**SSE/Segment**					
Segment 1	3	18.8%	0.7					
Segment 2	6	37.5%	0.8	**SSE Total**	**3.8**			
Segment 3	4	25.0%	1.0					
Segment 4	3	18.8%	1.3					
TOTAL	16	100.0%						

Output for FIVE Clusters/Segments

Mean/Centroid	*Destination*	*No. Of Passengers*	*Parking Infrastructure*	*0*	*0*	*0*	*0*	*0*
Segment 1	0.00	4.50	0.00					
Segment 2	1.00	4.00	1.00					
Segment 3	0.00	1.67	1.00					
Segment 4	0.00	4.17	1.00					
Segment 5	1.00	4.50	0.00					
AVERAGE	0.19	3.81	0.63					
Respondents	**Number**	**%**	**SSE/Segment**					
Segment 1	4	25.0%	1.0					
Segment 2	1	6.3%	0.0	**SSE Total**	**3.0**			
Segment 3	3	18.8%	0.7					
Segment 4	6	37.5%	0.8					
Segment 5	2	12.5%	0.5					
TOTAL	16	100.0%						

Figure 13 Cluster Analysis

Country	Operator	Allocated Segment for 1 Cluster	Allocated Segment for 2 Clusters	Allocated Segment for 3 Clusters	Allocated Segment for 4 Clusters	Allocated Segment for 5 Clusters
Belgium	Zen Car	1	1	2	4	5
Czech Republic	Car4Way	1	1	2	3	1
Finland	Ekorent	1	2	3	2	4
France	Drivy	1	2	1	4	2
Hungary	GreenGo	1	2	1	2	4
Ireland	GoCar	1	1	2	4	5
Italy	Share'nGo	1	2	3	1	3
Luxembourg	Carloh	1	1	2	3	1
Netherlands	Car2Go	1	2	3	1	3
Poland	Vozilla	1	2	1	2	4
Portugal	Emov	1	2	3	2	4
Romania	BCR eGO	1	2	1	2	4
Spain	ZITY	1	1	2	3	1
Switzerland	ENUU	1	2	3	1	3
Sweden	MoveAbout	1	1	2	3	1
UK	eCar	1	2	1	2	4

Table 9 In which cluster/segment is the respondent allocated?

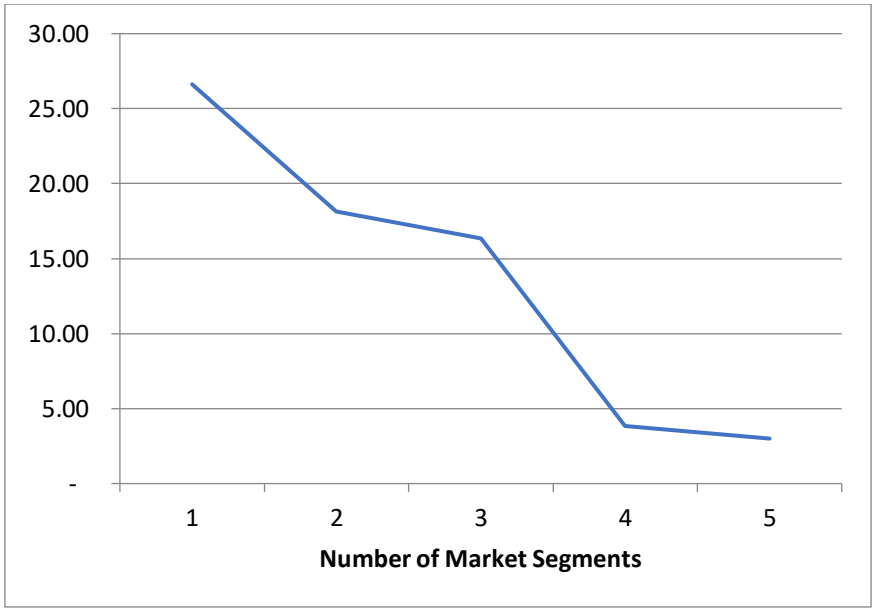


Figure 14 Total SSE by number of segments

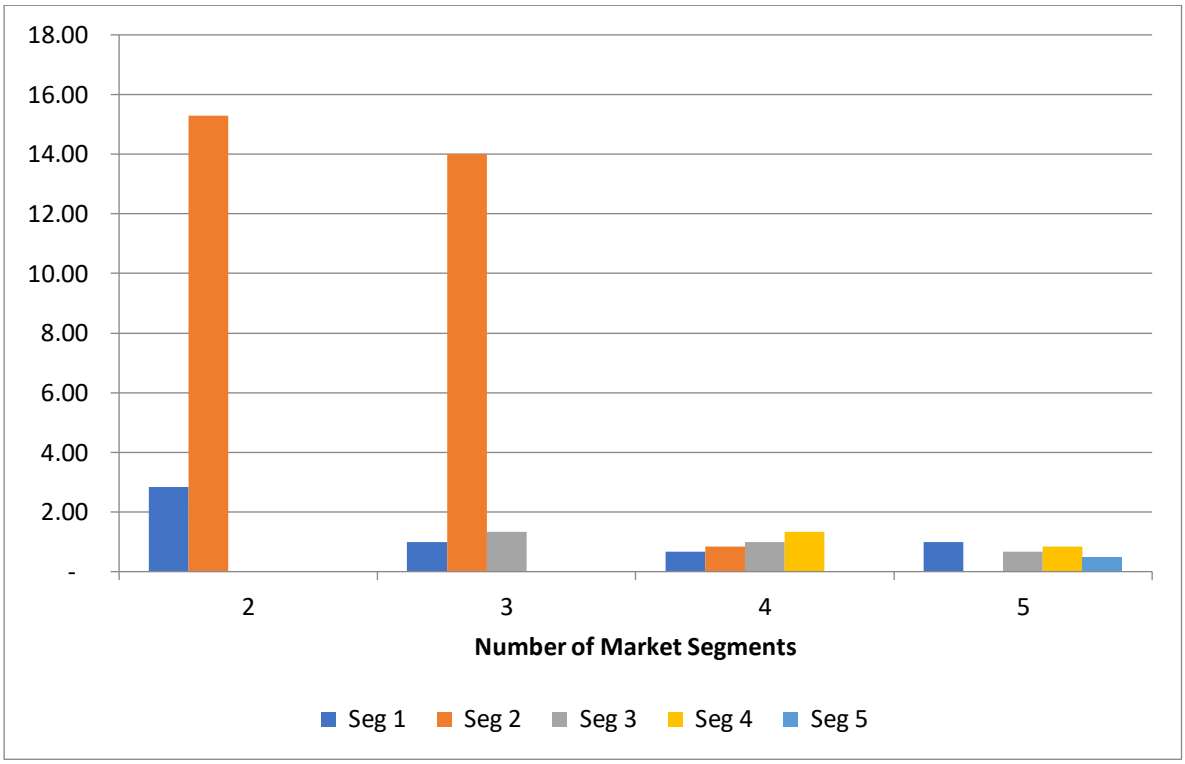


Figure 15 SSE per segment

Cluster 1: 4 Passengers, Free floating

France (Drivy); Hungary (GreenGo); Poland (Vozilla); Romania (BCR eGo); UK (eCar)

The first cluster describes the operators that offer vehicles big enough for 4 passengers and allow free floating parking service. The English car operator eCar is a privately owned company is a typical representative of this cluster. eCar can be booked for booth roundtrip and one way journeys lasting from few hours to several days. The vehicles can be booked through an app and the user has pay only a monthly charge of €15. The vehicles range from small Renault Zoe to big vans like Renault Kangaoo Z.E.. The vehicles can be booked instantly but the return time must be specified at the time of booking. The customers can use their smartphones to unlock the vehicles. Which is similar to other members of this cluster. eCar owns the vehicles can does the maintenance and repairs on the car. Even the charging is done by the operator. Insurance is covered by the fees of each transaction. It also takes some amount for insurance from the monthly fees. Like other members, this is also a for-profit company.

Cluster 2: 4 Passengers, Dedicated stations

Czech Republic (Car4Way), Ireland (GoCar); Sweden (MoveAbout), Belgium (ZenCar); Spain (ZITY)

This cluster is very similar to first cluster in many aspects. The only big difference is instead of having free floating parking service, the cars are to be dropped at dedicated charging stations from where other customers can use the service. This also describes operators providing roundtrip and one way journeys. The major representative of this cluster is GoCar from Ireland. They provide two similar sized cars BMW i3 and Renault Zoe. Both can accommodate 4 passengers. Each trip comes with a 50km range free and the subsequent kilometres are charged at 50 cents. The cars are to be dropped at the same location where they were picked up from. The cars can be booked via a dedicated application. A customer card is used to unlock the vehicle and the keys are available in the glovebox. While the vehicles are owned by the company, they can be parked at any public parking space if the

dedicated spot are not available or are occupied. Customers are required to leave the vehicles with at least 25% of battery.

Cluster 3: free floating, one time membership fee

Finland (EkoRent); Italy (Share'nGo); Netherland (Car2Go); Portugal (Emov); Switzerland (ENUU);

The largest cluster of the all but the differences in business model is not very apparent on first sight. All the operators provide free floating parking service and ask for membership fees only once or never. They all usually have similar kind of vehicles in their fleet and all seat less than 4 passengers. ENUU based in Switzerland is only a single seater vehicle which is not considered a car and can be driven by anyone on bicycle lanes. It is difficult to use any of the operators in the cluster to be a leading example but for the sake of analysis we consider Italy's Share'nGo service which is based in Milan. They use a custom made 2-seater vehicles which have a range of 120km and maximum speed of 80km/hr. They are free to park anywhere in the city even in the central district without paying extra charges unlike normal vehicles. The booking is made through an application and the vehicle can be opened either by the smartphone or the membership card. They are charged on per minute basis. The customers are not required to pay any membership fee as the registration to the service is free of cost. Customers pay as they use the vehicles. They are maintained and charged by the operator this giving a somewhat peace of mind to the customer.

Discussion

The inter cluster comparison of the three clusters show some intriguing insights into electric car sharing. The biggest electric car sharing system provide one-way free-floating parking system service. Where the maintenance is done by the operator and have one time or no membership fee. The customer pay as and when they use the service and booking is done through an app. The one-way trips also compliment or competing with public transport and taxis. Most of the members of first and third cluster can be booked by the minute and used for single direction journey. Hence they justify the need to use the service for journeys that do no require the effort of hiring a car (shopping trips). Few operators provide free distance in the range of 20 and 50 kilometres which allows the customer to use the service for longer distance as in our case.

This report contributes to the theory in several ways. Not only it compares the various electric car sharing business models which rely heavily on technological advances, but these advances can be linked to the creation of economic value. The car sharing is the biggest and most mature sector in sharing economy. The workings and understanding from this report can also be applied to younger sectors. The business model concept has not been fully transferred to electric car sharing sector. Hence the research has been integrated to already existing business models with the help of VISOR analysis. The taxonomy allows for deeper study and in-depth analysis of electric car sharing business model in a systematic manner.

The concept of business model is most powerful when all three hierarchical layers are used in combination. These hierarchical layers are fundamentals belonging to business model, the archetypes describing frequently observable configurations and real companies. The existing studies used only on of the above mentioned layers hence the research design for this report was derived on this strategy and by using VISOR approach to compliment it. The taxonomy that has been developed to deal with the limitations of business model configurations, that already exists, in such a way we don't stick to them.

The research makes two important contributions. Firstly, the database of operators and the taxonomy provide a fairly comprehensive market summary. The taxonomy and archetypes give a better understanding of important features of various business models. Secondly, the taxonomy developed can be used by the electric carsharing operators to analyse theirs and their competition's business models to identify the differences and enhance their products.

Conclusion

If we look at our needs with respect to the tourism in Asti, we can highlight the business model features which we require the most and analyse in which cluster it closely falls under and then develop our own model by taking inspirations from the members of that cluster. Following are the highlights that will help in deciding the basic structure of our model.

- The average size of family coming as tourists is 2.5. We can round that number up to 3 in order to accommodate some margin for flexibility in the system
- The average nights spent on trip by tourists in Piedmont is 1.9 (or 2 for simplicity).

- The heritage sites are spanned over a distance of 80 kilometres which take about 90 minutes to cover by road.
- The route passes through tolls and most part of it is on an autostrada.
- Tourists prefer to stay in Metropolitan City of Turin.
- Turin and Asti are well connected by railway lines and roads.
- Asti does not have big hotels but have many private accommodations available for tourists.

Looking at these factors above, we see that it is important that the vehicle have the capacity of at least 3 people. Since the nights are spent in Turin or in Asti which are both well connected it is safe to assume that tourists will start their day from either of the two locations and end at the same place for their accommodation. The vehicle should be powerful enough and have a enough range to drive on the motorways. With a roundtrip journey of about 150 km it is difficult to keep all cars ready to be used at all moments, especially in the peak tourist seasons. Hence it is advisable to have a one way trip system where the vehicles can be parked near any of the UNESCO heritage sites. They can continue their journey by picking up another vehicle. Since as mentioned before, the cars need to be ready all the time, having a free-floating parking system would mean the cars are not getting charged when not in use and they might not be able to make the journey to the next village. Hence having a station parking for the cars will ensure that they are charged before being used by another customer. To summarise the needs, we are looking for a one way dedicated station parking system. Which is closest to our second cluster we found out before. We can now handle the formation of our electric car sharing model by looking at the models of the members of second cluster.

- Taking inspiration from GoCar (Ireland) the station based parking system is best suited for us as all vehicles will be plugged in charging by the customer and hence will be usable by next person.
- The one way journey from Car4Way will help ensure that the vehicle is always charging when not in use.
- The vehicle will be unlocked by the smartphone of the customer using a dedicated app.
- The charging station will be located near each UNESCO heritage site.
- The membership or joining fee will be €0.

- The appropriate vehicle would be Renault Zoe with capacity of 4 people. It is good to have a single model fleet which will help in reducing cost for maintenance as parts can be bought from supplier in bulk and less training costs for mechanics as they would learn to operate on one model only.
- 2 plans would be available to customers. In other words the customer can decide in what way she would like to get charged. An hourly rate of €12 or a daily rate of €70 with first 50 kms free then additional charges for subsequent distance or time.
- The range of tourists who visit the UNESCO sites range from less than hundred in off season to about 500 hundred in on season. Hence a fleet of 50-60 cars is enough if we assume at least half the tourists use this service. Not to forget, the residents can also make use of the electric car sharing system.

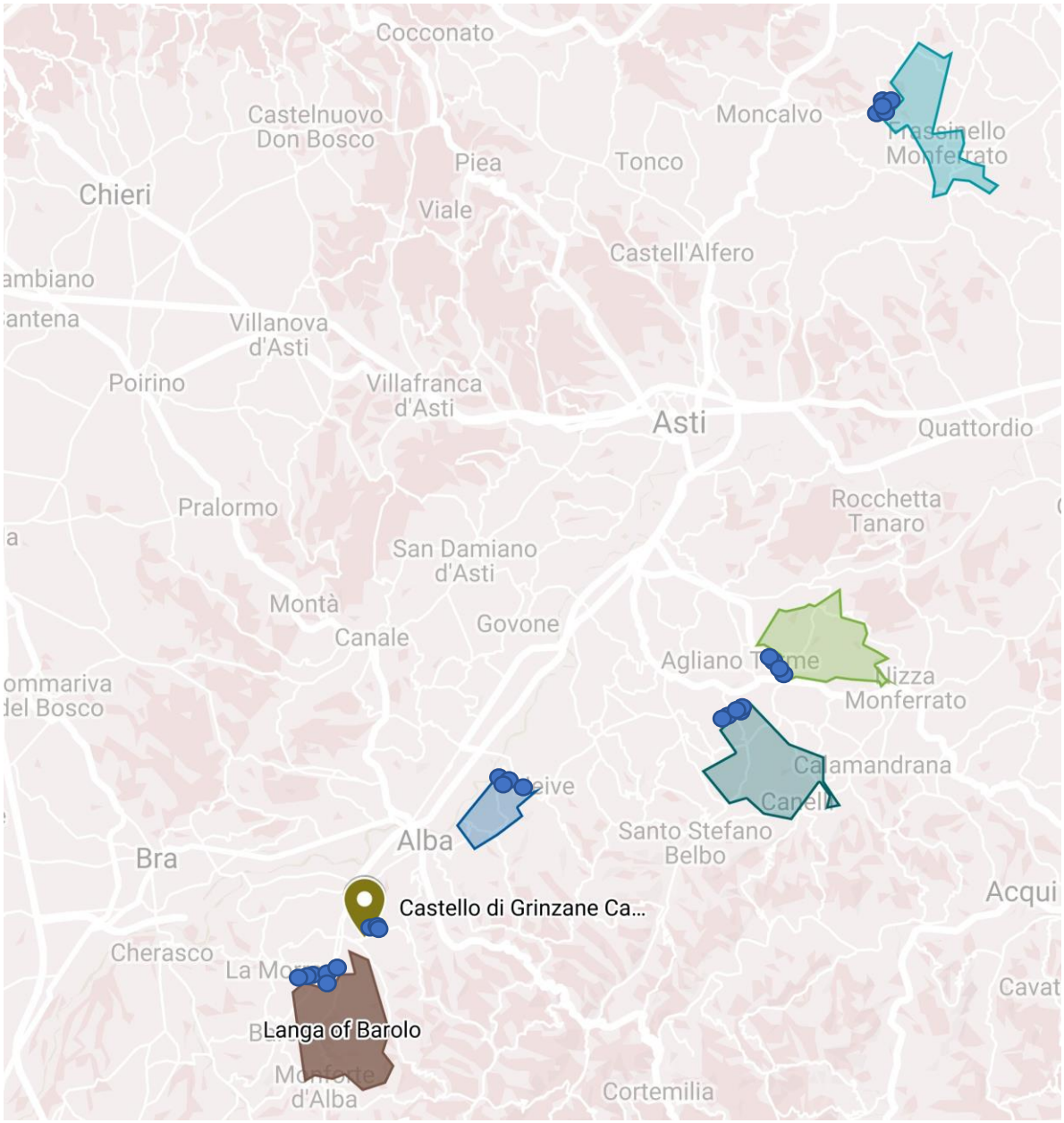


Figure 16 Suggested locations for parking stations

Drawbacks and Future Prospects

This research is obviously not free of drawbacks. The limitations and future prospects on how to develop this proposed business model are described in this section. The taxonomy approach is never perfect but in most cases is useful. The proposed taxonomy is definitely helpful in better understanding the business models of various operators. There is also no perfect number of clusters. We were limited to just three clusters that because of small dataset. Had there been more operators number of clusters would have been more and we

could have designed our business model more suitably. The three clusters are only the three useful clusters. A fourth and fifth clusters were also formed but the relation between the members were not apparent as there was only one member in each cluster. The overall usefulness of this study will become clear with future research on taxonomy and clustering.

The proposed business model however can be greatly enhanced as many blanks have been left. This being a theoretical research, only an estimate can be made of how many factors will affect in moulding this model overtime. Advertising, collaboration with public transport authorities, railway authorities, airlines, municipality, subsidised electricity to provide power to our network. Discounts for residents in off season so that vehicles don't remain unused. Free floating parking within designated zones near the heritage site are just few of the examples this model can be upgraded.

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