St. Petersburg State University
Graduate School of Management

Master in Management program

Car-sharing performance in the European Union: role of business model, ownership and first-mover advantage

Master's Thesis by the 2nd year student,
Concentration – International Business
Tatiana Pochevalova

Research Advisor: Candidate of Economics,
Department of Strategic and International Management
Olga L. Garanina

St. Petersburg
2021

ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

Я, Почевалова Татьяна Александровна, студент второго курса магистратуры направления «Менеджмент», заявляю, что в моей магистерской диссертации на тему «Результативность каршеринга в Европейском союзе: роль бизнес-модели, собственности и преимущества первопроходца», представленной в службу обеспечения программ магистратуры для последующей передачи в государственную аттестационную комиссию для публичной защиты, не содержится элементов плагиата.

Все прямые заимствования из печатных и электронных источников, а также из защищенных ранее выпускных квалификационных работ, кандидатских и докторских диссертаций имеют соответствующие ссылки.

Мне известно содержание п. 9.7.1 Правил обучения по основным образовательным программам высшего и среднего профессионального образования в СПбГУ о том, что «ВКР выполняется индивидуально каждым студентом под руководством назначенного ему научного руководителя», и п. 51 Устава федерального государственного бюджетного образовательного учреждения высшего образования «Санкт-Петербургский государственный университет» о том, что «студент подлежит отчислению из Санкт-Петербургского университета за представление курсовой или выпускной квалификационной работы, выполненной другим лицом (лицами)».

06.06.2021

STATEMENT ABOUT THE INDEPENDENT CHARACTER OF THE MASTER THESIS

I, Pochevalova Tatiana, second year master student, program «Management», state that my master thesis on the topic « Car-sharing performance in the European Union: role of business model, ownership and first-mover advantage», which is presented to the Master Office to be submitted to the Official Defense Committee for the public defense, does not contain any elements of plagiarism.

All direct borrowings from printed and electronic sources, as well as from master theses, PhD and doctorate theses which were defended earlier, have appropriate references.

I am aware that according to paragraph 9.7.1. of Guidelines for instruction in major curriculum programs of higher and secondary professional education at St.Petersburg University «A master thesis must be completed by each of the degree candidates individually under the supervision of his or her advisor», and according to paragraph 51 of Charter of the Federal State Institution of Higher Education Saint-Petersburg State University «a student can be expelled from St.Petersburg University for submitting of the course or graduation qualification work developed by other person (persons)».

06.06.2021

АННОТАЦИЯ

Автор	Почевалова Татьяна Александровна
Название ВКР	Результативность каршеринга в Европейском союзе: роль бизнес-модели, собственности и преимущества первопроходца
Направление подготовки	Менеджмент
Год	2021
Научный руководитель	Гаранина Ольга Леонидовна, кандидат экономических наук Кафедра стратегического и международного менеджмента
Описание цели, задач и основных результатов	Исследование посвящено каршерингу в Европейском Союзе с целью выявления факторов, влияющих на результативность каршеринговых фирм. Поскольку бизнес-стороне каршеринга уделяется мало академического внимания, в этой работе исследуется контекст бизнес-моделей в большом количестве стран за длительный 30-летний период. На основе обширных собранных данных, отражающих текущую ситуацию в европейской индустрии каршеринга, результативность действующих операторов оценивается с использованием таких теоретических концепций, как преимущество первопроходца, зависимость от предшествующего пути развития и инновационность бизнес-моделей. Таким образом, исследование дает широкое описание каршеринговых бизнес-моделей, анализ временных и пространственных моделей входа в отрасль и показатели эффективности. Результаты подтверждают существование преимущества первопроходца для каждой бизнес-модели каршеринга и рынка в целом. Каршеринговые фирмы, принадлежащие производителям автомобилей, демонстрируют более высокую результативность, подтверждая зависимость отрасли от пришедших из смежных отраслей игроков. Установлено, что наличие электромобилей в автопарке положительно влияет на результативность, работая как инновационное конкурентное преимущество для фирмы. Результаты исследований могут широко использоваться для дальнейших исследований и стать основой для углубления знаний в сфере каршеринга.
Ключевые слова	Каршеринг, бизнес-модель, автопарк, парк электромобилей, собственность, автопроизводители, рынок ЕС, результативность

ABSTRACT

Master Student's Name	Pochevalova Tatiana
Master Thesis Title	Car-sharing performance in the European Union: role of business model, ownership and first-mover advantage
Main field of study	Management
Year	2021
Academic Advisor's Name	Olga L. Garanina, Candidate of Economics Department of Strategic and International Management
Description of the goal, tasks and main results	The research is devoted to car-sharing in the European Union with the research goal of identifying factors that affect the performance of car-sharing firms. Since the business side of car-sharing services receives little academic attention, this study explores the context of business models in a wide range of countries and over a long 30-years period. Based on extensive collected data reflecting the current situation in the European car-sharing industry, the performance of existing service operators is evaluated using such theoretical concepts as the first-mover advantage, the path dependence, and the innovativeness of business models. Thus, the research gives a broad description of car-sharing business models, the entry temporal and spatial pattern analysis and performance measures. The results support the existence of the first-mover advantage for each car-sharing business model and the market as a whole. Car-sharing firms owned by car manufacturers demonstrate better performance confirming the path dependence in the industry. The availability of electric vehicles in a fleet is found to affect the performance positively, working as an innovative competitive advantage. Research results can be extensively used for further studies and become a basis to deepen knowledge in the car-sharing industry.
Keywords	Car-sharing, business model, vehicle fleet, EV fleet, ownership background, car manufacturers, EU market, performance

Table of contents

List of Figures

List of Tables

Introduction

Being one of the most significant segments of the sharing economy, car-sharing has been gaining in popularity over recent years and demonstrating flourishing growth (PricewaterhouseCoopers, 2014). The world car-sharing industry is predicted to account for 29.58 million users and 610.6 thousand vehicles in 2021 that is 85 and 53 times, respectively, more than in 2006 (Smith et al., 2017; Shaheen et al., 2018).

By its nature, car-sharing presents a sustainable mobility service that attracts public authorities, citizens, mobility actors, and companies from related industries. It has become one of the major transportation trends with new mobility opportunities, bringing new ownership models, vehicle concepts, services, and business partnerships (Wells, 2013).

To date, the car-sharing industry is still in the emerging phase, with policies and regulations in the making. Over several decades of its development, the European region remains the leading field for car-sharing solutions with consistent initiatives from players of different backgrounds (Deloitte, 2017). In recent years, car-sharing operators have entered new and formerly unexplored countries among the European Union and have expanded business approaches. Therefore, car-sharing firms operate in a few competing business models, such as cooperatives, P2P, B2C Round-trip, and B2C One-Way (Shaheen & Cohen, 2013; Vaskelainen, 2014), demonstrating various success results. While the general trend in car-sharing shows an increase in the number of service operators, there are still firms that are less successful or even leave the market, so the churn rate is high among new entrants (Le Vine et al., 2014).

Although car-sharing performance is widely discussed in the academic literature, scholars explore it only through narrow scopes, focusing on one-country level (Münzel et al., 2018) or one type of business model (Sprei et al., 2019) or a short observed period. Thus, the business side of car-sharing services receives little attention. This paper covers *the research gap* by examining the performance of car-sharing operators in a vast geographical market of the European Union over the past 30 years and explaining the differences in car-sharing firm performance. The entry pattern analysis and business model context of firms' operations give the evidence to evaluate car-sharing success.

T*he research goal* of this master thesis is to identify factors that affect car-sharing firms' performance. Supporting earlier studies, the research contributes to developing theoretical common knowledge about car-sharing firms' performance in Europe and the elaboration of recommendations for industry players to support the car-sharing service provision.

To achieve the research goal, the following *objectives* have been defined:

- To examine the status of the car-sharing and its existing business model diversity;
- To review and analyze how the entry pattern, business model dimensions, and business innovativeness affect the performance of car-sharing providers;
- To collect data on car-sharing firms currently operating in the European Union and group them based on revealed business model characteristics;
- To analyze the distributional and entry pattern of car-sharing operators across the observed countries and evaluate their performance;
- To identify business models' features of car-sharing that influence the firm's performance;
- To elaborate recommendations for existing and new car-sharing operators on the successful service provision.

The research is conducted with statistical methods of analysis based on the comprehensive dataset of 174 car-sharing providers from 27 countries. The results are interpreted with the help of such theoretical concepts as first-mover advantage, path dependence, ownership background, and innovative business models.

The research consists of several parts. It begins with the introduction, followed by Chapter 1 with a broad literature review that reflects the research context and the existing theoretical literature on car-sharing performance and its business models. Chapter 2 is the methodological section with a detailed description of the research design. In Chapter 3, data analysis and research results are presented. The following is the conclusion and discussion section, together with the research limitations and future suggestions. The study concludes with the reference list and five appendixes. The paper contains seven Tables and ten Figures.

Chapter 1. Research context and theoretical background

1.1 Car-sharing industry overview

1.1.1 The sharing economy phenomenon

Nowadays, the sharing economy has become a buzzword among scholars, policymakers, businesses, and individuals. The concept became popular after the financial crisis of 2007-2008, which led to the shift in consumption patterns and attitudes towards ownership due to consumers' financial difficulties (Böcker & Meelen, 2016). Since then, the sharing economy phenomenon has been investigated from different perspectives, such as disruptive innovation (Guttentag, 2015), consumer behaviour (Belk, 2014; Bardhi & Eckhardt, 2012), environmental impact (Cohen & Muñoz, 2016), mobility business models (Morris et al., 2005; Murmann & Frenken, 2006; Wells, 2013; Cohen & Kietzmann, 2014; Vaskelainen, 2014).

Although the sharing of goods and services concept appeared long ago (Sánchez-Pérez et al., 2021), its active usage has been in place only with the spread of the Internet (Belk, 2014), as it became possible to effectively match the supply and demand through online platforms and build trustworthy ties among users and the reliability of work. Puschmann and Alt (2016) list the key factors that led to the recent advent of the sharing economy:

- Changing consumer behaviour (the shift from ownership to access approach);
- Active usage of social networks and the development of electronic markets (transactions among peers);
- Growth of mobile devices and electronic services («app economy» where purchases are made with the help of electronic devices);
- Closer attention towards sustainability in consumption.

Considering the above factors, the sharing economy refers to numerous notions since it overlaps with different concepts. So, Botsman and Rogers (2011) mention the notions such as digital economy, on-demand services, platform economy, collaborative consumption, product-service system, access economy.

Broadly speaking, the sharing economy means sharing underutilized assets with IT-based technologies. However, given the various aspects of the term, some scholars define it more precisely, referring to particular characteristics. Görög (2018) refers to the sharing economy that its focus is sharing underutilized assets, monetized or not, in ways that improve sustainability, efficiency, and community. Like others (Eckhardt et al., 2019; Curtis & Lehner, 2019), the author promotes more sustainable consumption as the main focus of the sharing economy.

Meanwhile, some authors argue about the profit intention of sharing businesses, distinguishing true and pseudo-sharing. For instance, Belk (2014) defines true sharing as entailing

temporary access rather than ownership, no fees or compensation, and the use of digital platforms. If any fees occur, the author refers an activity to the collaborative consumption concept, namely, «people coordinating the acquisition and distribution of a resource for a fee or other compensation» that integrates bartering, trading, and swapping but excludes sharing. Thus, Belk (2014) believes that nowadays, most commercial platforms included in the sharing economy do not belong there. However, other authors (Frenken et al., 2015) define sharing economy as when «consumers (or firms) granting each other temporary access to their under-utilized physical assets (idle capacity), possibly for money», thus emphasizing the presence of a profit component.

Whatever the definition and profitability of the sharing economy, the practice shows that this industry has been evolving very rapidly with the potential to increase the global revenue from only $15 billion in 2014 to around $335 billion by 2025 (PricewaterhouseCoopers, 2014). According to Codagnone and Martens (2016), sharing economy platforms affect the entire economy, being engaged in both factor (capital and labour) and product (goods and services) markets. Speaking of specific sectors, the sharing economy is growing worldwide in many industries such as transportation, retail, accommodation and rental, office space and logistics, finance and consumer credit, and the labour market.

1.1.2 Car-sharing as a significant segment of the sharing economy

Along with the overall growing interest in the topic of sharing economy, one of its most significant segments, car-sharing (PricewaterhouseCoopers, 2014), is also gaining considerable attention. Platforms granting access to goods and services are very noticeable in the mobility industry, where car-sharing has become a significant transportation trend. Based on the data from Le Vine et al. (2014) and Shaheen et al. (2018), the number of car-sharing members worldwide had increased from 0.35 million in 2006 to 15.05 million in 2016, while the number of car-sharing vehicles had increased from 11.5 to 157.42 thousand accordingly (Figure 1).

Some researchers (Smith et al., 2017) predict the world car-sharing industry to account for 29.58 million users and 610.6 thousand vehicles in 2021, demonstrating continuous flourishing growth.

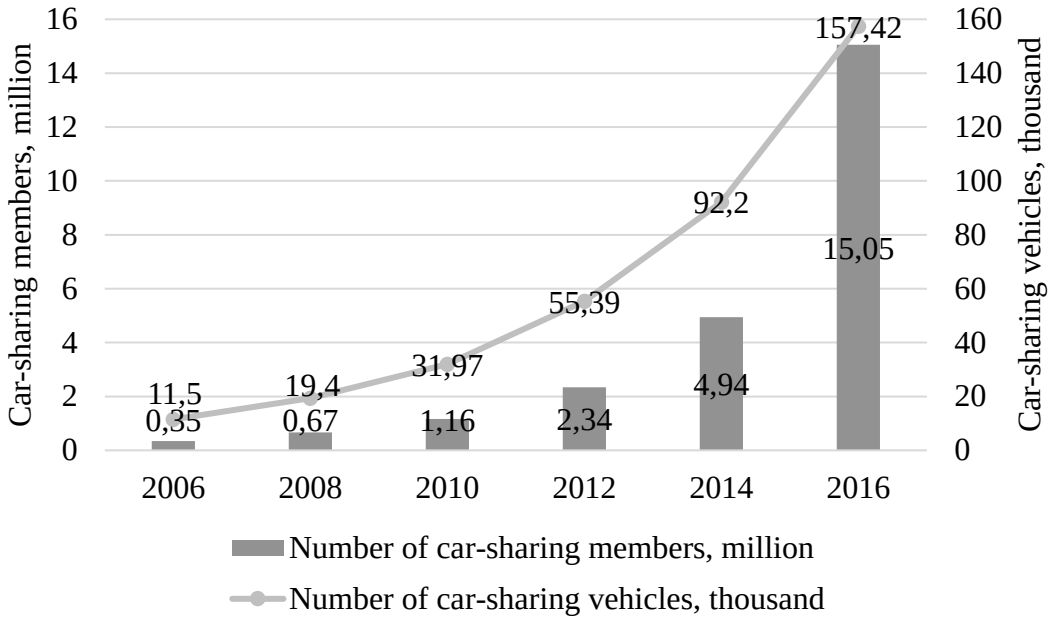

Figure 1: The world car-sharing industry overview

Source: made by the author based on Le Vine et al. (2014) and Shaheen et al. (2018)

Car-sharing is a system when people use available local vehicles at any time for any duration (Frenken et al., 2015). In more details, it is defined as a business model with the following characteristics:

- A person rents a car for a short period: some hours or some days;
- A customer takes a car that is ready for usage immediately;
- The insurance, maintenance cost, and fuel expenses are included in the price of the renting;
- The car fleet is organized by mobility providers;
- Access to renting is provided through special apps or other electronic systems;
- Different vehicles are offered at various places around the city;
- Cars can be left at any point from the point of origin of the lease.

The first car-sharing initiatives started more than 30 years ago[1] in two European countries – Switzerland in 1987 and Germany in 1988. Groups of people were motivated by the idea of replacing some privately-owned cars with one shared car (Shaheen et al., 1998). Originally, an organization, whether for-profit or non-profit, owned a fleet of cars and leased them to registered customers, operating as a B2C business model[2]. At the end of the renting, customers had to return

[1] It is worth mentioning that until the late 1980s, some experiences with car-sharing already took place but turned out to be failed. The first car-sharing cooperative was called «Sefage» and was initiated in 1948 in Zurich, Switzerland. The next car-sharing initiative, «Procotip», began in 1971 in Montpellier, France. The third project called «Witkar» was attempted in 1973 in Amsterdam, the Netherlands.

[2] Different types of car-sharing business models are discussed in more detail in Chapter 1.2.

cars to the place where it was taken from (local neighbourhood, a worksite, or a transit station), so trips were on a round basis.

Early car-sharing businesses were managed manually since the number of vehicles was low (Shaheen et al., 1999). However, with the fleet size expanding in the 1990s, the manual system of operation was becoming more inconvenient and expensive for several obvious reasons: more people were needed to handle the booking process, operators made mistakes in reservations, cars were susceptible to theft and vandalism. The challenges above gave room for applying intelligent solutions and creating digital applications to provide access to car-sharing services.

In 2008, one-way car-sharing trips began due to the availability of new mobile technologies where users were allowed to finish the trip anywhere within the operational area or at any provider station. These B2C car-sharing business models were called free-floating and station-based accordingly[3]. This concept was different from the round trips and gave more freedom to car-sharing members while actively attracting new users to the service.

A completely different business model, P2P, entered the car-sharing industry in 2010. In a nutshell, the firm provided a two-sided online platform where users could act both as a consumer of services and the supplier. The firm itself made it possible for car owners and car users to be matched and provided supplementary services like insurance for the platform's members.

As part of the sharing economy concept, technological forces have driven car-sharing and has changed consumption to the access-based mode (Botsman & Rogers, 2010; Bardhi & Eckhardt, 2012). Academic literature has long shown a clear trend in the consensus that the consumption based on access differs from traditional rentals in that it is digitally driven, more self-serving, and therefore more collaborative but not always mediated by the market (Botsman & Rogers, 2010). However, while undertaking an analytical investigation into the phenomenon of access-based consumption in car-sharing, Bardhi and Eckhardt (2012) have found out that during the 2000s, market-mediated access was becoming more pervasive and therefore more critical as companies found means how to monetize it. In this way, thanks to technological development, car-sharing has become an access-based system available to consumers daily, followed by the idea that value depends more and more on cultural rather than tangible resources.

Access-based consumption had gained popularity since the global economic crisis (Bardhi & Eckhardt, 2012) when ownership was rendered as a less stable and more precarious consumption mode. People are changing their spending habits and revising their values, including the relationship between ownership and well-being. Additionally, the access issue is especially acute in urban areas where space limitations exist by nature, such as limited parking zones in the city

[3] Different types of car-sharing business models are discussed in more detail in Chapter 1.2.

centre. Although historically, car-sharing was fed from ecological and moral motives, today it is more driven by shifting from ownership to sharing behaviour user patterns: from «pay and use» to «pay per use» (McKinsey, 2016).

Proponents of car-sharing have figured out that joining the car-sharing services can reduce private vehicle ownership (Namazu & Dowlatabadi, 2018; Le Vine & Polak, 2019). In the study of the early-stage impact of free-floating carsharing on private car ownership in London, researchers (Le Vine & Polak, 2019) find that a third of car-sharing service-users decided not to buy a car, 4% disposed of a private car in the past three months, and 3% stated about the selling a private car within the next three months. Other authors (Namazu & Dowlatabadi, 2018) have managed to analyze the vehicle ownership reduction for both free-floating and station-based car-sharing business models. Then, round-trip car-sharing is found to be more effective in reducing car ownership because round-trips with a shared car can fully replace a private car.

Car-sharing is one of the existing mobility concepts, such as public transport, car-pooling (for example, «BlaBlaCar»), taxi, and rental car (for example, «Europcar» and «Hertz»). Compared to the car rental concept, using car-sharing vehicles does not imply the manual keys collection to open cars. That is more crucial, car-sharing vehicles are available 24/7, up to the last-minute booking, distributed locally, and available for any duration. All the mentioned features are possible thanks to innovative technological solutions. Car-sharing is a superior alternative to car rental in terms of flexibility and cost-efficiency for short trips that were confirmed by Millard-Ball et al. (2005). The authors found out that rental cars typically tend to be less expensive for long-distance trips, while shared cars are better for short and medium distances.

Since the advent of car-sharing, many academics have shown significant interest in car-sharing as an alternative to sustainable transportation. From the car-sharing organizations' perspective, they position themselves as a green brand with sustainable driving particularly due to the presence of electric vehicles[4] in fleets and decreasing the usage of private cars by car-sharing customers (Bardhi & Eckhardt, 2012). Indeed, some researches support the positive effect of car-sharing. Ceccato and Diana (2018) have explored the free-floating and one-way station-based car-sharing services in Turin and concluded that car-sharing can substitute the private cars' driving. Investigating Germany, one of the leading car-sharing markets, Loose (2016) has found two considerable conclusions. According to the scholar's calculations, people using car-sharing services reduce car ownership by 62%, while one shared car can replace up to 20 private ones.

[4] Many car-sharing companies build their marketing strategy promoting responsible, sustainable driving with zero-emission and less environmental impact. As an example, «WeShare» car-sharing describes its business on the homepage of the website (https://www.we-share.io/en) as follows: «100% electric, 100% green energy, 0% emissions: WeShare brings electric car sharing to your door. With easy access to our fully electric fleet, you can enjoy as much or as little car in your life as you want, sustainably».

Many researchers are focused on the environmental effect of car-sharing in cities and report its positive impact, namely lower greenhouse gas emissions (Martin & Shaheen, 2011; Firnkorn & Müller, 2015; Chen & Kockelman, 2016). Analyzing the USA car-sharing market in the dense urban neighbourhoods and its representatives who travel a few miles by private cars and have access to transit, authors (Chen & Kockelman, 2016) have suggested that joining car-sharing services can reduce the transport-related energy use and greenhouse gas emissions by 51%. Martin and Shaheen (2011) evaluate the annual emissions of households that join car-sharing in North America. Although some households increase emissions by gaining access to shared cars, other households decrease it because of driving less. So, the overall collective effect is reducing greenhouse gas emissions due to the 27% decline in vehicle kilometres travelled per year. Moreover, Kent (2014) has even found a positive correlation between car-sharing and active travelling, such as walking and cycling, that indirectly affects the decrease in the use of private cars.

Given the growing interest in car-sharing from citizens and its successive spread to big cities in Europe, some local governments provided access to parking slots within cities for car-sharing organizations to address the sustainable mobility agenda and urban development policy (Shaheen et al., 1999). As of 2019, car-sharing services are present in 59 countries and 3,128 cities worldwide, with 236 unique operators[5]. Within the framework of sustainable development, many scientists are exploring the potential of car-sharing to contribute to creating a sustainable transport system.

One stream of research reports that one free-floating shared vehicle can replace and remove some private cars from the road (Loose, 2016; Martin & Shaheen, 2016) that leads to the decreased need for parking spaces decreased traffic in the city centre. From the land consumption point of view, Firnkorn and Müller (2011) distinguish two types of land using: static (parking spaces) and dynamic (traffic jams). Authors conclude that car-sharing activity can only affect static consumption due to the decrease in the total number of vehicles. As for the traffic congestions in cities, other researchers show that using shared cars reduces the vehicle kilometres travelled and mitigates the so-called dynamic land consumption (Martin et al., 2010; Martin & Shaheen, 2011; Chen & Kockelman, 2016).

Thus, car-sharing services, on the one hand, allow users to satisfy their transportation goals and, on the other hand, have the potential to accomplish the sustainable urban transport concept in a sustainable and socially beneficial manner by reducing greenhouse gas emission, avoiding parking, and traffic congestion through decreasing the number of vehicles to a certain extent. In

[5] https://movmi.net/carsharing-market-growth-2019/

this regard, it is worth mentioning that all the above problems are especially relevant for high-density metropolitan areas.

1.1.3 The car-sharing industry overview in the European Union

As it was revealed before, the first car-sharing initiatives took place in Switzerland and Germany. Yet, over several decades of car-sharing development, the European region remains the leading place for car-sharing solutions with consistent initiatives from both local and international players. According to analysts from Deloitte (2017), Europe represents over 50% of the global car-sharing market with considerable growth potential. Based on conducted surveys, analysts of KPMG (2016) and McKinsey (2016) also confirm the rapid development of car-sharing in developed countries of the European region. There are a few reasons behind that.

Firstly, the European region consists of densely populated cities that is a crucial prerequisite for the emergence of car-sharing. This factor has been precisely studied and confirmed by many researchers (Schaefers, 2013; Schmöller et al., 2015; Kortum et al., 2016). In general, European cities attract the close attention of academics in terms of investigating car-sharing initiatives. In particular, Schmöller et al. (2015) examine the car-sharing activity from 2011 to 2015 in Munich and Berlin and identify that areas with high numbers of car-sharing vehicles have common features: a high population density and a high density of shopping possibilities and working places. Based on driving patterns within 33 different cities, including European ones[6], Kortum et al. (2016) find that residential density and household size are the key factors affecting the growth rate of car-sharing.

Thus, a great emphasis has been put to explain why car-sharing is popular in densely populated cities of Europe; however, much less attention has been put on other factors to explain differences in the intercity supply of shared vehicle services. Moreover, in terms of geographical coverage, most car-sharing papers focus on particular cities or countries without considering the whole region or broad pool of countries. Münzel et al. (2020) has recently made a considerable contribution to close two just mentioned gaps. While analyzing the car-sharing supply in 177 large cities of Western European countries[7], authors find more factors affecting the size of the car-sharing market in addition to the city size and population density. According to the research results, universities and high education levels have a positive relationship with car-sharing popularity in

[6] The following European cities have been examined in the research: Amsterdam, Berlin, Cologne, Copenhagen, Düsseldorf, Florence, Frankfurt, Hamburg, Milan, Munich, Rome, Stockholm, Stuttgart, Turin, Ulm, Vienna
[7] The following cities have been analyzed: Belgium, France, Germany, the Netherlands, United Kingdom.

cities. Moreover, for the B2C type, car-sharing services are correlated with the number of green party votes. Authors (Münzel et al., 2020) support an essential idea that political and institutional factors affect the car-sharing supply among different cities and countries and believe that these factors should be considered to support the transition to a sustainable mobility system with car-sharing services.

The second reason explaining the leading role of the European region in the car-sharing global market is related to the green technologies adaptation and reducing greenhouse gas emission in the European Union (EU). The EU is known to apply strict regulations to reduce greenhouse gas emissions, with the current target to reduce the emission in 2030 by 40% compared to 1990 among 27-member states. One more EU's objective is to reach climate neutrality by 2050.

In industrialized countries, one of the primary sources of air pollution is the transport sector, mainly road transport (Arbolino et al., 2017). According to the European Environment Agency, transport sector activity excluding aviation accounts for about 23% of the overall greenhouse gas emissions in EU-27 as of 2018[8]. Each EU member state has its annual emission trajectories implemented in national targets. Taken together, the aggregated result for 2018 represents a 3% reduction compared to the 2005 base-year level (955 million tonnes CO2-equivalent).

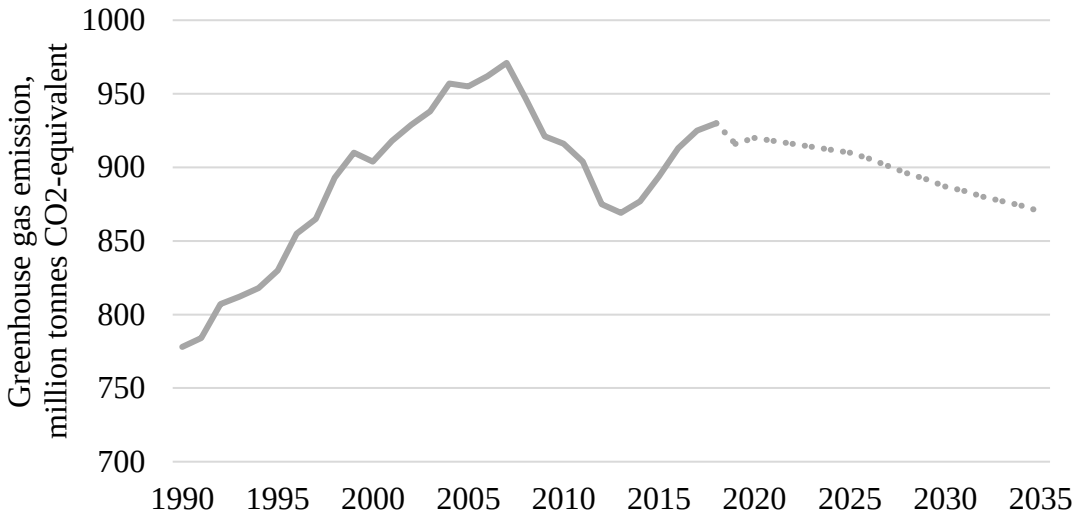

Figure 2: Greenhouse gas emission of transport (no aviation) in EU. Solid lines represent the historical data, while dotted lines represent projections for the scenario with existing measures

Source: made by the author based on the data from European Environment Agency [9]

[8] Author's calculations based on the data from European Environment Agency' report on Trends and projections in Europe 2020, https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2020

[9] https://www.eea.europa.eu/data-and-maps/daviz/ghg-emission-trends-and-projections-4#tab-dashboard-01

As it is reported by the European Environment Agency, in 2018, 11 EU member states (Austria, Belgium, Bulgaria, Cyprus, Estonia, Finland, Germany, Ireland, Luxembourg, Malta, Poland) had higher emission levels than their national targets. Based on the preliminary data, the same situation is expected to occur for 2019 emission indicators. Thus, EU countries will have to revise the pace of their annual targets of emission reduction to meet the overall Strategy-2030 goal.

In this context, the EU applied different policies to reduce the greenhouse gas emissions produced by the transport sector. Specifically, some main policy measures were adopted for road transport as a part of the Commission's Transport White Paper in 2009. The main legislative acts are listed in Table 1 below.

Legislative act name	Type and number	Description
Fuel Quality Directive	Directive №2009/30/EC	Greenhouse gas intensity in the energy used in road and non-road transport as regards the specification of petrol, diesel, and gas-oil
Regulation on CO2 from cars	Regulation №443/2009	CO_2 emission performance standards for new passenger cars
Labeling for tires	Regulation №1222/2009	Labelling requirements of tires concerning fuel efficiency, wet grip, external noises to increase the safety and the environmental and economic efficiency of road transport
Euro VI for heavy duty vehicles	Regulation №595/2009	Standards for emissions-heavy duty vehicles (Euro VI)
Promotion of Clean and Energy Efficient Road Transport Vehicles	Directive 2009/33/EC	Clean and energy-efficient road transport vehicles to reduce the overall transport emission

Table 1: Main policy acts included in the Transport White Paper to reduce the greenhouse gas emissions in the EU

Source: made by the author based on the research of Arbolino et al. (2017)

It should be considered that the emission reduction process is continuous and long-term, however right after the approval of several policy measures in 2009 in the EU, the emission levels had significant declining trends for a few years in a row (see Figure 2). Moreover, environmental initiatives resulted in the great explosion of new members in the car-sharing and the increase of fleets. In 2016, the number of car-sharing vehicles available for citizens in EU-27 countries was 5.3 times higher compared to 2008 (see Figure 3) – from 10.83 to 57.86 thousand. It also has led to the incredible growth of new members in free-floating car-sharing from 0.33 to 4.37 million (thirteen-fold between 2008 and 2016).

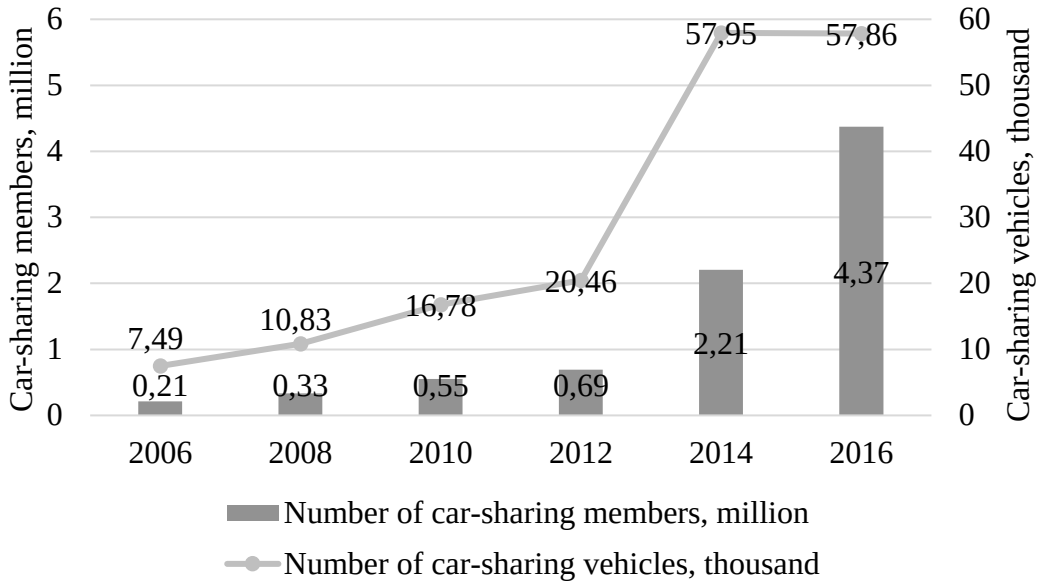

Figure 3: The European car-sharing industry overview (excluding P2P car-sharing)
Source: made by the author based on Shaheen et al. (2018)

Following the paper of Temenos et al. (2017), approaches for the reduction of greenhouse gas emission in the mobility sector can be divided into four following groups:

1. Legislative (for example, introduction of different directives or regulations such as in Table 1 above, and fuel taxes);
2. Technical (for instance, development of electric vehicles);
3. Infrastructural (development of urban cycling infrastructure in cities as a bright example);
4. Behavioural (promotion and adaptation of car-sharing services).

All in all, the car-sharing concept goes in line with the greenhouse gas emission agenda and addresses various approaches in different European countries. Thus, analysts of Deloitte (2017) differentiate individual countries' specifics and highlight some features. In terms of sustainability, car-sharing in France faces very strict regulations so that all free-floating vehicles should be electric or hybrid to have access to packing slots in city public areas. As of the Scandinavia region, high environmental regulations also tend to have more than 50% of electric vehicles in car-sharing fleets.

Taking the above factors into consideration, the European Union countries have been chosen for the research. In short, its dominant position in the global car-sharing market, its diverse spectrum of car-sharing types and companies, its rigorous market outset with the current ecological agenda determine the research interest.

Even though car-sharing services have been operating for a long time, they are still at the emerging phase with the policies and regulations in the making, and they function in a few competing business models that are genuinely typical for emerging technologies in service industries (Teece, 2010). The following subchapter reveals the theoretical background of business models and describes the existing operating car-sharing business models.

1.2 Business model concept

1.2.1 Business model definition applied to car-sharing

The business model concept has been under substantial attention from both academics and business practitioners over the past few decades; however, there is still no widely accepted definition. The concept has been gaining popularity in the literature since the mid-1990, marked by the advent of the Internet (Amit & Zott, 2001), despite the business model being associated with any economic behaviour or trading activity since the pre-classic time (Teece, 2010). Among other driving reasons why the business model concept has become prevalent in the research arena and the business consciousness since that time, scholars highlight the development of emerging markets (Thompson & MacMillan, 2010), the emerging knowledge economy, the outsourcing of business activities, and the restructuring of the global industry of the financial services (Teece, 2010).

According to Amit & Zott (2001), a business model reflects «the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities». Later, the authors come to the more conceptualized definition, namely: a «system of interdependent activities that transcends the focal firm and spans its boundaries» (Zott & Amit, 2010). In turn, Teece (2010) defines the business model through other lenses as that it «articulates the logic, the data and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value». The author accentuates three key business model elements accordingly, such as value proposition, value network, and value capture (revenue-cost model). In other words, the business model is about the benefit delivered to a customer, the way of delivering it, and the way to capture its portion.

Applying the latter approach to defining a business model, Sorescu (2017) interprets the business model innovation as a modification in value creation, value capturing, or value delivery, resulting in an essential change in the firm's value proposition.

Considering that researchers usually adopt the business model concept to fit the objectives of their study, all existing definitions appear to overlap only to a certain extent that provokes

various interpretations. With the lack of definitional clarity, some academics (Shafer et al., 2005; Zott et al., 2011) reveal the dominant research stream covering e-business[10] and information technology application for business purposes. In the broad literature review on business models, authors (Zott et al., 2011) find that one-fourth of studies are devoted to the e-business in terms of providing typologies and investigating components of models.

The growth of the Internet has caused fundamental changes in how companies deliver value to customers due to the easy access to digital data (Amit & Zott 2001; Zott et al. 2011). While the traditional way of value creation is based on manufacturing and subsequent, direct selling of a product to potential customers, digital and IT advances offer a new type of unconventional exchange mechanisms and transaction architectures between companies and customers (Amit & Zott, 2001).

Digital development has opened fundamentally new horizons for business model creation either within the firm and industry boundaries or across new organizational forms (Dunbar & Starbuck, 2006). In this regard, Teece (2010) notes that in the early stages under new settings, all market parameters need to be explored to gain the «deep truth» about that customer's value, the cost structure, the current dominant design, and alternatives in the market. Besides, due to the dot.com boom of 1998-2001, the Internet has become a novel and significant distribution channel (Teece, 2010) where companies have room to communicate with new and different, unlike competitors target customer groups using specific features of the business model.

Regarding the sharing economy, Codagnone and Martens (2016) declare the new business models and service providers emerge that may tremendously change various industries, with traditional companies becoming more and more jeopardized. Conventional business models are based on consumption through purchase and ownership of products but have limitations in achieving widespread sustainable innovation (Wells, 2013; Vaskelainen, 2014; Stoiber et al., 2019). In contrast, in our case about the mobility industry, business models based on sharing can meet the driving needs of consumers without owning a high-cost vehicle but with temporary access to it. Thus, innovative car-sharing business models are changing the value proposition of the conventional business model of car ownership so that the economic, environmental, and social benefits are increased by adding value to consumers.

Car-sharing innovative business models rely mainly on digital services and are presented in different organizational forms. Murmann and Frenken (2006) explain the lack of a dominant design in the car-sharing sector by the markets' fluidity, variety of regulations, and technological diversity. As some researchers claim (Morris et al., 2005), the car-sharing industry is still in the

[10] Including e-commerce, e-markets, and any commercial transactions conducted over the Internet

emerging stage and seeks a generic model that could become a standard with the subsequent formation of a single sharing business model (Teece, 2010). The variety of business models in car-sharing requires detailed consideration.

1.2.2 Characteristics of car-sharing business models

Car-sharing has been experiencing a significant boom in recent years, with 236 unique operators[11] worldwide as of 2019. With the widespread adoption of car-sharing, however, all companies operate under different business models, which are not created equally. Several researchers have attempted to classify main business models (Shaheen et al., 2006; Shaheen & Cohen, 2013; Cohen & Kietzmann, 2014; Vaskelainen, 2014). Figure 4 summarizes different types of car-sharing business models based on the existing literature on car-sharing.

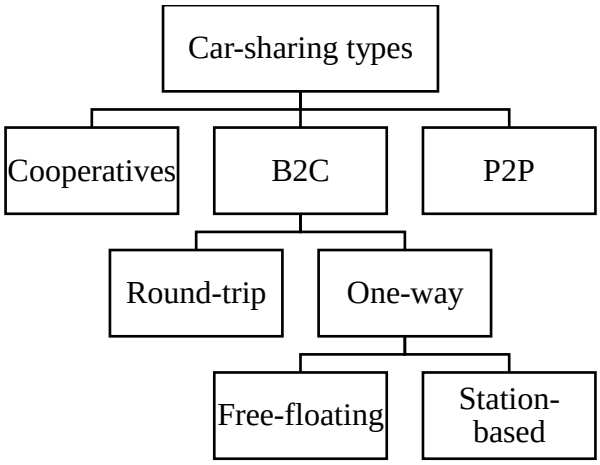

Figure 4: Different types of car-sharing business models
Source: made by the author

Basically, the authors distinguish three main car-sharing business models:

- cooperatives with non-profit orientation;
- P2P (Peer-to-Peer) car-sharing when individuals share cars via the intermediary platform which a firm provides;
- B2C (Business-to-Consumer) car-sharing when a firm owns a vehicle fleet and rents it out for customers on-demand for a short period. The B2C business model

[11] https://movmi.net/carsharing-market-growth-2019/

has two operational modes: round-trip and one-way[12], which in turn can be free-floating or station-based.

In essence, cooperatives present groups of individuals who contribute resources, share private cars with friends, neighbours, or families within closed communities, and collectively manage the car-sharing organization. What sets cooperatives apart from all other car-sharing business models is that they do not operate for profit, and their participants do not expect any financial gain. Cooperatives facilitate a cost-based car-sharing system to cover only the actual costs of using a car (Rodenbach et al., 2017). Members of cooperatives usually support standard tailor-made contracts, a registration platform, and sometimes with special car-sharing insurance. «CozyWheels»[13], a Belgium neighbour cooperative, can be a good example here. It should be borne in mind that this car-sharing business model is the least common among others. In addition, it is challenging to be detected because these cooperatives can be local and small with only a few people.

Below, Table 2 contains detailed characteristics of P2P, round-trip B2C, and one-way B2C car-sharing business models divided into a few blocks: value proposition, key assets, value capture, value network, and examples.

Peer-to-peer car-sharing presents round-trip usage with the decentralized fleet where cars are owned by private individuals (see Table 2 for more information). The firm operating under this business model provides a two-sided platform. Registered car users make their cars available (acting on a demand-side) for other users to rent (acting on a supply-side) for a short time. Users pay commission on transactions, but the operator does not charge vehicle acquisition and maintenance payments. Keys can be virtual through telematics devices and can be transferred physically to the vehicle-renter. From a business model perspective, the P2P concept aims to create an online marketplace to connect vehicle-owners with vehicle-renters providing necessary supplementary services that make the P2P model more environmentally sustainable than B2C models (Shaheen et al., 2012; Cohen & Kietzmann, 2014). Well-known companies of P2P car-sharing are «Getaround»[14] and «SnappCar»[15].

Cohen and Kietzmann (2014) believe that car-sharing is a capital-intensive business outside of P2P business models since it implies the operation of plenty of vehicles and the development of mobile and web technologies to maintain a stable and robust system of reservations, payments, and keyless access to shared cars.

[12] Some researchers call this type of car-sharing point-to-point.
[13] https://www.cozywheels.be/
[14] https://www.getaround.com/
[15] https://www.snappcar.com

Characteristic	P2P	B2C round-trip	B2C one-way
Value proposition			
One-way trips	No	No	Yes
Customer segment	Individuals	Individuals Companies Universities Families	Individuals Companies
B2B services	-	Pricing Invoicing Membership administration	Pricing Invoicing Membership administration
Fueling up	Expected / Penalized	Expected / Penalized	Included / Rewarded
Booking	In advance / Rental period fixed	In advance / Rental period fixed	Spontaneous / Open-ended
Minimal rental	One hour	One hour	One minute
Span of membership	National	National Global	National City-wide
Comment*	Reduces emissions and congestion; A vehicle when you want/need one and no requirement to return to same location	Reduces emissions and congestion; A vehicle when you want/need one	Reduces emissions and congestion; A vehicle when you want/need one and no requirement to return to same location
Key assets			
Fleet owner	Individuals	Car-sharing firm	Car-sharing firm
Fleet variety	Only insurance sets constrains	Size-based variety; Location / model-based variety	One-size-fit-all; Model variety
Electric cars	No	Partially No	Exclusively Partially

Value capture			
Pricing	Booking fee; Hourly fee; Kilometer fee; Gas fee; Insurance fee	Registration fee; Deposit; Annual / monthly fee; Hourly fee; Kilometer fee	Registration fee; Minute fee; Kilometer fee after quota
Additional revenue sources	-	Advertisements; Fleet management options; Deductible reduction	Charging stations
Value network			
Partners	-	Public traffic operators; Other car-sharing companies; Car rental companies	Public traffic operators; Other car-sharing companies
Owner	Private	Car rental companies; Public transit operator; Private; Customers	Car-manufacturing company
Customer interface*	P2P models encourage vehicle owners to share a resource; For the renter it also shifts from acquisition to shared use	Shift from vehicle acquisition to shared use	Shift from vehicle acquisition to shared use
Financial model*	Provides additional income to vehicle owners to offset the high cost of ownership; For renters it provides more affordable access to a vehicle for than owning and maintaining a personal vehicle; Scalable revenue model based on a percentage of transaction without need to acquire vehicles	More affordable access to a vehicle than owning and maintaining; Potential for profitability and exit	More affordable access to a vehicle than owning and maintaining; Potential for profitability and exit
Examples	«Getaround», «SnappCar»	«Cambio», «Ubeeqo»	«ShareNow», «Ford Carsharing»

Table 2: Main characteristics of different car-sharing business models

*Source: made by the author based on Vaskelainen (2014) and Cohen & Kietzmann (2014); * means citation from Cohen & Kietzmann (2014)*

B2C car-sharing presents variability in business models (see Figure 4). B2C round-trip model is based on hourly rentals with pre-booking and predetermined duration (see Table 2 for more information). In most cases, users must return the car to the place where they picked it up. Regardless of how long users drive the car, they pay for the time the car is accessed before returning it to the parking slot. Most operators target individual users; however, some companies organize their services with vehicle fleets allocation for university campuses, families, or companies. As for the vehicle fleet, it is usually owned by the car-sharing firm or leased from a partner. The fleet variety is categorized according to the vehicle size or model and its allocation. In this regard, Cohen and Kietzmann (2014) have found out that some large operators of B2C round-trip car-sharing have electric vehicles in fleets, albeit in small quantities. The authors have also noticed that among B2C round-trip car-sharing providers, big companies are owned by established transportation industry players, such as car rental companies and public transport operators. Some representatives of this car-sharing type are «Cambio»[16] and «Ubeeqo»[17].

One-way car-sharing is another type of B2C business model (see Table 2 for more information). It is clear from the name, it allows one-way trips and does not require any information about the duration or place of return a car to be specified in advance. No reservation is needed for driving; however, it can be possible just a few minutes in advance in some cases. Unlike P2P and B2C round-trip models, one-way car-sharing does not include any monthly or annual fee for the membership and, that is more, costs of the rental are calculated on a minute basis of a car using, not on an hourly basis of accessing it. All in all, the one-way car-sharing model is more flexible and affordable from the customer's viewpoint, although Boldrini and Bruno (2017) emphasize that the vehicle placement often becomes unbalanced over time, as cars can be concentrated in places with low demand.

What is particular about one-way car-sharing is that the fleet is usually standardized, and most operators have electric vehicles (Cohen & Kietzmann, 2014). While the cars with combustion engines can usually be parked anywhere, electric vehicles must be plugged in at the charging stations to ensure enough charge level for the subsequent users.

Within one-way car-sharing, two subtypes can be further distinguished. One-way free-floating car-sharing is the most flexible type with one-way trips within a specified geographic zone (Schaefers, 2013), which is determined for users in the app. Since cars are located on-street at parking places, contractual arrangements with the entity must take rights for legal parking. In contrast to free-floating, the station-based subtype means that users must pick up a car and return it to parking stations among the fixed provider's infrastructure. These stations are set up, for

[16] https://www.cambio.be/nl-vla, https://www.cambio-carsharing.de/
[17] https://www.ubeeqo.com/

example, at the charging points for electric vehicles or kiosks for customer service. The significant advantage for system providers here is that logistics is much simpler; however, there still can be problems for customers with the stations' capacity. At the same time, users are given less flexibility because they are tied to the location of parking stations.

One-way B2C business models can be characterized by the presence of large players who aggressively capture the car-sharing industry and even internationalize their operations to different countries. For instance, «ShareNow»[18], a joint venture of Daimler AG and BMW, provides free-floating car-sharing services in eight countries worldwide with more than 14 thousand vehicles among 16 big cities. Another example of a B2C large car-sharing operator is «Ford Carsharing»[19] that offers its services nationwide in German large, medium-sized, and small cities.

According to the research of Cohen and Kietzmann (2014), car-sharing companies rely heavily on local government support to provide incentives related to preferential parking or access to high-occupancy vehicle lanes, as car-sharing business models, except the cooperative one, are for-profit. It goes in line with the conclusion of the other group of scholars (Münzel et al., 2018) who say that B2C car-sharing should be offered at places where the potential density of vehicle use is high to make car-sharing providers profitable. As for the P2P business model, the authors believe it is appropriate in any region.

Following the commercial objectives, some operators provide services in combined business models, and in this regard, Gordon-Harris (2016) list some factors on which the success of the individual car-sharing business model depends to some extent:

1. Developed and stable public transport system;
2. The proper pricing structure of the business model;
3. Urban population of significant scale and diversity;
4. Available space allocated for charging stations and on-street parking;
5. Support from the public authorities.

To conclude the academic literature review by that moment, the car-sharing industry is very diverse in terms of business models and lacks a dominant one. Nevertheless, it is growing rapidly with new vehicles, members, and operators and expanding its geographical presence to new markets. Considering its fluidity and immaturity, it is momentous to investigate how current car-sharing operators co-exist and which factors affect their performance. The following subchapter describes how the performance of car-sharing business models can be measured and which business model components affect their performance mainly.

[18] https://www.share-now.com/
[19] https://www.ford-carsharing.de/de

1.3 Performance of car-sharing business models

1.3.1 First-mover advantage in the car-sharing industry

Authors and business practitioners agree that business models play a significant role in explaining firm performance (Zott & Amit, 2007; Giesen et al., 2007; Zott et al., 2011). Referring to the business model definition from the above literature review (see Subchapter 1.2.1), it describes resource use, value creation, and value delivery; thus, the adopted business model directly predetermines the firm's success. Based on the empirical analyses of the total value creation potential of entrepreneurial firms, Zott and Amit (2007) define the business model as an independent variable linked to performance.

Some scholars tend to concentrate on the performance through the business model novelty and say that the adaptation of innovative models leads to superior value creation (Morris et al., 2005). In this regard, Giesen et al. (2007) distinguish three types of business model innovations, namely industry models, revenue models, enterprise models. Authors study the relationship between firm performance and business model innovation and report that each business model innovation type can generate success. Particularly for enterprise models about the firm's structure in new or existing value chains, authors find that such innovations as partnerships or external collaborations are more effective in older firms than young ones. Zott and Amit (2008) examine the interconnection of business model and firm performance from the contingency theory view and conclude that novelty-centered business models positively affect the performance under the early entry into a market.

As for car-sharing business models, it is key to determine what operational and organizational characteristics influence the operator's performance and how they do it. Broadly speaking, Shaheen et al. (2006) have examined car-sharing organizations and revealed some features that make operators more likely to be economically successful. Specifically, a dense network and various vehicles should be provided, a diverse mix of users should be served, joint marketing partnerships should be created, a rating system should be simple and flexible, easy emergency access to taxis and car rentals should be provided.

It is worth mentioning that despite the rapid development of car-sharing, this market is still very small compared to the traditional private car ownership or rental markets (Münzel et al., 2018) that can explain the low entry barriers for newcomers. In the absence of a dominant business model in car-sharing, as follows from the preceding literature review, various business models currently coexist.

According to Münzel et al. (2018), car-sharing is known to be a market with strong network externalities, so «operators with a larger fleet size increase the proximity, availability, and variety

of their cars to their client». From the customers' point of view, they get more benefits from larger car-sharing service providers, unlike smaller ones. Following these assumptions, researchers state about the so-called «self-reinforcing rich-getricher» dynamic when large car-sharing firms are growing faster than small operators. In other words, it means that providers early entering the market benefit from the first-mover advantages in developing their vehicle fleet and from the self-reinforcing growth.

However, analysed the car-sharing providers in Germany, researchers also note that the first-mover advantage exists mainly within each business model and does not always take place at the level of the whole car-sharing market (Münzel et al., 2018). It follows from the fact that each car-sharing operator targets a different geographical market depending on the business model it applies since users come to car-sharing services solely in a town or city of their residence.

1.3.2 Role of the ownership background in car-sharing firms

The current car-sharing market is very diverse and represented by firms of different sizes and with different backgrounds. There are many stand-alone operators[20] and start-ups, as well as car-sharing operators backed by firms from different related industries[21], such as car manufacturers, car rental firms, rail operators, or energy companies, that can be observed. For instance, «Sixt» is originally a car rental company that has recently also started to provide car-sharing services in some countries such as Germany and the Netherlands. As an example of a provider with the rail operator's support, «Flinkster» is a car-sharing of Deutsche Bahn, a German railway and logistics company. The next example, «InnogyGo!», is a car-sharing operator of PGE Nowa Energia, a Poland energy enterprise.

Nowadays, the interdependence of car-sharing with car producers is the most prevalent phenomenon, while firms coming from other industries are still rare. Hence, in this research, only the automotive market is taken under consideration. Academic literature and analytical reviews have long shown a clear trend in the consensus that the automobile industry is heading into a restructuring phase, and car manufacturers are taking on a new role, increasingly becoming service providers for mobility-as-a-service and sharing concepts of all types (Firnkorn & Shaheen, 2016; Le Vine et al., 2014; McKinsey, 2016; CAR, 2016).

[20] A stand-alone car-sharing operator should be understood as a firm that is not connected to or owned by a firm from any related industry.

[21] In this research, a car-sharing operator backed by a firm from related industry refers to a firm initially operating in a different industry which is also working in the car-sharing market.

Many researchers believe that a firm's background significantly influences the business model applied for entering a new market (Chesbrough & Rosenbloom, 2002; Chesbrough, 2010; Garud et al., 2010). With its background and the main business model, a firm brings some previous routines and resources to a new market that predetermines its development path (Garud et al., 2010). As Chesbrough (2010) states, business models influenced by different backgrounds have diverse abilities for value creation and broad possibilities in a new market.

As for car manufacturers, they control the whole extensive value chain, from R&D, through production and sale, to long-term services after-sales. Considering the current saturation of many vehicle markets, Ruff (2015) concludes that the growth in the downstream service business has become a strategic point for traditional car-makers which seek to take a leading role in shaping the car-sharing market and enter it during the early stage, acting as a driving force for the innovation system. Following the study of Zhang et al. (2021), nowadays, original equipment manufacturers operate in the car-sharing market through two business modes: the self-built mode when a car manufacturer builds a sharing platform and the joined mode when a car manufacturer joins a third-party sharing platform.

Certainly, today car-sharing is not the traditional business model of car manufacturers. Therefore, it requires the allocation of resources to create specialized teams with special skills and capital investments in IT systems. However, car manufacturers have considerable opportunities to provide car-sharing services compared to stand-alone car-sharing providers for several reasons (Le Vine et al., 2014):

1. First, they have the financial stability to carry such risks as residual value and insurance.
2. Secondly, vertical integration between vehicle production and service delivery also allows for efficient integration of telematics equipment at the manufacturer's premises during vehicle assembly, rather than as additional equipment after the sale of the car.
3. Great resources allow trying various business models of car-sharing, including the ones with large vehicle fleets.
4. Besides, car manufacturers, unlike car hire firms, can use existing organizational advantages (e.g., market research and accumulated knowledge of consumers, brand recognition, established ties with the governments, internal IT systems, and others).

All these inherent competencies seem to create advantages for car manufacturers over competing firms. Nevertheless, it should be considered that stand-alone car-sharing operators are traditionally main buyers of cars from producers, as they need a large vehicle fleet for their

business development. It gives room for partnerships of car manufacturers and car-sharing stand-alone operators.

It is worth mentioning that although path dependence has a significant impact on business models, it works differently for backed and stand-alone car-sharing firms. Following Chesbrough and Rosenbloom (2002), car manufacturers fit the new car-sharing business model into their organization as an additional one, staying committed to its core business model of manufacturing and selling cars. Chesbrough (2010) also highlights that backed firms usually prefer to choose business models that give a fast, profitable growth, so they are limited from the business novelty perspective and follow its traditional logic. While car manufacturers are strongly influenced by path dependence, young stand-alone car-sharing firms are eager to invent innovative business models (Chesbrough & Rosenbloom, 2002) with a new partner structure or by targeting new users. Indeed, young firms have a limited internal recourse base that poses problems with overcoming entry barriers to the car-sharing market and takes more time to scale the business fast given the network externalities (Münzel et al., 2018).

Thus, these interdependencies are of great interest to be explored because they affect the business models' design and accordingly car-sharing firms' performance. Just a few research attempts have been made to study this phenomenon by today (Münzel et al., 2018; Münzel et al., 2020). In both studies, the authors confirm that firms from related industries choose a business model based on their current resources and competencies while organizing car-sharing services. Given that the German car-sharing market is the most saturated with backed by car manufacturers operators, authors find that these operators are present with large car fleets and usually «choose for a fast and large-scale roll-out of cars made possible by the one-way business model» (Münzel et al., 2018).

It can be assumed that such a phenomenon takes place not only in the German market due to the presence of car manufacturers but will be relevant for any market, which is of interest for the research.

1.3.3 Innovativeness of car-sharing business models on the example of electric vehicles

Car-sharing is the e-commerce-based industry, and its business models are innovative in essense in providing services. At the same time, the number of academics who see a business model innovation as a key to firm performance is increasing (Zott et al., 2011).

The electrification of cars can be considered as a significant example of innovation in the car-sharing business models. During the last decade, the research community has been

emphasizing the role of car-sharing in the context of the electrification of cars (Vasconcelos et al., 2017; Illgen & Höck, 2018; Friedel et al., 2019; Sprei et al., 2019; Huang et al., 2021; Roblek et al., 2021). Electric vehicles are known to be more environmentally friendly and ensure no harmful emissions compared to a car with an internal combustion engine. While academics argue about the environmental impact of car-sharing as a whole and find it controversial, car-sharing with adopted electric vehicle fleets undoubtedly produces a positive environmental impact. Vasconcelos et al. (2017) prove that gasoline, diesel, and even hybrid fleets fail to perform positively, unlike electric vehicles, gasoline, diesel, and even hybrid fleets.

Considering the initiatives of policymakers in European countries regarding greenhouse gas emissions (see Subchapter 1.1.3), electric car-sharing business models are gaining more popularity, as they allow reducing the congestion-related pollution. In particular, Sprei et al. (2019) find that free-floating car-sharing with electric fleets contributes to the transition towards mobility with low-carbon emission.

Moreover, electric vehicles are more appropriate for urban car-sharing than cars with an internal combustion engine because they have lower operating costs (Illgen & Höck, 2018). Accordingly, from a financial point of view, the price of an electric car pays off faster in a shared fleet than if a private person uses it. In terms of geographical markets, the authors reveal that Europe offers more profitable conditions for electric urban car-sharing than North America. However, there is still an open question about charging stations' infrastructure for electric vehicles that require regular recharging. Operators need to have a wide service network with free access for users that is possible either through direct investment in the construction of their stations or through partnerships, for example, with local governmental entities, to get access to urban parking areas (Huang et al., 2021). Another drawback of electric vehicles is less freedom regarding the free-floating business model since a car can not be left at any place within the operational area but should be plugged in charging equipment.

Car manufacturers also contribute to the electrifying of the car-sharing market and launch their electric fleets in line with congestion regulations and urban mobility concepts (Roblek et al., 2021). The most prominent example with the 100% electric fleet is «WeShare» – the European car-sharing provider initiated by Volkswagen Passenger Cars and Skoda.

Some car producers operating car-sharing services partly increase the share of electric vehicles to fulfill the CO2 emission requirements. For instance, «ShareNow» deploys a fully electric fleet in France, Spain, and the Netherlands due to strict environmental regulations, although in other European countries, the firm has different types of vehicles in fleets and is now on track to gradually increase the number of electric cars. In this regard, Friedel et al. (2019) examine multimodal vehicle on-demand platforms and find that the multimodal fleet with electric

vehicles demonstrates the increased users' activity up to 30%. It goes without saying that the fleet electrification used by a firm in the marketing approach has a positive perception by car-sharing users since they are also concerned about sustainable urban mobility.

All in all, more and more car-sharing operators are adding electric vehicles to their fleets, shifting to more sustainable business models that are predetermined by both environmental and economic reasons. While the environmental benefits of the electric vehicle business model are clear, its performance is still undefined and very little studied from the car-sharing operator's view.

1.3.4 Research hypotheses statement

Based on the literature review presented above, it can be claimed that the performance of car-sharing has only been studied through narrow scopes. Indeed, academics propose methodological approaches to evaluate car-sharing options and study factors influencing the firm performance. However, these factors are studied in isolation, and the authors focus only on particular market areas, such as one-country level or one type of a business model or short studied period. So, very little research has been conducted to evaluate the car-sharing success and diffusion in the broad market, although the car-sharing activity is gaining popularity across the whole European Union.

The need for studying of European field is becoming apparent since in recent years, car-sharing operators have entered new and formerly unexplored countries (the Eastern and Balkan countries) with their services and have actively been expanding their business approaches. The paper is aimed to cover *the research gap* by examining the car-sharing firms in a broad market from the 30 years entry pattern and business model perspectives. Thus, the research will support early narrow studies and contribute to the development of common theoretical knowledge about car-sharing performance in the European Union. Against the presented background, the research goal is to identify factors that affect car-sharing firms' performance.

The study analyses real data; therefore, hypotheses have been formulated to achieve the research goal. Table 3 contains the overview of the literature related to the performance of business models (see Subchapter 1.3) and indicates the hypotheses formulated based on the existing literature.

Following the stream of research on the firm's performance under the early entry into the market (Zott & Amit, 2008) and such car-sharing market feature as strong network externalities (), it is reasonable to examine the relation between the age of a firm and its performance. Based on the findings for the German market (Münzel et al., 2018), the first-mover advantage is expected

to play a significant positive role for car-sharing providers, which are early entering the market. So, the first hypothesis is formulated to address the age and performance relation in the car-sharing market with its precise examination for each business model type.

H1: The age of a car-sharing operator positively affects its performance.

H1.1: For the cooperative business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.

H1.2: For the P2P business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.

H1.3: For the B2C Round-trip business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.

H1.4: For the B2C One-Way business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.

Given the consensus of the authors that the firm background influences the business model choice when entering a new market (Chesbrough & Rosenbloom, 2002; Chesbrough, 2010; Garud et al., 2010), and the car-sharing market is closely related to car manufacturers (Münzel et al., 2018), we conclude that the ownership background affects the car-sharing performance. Indeed, car producers use their core competencies and resources to organize car-sharing services, as Münzel et al. (2020) find. Based on these findings, the next hypothesis for the European Union car-sharing market follows:

H2: Firms backed by car manufacturers will have higher performance indicators.

Speaking of the ownership background, some authors highlight that stand-alone car-sharing operators usually apply more innovative business models compared to firms backed by players from related industries (Chesbrough & Rosenbloom, 2002; Chesbrough, 2010). With this finding in mind, one more hypothesis is stated as follows:

H3: Stand-alone car-sharing firms will apply a more diverse variety of business models, unlike firms backed by car manufacturers.

Based on the studies on the increasing interest of users in car-sharing platforms with electric vehicles in fleets (Friedel, 2020) and the better appropriateness of electric cars for urban areas compared to cars with an internal combustion engine (Illgen & Höck, 2018), it follows that it can be an increase in interest in car-sharing services which are using electric vehicles. Given also that car manufacturers are actively launching car-sharing services with electric vehicles (Roblek et al., 2021) and the scholars support the positive impact of innovative business models on performance (Zott et al., 2011), we can assume the following:

H4: The availability of electric vehicles in the fleet will increase the performance results of car-sharing operators.

Authors	Name of the article	Journal and date	Key findings	Hypotheses
Zott, C., & Amit, R.	Business model design and the performance of entrepreneurial firms	Organization science, 18(2); 2007	The business model is defined as an independent variable and is linked to a firm's performance.	H1, H2, H3, H4
Giesen, E., Berman, S. J., Bell, R., & Blitz, A.	Three ways to successfully innovate your business model	Strategy & leadership; 2007	Authors distinguish three types of business model innovations: industry models, revenue models, enterprise models. Studying the relationship between firm performance and business model innovation, they report key findings: (1) each type of business model innovation can generate success; (2) innovation in enterprise models that focuses on external collaboration and partnerships is effective in older companies as compared to younger ones.	H1
Zott, C., & Amit, R.	The fit between product market strategy and business model: Implications for firm performance	Strategic management journal, 29(1), 1-26; 2008	Examining the interconnection of a business model and firm performance from the contingency theory view, researchers conclude that novelty-centered business models positively affect the performance under the early entry into a market.	H1
Münzel, K., Boon, W., Frenken, K. & Vaskelainen, T.	Carsharing business models in Germany: characteristics, success and future prospects	Information Systems and e-Business Management, 16, 271–291; 2018	Given the «self-reinforcing rich-getricher» dynamic and strong network externalities of the market, (1) large car-sharing firms grow faster than small operators, and (2) providers early entering the market benefit from the first-mover advantages in developing the vehicle fleet. Findings exist within each business model, not the whole car-sharing market. Young car-sharing firms have a limited internal recourse base that (1) poses problems with overcoming entry barriers to the market and (2) takes more time to scale the business. Car-sharing operators backed by car manufacturers have large car fleets and usually «choose for a fast and large-scale roll-out of cars made possible by the one-way business model».	H1, H2
Chesbrough, H., & Rosenbloom, R. S.	The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies	Industrial and corporate change, 11(3), 529-555; 2002	Path dependence has a large impact on a business model, but it works differently for backed and stand-alone firms. Firms, backed by players from other industries, fit a new business model into their organization as an additional one, staying committed to its core business model. In contrast, a stand-alone firm invents innovative business models with a new partner structure or by targeting new users.	H2, H3
Chesbrough, H.	Business model innovation: opportunities and barriers	Long range planning, 43(2-3), 354-363; 2010	Business models influenced by different backgrounds have diverse abilities for value creation and broad possibilities while entering a new market. Backed firms prefer to choose a business model giving fast profitable growth, so they are limited in the business novelty.	H2, H3

Garud, R., Kumaraswamy, A., & Karnøe, P.	Path dependence or path creation?	Journal of management studies, 47(4), 760-774; 2010	With its background and the main business model, a firm brings some previous routines and resources to a new market that predetermines its development path.	H2
Münzel, K., Boon, W., Frenken, K., Blomme, J., & van der Linden, D.	Explaining carsharing supply across Western European cities	International Journal of Sustainable Transportation, 14(4), 243-254.D; 2020	To organize car-sharing services, firms supported by players from related industries choose a business model based on their current resources and competencies.	H2
Shaheen, S. A., Cohen, A. P., & Roberts, J. D.	Carsharing in North America: Market growth, current developments, and future potential	Transportation Research Record, 1986(1), 116-124; 2006	Authors formulate some features of car-sharing business models that are inherent for economically successful operators: (1) a dense covered network and a variety of vehicles, (2) a diverse mix of served users, (3) joint marketing partnerships, (4) simple flexible rating system, (5) easy emergency access to taxis, car rentals.	H2, H4
Zott, C., Amit, R., & Massa, L.	The business model: recent developments and future research	Journal of management, 37(4), 1019-1042; 2011	A business model innovation is a key factor for the positive affect to firm performance.	H4
Illgen, S., & Höck, M.	Electric vehicles in car sharing networks–Challenges and simulation model analysis	Transportation Research Part D: Transport and Environment, 63, 377-387; 2018	Electric vehicles are more appropriate for urban car-sharing than a car with an internal combustion engine because of the lower operating costs. Europe offers more profitable conditions for electric urban car-sharing than North America.	H4
Sprei, F., Habibi, S., Englund, C., Pettersson, S., Voronov, A., & Wedlin, J.	Free-floating car-sharing electrification and mode displacement: Travel time and usage patterns from 12 cities in Europe and the United States	Transportation Research Part D: Transport and Environment, 71, 127-140; 2019	Free-floating car-sharing with an electric fleet contributes to the transition towards mobility with low-carbon emission.	H4
Roblek, V., Meško, M., & Podbregar, I.	Impact of Car Sharing on Urban Sustainability	Sustainability, 13(2), 905; 2021	Car manufacturers contribute to the electrifying of the car-sharing market and launch their electric fleets in line with congestion regulations and urban mobility concepts.	H4
Friedel, A.	Free Floating CarSharing Report 2020	Available online	The multimodal fleet with electric vehicles demonstrates the increased users' activity up to 30%.	H4

Table 3: The literature review on business model performance, and its relation to formulated hypotheses
Source: made by the author

Chapter 2. Methodology of the research

2.1 Statistical testing of hypotheses

The research is quantitative and based on the collected data; therefore, several hypotheses have been formulated in the previous chapter. It is essential to make sure of the significance of the findings when testing hypotheses. To do this, such an econometric method as the One-Way ANOVA test is applied at each stage of the research. The overall statistical analysis is conducted in the Excel «Analysis ToolPak» with the help of such analysis tools like Anova: SingleFactor, Correlation.

One-Way ANOVA is a type of statistical test whose purpose is to compare the variance of the mean values of a group within a sample, considering only one independent factor. This test is used in the research to confirm the significance of the hypotheses since each hypothesis considers the influence of a separate factor on the performance of car-sharing operators. This test satisfies the conditions of the formulated hypotheses. However, it should be noted that in the conditions of the collected dataset, the number of observations for the cooperative business model is small; therefore, for the mentioned business model, the test results may turn out to be insignificant.

The first group of hypotheses is aimed at testing whether age affects the performance for each of the four car-sharing business models and the market as a whole through the first-mover advantage theory. We take as a basis that the age of a firm is an indicator of a firm's success while accepting that the success of a firm is determined by the number of cars in its operating fleet (see Chapter 2.2). Moreover, we analyze firms' entry patterns for 30 years, building a column chart that shows the number of new operators by year per each business model. For each business model and then for the whole industry, we calculate the correlation coefficients between the number of cars and the years of operation of car-sharing providers. Besides, we use a plotted chart with trendlines to illustrate the calculations. The One-Way ANOVA-test is conducted to confirm the significance of the results.

The second and third hypotheses focus on the analysis of the path of dependence phenomenon, given the presence of car manufacturers in the car-sharing firms' background. Dividing the entire dataset into two groups depending on the owner's background, we analyze firms' approach to the choice of a business model when entering the car-sharing market and their performance indicators. This allows us to understand whether backed by car producer firms have an advantage over stand-alone firms and how the path of dependence affects the car-sharing market. The significance test also is carried out.

The last hypothesis explores how the innovative approach in business models, namely adding electric vehicles in fleets, affects the performance. Thanks to dividing all car-sharing

operators into three groups depending on the share of electric vehicles in fleets, the business model success are analyzed.

Thus, for all calculations and hypotheses throughout the research, significance tests are conducted by default. To insert many tables with test results throughout the paper, they are placed in the appendix part.

Nevertheless, the study is not limited to hypothesis testing. Hypotheses provide evidence for investigating what characteristics of firms affect their performance. Before proceeding to this stage, the formulation of the business model concept precedes, and the performance of firms is calculated. The next chapter describes in detail the sequential research process.

2.2 Justification for the choice of the performance indicator

The research explores determinants of car-sharing performance. In the case of emerging and immature markets like car-sharing, it can be challenging to define and compare the firms' performance. Münzel et al. (2018) support the claim that the car-sharing market is young and fluid, and among operating companies, many are in the founding stage, making it challenging to measure their profits.

Moreover, many car-sharing industry players are start-ups or small firms that raise the problem with reliable financial data since providers refuse to state the profitability results publicly. Lagadic et al. (2019) support the point that to date, no one car-sharing operator has revealed to the public the profitability results, except for the «Swiss Cooperative Mobility Carsharing». One more peculiarity is that not all car-sharing providers operate based on a profit logic. For instance, the cooperative business model is driven more by social and environmental goals, not profit ones. In the B2C business model, some operators work on the initiative of municipal authorities.

Under the reasons above, it is essential to define the performance indicator for this research. Financial indicators are generally known to reflect the firm's success; however, some authors argue with this narrow approach.

Following the study of small firms (Stam et al., 2014), firm performance is a multidimensional construct that can be measured through different aspects such as growth, profitability, or operational effectiveness. In this regard, Venkatraman and Ramanujam (1986) also distinguish between financial and non-financial performance indicators: the financial performance reflects the achievement of a firm's economic goals, while non-financial performance demonstrates the broader operational effectiveness of a firm.

In line with this, some researchers in previous studies (Münzel et al., 2018) have suggested alternative indicators to measure the performance of car-sharing firms, such as the size of a firm, the spatial diffusion of a firm, or the market share of a firm. Therefore, in this research, we also accept the number of shared vehicles in a fleet, the firm size, in other words, as the main performance indicator for car-sharing firms to capture their operational effectiveness.

2.3 Description of the research design

To address the research goal, the empirical part is conducted in several stages (see Figure 5). Below is a detailed description of each stage of the study with its visualized outline.

Stage 1. Identification of firms

The European Union market has been chosen to analyze business models in car-sharing since the region is dominant in terms of the number of vehicles and users. Moreover, the spectrum of car-sharing firms in this region is diverse, allowing finding implicit factors of success, if any exist. Conclusions drawn from such a diverse market can be applied to other, less mature, and smaller markets to support car-sharing service provision.

The European Union consists of 27 countries, so each country is considered a separate car-sharing market for the spatial analyses. It is important to note here that no car-sharing has been found in Greece.

Search for firms has been conducted through three perspectives: country, operational business model, and car manufacturer company, so all searching areas have been covered. However, it should be noted that cooperatives are difficult to find during the desktop research since they are usually small associations of residents who do not always run their services online.

Given that car-sharing cooperatives do not operate for profit, and this research focuses on car-sharing performance, the small number of cooperatives in the dataset does not pose a problem for the study. On the contrary, the information about cooperatives is intended for informational purposes, demonstrating the diversity of car-sharing business models and the history of its transition from an environmental and social initiative to a large business.

In total, 129 unique car-sharing providers have been identified. Because some firms operate in multiple geographic markets or provide services across multiple business models, there are a total of 174 observations in the dataset. If a car-sharing operator is present in more than one city within the same country, it is counted as one observation. In turn, a car-sharing firm operating in cities from different countries is counted for some cases depending on the number of countries it

is present. If one firm provides car-sharing services for the customers through business models with different operational characteristics simultaneously, it is counted for some observations.

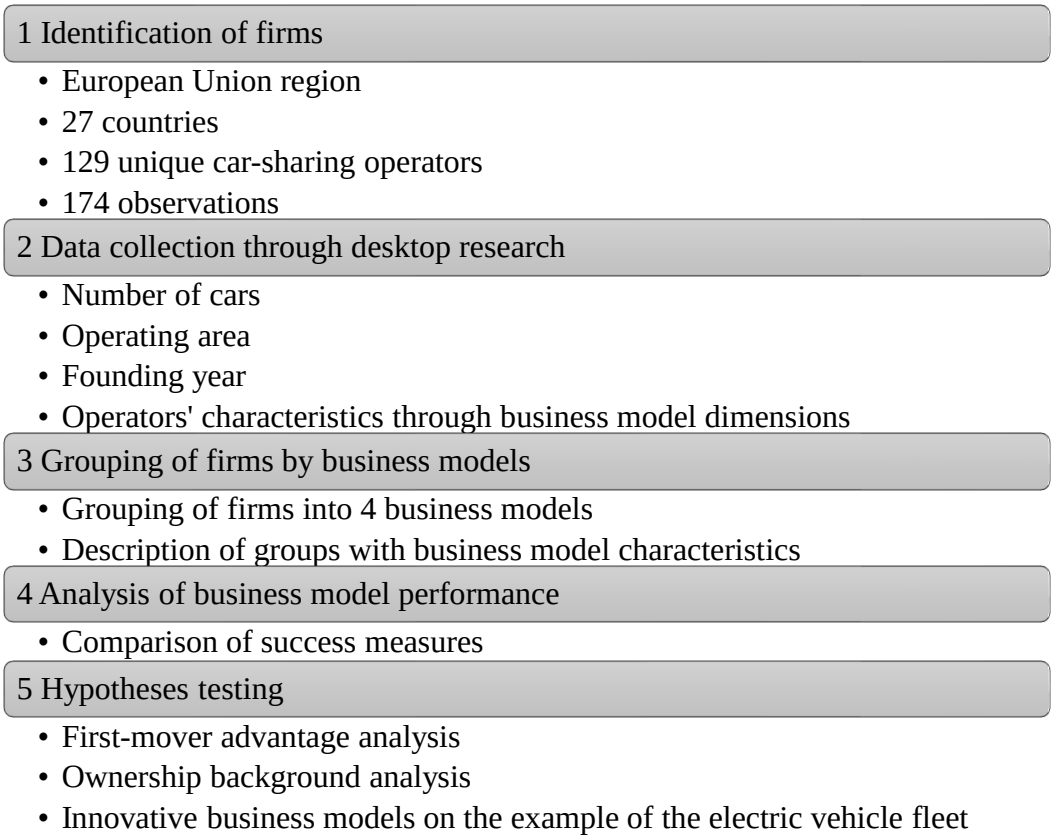

Figure 5: Outline of research design

Source: made by the author

Stage 2. Data collection through desktop research

For the data collection, the desktop research strategy has been applied. Both qualitative and quantitative data have been gathered piece by piece to characterise firms and various features of car-sharing business models.

At this stage of the research, a sufficient amount of data has been collected for each car-sharing firm, including the number of cars available to users, the area of operation at the country level, and the year of entry into the market. It is worth noting that if a firm is represented in several countries, then the year of foundation for each country may differ.

Furthermore, data about firms have been organised through three key business model dimensions as was discussed in Subchapter 1.2.1: value proposition, value network, and value capture (Teece, 2010). The value proposition dimension reflects the value that is offered to customers and includes the following indicators:

- trip type (round / one-way);

- fleet ownership (private users / provider);
- geographical span (operates within one country / international);
- avalaibility of electric vehicle in a fleet (a fleet is full of electric vehicles / some vehicles are electric (exact number not defiined by firms) / no electric vehicles in a fleet).

The second dimension, value network, is about the firm's connection with players outside the car-sharing industry. The owner background variable shows if car manufacturers back any car-sharing operators. And finally, the value capture dimension demonstrates if a car-sharing provider has a profit orientation.

The car-sharing market is very fluid. Some firms often shut down the operation in certain markets or even at all, while new firms constantly enter the market, and some services operate via the trial mode. With web pages of car-sharing operators as the main source of information, relevant data has been found. The data used in this study is relevant as of March 2021.

All in all, the desktop research includes ten parameters that are applied to 174 car-sharing services in 26 countries[22] of the European Union. The collected information on the current situation in the car-sharing market works as input data for the research.

Stage 3. Grouping of firms by business model type

In Subchapter 1.2.2, the typology of car-sharing business models has been built based on the existing academic literature (see Figure 4). Following this typology, all 174 car-sharing operators from the dataset have been divided into four groups. Since the collected data on business model dimensions is detailed, the process of the business model defining is clear and straightforward. Further, four groups of car-sharing operators have been broadly described.

Stage 4. Analysis of business model performance

Then, the analysis of car-sharing performance across defined business models follows. As discussed in the previous literature review (see Subchapter 1.3.1), financial indicators like profit or revenue are not appropriate to measure the performance of car-sharing firms.

Given the characteristic of the car-sharing market and the purposes of this research, two other performance indicators are used following the approach of Münzel et al. (2018). The first indicator is the absolute fleet size in the number of cars, and the second indicator is the relative fleet size. Authors believe that regardless of the business purpose of car-sharing, be it profit, environmental or social, the number of vehicles reflects the extent of success in promoting the

[22] As it was mentioned before, no car-sharing provider has been found in Greece.

service. As for the second indicator, the authors suggest dividing the absolute fleet size by the number of inhabitants in the market where car-sharing operates. In our research, the country-level scope is explored, so additional data on the countries' population is collected[23]. The number of cars per capita, in authors' opinion (Münzel et al., 2018), reflects the spatial diffusion of a firm and shows how dominant a firm is in the market, given the potential size of the market.

Relying on the above-presented performance indicators, 174 car-sharing firms have been studied to find how successfully they operate across business models.

Stage 5. Hypotheses testing

At this stage of the research, the most evidence for explaining the performance of car-sharing firms of different business models comes. Based on the literature review, four hypotheses have been formulated to determine what factors most affect car-sharing performance (see Subchapter 1.3.4). In this part of the research, the results are interpreted with the help of first-mover advantage theory and path dependence analysis.

The results obtained from all hypothesis testing and data analysis through different theories provide evidence for achieving the research goal. Thus, the logic of the research consistently addresses all the research objectives and the achievement of the research goal, while the research is organized according to the inductive reasoning approach, moving from individual observations to broader generalizations. The research begins with specific observations of car-sharing firms, proceeds to identify business model patterns with performance calculations, and the formulation of some preliminary hypotheses, which are tested on the real dataset. Eventually, it results in finding factors that determine the firms' success and the formulation of managerial implications in the business model context for car-sharing providers.

[23] https://ec.europa.eu/eurostat/databrowser/view/TPS00001/bookmark/table?lang=en&bookmarkId=c0aa2b16-607c-4429-abb3-a4c8d74f7d1e

Chapter 3. Data analysis and research findings

3.1 Descriptive statistics of car-sharing business models

Through desktop research, a total of 174 car-sharing operators have been identified in 27 countries of the European Union. Based on a typology of car-sharing business models from the existing academic literature, all firms have been categorized according to their operating features. Table 4 below contains the descriptive statistics of the dataset in the business model context, such as the number of operators, the average age in years, the average number of countries served, total and average fleet size in cars. Moreover, Table 4 shows the characteristics of 4 business models through business dimensions, such as value proposition, value network, value capture.

In the European Union, the representation of car-sharing varies significantly from country to country. There are large markets with a long history of car-sharing initiatives and institutional predisposition, while there are markets where car-sharing is just beginning to emerge.

Figure 6 shows the distribution of car-sharing in the countries of the European Union. The left map shows how many firms operate in the car-sharing market of a particular country, and the right map contains data on the number of shared cars available as of March 2021.

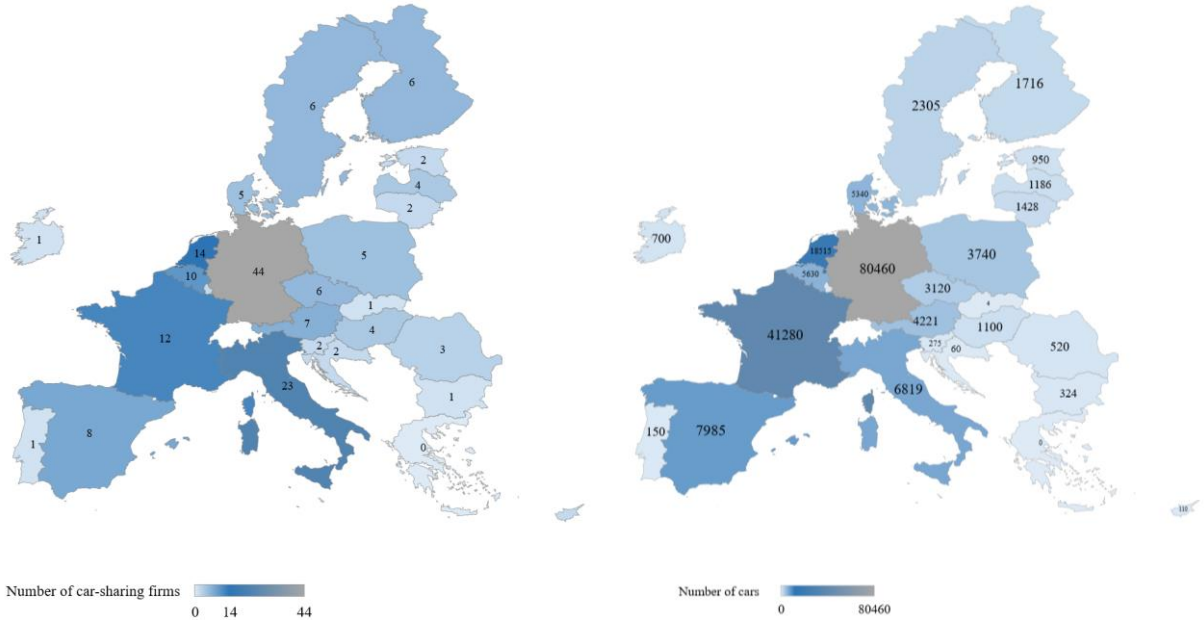

Figure 6: Distribution of car-sharing across EU countries by the number of operating firms (left map) and by the total number of available shared cars (right map)

Source: made by the author

Germany is the breakthrough leader in both indicators, with a long car-sharing story starting from the 1990s. France, Italy, the Netherlands, Belgium, and Spain can also be considered large markets. As can be seen from the maps, the eastern part of the region is characterized by

fewer cars and only a few firms per country, confirming the expanding trend of car-sharing in Europe. For countries such as Slovakia, Malta, Cyprus, the phenomenon of car-sharing is recent, and the first operators appeared from 1 to 3 years ago. In Greece, for example, there is still no car-sharing market. So, the European Union car-sharing market is very diverse in terms of geographical market saturation. Let us look at the market through the business model's scope.

As it can be seen from Table 4, most car-sharing firms, namely 81, operate via the B2C One-way business model. The second-largest business model is B2C Round-trip with 68 operators. Thus, B2C business models prevail in the European car-sharing industry, speaking in the number of firms operating through them, with a total share of 86%. This is followed by firms providing car-sharing services through P2P platforms in the amount of 19. The cooperative business model is the least common, with only six firms given the presence of their services online.

	Type 1 Cooperative	**Type 2 P2P**	**Type 3 B2C Round-trip**	**Type 4 B2C One-way**
Number of operators	6	19	68	81
Average age, years	8,7	10,1	13,7	7,1
Average number of countries served	1,2	1,7	1,1	1,4
Total fleet size, cars	999	96 628	37 818	52 793
Value proposition				
Trip type	Round	Round	Round	One-way
Fleet ownership	Private users	Private users	Provider	Provider
Geographical span	Within 1 country - 80% International - 20%	Within 1 country - 73% International - 27%	Within 1 country - 88% International - 12%	Within 1 country - 83% International - 17%
Availability of electric vehicle (EV) in a fleet	all EV - 50% some EV - 33% no EV - 17%	all EV - 5% some EV - 84% no EV - 11%	all EV - 19% some EV - 59% no EV - 22%	all EV - 46% some EV - 30% no EV - 24%
Value network				
Owner background	Stand-alone firms	Stand-alone firms - 95% Firms backed by car manufacturer - 5%	Stand-alone firms - 91% Firms backed by car manufacturer - 9%	Stand-alone firms - 80% Firms backed by car manufacturer - 20%
Value capture				
Profit	Non-profit	For-profit	For-profit	For-profit

Table 4: Car-sharing business models' characteristics

Source: made by the author

The first type of business model is cooperative with a non-profit orientation. In total, six cooperatives have been found, under the terms of which private car owners share a car for round trips. They are mainly organized in local communities; therefore, they work within their home country, and there are no firms backed by car manufacturers. Interestingly, among the cooperatives, there are small ones (for example, «Carsharing Zwolle» in the Netherlands with 3 shared cars), although there are also quite large ones (for example, «CozyWheels» in Belgium with 640 shared cars).

Type 2, P2P, consists of 19 firms providing car-sharing platforms where private users share their cars for round trips for profit. As shown in Table 4, this business model has the most significant number of available cars, namely 96 628. What is distinctive for the P2P business model is that there are two large international players: «Getaround» with 61 thousand vehicles operating in Austria, Belgium, France, Germany, Spain, and «Snappcar» with 31 thousand vehicles in Denmark, Germany, and the Netherlands in total. It is worth noting that some car-sharing firms operate entirely by electric vehicles (for example, «Som Mobilitat» from Spain with 20 electric vehicles). Besides, one car manufacturer supports this business model. «Skoda» has organized P2P car-sharing with its 1 500 branded cars in the Czech Republic.

Sixty-eight car-sharing firms operate under the B2C Round-trip business model, characterized by the highest average age of 13.7 years. Round trips are available through vehicles owned by the provider. For round trips, two operational characteristics are also distinguished: station-based and homezone-based. Sixty-one car-sharing firms out of 68 belong to the first operational characteristic. 88% of car-sharing firms of this business model type operate only in their home country. It is worth noting that the largest fleet size players are from Germany (for example, «Flinkster» with 4 500 vehicles or «Stadtmobil» with 3 200). 9% of car-sharing providers are backed by five car manufacturers, such as Ford, Volvo, Toyota, Hyundai, Renault.

The most significant number of car-sharing firms choose the B2C One-way business model. 26 out of 81 firms operate in such an operational mode that one-way trips can only be completed at pool-stations; the rest do not impose requirements in this regard so that cars can be left within the operational area. Compared to the B2C Round-trip business model, the average age of a B2C One-way operator is twice less – 7,1 years. However, the total size of the B2C One-way fleet is larger – 52 793 vehicles. It is noteworthy that a third of the entire fleet belongs to one firm – «ShareNow», which is one of the largest international players in the car-sharing market. This type of business model became the most attractive for car manufacturers, so seven companies (Daimler AG and BMW, Fiat, Renault, Groupe PSA, Kia, Toyota) have started the car-sharing services. Among for-profit business models, the fleet of the B2C One-way model is most

represented by electric vehicles. In more detail, 46% of all B2C One-way firms provide car-sharing services only on electric vehicles and, on the contrary, 24% do not use them at all.

Thus, as it follows from the description above, business models differ significantly in features through business dimensions. In this Subchapter, a broad description of car-sharing business model types has been given. The geographical distribution of car-sharing operators across the European Union region has been explained. Next, the analysis of car-sharing performance follows.

3.2 Performance of car-sharing firms by business models

Having a description of car-sharing business models, the performance of 174 operators can be compared. Table 5 presents the average success data by types of business model, the fleet size of an operator, and its fleet size per capita.

As it follows from the below Table 5, car-sharing operators of each business model perform differently in terms of the number of cars that are available to users and the number of cars per capita. The ANOVA-tests have been conducted to evidence the significance of calculations, and they turned out to be significant at the 1%-level.

	Type 1 Cooperative	**Type 2 P2P**	**Type 3 B2C Round-trip**	**Type 4 B2C One-way**
Average fleet size, cars	167	5 086	556	652
Cars / 1000 people	0,015	0,219	0,021	0,039

Table 5: Performance of car-sharing operators by a business model's type

Source: made by the author

Cooperative car-sharing, as can be seen from Table 5, offers on average the smallest number of cars for sharing (167 cars) and has the lowest ratio of vehicles per 1000 people. Considering that they do not operate for profit but rather for social and environmental reasons and that historically they appeared earlier than other car-sharing types, these services are immersed in local communities and have no high potential for growth and success.

On the contrary, through the P2P business model, the largest average number of 5 086 vehicles is offered. This can be explained by the operational characteristics of this business model, that owners supply their cars for sharing at zero marginal cost since the platform does not impose

any payments on that. A large number of offered vehicles, together with the absence of supply costs, imply a higher coverage area, and vehicles are offered in areas with high and low demand. However, it does not mean that every car is frequently used, so whether the individual supplier's profit target will be achieved remains open. Moreover, the most significant ratio of 0,219 cars per 1000 people is observed for P2P operators. It also should be mentioned that P2P car-sharing is, on average, the most «international» and covers 1,7 countries (see Table 4).

As it is confirmed for B2C car-sharing providers (Schmöller et al., 2015; Kortum et al., 2016), they offer their vehicles in areas with sufficient demand to at least break even. It leads to a lower number of offered cars compared to the P2P business model. The average fleet size of B2C Round-trip car-sharing accounts for 556 vehicles, while in the case of the B2C One-way car-sharing, it is 652 vehicles. As for the number of cars per capita, the logic behind its relation for B2C types remains the same – 0,021 and 0,039 cars, respectively. It turns out that among car-sharing operators with for-profit orientation, the size of the fleet is strongly determined by who owns and accordingly provides cars for sharing.

Summarizing the above, several conclusions can be drawn from statistically significant data on business models' performance. Considering the nature of car-sharing cooperatives and their performance indicators, they are locally rooted and serve the niche that big car-sharing operators avoid because of the deliberate profit failure and scale economy's absence. Due to zero marginal costs, P2P providers are the most sizeable in terms of both the average fleet size and the number of cars per capita, and they are not tied to any location: they are most international firms and, based on operational characteristics, they can operate both in dense urban and in rural areas.

Following the logic of B2C providers in making a profit, they are supposed to occupy the most promising markets. Indeed, B2C Round-trip and B2C One-way operators are more restrained in the number of fleet vehicles, cars per capita, and countries served; however, these business models are more professional and impersonal, making further unlimited growth possible. Comparing B2C types, the performance indicators of the B2C One-way business model are a bit higher, probably due to the greater flexibility in the operational mode.

3.3 Hypotheses testing

3.3.1 Existence of the first-mover advantage among car-sharing firms in the EU

In this part, it will be studied whether the first-mover advantage exists in the car-sharing market. First, to understand the entry pattern of car-sharing firms over time, Figure 7 has been

built. It shows the number of new car-sharing providers of each business model per year from 1991 to 2020.

It is seen that until the mid-2000s, the market was mainly represented by B2C Round-trip car-sharing. Consistently over the past 30 years, firms have been choosing this business model to enter the car-sharing market that indicates low entry barriers for the B2C Round-trip type.

Although the first B2C One-way car-sharing was launched back in the 90s, the extensive roll-out of operators with this business model began in the market about 13 years ago and has gained more and more popularity since 2013.

The emergence of cooperatives is a pervasive phenomenon in terms of time, characterized by low barriers to entry and by its nature independent of market conditions.

As it can be seen in Figure 7, the youngest for the European car-sharing market business model is P2P. Starting in 2009 and over the next nine years, we can see a cluster of P2P car-sharing entrances. However, it should be noted that over the last three years, no firms with such a business model have appeared on the market. This may indicate a strong and rising effect of network externalities leading to high entry barriers for newcomers.

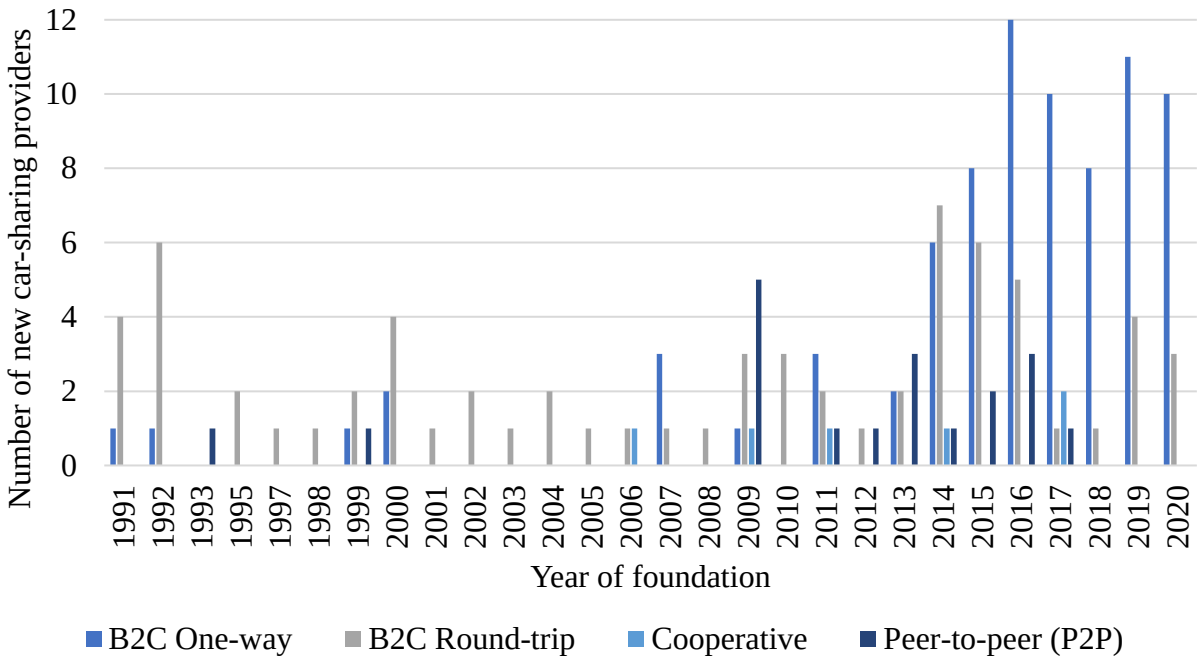

Figure 7: Number of new car-sharing providers entering the market per year[24]

Source: made by the author

[24] Note that two car-sharing firms of the B2C One-way business model have not been illustrated in the figure since they are outliers in terms of the year of foundation. «Carsharing Arezzo» from Italy was founded in 1964, and «Witkar» from the Netherlands – in 1974, while the mainstream of car-sharing started in the 90s.

In general, we can say that the car-sharing market has been experiencing a boom in new players since 2012. Although the car-sharing market has not followed a dominant business model over the 30 years of its development, over the past few years, there has been an overall trend in a large number of new players, most of which are operating through the B2C One-way business model and significantly predominating over other business models.

Next, the first group of hypotheses is tested by calculating the correlations between the number of cars and years of operation for each business model to explore whether the firm's age affects its performance. For all business models separately, positive correlation coefficients between the size and age of operators have been found:

- Cooperative business model: +0,41;
- P2P business model: +0,06;
- B2C Round-trip business model: +0,164;
- B2C One-way business model: +0,203.

For P2P and both B2C types, correlations are significant at the 1% and 5% levels, respectively. For the cooperative type, the correlation is also found to be positive but statistically non-significant even at the 10% level that can be explained by the low number of observations of cooperatives in the dataset.

Among for-profit business models, the strongest correlation is observed for the B2C One-way business model. As for the correlation coefficient for the P2P type, it is pretty low. Indeed, considering the entry pattern of car-sharing firms over time (see Figure 7) and the size of the P2P fleet (see Table 4), we see that firms with P2P business model have managed to establish extensive vehicles fleet for a short period, even outperforming B2C Round-trip and B2C One-way car-sharing operators.

Hence, we accept the first group of hypotheses and confirm that the first-mover advantage exists in the context of each business model. So, the older the car-sharing operator is for each business model, the larger the fleet size. For each business model, the fleet size of an older car-sharing operator is larger than the fleet size of a younger operator.

For clarity, the results are illustrated in Figure 8. It shows the relation between the number of cars and the age of operators for each business type. It should be noted that because of the outliers in the dataset, the logarithm of the number of cars is plotted. Moreover, trendlines for each business model are shown in the figure. According to the pattern in Figure 8, in the context of each business model, the older firm tends to have a more extensive fleet.

For the P2P business model, the positive correlation between the number of cars in the fleet and the age of operators has been found with a coefficient of +0,06. However, in Figure 8, the trendline for P2P car-sharing is shown with a slight negative slope due to the logarithm of the

number of cars. The logarithm of the number of cars is plotted in the Figure 8 to avoid outliers when illustrating the results since some P2P firms have abnormally large car fleets. So, this distortion of the coefficient has happened for mathematical reasons.

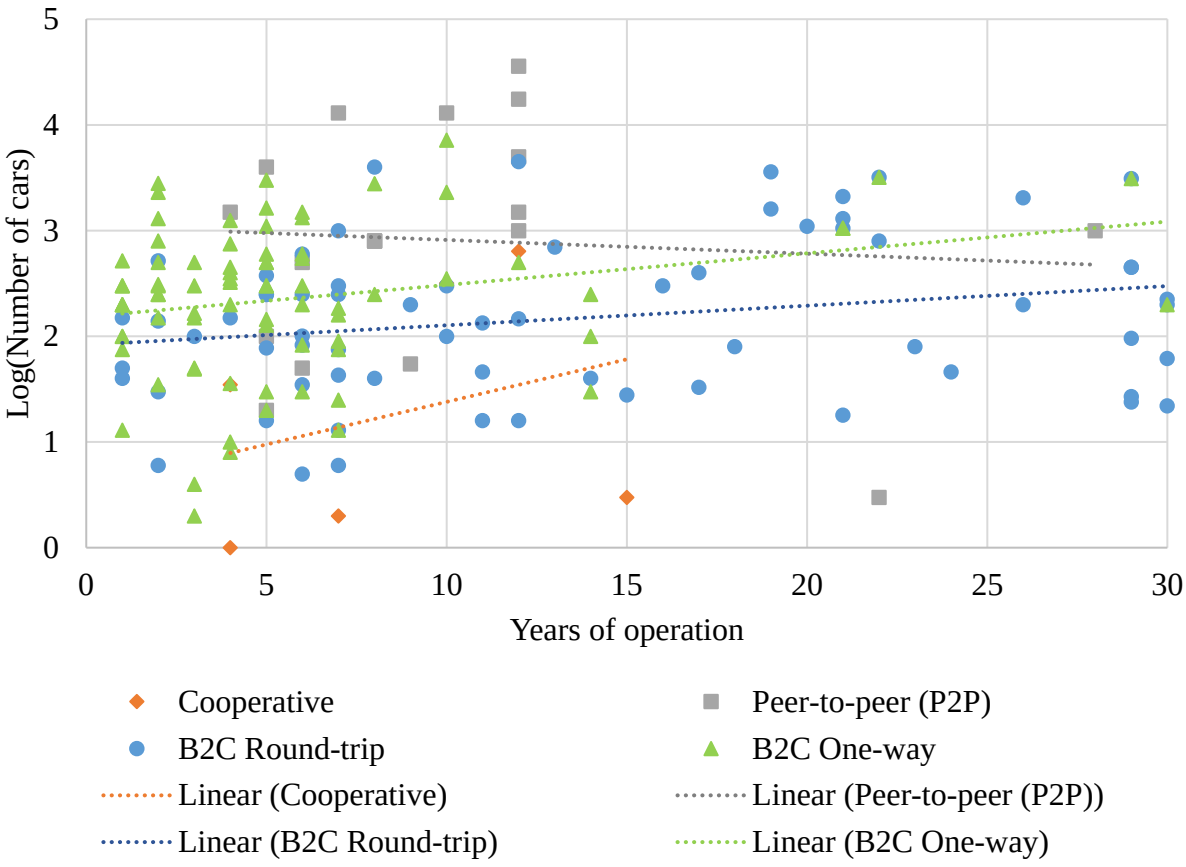

Figure 8: Relation between the vehicle fleet and the years of operation for car-sharing firms by business model type[25]

Source: made by the author

After confirming the hypothesis that the age of a car-sharing provider and its fleet size is positively related within each business model, it should be tested whether the same relationship is observed across the entire car-sharing market, regardless of the business model. The positive and significant at the 1% level correlation with the coefficient of +0,055 has been found for 174 car-sharing firms of all business models across the region of the European Union.

Thus, we conclude that the first-mover advantage exists at the level of the whole car-sharing industry. Given that the car-sharing market in the European Union is very diverse in terms of the duration of car-sharing presence in each country, it can be assumed that firms are entering

[25] Here two car-sharing firms of the B2C One-way business model also have not been illustrated since they are outliers in terms of the year of foundation. The age of «Carsharing Arezzo» is 57 years, «Witkar» has been operating for 47 years. Both firms are included in the calculation but are just not illustrated in the Figure.

new countries with small vehicle fleets to test market conditions and familiarize the audience with the service. Over time, firms tend to expand fleets to increase market coverage.

However, the correlation coefficient is very low that may be due to the presence of operators who directly enter the market with large fleets. These can be firms that internalize their services to markets with the evidence, based on the success of other players in that market, or firms with the backing of players from other industries. Then large, albeit young, car-sharing operators rapidly expand their fleets following the self-reinforcing growth dynamic (Münzel et al., 2018).

Summarizing the results obtained at this stage, we have a confirmed first group of hypotheses:

- *H1: The age of a car-sharing operator positively affects its performance.*
  - *H1.1: For the cooperative business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.*
  - *H1.2: For the P2P business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.*
  - *H1.3: For the B2C Round-trip business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.*
  - *H1.4: For the B2C One-Way business model, the fleet size of an older car-sharing operator will be larger than the fleet size of a younger one.*

The first-mover advantage exists in the car-sharing both within each business model and for the entire European Union market. The age of a car-sharing firm has been found to have a positive effect on its performance. Nevertheless, correlation coefficients between the fleet size and firm age vary significantly according to the calculation results, partly explained by the choice of different strategies for entering the market. Further research concerns the above points.

3.3.2 Influence of the ownership background on car-sharing performance

The next phase of the study will examine how car-sharing operators backed by car manufacturers perform and how they differ from stand-alone car-sharing operators in the business model's features. In the car-sharing market of the European Union, 23 backed firms have been found from such car manufacturers as Daimler AG, BMW, Ford, Volkswagen, Skoda, Renault, Fiat, Volvo, Groupe PSA, Kia, Toyota, and Hyundai. The total fleet size of car manufacturers' car-sharing accounts for 28 282 vehicles, about 15% of the whole car-sharing market.

Car manufacturers consider the following countries to be the most attractive for developing the car-sharing business segment: Germany, Italy, Austria, Spain, and France. In this regard,

Figure 9 shows the distribution of car manufacturers by country in terms of fleet size (number of vehicles). The whole figure is equal to the total size of the fleet – 28 282 vehicles. This figure is quite representative and can be read both from the inside (the country's point of view) and outside (the company perspective). You can see which car producers have chosen a particular country to launch their car-sharing service, and at the same time, you can find out which countries the particular company has entered.

Generally, the car manufacturer's logic behind the market choice for car-sharing seems to go in line with the overall market patterns (see Figure 6). Indeed, they choose the biggest markets in terms of the available vehicle number. One more observed trend is that companies launch car-sharing services in familiar markets since then, they have the accumulated knowledge about the audience, higher brand recognition, and customer loyalty. For instance, German brands, like Daimler, BMW, Volkswagen, operate in the home country with the most extensive fleets compared to other countries where they are present. French manufacturer, Renault, works in France and neighboring Spain. Czech Skoda has launched a rather big car-sharing service all alone in the Czech Republic.

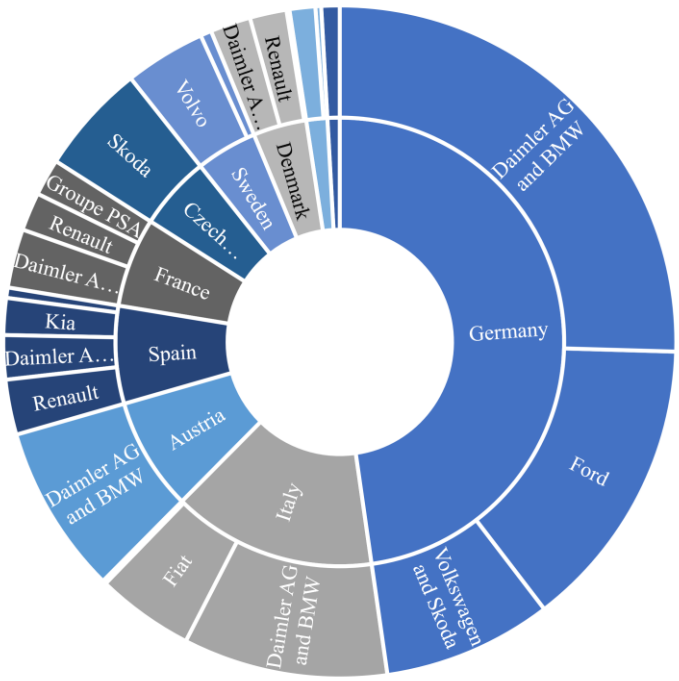

Figure 9: the country distribution of car manufacturers that provide car-sharing services by the number of offered cars

Source: made by the author

Car manufacturers in the car-sharing market are interesting to be studied from the path dependence perspective. To understand whether these car-sharing providers differ from the stand-

alone firms, distinct characteristics are presented in Table 6. As you can see, 23 out of 174 operators (13%) are from the auto industry. On average, they have a larger fleet compared to stand-alone firms – 1230 vehicles versus 1059[26]. As expected, car manufacturers bring their resources from core activities when adapting to new business areas (Münzel et al., 2018), which gives them an advantage over other players in the market.

Moreover, car manufacturers have recently been present in the car-sharing market, with an average age of 5,4 years, while others operate on average for 10,7 years (significance at the 5%-level). This means that car manufacturers have achieved better performance indicators in a shorter time than stand-alone car-sharing operators. It also supports the theory that large firms get richer faster.

	Number of operators	**Average fleet size, cars**	**Average age, years**
Car manufacturers	**23**	**1230**	**5,4**
B2C One-way	16	1330	5,2
B2C Round-trip	6	918	6,2
Peer-to-peer (P2P)	1	1500	4,0
Stand-alone firms	**151**	**1059**	**10,7**
B2C One-way	65	485	7,5
B2C Round-trip	62	521	14,4
Peer-to-peer (P2P)	18	5285	10,4
Cooperative	6	167	8,7

Table 6: Characteristics of car-sharing operators by the ownership background: backed by car manufacturers and stand-alone car-sharing firms

Source: made by the author

Based on the presented results, we confirm the existence of the path dependence phenomenon concerning car manufacturers in the car-sharing market and accept the third hypothesis. Firms with roots in the car manufacturing industry have higher performance in comparison with stand-alone car-sharing firms.

There are interesting results when analyzing what business model car manufacturers choose for the car-sharing market. First, all companies, except one P2P operator, set up car-sharing

[26] ANOVA-test shows the significance of results only at the 18%-level, probably due to the low number of backed firms compared to stand-alone firms and the outlier's presence in the dataset.

through B2C business model types with a predominance of one-way trips – 16 out of 22 B2C operators. This choice is explained by the presence of particular competencies brought from the background and core business activity (Garud et al., 2010). Thus, a solid authority and established ties with municipal institutions can help the car producers develop the B2C Round-trip car-sharing by providing access to parking lots in the city or at railway stations and airports. These initiatives by significant players in the automotive industry are consistent with the urban sustainable mobility concept.

We still should not ignore the main motive of manufacturers in the car-sharing market - making a profit. Relying on their classic audience and leveraging their existing producing competencies, companies choose such a business model to quickly roll out to a car-sharing market with a large vehicle fleet, which is only possible through the B2C One-way type. Comparing the average fleet size among B2C types for car manufacturers, one can see that a firm with a one-way operational mode is significantly ahead with 1 300 vehicles versus 918. Comparing the average fleet size among B2C types for car manufacturers and stand-alone firms, we observe the better performance of the former providers (One -way – 1 330 cars; Round-trip – 918 cars) than of the latter providers (One -way – 485 cars; Round-trip – 521 cars).

As for the P2P business model that is known to be innovative in organizing the car-sharing by connecting supply and demand on a two-sided P2P platform model, the only car manufacturer is observed. It supports the argument that backed firms prefer traditional business models instead of innovative approaches (Chesbrough, 2020).

Analysis of the distribution of firms by business model shows that stand-alone firms are more diverse in choosing a business model when entering the car-sharing market. Despite the existing financial and resource constraints, they are more prone to innovative novelty and cover different business niches, using One-way (43%) and Round-trip (41%) modes with almost the same frequency (see Table 6). At the same time, there is an evident focus of car manufacturers' car-sharing firms on B2C One-way type (70%).

So, the fourth hypothesis about the business model diversity is also confirmed for the European car-sharing market. We see that car-sharing firms without car manufacturer support have a more diverse business model distribution with a more innovative approach.

At this point, the second and third hypotheses have been confirmed.

+ *H2: Firms backed by car manufacturers will have higher performance indicators.*
+ *H3: Stand-alone car-sharing firms will apply a more diverse variety of business models, unlike firms backed by car manufacturers.*

Thus, we have found that backed and stand-alone firms differ in operational characteristics. Path dependence exists in the car-sharing industry and determines the higher performance and the

way firms operate in the market. Following the traditional goal of making a profit and applying the existing competencies, car manufacturers tend to choose the B2C One-way business model and bypass the business novelty. On the contrary, stand-alone firms are more diverse in terms of business models, despite financial and resource limitations, and lag slightly behind the large players from the related industry.

3.3.3 Impact of electric vehicles in the fleet on firm's performance

We now turn to explore how the introduction of electric vehicles into fleets affects the performance of car-sharing providers. The addition of electric vehicles to the fleet can be seen as an innovation in the car-sharing business model as it impacts the value proposition. Electric vehicles provide a fleet diversity, thus creating more attraction for environmental-friendly users. Also, the presence of electric vehicles requires new infrastructure concerning the charging stations, which entails new partnerships and positioning in the market.

Some statistics based on the dataset should be given to understand the ubiquity of electric vehicles in car-sharing services in the European market. 31% of operators offer fully electric fleets, which is 8% of the total number of cars in the car-sharing market, and the trend is increasing. 47% of operators have started adding electric vehicles into their activities, so they seem to be transitioning to a hybrid vehicle fleet. Across the European car-sharing landscape, the most electrified countries are Germany, France, Spain, the Netherlands, and Italy.

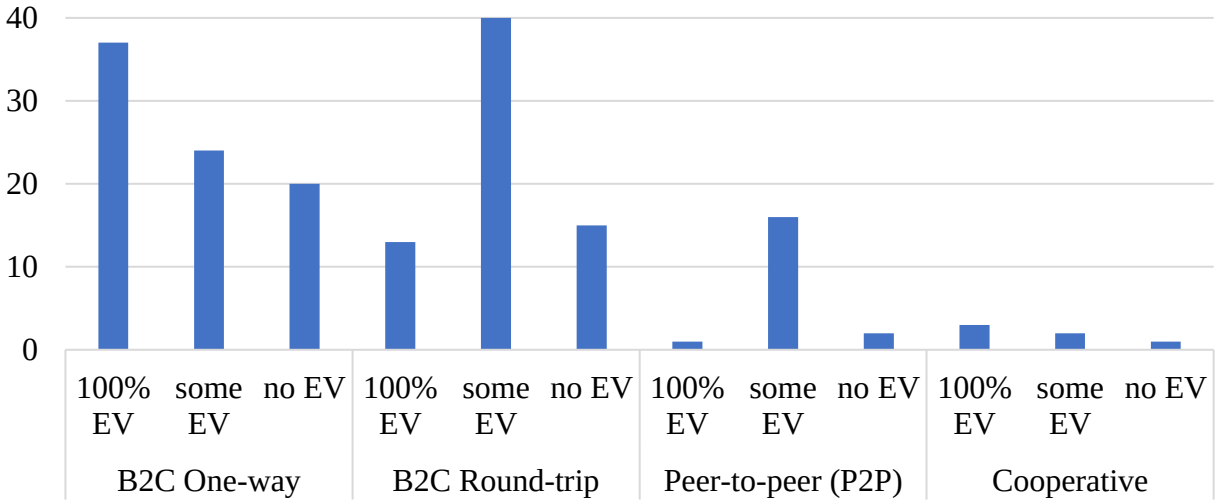

Figure 10: the number of car-sharing operators for each business model, depending on the electric vehicle (EV) availability in a fleet

Source: made by the author

Following the illustration on the number of car-sharing operators in terms of the presence of electric vehicles in Figure 10, we can conclude that the B2C One-way business model is the most popular choice for a car-sharing firm when launching a 100% electric vehicle fleet.

In general, electric vehicles are most commonly used in B2C models due to the ownership background. Indeed, in the P2P type, cars are provided to the platform by private owners. Therefore there is no centralized control over whether it is an electric vehicle or another if the platform itself does not make special requirements. Only one P2P car-sharing with a fully electric fleet has been discovered on the European market – Spanish operator «Som Mobilitat» with a small fleet of 20 cars. The same logic is applied to cooperative car-sharing. In the case of B2C operators, they are switching to electric vehicles for several reasons. The first reason is lower operating costs, which are relevant for small stand-alone firms due to the lack of considerable funding and for car manufacturers striving for rapid profit growth. Another reason behind this is enforced regulations regarding zero-emissions policy.

One more remarkable scope to explore is the role of car manufacturers in the electrification of car-sharing fleets. As it turned out, 12 out of 23 backed firms (52%) deploy 100% electric vehicle fleets, while only 4 of 23 ignore that at all. In the case of stand-alone firms, the share of the all-electric fleet is much lower, at only 28%, accounting for 42 out of 151 operators. 34 out of these 151 operators do not use electric vehicles at all.

Recall that the average size of the fleet is used as a performance indicator in the research. We can then analyze the models' success by dividing the entire car-sharing market into groups depending on the share of electric vehicles across their fleet operation (see Table 7). Cooperatives and P2P firms are out of scope for the above reasons.

	Cooperative	**P2P**	**B2C Round-trip**	**B2C One-way**
100% EV	13	20	138	364
some EV	161	5944	810	1391
no EV	640	752	241	298

Table 7: Average fleet size in number of vehicles per each business model's type, depending on the electric vehicle (EV) availability in a fleet

Source: made by the author

For B2C business models, performance indicators are found to be ambiguous in the context of electric vehicle availability. With a diversified fleet with some electric vehicles, the performance of a car-sharing operator is much higher (810 cars on average) compared to an operator without electric vehicles (241 cars). However, fully electrified fleets (138 cars) are inferior in success to

the latter. The B2C One-way business model with an innovative approach to fleet composition outperforms car-sharing without electric vehicles. In general, the average B2C car-sharing operator with at least some electric vehicles in the fleet performs better. We can accept the fourth hypothesis with the 10%-level significance.

The average age of car-sharing with a 100% electric fleet is six years, while without electric vehicles, it is nine years. We can say that the introduction of electric cars is an innovative approach in the car-sharing market. Given the average operator's age of 13 in the car-sharing category, which partially adds electric cars, it can also be assumed that some firms are in a transitional stage and are adapting their business model to the realities of the market. Given the immaturity of the car-sharing market and the trend towards fleet electrification, it is likely that soon the availability of electric vehicles will become a solid indicator of the success of the car-sharing service.

Thus, the fourth hypothesis has been confirmed:

+ *H4: The availability of electric vehicles in the fleet will increase the performance results of car-sharing operators.*

Car-sharing operators have been found to perform better when they practice an innovative approach to fleet design. The availability of electric vehicles works as a competitive advantage for the car-sharing firm.

Discussions and conclusions

The research aimed to study the factors affecting the performance of car-sharing firms. The first chapter of the study has revealed the essence and relevance of car-sharing as a significant segment of the sharing economy. Then the overview of the car-sharing industry has been conducted, and the leading market with its diversity and dynamism, the European Union, has been selected for the research purposes. In the course of the research, a broad set of data has been collected.

Based on the existing theory on business models, car-sharing firms have been grouped and described in detail through the main business dimensions. Given the immaturity and fluidity of the car-sharing industry, the existing literature on performance has been studied to develop an approach to evaluating firms' success for such a challenging industry as car-sharing. Combining path dependence theory and the first-mover advantage with business model features, a set of hypotheses regarding car-sharing firm performance have been investigated to achieve the research goal.

Theoretical contributions and discussions

The research delivers exploratory insights into different types of business models in the car-sharing market of the European Union, their diffusion pattern, and their characteristics. The results show that the representation of car-sharing varies significantly from country to country. There are large markets with a long history of car-sharing initiatives and institutional predisposition (Germany, France, Italy, the Netherlands). There are markets where car-sharing is just beginning to emerge (Slovakia, Malta, Cyprus). At the same time, there are markets where car-sharing is not present yet (Greece). Thanks to the entry analysis of the car-sharing presence, its expanding trend is confirmed for the European Union with the future growth potential in the region.

Considering the nature of car-sharing cooperatives and their performance indicators, they are locally rooted and serve the niche that big car-sharing operators avoid because of the deliberate profit failure and scale economy's absence. Due to zero marginal costs, P2P providers are the most sizeable, and they are not tied to any location: they are the most international firms and can operate both in dense urban and rural areas.

Following the logic of B2C providers in making a profit, they are supposed to occupy the most promising markets. Indeed, B2C Round-trip and B2C One-way operators are more restrained. However, these business models are more professional and impersonal, making further

unlimited growth possible. Comparing B2C types, the performance indicators of the newer B2C One-way business model outperforms the traditional older B2C Round-trip business model due to the greater operational flexibility, higher market penetration and more growth potential. B2C One-way business model is found dominant among car-sharing firms and outperforming over B2C Round-trip one.

Further contribution lies in that insights into entry patterns and path dependence have been gained. The study shows that at an early stage of car-sharing development, entry barriers were low, while in recent time, the choice of an operating business model indicates high barriers to entry and a growing effect of network externalities. Although car-sharing has not followed a dominant business model over the 30 years of development, since 2012, there has been an overall trend in a large number of new players, most of which are operating through the B2C One-way business model.

The results support the existence of the first-mover advantage for each car-sharing business model that aligns with previous similar research on isolated countries (Münzel et al., 2018). However, the positive effect of the first-mover advantage on the firm performance is also confirmed for the whole market level that makes this study distinctive from previous ones. Studying firms' ownership with the focus on car manufacturers has revealed the existence of path dependence strongly and positively affecting the performance of firms.

However, while car-sharing firms owned by a car manufacturer have higher performance, they lack innovation stimulus as automotive companies are driven by a dominant business model, hence the race for profits. Following the traditional goal of making a profit and applying the existing competencies, car manufacturers tend to choose the B2C One-way business model, which provides the highest profit possibilities ceteris paribus, and bypasses the business novelty. On the contrary, stand-alone car-sharing firms are more diverse in terms of business models, despite financial and resource limitations.

Supporting the theoretical claim of scholars about the positive influence of business model innovation on a firm's performance (Zott et al., 2011), car-sharing firms have been explored from the fleet design perspective. The availability of electric vehicles has been considered as innovation and, furthermore, found to affect the performance positively working as a competitive advantage.

Thus, the research contributes to developing theoretical knowledge and provides insights on business model factors that affect car-sharing performance, covering a wide range of countries and long period. The results reveal the important influence of business model factors on car-sharing firm performance.

Managerial implications

In addition to theoretical contributions, some practical managerial implications can be derived from research results. Car-sharing is a relatively recent phenomenon in mobility, with much of the growth seen in the last decade since 2012. The industry is under active growth, so that development can take different paths depending on technological innovation, future regulatory policies from the state, and adaptation of business strategies by firms.

First, for both managers of existing car-sharing firms and entrepreneurs, it is recommended to pay attention to the countries of the European Union, where the car-sharing market is still unsaturated and is just starting to emerge. As the analysis shows, this applies to the Balkan countries, and Cyprus, and Greece is also a vacant market.

According to the results of the study, the P2P business model performs significantly better. On account of the growing environmental concerns, governments of numerous countries in the European Union are undertaking initiatives to curb greenhouse emissions and reduce the ownership of private cars. It can be the right moment for P2P car-sharing operators to granting support from local municipalities, like free parking spots for vehicles around the city. It would provide the expansion of P2P services.

Next, the leading representation of B2C business models is revealed. It is already observed from the practice that today, some firms experiment with different operating business models, complementing the existing round-trip operating model with the newer one-way model or vice versa. The results of the research show that the B2C One-way business model is having higher performance. Hence, managers of B2C Round-trip car-sharing firms should combine two B2C business models. Considering the gap between various car-sharing business models to narrow over time, the earliest differentiation of business approaches will give a competitive advantage and increase the firm's performance.

Another important finding of the research is that car-sharing firms that have been launched by car manufacturers have higher performance indicators. From the car manufacturers' point of view, they are vulnerable under current market trends on car ownership decrease. Accordingly, they will continue to increase their presence in related business industries, including the car-sharing one. Small car-sharing firms, both existing and those wishing to open, should consider a strategy for a joint business with companies from the automotive industry instead of launching a car-sharing service on their own since experience from related industries is supposed to be a success driver. Indeed, instead of competing with a notoriously more successful player, it is wise to try making him your partner. A car manufacturer can provide a large vehicle fleet and jump into the car-sharing industry with resources and connections, while entrepreneurial representatives can

offer an advanced technological product and come up with innovative ideas, which car manufacturers usually lack.

Anticipating future shared mobility trends and pursuing innovative business models, car-sharing firms can also evolve towards corporate car-sharing.

Limitations and recommendations for further research

Although the research completes the stated objectives and achieves the main goal, it is worth mentioning that it has a couple of limitations. This study uses an alternative evaluation approach to capture the broader operational effectiveness of firms, namely firm size in terms of the number of shared cars available to users. Following research by several authors (Venkatraman & Ramanujam (1986); Stam et al. (2014); Münzel et al. (2018)), an attempt has been made to measure the performance of car-sharing firms through non-financial indicators, highlighting the multimodality of the performance concept. It goes in line with the characteristic of the car-sharing industry, which is young and fluid and includes mainly small firms, which makes it challenging to acquire the financial data and presents the limitation of the research.

Thus, with the absence of publicly stated financial data in the car-sharing industry, further research could focus on surveying firms about their financial indicators in order to measure the firms' performance in terms of profitability. Some expert interviews could also be a tool for further research. The sample of firms willing to disclose their financials is most likely to be small for trade secret reasons, but this could shed light on the lucrative side of the business and reveal new features of car-sharing business models.

Continuing the context above, there is also a data limitation regarding the car-sharing cooperative business model, whose firms are mainly not represented online but work among local communities. Since, moreover, cooperatives are not profit-driven but follow social and environmental motives, further research could exclude them and focus only on profit-oriented car-sharing business models (P2P and B2C).

The study covers the ownership dimension of car-sharing firms concerning car manufacturers. The automotive industry is currently facing the risk of conflict with the car-sharing business since one shared car is calculated to replace up to 20 private cars (Loose, 2016). The study results could become a ground for a deeper research of ways to actively expand the presence of car manufacturers in the car-sharing market. On the other hand, the car-sharing market is an attractive arena for players from other related industries, such as energy companies or transport service municipalities. It may be interesting to explore further the performance and features of

synergy players with different backgrounds in the car-sharing market when the number of such cases starts to grow.

One more direction for further research could be testing whether the obtained results are applicable and can be extrapolated to other car-sharing markets, such as North America or Asia. Considering local peculiarities, it could seem possible to draw a conclusion about a universal car-sharing business model to implement it in any new market with growth potentials such as the Middle East or Latin America.

In addition to examining the performance of current car-sharing operators, further research could look at unsuccessful outliers and understand why certain firms fail in the market. This could provide car-sharing business model features for a counterexample.

All in all, the conducted research gives a rather extensive picture of different dimensions of car-sharing firms and car-sharing business model's characteristics. The main research goal has been achieved by identifying factors that affect car-sharing providers' performance in the European Union. Thus, the research results can be extensively used for further studies and be a basis to deepen knowledge in the car-sharing industry.

References

1. ACEA. (2018). World Production. Available online: https://www.acea.be/statistics/tag/category/world-production. Accessed on 02.11.2020.

2. Amit, R., & Zott, C. (2001). Value creation in e-business. Strategic management journal, 22(6-7), 493-520.

3. Arbolino, R., Carlucci, F., Cirà, A., Ioppolo, G., & Yigitcanlar, T. (2017). Efficiency of the EU regulation on greenhouse gas emissions in Italy: The hierarchical cluster analysis approach. Ecological Indicators, 81, 115-123.

4. Bardhi, F., & Eckhardt, G. M. (2012). Access-based consumption: The case of car sharing. Journal of consumer research, 39(4), 881-898.

5. Belk, R. (2014). You are what you can access: Sharing and collaborative consumption online. Journal of business research, 67(8), 1595-1600.

6. Belk, R. W. (2014). Sharing versus Pseudo-Sharing in web 2.0. Anthropologist, 18, 7–23.

7. Böcker, L. & Meelen, T. (2017). Sharing for people, planet or profit? Analysing motivations for intended sharing economy participation. Environmental Innovation and Societal Transitions, 23, 28–39.

8. Boldrini, C., Bruno, R. (2017). Stackable vs autonomous cars for shared mobility systems: a preliminary performance evaluation. In: Proceedings of the IEEE 20th International Conference on Intelligent Transportation Systems, 232–237.

9. Botsman, R., & Rogers, R. (2011). What's Mine Is Yours: The Rise of Collaborative Consumption. Harper Collins Publishers: New York, NY, USA.

10. Botsman, R., & Rogers, R. (2010). What's mine is yours. The rise of collaborative consumption.

11. CAR. (2016). The Impact of New Mobility Services on the Automotive Industry. Available online: https://www.cargroup.org/wp-content/uploads/2017/02/The-Impact-of-New-Mobility-Services-on-the-Automotive-Industry.pdf. Accessed on 04.11.2020.

12. Ceccato, R., & Diana, M. (2018). Substitution and complementarity patterns between traditional transport means and car sharing: a person and trip level analysis. Transportation, 1-18.

13. Chen TD, Kockelman KM (2016) Carsharing's life-cycle impacts on energy use and greenhouse gas emissions. Transp Res Part D Transp Environ 47:276–284.

14. Chesbrough, H. (2010). Business model innovation: opportunities and barriers. Long range planning, 43(2-3), 354-363.

15. Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Industrial and corporate change, 11(3), 529-555.

16. Codagnone, C. & B. Martens. (2016). Scoping the Sharing Economy: Origins, Definitions, Impact and Regulatory Issues. Institute for Prospective Technological Studies Digital Economy Working Paper, 1. Available online: https://ec.europa.eu/jrc/sites/jrcsh/files/JRC100369.pdf.

17. Cohen, B., & Kietzmann, J. (2014). Ride on! Mobility business models for the sharing economy. Organization & Environment, 27(3), 279-296.

18. Cohen, B., & Muñoz, P. (2016). Sharing cities and sustainable consumption and production: towards an integrated framework. Journal of cleaner production, 134, 87-97.

19. Curtis, S. K., & Lehner, M. (2019). Defining the sharing economy for sustainability. Sustainability, 11(3), 567.

20. Deloitte Monitor. (2017). Car Sharing in Europe Business Models, National Variations and Coming Disruptions. Available online: https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consumer-industrial-products/CIP-Automotive-Carsharing-in-Europe.pdf. Accessed on 15.01.2021.

21. Dunbar, R. L., & Starbuck, W. H. (2006). Learning to design organizations and learning from designing them. Organization Science, 17(2), 171-178.

22. Eckhardt, G. M., Houston, M. B., Jiang, B., Lamberton, C., Rindfleisch, A., & Zervas, G. (2019). Marketing in the sharing economy. Journal of Marketing, 83(5), 5-27.

23. Firnkorn, J. & Shaheen, S. (2016). Generic time- and method-interdependencies of empirical impact-measurements: A generalizable model of adaptation-processes of carsharing-users' mobility-behavior over time. Journal of Cleaner Production, 113, 897–909.

24. Firnkorn, J., & Müller, M. (2015). Free-floating electric carsharing-fleets in smart cities: The dawning of a post-private car era in urban environments?. Environmental Science & Policy, 45, 30-40.

25. Frenken K, Meelen T, Arets M, Van de Glind P. (2015). Smarter regulation for the sharing economy. The Guardian, 20 May 2015. See https://www.theguardian.com/science/political-science/2015/may/20/smarter-regulation-for-the-sharing-economy. Accessed on 06.02.2021.

26. Friedel, A. (2020). Free Floating CarSharing Report 2020. Available online: https://www.dropbox.com/s/keaudxjq9aje2on/2020%20Free%20Floating%20Car%20Sharing%20Report.pdf.

27. Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path dependence or path creation?. Journal of management studies, 47(4), 760-774.

28. Giesen, E., Berman, S. J., Bell, R., & Blitz, A. (2007). Three ways to successfully innovate your business model. Strategy & leadership.

29. Görög, G. (2018). The Definitions of Sharing Economy: A Systematic Literature Review. Management, 13(2), 175–189.

30. Guttentag, D. (2015). Airbnb: disruptive innovation and the rise of an informal tourism accommodation sector. Current issues in Tourism, 18(12), 1192-1217.

31. Huang, Y., Qian, L., Soopramanien, D., & Tyfield, D. (2021). Buy, lease, or share? Consumer preferences for innovative business models in the market for electric vehicles. Technological Forecasting and Social Change, 166, 120639.

32. Illgen, S., & Höck, M. (2018). Electric vehicles in car sharing networks–Challenges and simulation model analysis. Transportation Research Part D: Transport and Environment, 63, 377-387.

33. Kent, J. L. (2014). Carsharing as active transport: What are the potential health benefits? Journal of Transport & Health, 1(1), 54–62.

34. Kortum, K., Schönduwe, R., Stolte, B., & Bock, B. (2016). Free-floating carsharing: City-specific growth rates and success factors. Transportation Research Procedia, 19, 328-340.

35. KPMG. (2016). Global Automotive Executive Survey 2016. Available online: https://assets.kpmg.com/content/dam/kpmg/pdf/2016/01/gaes-2016.pdf. Accessed on 04.12.2020.

36. Lagadic, M., Verloes, A., & Louvet, N. (2019). Can carsharing services be profitable? A critical review of established and developing business models. Transport Policy, 77(C), 68-78.

37. Le Vine, S., Zolfaghari, A., & Polak, J. (2014). Carsharing: Evolution, Challenges and Opportunities. Brussels, 22nd European Automobile Manufacturers Association (ACEA) Scientific Advisory Group Report. Available online: https://www.acea.be/uploads/publications/SAG_Report_-_Car_Sharing.pdf. Accessed on 02.11.2020.

38. Le Vine, S., & Polak, J. (2019). The impact of free-floating carsharing on car ownership: Early-stage findings from London. Transport Policy, 75, 119-127.

39. Lemme, R. F., Arruda, E. F., & Bahiense, L. (2019). Optimization model to assess electric vehicles as an alternative for fleet composition in station-based car sharing systems. Transportation Research Part D: Transport and Environment, 67, 173-196.

40. Loose, W. (2016). Mehr Platz zum Leben—wie CarSharing Sta¨dte entlastet. Ergebnisse des bcs-Projektes CarSharing im innersta¨dtischen Raum—eine Wirkungsanalyse Endbericht. Berlin.

41. Martin, E. W., & Shaheen, S. A. (2011). Greenhouse gas emission impacts of carsharing in North America. IEEE Transactions on intelligent transportation systems, 12(4), 1074-1086.

42. Martin, E., & Shaheen, S. (2016). Impacts of car2go on vehicle ownership, modal shift, vehicle miles traveled, and greenhouse gas emissions: An analysis of five North American cities. Transportation Sustainability Research Center, UC Berkeley, 3.

43. Martin, E., Shaheen, S. A., & Lidicker, J. (2010). Impact of carsharing on household vehicle holdings: Results from North American shared-use vehicle survey. Transportation research record, 2143(1), 150-158.

44. McKinsey. (2016). Automotive Revolution & Perspective Towards 2030. How the convergence of disruptive technology-driven trends could transform the auto industry. Available online: https://www.mckinsey.com/~/media/McKinsey/Industries/High%20Tech/Our%20Insights/Disruptive%20trends%20that%20will%20transform%20the%20auto%20industry/Auto%202030%20report%20Jan%202016.ashx. Accessed on 02.11.2020.

45. Millard-Ball, A., Murray, G., Schure, J.T., Fox, C. (2005). Car-sharing: Where and how it succeeds (Vol. 60). Transportation Research Board.

46. Morris, M., Schindehutte, M., & Allen, J. (2005). The entrepreneur's business model: toward a unified perspective. Journal of business research, 58(6), 726-735.

47. Münzel, K., Boon, W., Frenken, K. & Vaskelainen, T. (2018). Carsharing business models in Germany: characteristics, success and future prospects. Information Systems and e-Business Management, 16, 271–291.

48. Münzel, K., Boon, W., Frenken, K., Blomme, J., & van der Linden, D. (2020). Explaining carsharing supply across Western European cities. International Journal of Sustainable Transportation, 14(4), 243-254.D.

49. Murmann, J. P., & Frenken, K. (2006). Toward a systematic framework for research on dominant designs, technological innovations, and industrial change. Research policy, 35(7), 925-952.

50. Namazu, M., & Dowlatabadi, H. (2018). Vehicle ownership reduction: A comparison of one-way and two-way carsharing systems. Transport Policy, 64, 38-50.

51. PricewaterhouseCoopers LLP. (2014) The Sharing Economy: How Will It Disrupt Your Business? Megatrends: The Collisions. USA. Available online: http://pwc.blogs.com/files/sharing-economy-final_0814.pdf. Accessed on 02.11.2020.

52. Puschmann, T. & Alt, R. (2016). Sharing Economy. Business & Information Systems Engineering, 58(1), 93–99.

53. Roblek, V., Meško, M., & Podbregar, I. (2021). Impact of Car Sharing on Urban Sustainability. Sustainability, 13(2), 905.

54. Rodenbach, J., Mathis, J., Chicco, A., & Diana, M. (2017). Car sharing in Europe: a multidimensional classification and inventory.

55. Ruff, F. (2015). The advanced role of corporate foresight in innovation and strategic management – Reflections on practical experiences from the automotive industry. Technological Forecasting and Social Change, 101, 37–48.

56. Sánchez-Pérez, M., Terán-Yépez, E., Marín-Carrillo, M. B., & Rueda-López, N. (2021). 40 years of sharing economy research: An intellectual and cognitive structures analysis. International Journal of Hospitality Management, 94, 102856.

57. Schaefers, T. (2013). Exploring carsharing usage motives: A hierarchical means-end chain analysis. Transportation Research Part A: Policy and Practice, 47, 69–77.

58. Schmöller, S., Weikl, S., Müller, J., & Bogenberger, K. (2015). Empirical analysis of free-floating carsharing usage: The Munich and Berlin case. Transportation Research Part C: Emerging Technologies, 56, 34-51.

59. Seign, R., Schüßler, M. & Bogenberger, K. (2015). Enabling sustainable transportation: The model-based determination of business/operating areas of free-floating carsharing systems. Research in Transportation Economics, 51, 104–114.

60. Shafer, S. M., Smith, H. J., & Linder, J. C. (2005). The power of business models. Business horizons, 48(3), 199-207.

61. Shaheen, S. A., & Cohen, A. P. (2013). Carsharing and personal vehicle services: worldwide market developments and emerging trends. International journal of sustainable transportation, 7(1), 5-34.

62. Shaheen, S. A., Cohen, A. P., & Roberts, J. D. (2006). Carsharing in North America: Market growth, current developments, and future potential. Transportation Research Record, 1986(1), 116-124.

63. Shaheen, S. A., Sperling, D., & Wagner, C. (1999). A Short History of Carsharing in the 90's.

64. Shaheen, S., Cohen, A., & Jaffee, M. (2018). Innovative Mobility: Carsharing Outlook. UC Berkeley: Transportation Sustainability Research Center. Available online: https://escholarship.org/uc/item/49j961wb.

65. Shaheen, S., Sperling, D., & Wagner, C. (1998). Carsharing in Europe and North America: Past, present, and future. Transportation Quarterly, 52(3), 35–52.

66. Smith, B., Spulber, A., Modi, S. & Fiorelli, T. (2017). Technology Roadmaps: Intelligent Mobility Technology, Materials and Manufacturing Processes, and Light Duty Vehicle Propulsion. Center for Automotive Research, Ann Arbor, MI.

67. Sorescu, A. (2017). Data-driven business model innovation. Journal of Product Innovation Management, 34(5), 691-696.

68. Sprei, F., Habibi, S., Englund, C., Pettersson, S., Voronov, A., & Wedlin, J. (2019). Free-floating car-sharing electrification and mode displacement: Travel time and usage patterns from 12 cities in Europe and the United States. Transportation Research Part D: Transport and Environment, 71, 127-140.

69. Stam, W., Arzlanian, S., & Elfring, T. (2014). Social capital of entrepreneurs and small firm performance: A meta-analysis of contextual and methodological moderators. Journal of Business Venturing, 29 (1), 152-173.

70. Stoiber, T., Schubert, I., Hoerler, R., & Burger, P. (2019). Will consumers prefer shared and pooled-use autonomous vehicles? A stated choice experiment with Swiss households. Transportation Research Part D: Transport and Environment, 71, 265-282.

71. Teece, D. J. (2010). Business models, business strategy and innovation. Long range planning, 43(2-3), 172-194.

72. Temenos, C., Nikolaeva, A., Schwanen, T., Cresswell, T., Sengers, F., Watson, M., & Sheller, M. (2017). Theorizing mobility transitions: an interdisciplinary conversation. Transfers, 7(1), 113-129.

73. Thompson, J. D., & MacMillan, I. C. (2010). Business models: Creating new markets and societal wealth. Long Range Planning, 43(2-3), 291-307.

74. Vasconcelos, A. S., Martinez, L. M., Correia, G. H., Guimarães, D. C., & Farias, T. L. (2017). Environmental and financial impacts of adopting alternative vehicle technologies and relocation strategies in station-based one-way carsharing: An application in the city of Lisbon, Portugal. Transportation Research Part D: Transport and Environment, 57, 350-362.

75. Vaskelainen, T. (2014). Sustainable Business Models-The Case of Car Sharing. In Resilence-The New Research Frontier: Proceedings of the 20th Annual International

Sustainable Development Research Conference. Norwegian University of Science and Technology; International Sustainable Development Research Society.

76. Venkatraman, N., & Ramanujam, V. (1986). Measurement of business performance in strategy research: A comparison of approaches. Academy of management review, 11(4), 801-814.

77. Wells, P. (2013). Sustainable business models and the automotive industry: A commentary. IIMB Management Review, 25, 228–239.

78. Zhang, Y., Huang, M., Tian, L., Jin, D., & Cai, G. G. (2021). Build or join a sharing platform? The choice of manufacturer's sharing mode. International Journal of Production Economics, 231, 107811.

79. Zott, C., & Amit, R. (2007). Business model design and the performance of entrepreneurial firms. Organization science, 18(2), 181-199.

80. Zott, C., & Amit, R. (2008). The fit between product market strategy and business model: Implications for firm performance. Strategic management journal, 29(1), 1-26.

81. Zott, C., & Amit, R. (2010). Designing your future business model: An activity system approach. Long Range Planning, 43(2), 216-226.

82. Zott, C., Amit, R., & Massa, L. (2011). The business model: recent developments and future research. Journal of management, 37(4), 1019-1042.

Appendixes

Appendix 1: ANOVA-test results for the firms' performance by a business model at 1% significance level

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
B2C One-way	81	52793	651,7654	1160441
B2C Round-trip	68	37818	556,1471	1010196
Cooperative	6	999	166,5	69125,9
Peer-to-peer (P2P)	19	96628	5085,684	83250913

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3,43E+08	3	1,14E+08	11,72638	0,000001	3,898899407
Within Groups	1,66E+09	170	9761061			
Total	2E+09	173				

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Cooperative	6	0,087373	0,014562	0,000518
Peer-to-peer (P2P)	19	4,155099	0,218689	0,061491
B2C Round-trip	67	1,399531	0,020889	0,001421
B2C One-way	80	3,085421	0,038568	0,004873

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,615343	3	0,205114	21,6974	0,00000	3,900323
Within Groups	1,588173	168	0,009453			
Total	2,203517	171				

Appendix 2: correlation coefficients between the firms' performance and age for each business model separately and the whole dataset

Cooperative business model

	Column 1	*Column 2*
Column 1	1	
Column 2	0,410	1

P2P business model

	Column 1	*Column 2*
Column 1	1	
Column 2	0,060	1

B2C Round-trip business model

	Column 1	*Column 2*
Column 1	1	
Column 2	0,164	1

B2C One-way business model

	Column 1	*Column 2*
Column 1	1	
Column 2	0,203	1

All business models

	Column 1	*Column 2*
Column 1	1	
Column 2	0,055	1

Appendix 3: ANOVA-test results for the firms' performance and age for each business model separately and the whole dataset

Cooperative business model (1% significance level)

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
X				
Years of operation	6	52	8,667	19,86666667
Number of cars	6	999	166,5	69125,9

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	74734,08333	1	74734	2,161638722	0,17224	3
Within Groups	345728,8333	10	34573			
Total	420462,9167	11				

P2P business model (5% significance level)

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
X				
Years of operation	19	191	10,0526	36,274854
Number of cars	19	96628	5085,68	83250913

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2,4E+08	1	2,4E+08	5,8795567	0,020463852	4,113165277
Within Groups	1,5E+09	36	4,2E+07			
Total	1,7E+09	37				

B2C Round-trip business model (1% significance level)

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
X			13,6912	
Years of operation	68	931		87,91813
Number of cars	68	37818	556,147	1010195,5

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1E+07	1	1E+07	19,805897	0,00001787	6,827858182
Within Groups	6,8E+07	134	505142			
Total	7,8E+07	135				

B2C One-way business model (1% significance level)

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Years of operation	81	573	7,07407	85,494444
Number of cars	81	52793	651,765	1160440,6

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,7E+07	1	1,7E+07	29,009071	0,00000025319	6,79595794
Within Groups	9,3E+07	160	580263			
Total	1,1E+08	161				

All business models (1% significance level)

Anova: Single Factor 1%

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Number of cars	174	188238	1081,83	1,2E+07
Years of operation	174	1747	10,0402	87,3568

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	99939347,9	1	1E+08	17,2655	0,00004	6,7087
Within Groups	2002781316	346	5788385			
Total	2102720663	347				

Appendix 4: ANOVA-test results for the firms' performance by the ownership background at the 18% and 5% significance level accordingly

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Stand-alone firm	149	106456	714	2929804,44
Car manufacturer	23	28282	1230	2714072,15

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5288197	1	####	1,82233108	0,179	1,8125
Within Groups	4,93E+08	170	####			
Total	4,99E+08	171				

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Stand-alone firm	151	1623	10,7	94,1895806
Car manufacturer	23	124	5,39	18,7035573

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	572,803	1	573	6,77597642	0,01	3,8961
Within Groups	14539,92	172	84,5			
Total	15112,72	173				

Appendix 5: ANOVA-test results for the firms' performance depending on the EV-presence in a fleet at 10% significance level

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
100% EV	41	15304	373,2683	275044,4
some EV	58	159290	2746,379	79624155
no EV	33	11726	355,3333	241707

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,84E+08	2	92178197	2,60921	0,077474	2,344179
Within Groups	4,56E+09	129	35328010			
Total	4,74E+09	131				