Risk Management in the Car-sharing Industry

Masterthesis

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List of Abbreviations

PSS – Product-Service System
KH – Kraftfahrzeug Haftpflichtschaden (Third Party Liability Claims - TPL)
GDV – Gesamtverband der Deutschen-Versicherungswirtschaft

(The Association of German Insurance Companies).
Abstract

In the past few years, car-sharing has acquired momentum as an innovative mobility service. This emerging automotive niche is becoming increasingly attractive not only for new companies entering the market, but also for established rental companies and traditional automotive manufacturers who want to widen their service offer and keep the pace with fast changing mobility trends. The basic feature of the service, involving free-floating fleets of cars that customers can spontaneously access, and its rapidly changing market nature impose major challenges and risks, which car-sharing operators have to face on a daily basis. Being the very core of the business model, vehicles are the main source of such risks. Particularly, damages related expenses represent day-to-day issues in the sector, which, if not appropriately kept under control, will in turn inflate insurance costs. Customers’ driving behaviours are hard to screen and monitor, even more difficult is detecting low from high risk users before they become service members. Hence, the important role cost mitigation measures play to ensure sustainable business profitability. The following analysis focuses on the evaluation of insurance claims in the car sharing industry and has the ultimate objective of identifying potential relations with customer base’s characteristics. Theoretical and industry practices are supported by empirical company data provided by the market leader for flexible short-term car rentals: car2go. By helping in the identification of major drivers shaping the company’s risk profile, results will provide suggestions to fill in the gap and improve the currently available risk management policies and perhaps the realization of ad hoc procedures for special customer segments along with some recommendations for future studies to increase the cooperation between the car sharing and the motor insurance sectors.

The analysis covers car2go European operative locations, with particular focus on the German ones, during the time frame 2013 to 2014.
1. Theoretical Framework

Urban mobility has become a recurring theme within public discussion. World population is moving towards inner city-areas. Currently above 50% of citizens are estimated to be based within urban areas and this percentage is expected to grow till 67% by 2050. Increasing demand for convenience, for speed and for individualization of mobility services and increasingly congested city centres are all factors that have contributed to shape people’s needs for mobility requiring the development of a new approach to rethink personal cars, car ownership and all related costs.¹

Overtime the concept of urban mobility has shifted from the idea of structuring urban areas to accommodate their traffic flows to the development of mobility means adapted to urban transportation needs. This framework facilitated and helped the expansion of an innovative mobility service: car-sharing. Car-sharing is changing the traditional concept of cars perceived merely as products: vehicles are no longer considered just as physical objects characterized by private ownership, but are perceived also as means through which new services can be provided.

The integration of products and services has been discussed and described extensively in literature and this combination is often referred to as Product-Service Systems.

1.1 Product-service Theory

Since the early nineties, Product Service Systems (PSS) have become increasingly popular. Pushed by the last decade economic downturn, society and the business world have been looking at new ways to achieve a more resource-efficient economy, at the quest of the so called resource revolution²

A product-service system is defined as a mix of tangible products and intangible services designed and combined so that they are jointly capable of fulfilling final customer needs³. Hence, the focus is not anymore on the tangible product alone, but rather on the service the final user expects.

The difference between product-oriented and product-service businesses lies in the way they create value. While product-oriented companies focus on the volume of units sold, in the product-service business models the incentives are different. The tangible good becomes a cost element, while value is created by increasing the service life of the product.

The trend towards the integration of products and services, even in established manufacturing companies known more for their product offer than for their service offer, is not a completely new concept. To indicate such a union, the term *servitization* was coined in an article published in 1988. The word indicates the joint offer of service and product, more precisely it implies a process of innovation in the capabilities and in the skills of an enterprise to improve the value created, both for the final customer as well as for the company itself, shifting from the sale of mere products to the sale of systems of products and services. The shift involves primarily manufacturing companies which, next to their traditional business focused on products, want to widen their supply range offering services too. After all, in today’s business there are not just stand-alone products or just stand-alone services anymore; in the contemporary competitive environment, such a new business concept has often become an unavoidable track to be taken for many industrial sectors. Customers look for solutions that are more complex than the simple product or the simple service. The drivers, indeed, that lead a manufacturing company to follow a product-service strategy are mostly related to the basic drivers pushing companies to maintain their competitiveness; such drivers can be of economic nature, such as a reduced products’ profitability and/or of strategic nature, as adding services to the product offer is often seen as a way to differentiate the offer and acquire a competitive advantage, enriching the ability of offering solutions and not simply products to customers. Moreover, a service has a relational feature that a product generally does not have, increasing offer customization and clients’ loyalty, by establishing long lasting relations.

With the evolution of *servitization* strategies towards more complex forms, also the type of product-service offered as well the pricing scheme used tend to evolve towards more sophisticated solutions, in which the final price paid by the client is progressively less related to the ownership of the physical product.

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Product-services can be classified in four main categories relatively to the kind of service which is integrated in the offer: services technically connected to the products (maintenance, warranties), services which facilitate the use of the product (financing, insurance, computer consulting), usage-oriented product-services (sharing, car-pooling, leasing), result-oriented product-services (i.e. printing appliances integrated into document management system solutions). Among the described categories, the use-oriented and the result-oriented product-service systems have a higher degree of complexity as they offer to the final customer a comprehensive solution more adapted to his needs and more complex usage- or result-based pricing strategies.

Car-sharing is a fast growing mobility service perfectly embodying the concept behind product-service systems. The very first car-sharing model finds its roots back in the early 1950s. In 1948 the first European car-sharing initiative took place in Zurich through the so-called Selbstfahrergemeinschaft. However, due to the lack of technological expertise and sophistication of these very initial attempts, the business has acquired momentum only starting from the 1990s. The evolution of car-sharing not only as a stand-alone offer, but especially as an integrated feature within the offer of established automotive manufacturers, has been facilitated by favourable conditions created by the downturn experienced in the automotive sector and by the increased social concern with respect to sustainability issues. Changing needs and changing competitive dynamics drove major manufacturers to enhance and differentiate their offer by including innovative mobility services, along with traditional vehicle-related services, mainly of financial nature such as leasing or financing.

The general PPS value proposition reflects in the car-sharing model as the main objective is for individuals to still enjoy the benefits of a private car, without actually needing to own one. Car sharing, in effect, has been included in the category of PSS defined as use-oriented where the main purpose is to make the most out of a single vehicle, boosting the utilization rate of single cars by increasing their operation among multiple users.

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Car-sharing usage-intense feature is what differentiates it from traditional automotive enterprises: it is not a matter of selling individual vehicles anymore, but the focus is to improve the service offered through the product, cars in this instance, to the final customers in order to increase value creation by maximizing the operation rate of a single unit.

1.2 Insurance Theory
Car-sharing as a use-oriented product-service system has emerged as a mainstream transportation mode over the past decade.

The decision to take part to a car sharing program is supported by different reasons. Among many, the most popular are conveniences, as car-sharing programs allow members to rent cars on *as-needed* basis paying only the kilometres and time driven, and the transparent and easy to understand price, which is normally calculated by the minute or by the hour, including all vehicle-related costs, such as maintenance and repairs, parking and insurance\textsuperscript{11}.

From end users’ point of view, the service represents the chance to enjoy the benefits of using a private car without directly dealing with all the costs and responsibility connected with ownership.

While from a customer’s point of view the all-inclusive price has the aim of boosting convenience, car-sharing operators are struggling to improve their cost efficiency, especially in relation to insurance costs. The insurance sector is slowly adapting and learning how to deal with this new sector’s needs in terms of risk management\textsuperscript{12}. Nevertheless, premiums are progressively increasing for service providers as their customer base keeps on expanding, making claims and risks increasingly difficult to monitor and to optimally improve.

Uncertainty and delegation of action are, thus, primary features characterizing the car-sharing context where drivers appear to have more knowledge and control over their ability to drive than car-sharing operators and insurance providers do. The relationship closely resembles the one theoretically described in the so-called *principal-agent* theory. The insurance sector environment is, in fact, often taken as example when it comes to empirically describe the standard scenario.

involving power delegation within an unevenly distributed information setting in which the agency theory has its roots\textsuperscript{13}.

1.2.1 Principal-agent Theory

An agency relation exists when two economic actors, denominated \textit{principal} and \textit{agent}, having different objective functions and different approaches towards risk, interact according to specific modalities. The relation develops when one of the two subjects, namely the principal, delegates to the other subject, namely the agent, the amount of authority necessary for the execution of certain tasks and for the achievement of predefined objectives. The agent is thus expected to carry out the assigned tasks on the behalf and in the interests of the principal. However, given that both parties are expected to be utility maximizers, meaning they are expected to behave in such a way to fulfil their own well-being first, there is a significant probability that the agent won’t always have enough incentives to appropriately act in order to fulfil the interests of the principal\textsuperscript{14}.

Hence, agency theory sets the objective of identifying and understanding the causes and the consequences related to the divergence of interests among interacting actors, (the agent and the principal). It provides description of the contractual agreements drawn up by agents and principals, aimed at managing and reducing the costs due to the presence of an agency relation\textsuperscript{15}.

As they generally describe relations among subjects having different utility functions as well as different perceptions of risk and different levels of information, agency relations imply the inability to achieve the optimal resource allocation\textsuperscript{16} and require the implementation of contractual measures to achieve a balance relatively to information asymmetries and different propensities to risk. Therefore, due to its implications on the optimal resource allocation and the resulting generation of inefficiencies, the agency problem entails costs which are included in the so-called transaction cost category\textsuperscript{17}. However, the contribution of agency theory to the analysis of transaction costs lies in the closer focus on information asymmetry and uneven risk tendencies.

\textsuperscript{13} Cf. Ross (1973), 134.
\textsuperscript{14} Cf. Jensen and Meckling (1976), p. 4f.
\textsuperscript{15} Cf. Einsenhardt (1989), p. 60.
\textsuperscript{17} Cf. Williamson (1981), p.552f.
Among the most relevant factors characterizing the agency relation are in fact the existence of conflicting goals between actors, the reduced ability of the principal to verify the actions actually taken by the agents; the reduced verifiability by the principal could be due to the difficulties in collecting information on the agent’s behaviour as well as to the costs information collection entails. Additional important factors relate to the appreciation of risk that the principal and the agent have. The different approach to risk ultimately influences the actions the agent and principal would take.

Ideally, the parties could attempt to mitigate the disparity by trying to design complete contracts, where by complete it is meant a contract foreseeing every future event potentially affecting the transaction. However, this implies the parties’ human ability to optimally define their current and future intents in each and every detail. Unfortunately, in practice contracts are almost never complete\textsuperscript{18}; in real life incomplete contracts are the best can be achieved\textsuperscript{19}. Lack of completeness, though, prevents the full elimination of the inefficiencies deriving from asymmetry in information\textsuperscript{20}. Contractual incompleteness can have different grounds. It could be due to a precise will of the parties involved to leave openings in the contract to allow for future contract adaptation, given the excessive costs that would have to be incurred in the attempt of a complete contractual relation definition, or simply due to human bounded rationality to fully forecast every potential occurrence\textsuperscript{21}.

Agency theory, in fact, assumes that the contractual agreement, regulating the relation between the agent and the principal, is influenced by peculiar features of the subjects involved. These features are categorized as: human assumptions, since the agent and the principal are characterize by bounded rationality, selfish interests, opportunism and risk aversion, organizational assumptions, related to conflicting goals and limited verifiability\textsuperscript{22}.

Then, the core problem of the agency relation, deriving from the variables distinguishing the subjects involved, is represented by the choice of the means through which the principal is able to induce the agent to act and behave in order to achieve his (principal’s) own goals and consequently fulfil his own interests,

\textsuperscript{18} Cf. Hart and Moore (1999), 115f.
given the agent has superior information and he is as well as moved by personal interests conflicting with the principal’s.

Handling the agency relation should lead to the identification of a balance between the agent and the principal reflecting the most efficient outcome relatively to the management of the agency costs originating from the information asymmetry and risk perception.

With the objective of reducing the gap between the agent’s action and the expected results, the principal should design a system of incentives able to align the behaviour of the agent with the principal’s interests and should establish mechanisms of monitoring and control providing valuable information enabling the evaluation of the agent’s actions.

It is evident how the initial assumptions underlying the agency problem imply the generation of costs summing up with the costs generated by the gap between the decisions taken by the agent and those that would have actually led to the maximization of the principal’s utility function.

Following the scheme outlined by Jensen and Meckling\textsuperscript{23}, hence, the agency costs can be identified as the sum of: resources allocated by principal with the aim of monitoring the agent’s behaviour (control process implementation, reward mechanisms) and residual losses identified as the costs generated by the gap between the decisions taken by the agent and those that would have optimized principal’s utility function.

Therefore, the principal-agent theory allows understanding the way the economic subjects define the contractual agreements which limit the subjects’ actions in order to reduce the agency costs. It is important, though, to underline that the framework of the agency problem places the relation between the agent and the principal in a context of uncertainty. Such an uncertain environment has significant implications particularly for the principal and on the definition of the optimal contract: the principal has not complete knowledge on the actions actually carried out by the agent and/or on the level of information the agent possesses, which constitutes the information gap; moreover, the outcome of some behaviours can be uncertain for the agent himself, increasing the uncertainty the principal faces

\textsuperscript{23} Cf. Jensen and Meckling (1976), p.5f.
as he is not able to clearly detect a causal relation between the agent’s actions and the resulting effects.

The gap in information level can have two manifestations, dependant on the timing in which the information asymmetry arises. When the agent has hidden undesirable characteristics which the principal cannot detect before entering into the economic transaction, the problem is defined as adverse selection. When, instead, the agent takes hidden action that the principal is not able to directly monitor and control, after the agreement, the problem is defined as moral hazard.24

From the uncertainty and the information asymmetry derives the need to introduce in the contractual agreement, defining the principal-agent relation, limitations which increase the complexity of contracting.

It is exactly the asymmetry in information, one the key concept in the agency theory, which specifically requires the definition of ad hoc incentive schemes.

1.2.2 Principal-agent Theory in the Insurance Sector
Several studies have often analysed the existence of agency problems in the insurance sector.25 In particular, asymmetry in information acquires a significant relevance in the context of insurance contracts. Two scenarios could potentially emerge. On one hand, when an insurer provides high coverage insurance contracts to most of its clients, it could attract bad risk clients in the first place, triggering a mechanism of adverse selection leading to customers’ self-selection forehand. In the second scenario, an insured’s unobservable effort after entering the contractual relationship can increase the probability of an insurance claim. A person with extended insurance coverage has a reduced incentive to undertake precautions, which in turn increases the likelihood of a loss. The controversial incentive effect of insurance coverage on an individual’s behaviour, which may then change the likelihood or the size of losses, or both, is what constitutes moral hazard.26

From a theoretical point of view, insurance companies are assumed to operate in a competitive market where new players can freely enter and where players are assumed to have financial resources that they are willing to devote in contracts as long as they foresee an expected profit. These basic assumptions guarantee

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that any contract that is demanded and that is expected to be profitable will be supplied. Once analysed the expected profitability, insurers issue contracts which are generally highly standardized based on variables which can be summarized in a small number of quantitative and qualitative indicators (i.e. loss expense, driver’s age, gender, type of driving license) defining the risk profile of the insured subject. Historical data on the mentioned variables and on costs are diligently stored in databases to facilitate estimations.  

In the traditional insurance field the agency problem is what characterises the relation between the insurer, namely the principal, and the policy holder, embodying the agent. Insurance companies try to reduce the level of uncertainty regarding the expected driving behaviours of their customers by compensating their lack of information with estimations of risk, based on extensive actuarial statistics of historical loss figures. Those statistics help the insurers in the definition of the insurance contracts. On one hand, insurance providers tries to detect in advance those clients that could potentially represent a high risk for the company, by drafting more expensive contractual agreements based on factors supposed to increase the level of riskiness of an individual, such as young age. On the other hand, contract terms are periodically reviewed as a mean of deterring ongoing bad driving behaviours. In this way, the evaluation of the riskiness of a driver is adjusted to more appropriately reflect his actually driving performance.

The same agency relation applies between actors operating in the car-sharing field. However, in the car-sharing context the economic actor playing the role of the principal is not directly the insurer, but the car-sharing provider.

1.2.3 Principal-agent Theory in Car-sharing

In the framework of car-sharing, a vehicle insurance contract does not represent a direct link between the insurer and those actually responsible for vehicle claims anymore. The car-sharing company buys insurance coverage for its vehicle fleet against damages caused by its own customers. Hence, the agency problem is no more directly associated with the traditional relation between the insurance company and the party buying the policy. The traditional dilemma deriving from asymmetry of information shifts to the relation between the car-sharing service provider and its own user base.

Being car sharing a developing market sector and due its dynamic market nature, there is a need to further study the relation between car-sharing members and their risk profiles. To improve risk-management in the sector, it is important to be able to clarify the existence of an adverse selection or moral hazard, or both, problems when individuals acquire service membership status.

A series of studies showed that individuals attracted to car-sharing are environmentally concerned and normally possess an above-average level of education which have been proved to be characteristics connected to a lower level of riskiness\textsuperscript{28}. However, there are blurred boundaries in knowledge which do not allow to clearly determining if asymmetric information plays an important role when an individual joins a car-sharing program.

As previously mentioned, car-sharing members avoid the fixed costs of car ownership, as they neither are forced to buy vehicle insurance nor they need to worry about vehicle maintenance and repairs. Those costs are included in the variable fee users pay accordingly to the amount of time and/or kilometres driven. The all-inclusive price is what differentiates, though, the car-sharing agency problem from the traditional insurance agency relation. While insurers have contractual means to screen somehow their customer base (the agents) before as well as during the contractual relationship, car-sharers cannot. It is hard for a car-sharing operator to detect in advance if a customer represents or not a high risk for the business. As all customers are normally charged the same price, both good and bad clients will be attracted even if they know in advance they will represent a major risk for company, they will anyways face equal costs for enjoying the service. Even when a client reveals risky driving behaviours during the use of the service, it is hard to reduce the agency costs incurred. Car-sharers can apply a deductible to claim expenses which the driver is held responsible for, meaning sharing liability and costs, but more effective measures should be implemented to efficiently deter wrong behaviours.

Therefore, it is of primary concern for service providers to have a clearer understanding if their customers, or more likely particular segments among them, are more prone to illicit driving behaviours leading to major damage claims.

The insurance coverage already included in the service fee, the lower degree of attachment to the car due to no ownership relation and the current limitations

\textsuperscript{28} Cf. Le Vine et al. (2014), p.10.
providers have in efficiently tracking customers’ damage faults, might represent incentives for some customers to engage in dangerous or at least less careful driving behaviours reducing the cost efficiency of the business.

2. Car-Sharing Industry

Understanding the structure and the competitive environment in which car sharing companies operate is fundamental to get a deeper insight into the market problematic issues and into the prospective solutions to deal with them. The following description aims to investigate main market characteristics along with its current and future potentials.

2.1 The car-sharing Industry Overview

Car-sharing represents a particular business segment within the larger automotive industry. It refers to the sequential use of a vehicle by multiple users in which costs are time or distance based as customers are charged for the amount of time and/or for the amount of kilometres they drive.

In the past years, car-sharing has acquired momentum gradually been accepted as the symbol of a new urban mobility paradigm. The service enables customers to access free floating fleets of vehicles within predefined urban areas relatively to their needs and to the availability of vehicles. The main difference with the car rental sector lies in the duration of the rental as car-sharing rentals are relatively shorter both in terms of time as well as distance driven.

Car-sharing programs have become more and more popular, enabling drivers, especially those who do not possess a vehicle, to enjoy an independent transportation mode. The shift from a product-ownership to a product-service concept allows keeping the benefits of a private car, in terms of flexibility and comfort, while potentially lowering costs with respect to car ownership²⁹.

Car sharing surely represents a change both from the demand as well as from the supply side. On one hand, it expresses a changing need in demand through the will of an increasingly higher number of people who simply want to have ac-

cess to car usage by paying on demand. On the other hand, it requires a restructuring of the supply system which needs to be adapted to a new market need\textsuperscript{30}.

Big automotive companies as well, such as BMW and Daimler, became major forces behind this shift. Big multinationals too faced the need to develop a new business model to activate their own car-sharing service. Such a new business model works according to mechanisms which are slightly different from the ones driving the standard automotive company since the focus is not directly on units sold anymore but rather on the utilization of a single unit. The objective is now increasing the utilization of a single vehicle rather than increasing the sales of multiple units.

Therefore, this particular niche, which is becoming truly global in scope covering three continents (Europe, America and China), is redefining its own architecture through an innovation process, following the service economy trend developed particularly from the 1990s on\textsuperscript{31}.

2.2 Market structure and Main Competitors

The expanding trend in car sharing diffusion and the current limited number of competitors represent the ideal premises for attracting companies and new investments in the sector. Foreseen profitability pushed enterprises already operating in the car rental industry, like Avis and Hertz, along with industrial groups specialized in other sectors to launch their own car sharing business hoping to reap some of the benefits\textsuperscript{32}.

Some well-known European success cases are DriveNow by BMW, Autolib in France by the Bolloré Group and the current leader within flexible short-term car rental market, car2go by Daimler\textsuperscript{33}.

2.2.1 DriveNow

German automotive giant BMW has entered the car sharing business during April 2011 with the establishment of DriveNow, a 50\% joint venture in collaboration with another giant in the car rental sector, Sixt\textsuperscript{34}.

\textsuperscript{30} Cf. Firnkorn and Müller (2012), p.266.
\textsuperscript{32} Cf. Stanley (2013), p1f.
\textsuperscript{34} BMW Group Corporate and Governmental Affairs (ed.) (2011), p.1f.
DriveNow enables users to rent station-free vehicles via an app, the website or directly on the road. The service is currently available in Munich, Berlin, Düsseldorf, Hamburg, Cologne, San Francisco, Vienna and, since December 2014, in London, too. The fleet consists of about 2,800 cars. At the end of 2014, over 390,000 customers had benefited from the premium car-sharing service. The selection of vehicles offered includes: BMW series 1, BMW X1, Mini Cooper, Mini Cooper D, Mini Clubman, and Mini Cabriolet.35

The system is quite innovative due to the good integration between premium segment vehicles and a well-organized supply. On one side, BMW offers high quality cars and vehicle technology while SIXT inputs its know-how in car rentals, IT systems and a global network for customer membership registration. Moreover, the service is offered through the sub-brand BMWi which still has the flexibility of a start-up while taking advantage of the big pool of resources of the larger BMW Corporation.

The price model is quite simple and easy to read by customers. Customers need to pay a membership fee of 29€, the price/min is about 0.31€ which includes fuel, parking, insurance and car taxes.36 The project has immediately raised interests, demonstrating the increasing demand for urban flexible mobility services.

2.2.2 Autolib

Autolib is car sharing system which was firstly launched in Paris at the end of 2011. It is operated by the French Industrial Group Bolloré. The French giant is among the biggest five hundred companies and has strong market power in the transportation and logistics fields, media and communication and in the field of storing electric power.37

Autolib is meant to complement the earlier established bicycle sharing business, Velib, which was launched in 2007. The business is operated through a fully electric vehicle fleet, the Bluecars Bolloré model, and currently has available 2,400 Bluecars vehicles with about 5,000 charging points in the French territory. Subscribers reached about 55,000 as of June 2014.38 The service is available in Paris, where it started, and has been recently launched in Lyon and Bordeaux too. In the pipeline, two new cities are expected to be included in the geographical

36 Cf. DriveNow (2015)
scope of the group, London and Indianapolis, expanding the international reach of the service.  

The major innovation is represented by the lithium metal power battery particularly suited for the urban and suburban electric vehicles and ensures a driving autonomy of 250 km. Autolib price schemes slightly differ from the generally used price per minutes charges by other car sharing programs, such as DriveNow and car2go. Rates are calculated per 30 minutes of service use in addition to a lump sum fee to paid on a yearly, monthly, weekly or daily basis. Autolib has demonstrated to be a particularly good business model in a city like Paris of high population density with low parking opportunities and where 58% of the urban population does not own a car.

2.3 car2go

car2go is a mobility service offered by the automotive multinational group Daimler AG and positions as the market leader within short-term flexible rental sector.

The project was first developed in 2007 by Daimler’s Business Innovation Division, responsible for identifying future opportunities and developing new business models to be integrated in the core manufacturing business. The initial phase officially started in October 2008 with the launch of the first location in the city of Ulm. The following phases defined car2go as the market leader worldwide, currently present in 29 cities among eight countries across two continents (North America and Europe). The European locations have been operated as a joint venture corporation, car2go Europe GmbH, which is owned 75% by Moovel GmbH, also part of Daimler, and for 25% owned by the rental car company Europcar till mid-2015.

Within the for-profit car-sharing companies, car2go operates a free-floating fleet of SMART fortwo cars: the system does not have fixed stations and car bookings can be made spontaneously via smartphone or through the internet portal. The advantage for users is that they can freely use cars within predefined operational areas (called home areas) following access-based consumption logic, without the

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need to book in advance or bring the cars back to a specific spot, which makes one-way rentals possible. Users can get into the closest available car and experience the comfort of a private car without actually owns it. The standard fare goes by the minute according to the duration of the rental, following a one-time subscription fee of 29 €.

By the end of 2014, car2go achieved more than one million customers for its mobility services for the first time worldwide, of which more than 500.000 located in European countries and approximately 13.000 vehicles distributed globally, of which 1.300 are electric vehicles, making car2go the largest provider of electric mobile car-sharing.\(^\text{45}\)

Within EU borders, car2go experienced major boost in terms of customer expansion. Between 2013 and 2014 car2go customers grew by 60%, highly above expectations.\(^\text{46}\) Thanks to great customer acceptance overtime, the company carried major rollouts over the years being operational in fifteen European locations (table 1), covering major German cities (Hamburg, Berlin, Frankfurt, Stuttgart, München, Düsseldorf and Köln), main Italian cities such as Rome, Milan, Florence and Turin, as well as Austrian capital, Wien, and the Dutch capital, Amsterdam. Late 2014, it also started operations in Scandinavian locations (Copenhagen and Stockholm). Besides North America and Europe the company has entered more complicated and challenging markets too, such as China.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{City} & \textbf{Country} & \textbf{Vehicles} & \textbf{Type of car} & \textbf{Start date} \\
\hline
Düsseldorf & Germany & 225 & Gasoline & Feb. 2011 \\
Hamburg & Germany & 685 & Gasoline & Apr. 2011 \\
Amsterdam & Netherlands & 281 & Electric & Nov. 2011 \\
Vienna & Austria & 772 & Gasoline & Dez. 2011 \\
Berlin & Germany & 1,017 & Gasoline & Apr. 2012 \\
Köln & Germany & 350 & Gasoline & Sep. 2012 \\
Stuttgart & Germany & 516 & Electric & Nov. 2012 \\
München & Germany & 295 & Gasoline & Jun. 2013 \\
Milan & Italy & 689 & Gasoline & Aug. 2013 \\
Rome & Italy & 587 & Gasoline & Mar. 2014 \\
\hline
\end{tabular}
\caption{car2go European Locations\(^\text{47}\)}
\end{table}

\(^{46}\) car2go company data.
\(^{47}\) Figures as of end December 2014, excluding Turin launched in April 2015.
Florence | Italy | 200 | Gasoline | Mai 2014
Frankfurt | Germany | 201 | Gasoline | Sep. 2014
Copenhagen | Denmark | 194 | Gasoline | Sep. 2014
Turin | Italy | 200 | Gasoline | Apr. 2015

Own elaboration. Source: car2go company data.

However, given the fast-changing nature of the market, challenges are constantly in ambush. Increased competition (such as fierce competition of BWM’s owned DriveNow in München and Wien, or the Fiat-Trenitalia’s Enjoy in Milan, quickly changing consumers’ behavioural patterns regarding car ownership as well environmental impact, and rising costs make progressive expansion quite difficult, hence, the closing of few locations in the last years within European borders (table 2).

Table 2 - car2go closed-down European Locations

<table>
<thead>
<tr>
<th>City</th>
<th>Country</th>
<th>Start date</th>
<th>End date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyon</td>
<td>France</td>
<td>Feb. 2012</td>
<td>June 2012</td>
</tr>
<tr>
<td>London</td>
<td>United Kingdom</td>
<td>Dec. 2012</td>
<td>May 2014</td>
</tr>
<tr>
<td>Birmingham</td>
<td>United Kingdom</td>
<td>May 2013</td>
<td>May 2014</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go company data

2.4 Future Trends

Major uncertainties characterise car-sharing future. Uncertainty mainly relates to future technological improvement and customer acceptance, hence, the numerous studies by industry practitioners and consulting firms trying to project its future developments. Nevertheless, according to the frequently cited car-sharing sector analysis carried by out by the renown consulting firm Frost and Sullivan, some major trends are described that will positively influence the adoption of car-sharing services by cities and citizens. Municipalities will progressively implement smart and sustainable mobility systems within their territories, thanks to the greater harmonization across transportation modes, being buses, metros or shared vehicles, enhancing inter-operability across them. Infrastructures will be
improved and the service will become increasingly technology embedded with smart-phone based payment and booking methods.\textsuperscript{48}

Those trends will contribute to shape even more the traditional definition of car and of its usage. New platforms will be needed due to the shift from cities designed to accommodate traffic flows to cars designed to adjust to cities’ needs. Moreover, not only there is an increasing need for city-friendly cars, which are already available on the market, but there is a need for flexible and eco-friendly mobility solutions, freed from the hassles of maintenance, congestion, parking, inspection and insurance.

Market projections made by Frost and Sullivan (2011) depict a quite positive future for the overall car-sharing market: membership subscription being 14 million in Europe by 2020, shared vehicles being 200,000 in Europe by 2020, with 77,000 vehicles projected within 2016, expecting to replace over 1 million cars and a revenue stream reaching 7 billion € in Europe by 2020.\textsuperscript{49}

However, car sharing future raises important challenges too. Competition will become tougher. Due its potentials, the sector is attracting new entrants and pushing the currently existing ones, such BMW’s DriveNow, Fiat’s Enjoy, to make their business strategy fiercer. Expansion is crucial, launching new locations, entering new market to exploit first mover advantages, while greatly investing in marketing strategies to increase customer loyalty, key to ensure profitability of established locations.

Not only new companies will arise, but also established car rental companies, such as Zipcar in North America and Europcar, together with established auto manufacturers are expected to invest to reap the potentials of their own car-sharing businesses, of which car2go is an example.\textsuperscript{50}

Another pretty undiscovered, but rising trend that could impose major obstacles, if not promptly included in the offer range, is the so called peer-to-peer car sharing (P2P car-sharing). P2P car sharing is defined as

\begin{quote}
\textit{an innovative approach to vehicle sharing in which privately owned vehicles made temporarily available for shared use by an individual or members of a peer-}\end{quote}

\textsuperscript{48}Cf. Leveque (2011), p. 3-5.
to-peer company, with pickup and drop-off locations agreed on between the two parties (typically round trip).\textsuperscript{51}

Beyond P2P car sharing, car-sharing providers are trying to further differentiate their offer trying to expand their traditional range from traditional B2C (business to consumer) to include also business and premium customers (B2B – business to business).

3. Risk-related costs in the car-sharing industry

3.1 Main cost drivers

Despite the challenges characterising every growing market sector, car-sharing business appears to have great potentials, not only in terms of future growth, but also with respect to the sustainable development of cities. Among the many reasons customers would choose to rely on car-sharing for their daily or occasional mobility needs, one is the reduced costs they would incur. Primarily, they would avoid the hassles of dealing with all the fixed costs associated with vehicle ownership especially in terms of insurance, vehicle maintenance and parking costs\textsuperscript{52}. From service users’ point of view those cost elements acquire a different nature becoming variable cost items as they get to be included in the service variable fee customers are charged, which fluctuates according to minutes and kilometres driven.

For every user’s benefits, though, there are complications providers have to face. If on one hand, customers are better off reducing the burden of their car-related fixed expenses, on the other hand insurance and maintenance costs represent a big part of the cost load when considered from the perspective of car-sharing companies. Being cars the core of the business model, insurance is an especially problematic issue, to the point that many practitioners state that auto insurance represent a major obstacle to the expansion of the service\textsuperscript{53}.

Those companies which cannot self-insure must purchase their vehicle insurance in the open market. So far, though, it seems that the insurance sector is not prepared, yet, to face or efficiently respond to the special needs of car-sharing companies. A direct consequence is the inefficiency generated due to rising insur-

\textsuperscript{51} Ballús-Armet et al. (2014), p.28.
\textsuperscript{52} Cf. Britton (1999), p.80.
ance premiums which in turn makes the insurance charge car-sharers pay three to four times higher than what an individual car owner would otherwise pay.\textsuperscript{54}

Therefore, one interesting future analysis could be devoted to the understanding of how the insurance market should be better structured to accommodate and respond to the needs related to the shared used of vehicle among multiple drivers.

Another important issue is liability definition under current legislations in the different countries. The definition of the car-sharing business is still blurred for most insurance companies, thus it is still quite unclear how to optimize members' insurance coverage. This lack of clearness makes car sharing providers liable for any violation, collision, damages to other vehicle caused by a service member to third parties. Additionally, the dispersion of the service customer base implies a greater degree of difficulty in monitoring and controlling the company's exposure and risk.\textsuperscript{55}

Hence, the increasingly important role crashes and insurance-related cost mitigation and controlling measures play in order not to prevent the sustainable development of the business.

Due to its still small size compared to the bigger car rental business, though, car-sharing coverage problematics are not of primary importance for the insurance sector relatively to investments to develop customized insurance products\textsuperscript{56}. This in turn leads car-sharing operators to price insurance to their customers in quite rough ways, far less refined in comparison to the sophisticated pricing models used for individual private motor insurance. The price operators charge for insurance frequently does not vary among different drivers, but is rather embedded in the overall car-usage charges and invisible to the end user.\textsuperscript{57}

Car-sharers are trying to deal on their own with the issues, for instance, by equipping their vehicles with telematics technologies. Telematics could be a very useful mean of keeping track of customers' driving behaviour, let alone deterring unsafe driving. Taking full advantage of telematics potential is one of the first step toward a more efficient and effective risk management and cost mitigation.

\textsuperscript{55} Cf. Harris (2012), p.47.
\textsuperscript{56} Cf. Brook (2004), p.3.
\textsuperscript{57} Cf. Le Vine et al. (2014), p.8.
To mitigate those costs, it is very important for car-sharing enterprises to improve their risk management activities, enhancing their ability to analyse customers’ driving behaviours, monitoring violating behaviours and filling the gap in the policies implemented to foresee as well as deter potentially risky driving patterns.

3.1.1 Motor third party liability (MTPL)

When considering vehicle claim costs in the car-sharing sector, the major costs accounted for are those related to third party liability claims (TPL). Motor third party liability insurance covers civil liability in relation to damages that have been caused to third parties. Specifically, it ensures that damages caused to a third party’s health and/or property resulted from an accident are actually covered.\textsuperscript{58} TPL insurance coverage is the most popular and known one also due to the fact that it is required by law for all registered vehicles in countries within the European borders.

In Europe, motor third party liability is compulsory as it is prescribed by the \textit{EU Motor Insurance Directive 2009/103/EC} as of 16\textsuperscript{th} September 2009. The obligatory nature of motor insurance in the EU has the main objective of protecting European citizens and the public in general in relation to motoring-related damages throughout the EU countries. However, that fact that insurance coverage is required in all EU member states does not imply the application of homogeneous insurance premiums. Premiums can differ across member states due different adopted approaches towards risk assessment and compensation schemes\textsuperscript{59}.

In spite of their different levels across countries, motor insurance premiums represent a great share of the turnover generated within the non-life insurance segment. Motor insurance income is estimated to represent almost the 30% among all revenue generated by non-life insurance premiums\textsuperscript{60}. The substantial revenue generation by motor insurance is also due to the increasing expansion of vehicle fleets, whose growth car rental and car sharing companies significantly contribute to.

The renowned ultimate principal in insurance is that insurers will provide an insurance contract as long as their expected profit is higher than zero. An insurer’s

\textsuperscript{58} International Risk Management Institute (ed.) (2015a).
profitability in turn depends on the premium charged, on the expected claims costs and claim management expenses. Therefore, insurance companies will be willing to provide coverage only if the rates charged are consistent with the risks they estimate\(^{61}\).

Profitability estimation is particularly challenging especially in the vehicle insurance sector, due to the high volatility of risks together with other external factors (as inflation) which increase the pressure insurers face when it comes to forecast future requirements to be able to meet claim costs. Consequently, the uncertain nature characterizing estimations requires premiums to be periodically readjusted, usually on a yearly basis, in order to reassess the risk that could be incurred.

European insurance market differs across countries especially in relation to their level of sophistication and development.\(^ {62}\) If generally the market for motor third party liability coverage in developed European countries is competitive, the level of competition of each individual market is dependent upon the length of time the state’s insurance market has been deregulated, taking into consideration the relatively recent deregulation wave of the early 1990s. With the issue of the so-called Third-Generation Insurance directives, namely directive 90/618/EWG as of 11\(^{th}\) August 1990, second directive 90/619/EWG as of 11\(^{th}\) August 1990, for the first time financial markets in Europe were deregulated as part of the European Union’s objective of creating a single market for financial services, liberalising insurance markets with respect to virtually all price and product competition.\(^ {63}\)

Deregulation favoured the increase in market complexity which in turn increases the sophistication reflected in the definition of the premium rates too. If in the past, rates were simply defined by the type of car, nowadays multiple variables are included in the determination of the premiums, for instance driver age has become more and more relevant\(^ {64}\).

Due to the rapidly increasing complexity, premium calculation represents a major issue. Many steps have to be taken to accurately calculate the adequate rate. The major problem is that insurance service price is normally defined before the service costs, namely damage claims, are actually known. Fundamentally, the insurer needs to calculate a fare rate, without complete knowledge on the timing of

claim, the duration of the claim settlement process, which could take years, the
total number and total monetary amount of the damage\textsuperscript{65}.

In practice, though, insurance companies have normally plenty of data and rec-
ords to calculate rate and forecast risk exposure as accurately as possible to
avoid mismatching between risk incurred and price paid by the insured.

Among the steps taken to properly determine coverage price, insurers collect
past claim costs, create analysable actuarial datasets to better understand the
characteristics of the claims, calculate most relevant key performance indicators,
such as claims’ frequency and loss ratio (total losses defined as a percentage of
premium paid), calculate the effect of all the variables influencing claims costs
and simulate potential results.

However, no matter the development of the market, insurance contracts are still
highly standardized\textsuperscript{66}. Standardization is imposing serious challenges in sectors
such as car sharing. New needs are arising relatively to insurance coverage, for
which the insurance sector seems not yet prepared to meet efficiently. One hand,
car sharing is still a quite small market, which can be one of the main reasons
behind the wait-and-see approach insurance companies are adopting. On the
other hand, contract standardization could be generally questioned in relation to
recent regulatory and technological innovations, which do not regard car sharing
only.

Nowadays, insurers have extensive databases with sector’s specific records on
losses that reduce the need to rely on industry aggregate loss data. Sector spe-
cific losses data enables insurers to have plenty of information for the insurer’s
specific culture and claim practice. Additionally, technological development is im-
proving customization and data collection management, which allow getting real
time data on driving behaviours rather than relying on historical records through
the implementation of advanced recording appliances directly on vehicles. How-
ever, it might be still true that smaller companies do not have extensive records
to rely on or enough resources to invest on state-of-the-art vehicle technologies.
In such an instance, then, they could begin relying on aggregate data collections

\textsuperscript{65} Cf. Doron (2010), p.3f.
while progressively making adjustments to the data based on its own contractual deviation.\textsuperscript{67}

### 3.2 Risk-related cost overview - car2go

As defined in previous paragraphs, insurance companies calculate their premium by means of actuarial statistics based on historical records on losses.

Insurers evaluate their private and corporate clients by computing specific key performance indicators (KPI) to determine any change in risk exposure.

Among others, one of the most frequently used KPIs is the \textit{loss ratio KPI} defined as follows:

\begin{quote}
\textit{Proportionate relationship of incurred losses to earned premiums expressed as a percentage. If, for example, a firm pays $100,000 of premium for workers compensation insurance in a given year, and its insurer pays and reserves $50,000 in claims, the firm's loss ratio is 50 percent ($50,000 incurred losses/$100,000 earned premiums).}\textsuperscript{68}
\end{quote}

Increasing in the loss ratio implies a higher risk exposure for the insurer, which in turn exponentially increases the chance the premium, to be paid, will be adjusted upward.

Specifically, within car2go European operations, the insurance company \textit{Zurich} (German subsidiary) provides insurance coverage for the whole fleet. \textit{Zurich} is also responsible for managing claims and providing monthly statistics on accidents. Claim statistics are delivered regularly covering in details German car2go locations including Berlin, München, Rheinland area (consisting of Köln and Düsseldorf), Hamburg, Stuttgart, Ulm. Figures on other major car2go regions such as Italy, Austria and Netherlands are periodically provided as summary overviews.

Table 3 shows the evolution of loss ratios across European car2go cities, separating car2go locations in two major blocks, one covering German operations (DE) and the other covering non-German entities (Non-DE). The separation clearly shows the significant increase in the loss ratio for German entities since 2011.

\textsuperscript{68} International Risk Management Institute (ed.) (2015b).
Table 3 - car2go Loss Ratios 2008-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Premium</th>
<th>Total loss</th>
<th>Loss ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 DE</td>
<td>261,542 €</td>
<td>281,630 €</td>
<td>108%</td>
</tr>
<tr>
<td>2012 DE</td>
<td>1,252,304 €</td>
<td>1,372,984 €</td>
<td>110%</td>
</tr>
<tr>
<td>2013 DE</td>
<td>2,383,868 €</td>
<td>2,484,687 €</td>
<td>104%</td>
</tr>
<tr>
<td>2014 DE</td>
<td>2,543,901 €</td>
<td>3,341,859 €</td>
<td>131%</td>
</tr>
<tr>
<td>Total DE</td>
<td>6,441,615 €</td>
<td>7,481,160 €</td>
<td>116%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Premium</th>
<th>Total loss</th>
<th>Loss ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Non-DE 2011</td>
<td>38,586 €</td>
<td>4,535 €</td>
<td>12%</td>
</tr>
<tr>
<td>Total Non-DE 2012</td>
<td>1,107,010 €</td>
<td>733,334 €</td>
<td>66%</td>
</tr>
<tr>
<td>Total Non-DE 2013</td>
<td>2,050,386 €</td>
<td>1,248,916 €</td>
<td>61%</td>
</tr>
<tr>
<td>Total Non-DE 2014</td>
<td>3,029,976 €</td>
<td>1,993,166 €</td>
<td>66%</td>
</tr>
<tr>
<td>Total Non-DE</td>
<td>6,225,958 €</td>
<td>3,979,951 €</td>
<td>64%</td>
</tr>
</tbody>
</table>

Graph 1 shows a pretty similar increase in the premium paid in the two different areas, but major deviation in the evolution of loss ratio. Overtime German entities always outweighted the premium paid, leading to loss ratio always above 100%, highlighted in red color. Outside German borders, losses appear to be more in line with the coverage costs and never above them, highlighted in green.

Such steep increase in the German area has been registered due to major losses incurred overtime and particularly in 2014 when the loss ratio reached an ever high 131% loss ratio. Major losses, defined as the share of claims breaking the 20.000 € threshold amount, have contributed to reach an average loss ratio around 113% during the time period 2011-2014. This result means that car2go locations, German ones above all, have incurred losses far above the insurance premiums paid, representing major source of loss for the insurance company. The increased insurer’s risk exposure translated into 25% increase in the yearly premium paid per vehicle within the German fleet.

Expensive claims mainly interested big car2go locations such as Hamburg and Berlin, whose loss ratios achieved the highest level in 2014, respectively of 315% and 147% as represented in graph 1.

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4. Insurance Claims

4.1 Claim statistics in car2go

car2go European operations experienced over the past years a significant increase in the amount and in the loss generated by fleet damages.

car2go’s motor third party liability claims (TPL) filed with Zurich are periodically registered, analysed and stored in dedicated statistics databases. Stored damage information includes monetary amounts to cover claims, the reserves estimated by the insurer in order to face damage reimbursement, the date of the claim event, the cause generating the damage and, where available, the driver responsible for the event along with some particular driver characteristics relatively to age, gender, type of driving licence, which represent the basics for an appropriate risk management analysis.

Damage statistics provided by Zurich Deutschland tracking losses within car2go European fleet show an exponential increase in the volume of claim costs, which is not comparably registered within other major operative regions, namely Austria, Netherlands and Italy (where Italy includes Milan for 2013, while in 2014 it includes also Rome and Florence) (graph 2).

Graph 1 - car2go Loss Ratios by location 2011-2014

<table>
<thead>
<tr>
<th>Location</th>
<th>Loss % 2011</th>
<th>Loss % 2012</th>
<th>Loss % 2013</th>
<th>Loss % 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULM</td>
<td>100%</td>
<td>143%</td>
<td>221%</td>
<td>20%</td>
</tr>
<tr>
<td>DUS</td>
<td>118%</td>
<td>71%</td>
<td>69%</td>
<td>76%</td>
</tr>
<tr>
<td>KÖLN</td>
<td>17%</td>
<td>49%</td>
<td>38%</td>
<td>57%</td>
</tr>
<tr>
<td>MÜN</td>
<td>08%</td>
<td>52%</td>
<td>32%</td>
<td>29%</td>
</tr>
<tr>
<td>STG</td>
<td>118%</td>
<td>75%</td>
<td>78%</td>
<td>49%</td>
</tr>
<tr>
<td>HAM</td>
<td>17%</td>
<td>70%</td>
<td>97%</td>
<td>49%</td>
</tr>
<tr>
<td>BER</td>
<td>08%</td>
<td>59%</td>
<td>59%</td>
<td>315%</td>
</tr>
<tr>
<td>AT</td>
<td>08%</td>
<td>92%</td>
<td>59%</td>
<td>147%</td>
</tr>
<tr>
<td>IT</td>
<td>17%</td>
<td>46%</td>
<td>42%</td>
<td>76%</td>
</tr>
<tr>
<td>AMS</td>
<td>08%</td>
<td>59%</td>
<td>42%</td>
<td>59%</td>
</tr>
</tbody>
</table>
Due to the significant impact of German claims and to the wider and more detailed data provided by the insurer on German locations, the analysis is limited to German locations. However, this does not reduce the validity of the investigation as Germany is the most mature and biggest market for car2go.

Germany has experienced over the past two years a remarkable 68% increase in the costs incurred to cover third party liability damages. Costs rose from about 2.3 million € at the end of 2013 to about 3.8 million € registered at the end of 2014.

The upward trend in the absolute costs incurred could be partly explained by the rise in the amount of damages. However, the increase in the number of claims is not proportional to the steep increase in the costs: the amount in the number of claims only rose by 12% compared to the 68% increase in the costs.

The disproportional growth is mainly related to the increasing impact of major damages. Major damages, classified as those damage claims which exceed the threshold of 20,000 €, experienced a three-fold increase in cost in Germany over 2014 as represented in graph 3.

Own elaboration. Source: Zurich Deutschland.
Strikingly enough, even though major damages represented only the 0.7% of total third party liability damages in 2013 and 2.4% of total claims in 2014, those damages actually characterized a significant 24% and 44% of total costs in the two respective years.

The remarkable increase in damage expenses also helps explaining the 50% increase in the average damage € amount in Germany from 2013 to 2014. While in 2013 the average expense for a single damage in Germany was about 3.100€ with an average frequency of 22%, implying a damage occurrence every five cars, in 2014 a single damage touched the 4.700€ level, with an overall frequency 24%, meaning every fourth vehicle was subject to a claim.

Table 4 shows more into details the distribution of damages, depicting loss evolution over 2013 and 2014 for each individual German location. This helps better identifying which locations are the major drivers behind the overall region bad claim performance. As shown, Berlin and Hamburg appear to be the riskiest locations both in the amount as well as in the cost generated in both periods. Those locations, though, are also the ones presenting the biggest number of rentals and the highest vehicle utilization whereby vehicle utilization represents the rate at which cars are used on a daily basis within the predefined operational area. The positive relation between utilization and losses confirms the general logic by which the more the vehicle is used by customers the more is subject to potential accidents.
Therefore, it is important to relate the riskiness of the different cities to their level of driving activity in order to appropriately assess which variables are behind the progressive expansion of insurance claim expenses and to assess their relation with customer characteristics and their individual driving behaviours.

### 4.1.1 Causes of Claims

Among the various causes leading to a claim, graph 4 depicts the most frequent reasons leading to the filing of an insurance claim within car2go German operations.

Causes of damages seem pretty stable over both years of observation. The highest number of claims is due to rear-ending accident (“Auffahrschaden”), covering about 37% and 30% of the whole claim amount in 2013 and 2014 respectively.

Parking and scratch-related damages (“Ein-/Ausparken”, “Berührung/Streifschaden”) also make up for a significant share of losses, constituting about 30% of total claims over the whole time interval. Lastly, changing lanes and reverse manoeuvring (“Überholen/Spurwechsel”, “Zurückssetzen/rangieren”), covering about 16% of whole claim sample, are as well included in the top three sets of most recurrent risky driving behaviours.
While graph 4 focuses on the driving behaviours most frequently leading to an accident, graph 5 focuses on the causes that contributed the most to the rising claim costs. Despite the low average cost per damage of about 2.600€\textsuperscript{71}, the high number of accident caused makes rear-ending the behaviour covering the biggest share of the costs in 2013 (about 31\%) and a significant portion in 2014 too (about 17\%). In 2014, turning off the main street (“Abbiegen/wenden”) caused damages for an average cost of about 20.000€. Even though, not extremely expensive on an individual level, the moderate number of claims caused, led to the generation of a quite significant share of costs (about 20\%). Finally, the impact of big damages, defined as those claims above 20.000€ is quite evident. In 2013 for instance, a single claim due to driving in the opposite track (“Kollision Gegenverkehr”) represented 15\% of the total costs with a cost of about 388.000€.
4.2 Comparison of car2go risk-related costs within the sector

car2go appears to have a significantly high risk profile. Company insiders mentioned the particular free floating business model as contributing to deteriorate the overall fleet’s riskiness. If on one hand free floating is beneficial to users, giving them greater freedom in their transfer choices, on the other hand it imposes major difficulties in monitoring how vehicles are actually used. In a traditional car rental businesses for instance, customers have to bring cars either back to the starting station or to another end-trip station. In both cases, cars’ conditions are assessed before ending the rental. In a free-floating fleet business, cars’ can be left almost anywhere as long as traffic rules and street law are respected. The reporting of newly caused damages is to a great degree up to customers’ moral responsibility.

For instance, within car2go’s usage conditions, before a user can actually start driving, he or she is requested to report any new damage. The same happens before ending the rental. In the event a new damage is noticed or the driver himself causes damage to the vehicle during the rental, the damage has to be reported by calling the company service centre\(^2\). All the process evidently leaves a great deal of discretion to the customer, who might decide to avoid the hassle of

going through the whole reporting procedure with the drawback of making damage responsibility tracking even more difficult.

This reflects into an overall risk profile for car2go European operations greater than comparable companies within the business.

The insurance company Zurich analysed overall car2go traffic risks within German market in comparison with data on other companies included in its corporate customer pool.

The table below (table 5) gives an overview on the characteristics of the companies set as terms of comparison with car2go. car2go fleet positions in between in terms of size and is characterized by shorter rental performed within inner urban areas with respect to the other two fleets which cover mainly daily rentals.

<table>
<thead>
<tr>
<th>Fleet size</th>
<th>Operative area</th>
<th>Type of rental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car2go Deutschland</td>
<td>About 3.600 cars</td>
<td>Inner urban areas</td>
</tr>
<tr>
<td>Fleet A</td>
<td>Ca. 2.000 cars</td>
<td>Germany area</td>
</tr>
<tr>
<td>Fleet B</td>
<td>Ca. 15.000 cars</td>
<td>Germany area</td>
</tr>
</tbody>
</table>

Own elaboration. Source: Zurich Deutschland

The analysis focuses on third party liability damages. Graph 6 shows the remarkable higher damage frequency that car2go experienced in 2013 and 2014 in relation to Fleet A and Fleet B. In addition it includes the average damage frequency as reported by the Gesamtverband der DeutschenVersicherungswirtschaft (GDV – the association of German insurance companies). While in car2go there is an accident every four vehicles, the German average according to the GDV estimates a claim every ten cars.

Data on comparable companies are given in anonymous format.
The analysis covered actual data till September for year 2014, following months till December 2014 were forecasted based on past values.
The same trend can be identified in the average damage cost. Even though there is an upward trend in the whole sample (for those fleets in which 2013 data were available), car2go growth is remarkably sharper and evidently higher than the average registered by GDV as pictured in graph 7. 2014 marks a steep increase in the average damage cost, almost approaching the 5.000€ threshold far above the sector average as display by GDV figure (about 4.000€) and the other fleets set as terms of comparison (both below 4.000€).

Graph 7 – Average claim cost comparison (€): car2go, Fleet A, Fleet B and GDV

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The direct consequence is a steep increase in the claim requirements the insurance provider estimated to be able to cover expected car2go damage expenses as displayed in graph 8.

**Graph 8 - comparison of claim requirements (€): car2go, Fleet A, Fleet B and GDV**

![Graph showing claim requirements comparison](image)

Source: Zurich Deutschland

Car2go's requirements increased by about 55% from 2013 to 2014, more than doubling the average claim requirement estimated by insurers in the German market as displayed by GDV line.

From this general comparison, it seems to exist intrinsic characteristics in car2go, shaping its own risk profile. Many features could be taken into consideration, but one above all could help getting a deeper insight in what contributes increasing the business riskiness: the customer base. Users, after all, are the ones directly causing claims. Therefore, a clearer description of what drives individuals to participate to this type of service and of the most evident user demographical characteristics could help increasing the understanding of the most significant risk drivers.

### 5. Customer profile

Different are the reasons driving individuals into becoming car-sharing members: ranging from cost convenience to the need for flexibility and environmental concern. Yet, it is hard to determine whether individuals self-select right from the

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start, as they decide to become members, or if they somehow modify their behaviour once they acquire complete awareness of the benefits of the service. On one hand, some people could potentially join attracted from the very beginning by the advantage of a variable fee already covering all traditional vehicle fixed expenses, including insurance and maintenance. On the other hand, there might exist another group of people who at first chooses the service for rather moral reasons as environmental sustainability and only in the second place, once they start actively using it, they become fully conscious of the advantages to avoid the hassles connected to vehicle insurance, maintenance, parking, to name a few. Both cases could possibly lead to the same result: users could reduce their level of carefulness while driving which increases the odds of causing damages and accidents. Therefore, a detailed overview on the socio-demographic profile of users and a better understanding of the incentives behind the decision to actively join the service are the basics in order to actually determine if there is an asymmetric information mechanism taking place affecting damage records.

5.1 Overview on car-sharing customer base

Different reports have been devoted to the description and analysis of the most evident features characterizing car-sharing users. As a very first distinction, studies examining the status of European car-sharing across different providers indicate that current car-sharing members are prevalently males. Male normally represent a considerable share of the overall customer base of about 54%, even though women participation is expected to grow overtime.79

Users are generally characterized by a young age profile. Customers are estimated to mainly belong to the age segments between 25 and 35 years old.80 Segments at the extremes of the age range, namely those individuals under 25 and those in elderly age tend to be less represented.81

Car sharing customers normally possess a level of education which is on average relatively higher, which is confirmed in many other European studies.82

A key feature of participants is the decidedly lower number of cars in their households compared to population average. In effect, studies show that in continental

Europe car-sharing has a quite significant impact on the number of privately owned cars estimating that each car-sharing is replacing four to ten privately owned vehicles. \(^{83}\) Further studies estimated that customers in a range from about 16% to 31% sold a vehicle after joining car-sharing; while a more conservative segment in a range 23% to 26% postponed the decision of buying personal car. \(^{84}\)

Users, though, has evolved since the very first car-sharing initiatives. In particular, there has been an evolution in the main drivers behind the decision of becoming active car sharing members. Today, users seems to be attracted by convenience and cost savings potential, rather than driven by environmental concern, which, though a relevant reason, does not seem to be the most important motivation for joining the service anymore. \(^{85}\)

In a study carried by the city of Denver to assess car sharing business in 2014, nearly all members (almost 91%) cited convenience and increased mobility options as one of the reasons why they joined car-sharing programs and nearly 45% of the pool of interviewees cited cost savings among the main drivers behind the decision to join the program. Not surprisingly, another important reason is flexibility in parking options, relevant for almost 76% of the people interviewed. \(^{86}\)

It is often the case, in effect, that car sharing companies operate their free floating vehicle fleet in central urban and metropolitan areas, where parking is either extremely difficult to find or is extremely expensive.

As the above studies demonstrates, car sharing customer base is pretty young in terms of age and it is not as much concerned about environmental sustainability as it is in cost savings, convenience and in increased flexibility.

The potential of this particular alternative to car ownership is further enhanced by the emergence of mobility and technology options which allow car drivers to stay connected and productive while on-the-go and which represent a major tool of attracting young generation drivers. Usually car sharing rentals are technology enabled, from the possibility to book the closest vehicle from personal smartphones to a smartphone-based car access.

\(^{84}\) Cf. Shaheen and Cohen (2007), p 82.
With the ever increasing consumers’ desire for convenience and value, new models and forms of transportation will continue to challenge traditional car ownership and push the evolution of mobility. Especially, young individuals want lower costs. As previously discussed, costs associated with vehicle ownership is among the most influential factors pulling young customers away from vehicle ownership. To deal with these concerns, an increasingly higher amount of young individuals are turning to transportation models providing convenient mobility without the long-term cost obligations, often seen as a burden, associated with vehicle ownership. Therefore, automakers have to progressively look beyond the product increasing their focus on alternative business models, while simultaneously improving customers’ experience, to satisfy current and future Gen Y consumers.\footnote{Cf. Giffi et al. (2014), p. 80f.}

### 5.2 car2go Customer Base

car2go customers have progressively expanded ever since the very beginning of the program in 2008. During this time frame the company has enlarged its business across new regions such as Italy and Scandinavia, while still growing its most established market, Germany.

The interest is to determine if the evolution of car2go’s user base reflects the general findings characterising car-sharing customer base as a whole or if it present independent features that could help explaining the bad performance with respect to vehicle losses.

Data on customers covers two years, from 2013 to 2014 and it includes information on age, gender, kilometres driven and rentals focusing on the major European locations (Berlin, Hamburg, Rheinland area including Köln and Düsseldorf, Stuttgart, Ulm, München, Milan, Rome, Florence, Wien and Amsterdam).
5.2.1 Age Segmentation

Customers are separated in four main age segments: the first segment including individuals between 18 and 25 years old, the second segment comprising users between 26 and 35 years old, a third segment for those drivers being in-between 36 and 49 years old and a last group for all those above 50 years old.

As display in the charts below (graph 9), car2go customer base reflects the general sector pattern in terms of age segmentation. The predominant age segment is between 26 and 49 years, considering the European customer base on a consolidated basis, representing 69% of the whole member base in both years.

![Graph 9 - car2go European users’ age segmentation](image)

Own elaboration. Source: car2go statistics database

Among this most prominent group, individuals in their late 20s and early 30s emerge as the ones who have more extensively taken part to car2go car sharing program. Age groups at the extremes of the age range, instead, seems to be less represented, with the youngest users representing only the 17% of all users and oldest drivers making up for only the 14% on average over the two periods.

No major trends can be detected overtime; age split stays pretty stable with no relevant changes. One slightly difference can be observed when separating the user base to compare the German and the Italian customer base (including the following locations: Milan, Florence and Rome, these two latter ones both launched mid 2014).

The chart below (graph 10) shows how among Italian cities, the majority of individuals becoming car2go members are slightly older compared to their German neighbours. From graph 10, it emerges that there has been more acceptance
among adult rather than young drivers within the Italian territory where the oldest customer groups (36-49, plus 50) make up for 55% of the overall customer base, while in Germany it constitutes a lower percentage, of about 44%.

Graph 10 - car2go users’ age segmentation by regions (2013-2014)

Although a minor difference, the finding could represent a first starting point to determine if the general implications, shown in many studies resulting from young drivers being an important source of traffic accidents, are valid also within car2go customer base\(^{88}\). Alternatively, it could confirm the other spread result which consider old people the most risky ones due to the lower reaction time and reduced mental alertness\(^{89}\).

Further deep, the regional pattern is reflected at the location level too. Graphs 11 and 12 show in details the age segmentation of users for individual European locations. No significant difference can be observed, the charts only further confirm previous findings, with German locations having a majority of below 35 years old users, while the Italian once having a slightly older customer base.

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89 Cf. Daigneault et al. (2002), p.221.
5.2.2 Gender Segmentation

In line with gender segmentation in the overall car-sharing sector, males are more likely to subscribe to car2go car-sharing service.

Graph 13 displays the remarkable majority of male users over females, representing on average 67% of the whole user population, while women being only the 33%.

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90 Location Florence and Rome not yet launched in 2013.
Similar to age segmentation, gender groups show stable pattern over time with no relevant changes. One slight difference can be observed in the growth pattern between men and women: female member group presents a small rise (+2%) over the past two-year-time opposite to males.

Several studies analyse men compared to women in relation to their driving habits. It will be of interest to determine whether the results on male and female risk-taking behaviours carried out by other scholars\(^9\), finding women to be less prone to adopt risky attitudes towards most situations in life will be confirmed by the findings in the car2go database.

### 5.2.3 Gender and Age Driving patterns

To further analyse the European customer base, it is significant to understand not only the general age and gender distribution, but also the distribution of kilometres driven in order to evaluate the intensity of driving of different age and gender groups. This further analysis is carried out following the findings of several studies\(^9\) testifying the increased risk potential of individuals as a function of a more intense driving activity.

Taking as basis of analyses always car2go customers, graph 14 presents a percentage distribution of kilometres driven per age group and shows how the distribution of kilometres driven does not differ significantly from the general age dis-

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tribution in the customer base. The most represented customer segments be-
tween 26-35 years old is actually the one driving the most, covering about 40% of
all kilometres driven in both years.

Graph 14 - car2go European users age groups’ km driven

![Pie chart showing age groups' km driven in 2013 and 2014]

Own elaboration. Source: car2go statistics database

Remarkably, even though the youngest customer group is one of the less repre-
sented proportionally in all European locations, the data in graph 15 highlights
how each individual of age between 18 and 25 year old is actually driving more
on average than an individual in the most represented age segments (26-35 and
36-49 years old). While a single user in the age cluster 26-35 drives on average
about 15 km, a user in the youngest age cluster covers almost 17 kilometres on
an average trip.

Graph 15 - km driven per individual in different age groups (2013-2014)

![Bar chart showing km driven per age group]

Own elaboration. Source: car2go statistics database

The same result applies when considering the number of rentals performed by
age groups on an individual level. As graph 16 exhibits, an individual below 25
years old makes more rentals on average than any other single user in the remaining age datasets.

**Graph 16 - number of rentals per individual in different age groups (2013-2014)**

![Graph 16](image)

Own elaboration. Source: car2go statistics database

Hence, an individual member below 25 years old uses car2go car sharing service more intensely than any other single individual part of the other age segments.

Males and females as well show quite similar rental patterns over both time periods, with no remarkable difference. As graph 17 pictures, the distribution of rentals across gender reflects the percentage of men and women in the overall customer base, where males cover about 70% of the rentals while women about 30%.

**Graph 17 – Share of rentals by gender (%)**

![Graph 17](image)

Own elaboration. Source: car2go statistics database

Similar outcomes result when analysing the intensity of driving of male and female users, measured by the amount of kilometres driven on average per year.
Men constitute the biggest share of members and they also appear to predominantly drive more and perform more rentals (about 70% of total kilometres driven).

**Graph 18 – share of kilometres driven by gender (%)**

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th></th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>km_male</td>
<td>27%</td>
<td>km_male</td>
<td>28%</td>
</tr>
<tr>
<td>km_female</td>
<td>73%</td>
<td>km_female</td>
<td>72%</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go statistics database

6. Customer risk profiles

The previous descriptive analysis suggests that males in their early thirties are the most significant cluster within car2go members' population. However, when analysed at single individual level, the youngest group within male drivers are actually the ones more intensively using car2go car sharing service. Overall, then, we would expect young male users below 35 years old to potentially be the ones having the highest risk profile.

To confirm this preliminary result, a sample of 1560 data items have been collected from car2go’s insurance provider; Zurich Deutschland, covering claim expenses over the period 2013-2014. Data comes from the insurer’s proprietary database where the monetary amount of the claims, the week day along with the location in which the loss occurred are tracked.

The data focuses on German locations, namely Hamburg, Berlin, Köln, Düsseldorf, Stuttgart, Ulm93 and München, due to the largest availability of data as well as due to the largest share of losses generated in those locations. The focus is

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93 Ulm is not operational anymore, while figures on Köln und Düsseldorf are at times combined in Rheinland area.
on third-party liability claims and not on more extensive insurance coverages such as full- or partial-Casco insurance.\textsuperscript{94}

The system stores data on customers causing claims too. Customer data relates to: age, gender, date of birth and location where the driver caused the loss. Data on the different customer variables, though, do not cover the full sample. As previously mentioned, free floating makes it quite difficult to track each loss to the individual liable for it. Hence, it can happen that the loss is registered, but no information on the driver can be retrieved.

Table 6 provides a summary on data composition and data availability.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of claims</td>
<td>1560</td>
</tr>
<tr>
<td>information on driver’s gender</td>
<td>1167</td>
</tr>
<tr>
<td>information on customer age</td>
<td>155</td>
</tr>
</tbody>
</table>

Own elaboration. Source: Zurich Deutschland.

6.1 Locations

From the previously described high level analysis, locations’ claim overview ranked Hamburg and Berlin as the riskiest locations, generating all together 76% of the costs incurred in Germany over the two-year sample period (2013-2014) as shown in graph 19.

Graph 19 – Share of claim costs by German locations 2013-2014 (%)

Own elaboration. Source: Zurich statistics database

\textsuperscript{94} Full and partial-Casco coverage provides full or partial coverage not only for physical and property damages caused to third parties, but also to the individual at fault and can be adopted on a voluntary basis.
The two cities also rank in the highest positions considering the elevated number of claims incurred, which on a consolidated base they represent the 73% of the overall number of damages registered in the German area as displayed in the below chart (graph 20).

Graph 20 – Share of claims by German locations 2013-2014 (%)

Own elaboration. Source: Zurich statistics database

It is important, though, to describe the cost and number of damages not only per se, but also to put them in perspective by relating those items to some specific features characterising customers' driving patterns in the different locations. Such characteristics can be summarized in: the level of utilization of vehicles, which is calculated as the ratio of rental minutes in the single location over the total minutes potentially available for rental given the number of total cars operating, the total amount of kilometers driven by users and the total amount of rentals performed in a specific location.

Both in relation to vehicle utilization as well as relatively to the number of rentals performed by members (graph 21 and graph 22), Hamburg and Berlin once again position on the top of the ranking as the most active locations, with average vehicle utilization of 11% and 7% respectively and overall share of rental of about 67% over the whole sample period.
Graph 21 – average vehicle utilization by German locations 2013-2014 (%)

Own elaboration. Source: car2go statistics database

Graph 22 – share of rentals by German locations 2013-2014 (%)

Own elaboration. Source: car2go statistics database

Not only the highest number of rentals occurred in those locations, but those rentals also cover the biggest share of total kilometers driven (68%) by members using car2go service within Germany as shown in graph 23.

Graph 23 – share of km driven by German locations 2013-2014 (%)

Own elaboration. Source: car2go statistics database
On the other side, München often appears in the lowest positions. However, when the number of kilometers driven by individual customer and the number of kilometers driven on average at each rental is observed, München rises up on the ranking chart. Graph 24 shows how on average a single customer in München drives almost as much as a member in Hamburg, about 13 km per customer.

Graph 24 – average kilometres driven by customer - German locations
2013-2014 (%)

Own elaboration. Source: car2go statistics database

Graph 25 shows, instead, how each rental in München covers the highest number of kilometres with respect to other German cities, about 8 km driven per rental.

Graph 25 – average kilometres driven by rental - German locations
2013-2014 (%)
Thus, it is interesting to notice how in München, one of the smallest locations in terms of car sharing activity, an individual user and a single rental present on average almost the highest amounts of kilometers driven.

To further understand the loss probability of the different cities, weights are assigned to the different locations according to the share of rentals performed as displayed in graph 23, standing for the level of driving activity done in a specific city. One background reasoning is taken as relevant logical assumption: damages are assumed to be correlated with claims (i.e. higher number of rentals will most likely lead to a high number of claims). Furthermore, claim incidence for each location is calculated as a percentage of total rentals completed in that specific location (table 7).

### Table 7 – Frequency of an accident- German locations (% of total city rentals)

<table>
<thead>
<tr>
<th>Day</th>
<th>number of claims</th>
<th>Frequency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburg</td>
<td>508</td>
<td>0.019%</td>
</tr>
<tr>
<td>Berlin</td>
<td>617</td>
<td>0.018%</td>
</tr>
<tr>
<td>Stuttgart</td>
<td>171</td>
<td>0.017%</td>
</tr>
<tr>
<td>München</td>
<td>44</td>
<td>0.015%</td>
</tr>
<tr>
<td>Rheinland</td>
<td>175</td>
<td>0.014%</td>
</tr>
<tr>
<td>Ulm</td>
<td>34</td>
<td>0.008%</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go statistics database

By applying conditional probability theory, the probabilities of having a potential loss, given a specific location is picked at turn, are calculated for the full sample of German locations. As table 8 shows, is München the location with the highest probability, 0.49%, compared to much lower probabilities in Hamburg and Berlin, whose percentages are respectively 0.06% and 0.05%.

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95 Rheinland including locations Düsseldorf and Köln
96 See Appendix on Conditional Probability
Table 8 – probability of an accident - German locations (%)

<table>
<thead>
<tr>
<th>Location</th>
<th>Probability of loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburg</td>
<td>0.06%</td>
</tr>
<tr>
<td>Berlin</td>
<td>0.05%</td>
</tr>
<tr>
<td>Stuttgart</td>
<td>0.16%</td>
</tr>
<tr>
<td>München</td>
<td>0.49%</td>
</tr>
<tr>
<td>Rheinland</td>
<td>0.10%</td>
</tr>
<tr>
<td>Ulm</td>
<td>0.18%</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go and Zurich statistics database

The overall result implies that, although Hamburg and Berlin appear to be the riskiest cities in terms of accidents amount, once normalized by the number of rentals, the probability of having an accident in that location is not the highest. This in turn means that, due to the higher number of rentals performed in that location, the number of accidents occurred is not so alarming.

On the other side München, despite of being the smallest location in terms of rentals over 2013-2014, seems to present other drivers besides rentals influencing claim amount.

6.2 Customer Gender

Gender is among the most common variables taken into consideration for estimation of drivers' riskiness.

The general overview on car2go’s users showed how males’ set dominates, covering the biggest share of car2go customers (about 70%). Moreover, men have been shown to drive more both in terms of kilometres and rentals covered (about 70% share of both kilometres and rentals).97

Those percentages are reflected as well in the share of claim expenses as resulted from the data in the sample under analysis. Men’s share of costs, generated by accidents and reported to the insurance provider represents almost 70% of total costs (graph 26).

97 See graphs 13-17-18.
Percentages slightly shift when the number of accidents caused by males and females is taken into consideration. Graph 27 shows how women's share (almost 40%) is slightly bigger than the share of females included in the general car2go user base (about 30%).

The above charts, thus, show that on a general basis, male drivers are the ones causing the biggest share of the damages and generating the biggest share of the losses too.

Once again, though, it is relevant to understand whether men actually present a loss probability higher than women or their apparently higher riskiness is rather a consequence of their greater vehicle usage and miles driven. Given the gender composition of ca2go customer base, damages frequency is calculated as the number of males (or females) doing an accident over the total average number of men (or women) characterizing the user base over the sample period 2013-2014.
Graph 28 – Gender composition and claim frequency- German locations 2013-2014 (%)

![Graph showing gender composition and claim frequency](image)

Own elaboration. Source: car2go and Zurich statistics database

Graph 28 clearly shows the higher frequency of damage among females (0.64%) compared to males (0.51%). This in turn generates a higher probability for women to be the ones causing an accident as displayed in table 9. Women are, in fact, estimated to cause a loss with a probability which is double the probability that a man will do an accident, being the respective probabilities 1.9% and 0.8%.

**Table 9 – Gender claim probability (%)**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Probability of loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.8%</td>
</tr>
<tr>
<td>Female</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go and Zurich statistics database

Furthermore, due to the much higher probability with respect to males, they are also expected to produce bigger losses (based on loss data over 2013-2014). By taking as basis for estimation the average claim cost and the average amount of individuals per gender class over the full sample period (2013-2014), the expected losses are computed given the damage probabilities previously assessed, which result in 5.7 millions € losses generated just by the women user segment as displayed in table 10.
Table 10 – Gender expected loss (€)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Avrg. claim costs</th>
<th>Avrg. number of individuals per group</th>
<th>Expected loss (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>€ 5,025</td>
<td>139,856</td>
<td>5,3 million</td>
</tr>
<tr>
<td>Female</td>
<td>€ 4,169</td>
<td>70,634</td>
<td>5,7 million</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go and Zurich statistics database

Therefore, although women are on average less represented in car2go customer sample, they are more likely to origin a loss.

6.3 Customer Age

Age is also another variable which is considered to highly influence the risk profile of an individual.

car2go customer base has been shown to be mainly constituted of individuals in their late 20s and early 30s, but it also resulted that, on an individual level, a young driver, one below 25 years, is estimated to driver more and, thus, to use the service more intensively.

Hence, first it is important to analyse the percentage of claims and the share of total costs for each age group, as exhibited respectively in graph 29 and 30, which will help in the identification of the age cluster with the highest impact in driving the company’s risk.

Graph 29 – Age composition and share of claim costs- German locations 2013-2014

Own elaboration. Source: car2go and Zurich statistics database
Graph 30 – Age composition and share of claims – German locations 2013-2014

Own elaboration. Source: car2go and Zurich statistics database

On one hand, the above graphs show how the most largely represented age group, namely those individuals between 26 and 35 years old, are the ones liable for the biggest share of expenses as well for the largest amount of claims, being responsible for 48% of the total damage costs and 46% of the total claims. However, the result is not unexpected. This age class, in fact, besides being the one who has most extensively joined car2go car-sharing service, is also the one driving the most98. On the other hand, the charts remarkably display the important contribution of young drivers, below 25 years old, to the overall damages expenses. The share of costs produced by young users (35%) far exceeds the share of expenses produced by the second most represented age group (36-49 years old), which covers only 17% of the total expenses. Youngest users are also a significant source of claims in terms of total damage amount. Their slightly lower share of total number of losses relatively to the their share of total costs, though, implies this group of less experienced drivers has an average claim expense far higher than any other age class, reaching the threshold of 15.000€ per damage (graph 31). This means, that the youngest group was liable for a moderate number of losses, but on average extremely expensive ones.

98 See graph 14.
Therefore, to more accurately determine which is the riskiest customer age group, it is relevant to analyse the loss generated taking into account the representativeness of each age class. Graph 32 reports the average age distribution in car2go user base along with the damage frequency characterizing each age datasets.

Graph 32 – Gender composition and claim frequency- German locations 2013-2014

Despite being the second least represented age cluster, individuals in the age segment 18-25 are actually the ones with highest damage frequency (0.10%). This in turn translates into a probability for individuals below 25 years to be a source of potential losses which is the highest across all segments. Table 11 presents the calculated probabilities for each age class to cause a damage. The supposedly less experienced drivers’ group has evidently a much greater
probability of generating losses (0.59%), more than doubling the probability of the largest users' segment (26-35 years old), 0.23%.

<table>
<thead>
<tr>
<th>Age</th>
<th>Probability of loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-25</td>
<td>0.59%</td>
</tr>
<tr>
<td>26-35</td>
<td>0.23%</td>
</tr>
<tr>
<td>36-49</td>
<td>0.19%</td>
</tr>
<tr>
<td>+50</td>
<td>0.15%</td>
</tr>
</tbody>
</table>

Table 11 – Age group claim probability (%)

Moreover, although not the biggest percentage within the customer base, young drivers not only have the highest probability of committing an accident, but they are also estimated to generate the biggest expected loss as displayed in table 12. By taking as basis for estimation the average claim cost and the average amount of individuals per age class over the full sample period (2013-2014), the expected losses are computed given the damage probabilities previously assessed, which result in 3 millions € losses generated just by the youngest user segment.

<table>
<thead>
<tr>
<th>Age</th>
<th>Avrg. claim costs</th>
<th>Avrg. number of individuals per group</th>
<th>Expected loss (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-25</td>
<td>€</td>
<td>15,449</td>
<td>3 million</td>
</tr>
<tr>
<td>26-35</td>
<td>€</td>
<td>10,792</td>
<td>2 million</td>
</tr>
<tr>
<td>36-49</td>
<td>€</td>
<td>6,819</td>
<td>0.9 million</td>
</tr>
<tr>
<td>+50</td>
<td>€</td>
<td>1,520</td>
<td>0.1 million</td>
</tr>
</tbody>
</table>

Table 12 – Age group forecasted claim amount (€)

Therefore, the findings confirm the general results previously quoted\(^99\) according to which young drivers are an important source of traffic accidents.

6.4 Customer Age and Gender

The previous sections described separately the main variables driving risk, age and gender, leading to the conclusion that females are riskier than men, and young, inexperienced drivers are more likely to generate losses in the future.

\(^{99}\) See p. 38.
To deepen the analysis, the two variables are combined and analysed in order to identify risk profiles narrower in scope. Chart 33 describes the composition of female and male group into the usual age classes.

**Graph 33 – Gender_age customer base composition - German locations 2013-2014**

Own elaboration. Source: car2go and Zurich statistics database

Both gender groups follow the typical pattern identified in the overall customer base composition. Youngest and oldest classes of drivers are the least represented ones, while members belonging to the two central classes, in terms of age distribution, constitute the biggest share of clients both in women and in men’s set (about 40% in both cases).

Considering the above percentage distributions, damage frequencies have been calculated for the separate age clusters. It results that men below 35 have the highest claim frequency. Among them, the individuals constituting the youngest subgroup are the ones with the highest incidence (0.13%) as shown in table 13.

**Table 13 – Gender_age claim incidence – German locations (2013-2014)**

<table>
<thead>
<tr>
<th>Age</th>
<th>M</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>plus 50</td>
<td>0.01%</td>
<td>0.02%</td>
</tr>
<tr>
<td>36-49</td>
<td>0.06%</td>
<td>0.08%</td>
</tr>
<tr>
<td>26-35</td>
<td>0.11%</td>
<td>0.05%</td>
</tr>
<tr>
<td>18-25</td>
<td>0.13%</td>
<td>0.06%</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go and Zurich statistics database
The above data helps in turn determining the accident probability for men and women in different age clusters. Table 14 illustrates the probability levels.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>M (Probability)</th>
<th>W (Probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-25</td>
<td>0.81%</td>
<td>0.32%</td>
</tr>
<tr>
<td>26-35</td>
<td>0.29%</td>
<td>0.12%</td>
</tr>
<tr>
<td>36-49</td>
<td>0.17%</td>
<td>0.22%</td>
</tr>
<tr>
<td>+50</td>
<td>0.11%</td>
<td>0.29%</td>
</tr>
</tbody>
</table>

Own elaboration. Source: car2go and Zurich statistics database

The interpolation of age and gender evidently indicates that an individual being male and being below 25 years old has the greatest chance of causing an accident (probability of 0.81%). Remarkably, while young men have a risk inclination clearly greater than older men drivers, among women, risk propensity is more homogenously distributed. Excluding the biggest age group 26-35, females have a quite significant risk exposure in the two oldest age groups, which is higher than men, indicating that older women are almost as risky younger ones, result which is not replicated in the men set.

7. Cost mitigation policies

Making the most of every penny spent is of vital importance for every fleet and for all those businesses seeking to optimize their cost structure.

New concepts in fleet management and the latest technology improvements create significant opportunities for cost reduction.

The car sharing sector, and particularly car2go, though, has been experiencing a noteworthy increase in the cost of coverage for their fleets with insurance premiums rising overtime. However, this trend is not bound to have an upward trend. After all insurance premiums reflect a company’s ability to manage and minimize its risk. Therefore, implementation of policies and improvement in measures aimed at controlling fleet’s risks can definitely help lowering premiums overtime.

Insurance firms value the committed approach of companies; they provide coverage to efficiently and effectively reduce accidents and costs for a better risk man-
agement. Thus, the priority for enterprises managing extended fleet of vehicles is to constantly seeking actual and potential loss areas and proactively defining measures to reduce them.

In the case of car-sharing, those measures are needed more than ever. The particular business model including free floating fleets of vehicles and the current all-inclusive pricing scheme, in effect, exposes vehicles to higher risks than normal car rental businesses.

Free-floating reduces the ability to strictly control vehicle conditions at the end of a rental, which in turns make retrieving data, essential for optimization measures definition, even more difficult.

Nevertheless, great help can actually derive from expedients as simple as adopting awareness programs for drivers or increasing driver’s responsibility especially for at-fault accidents, increasing their liability relatively to insurance expenses. Sharing liability with customers is something car2go has already implemented, imposing across all locations a claim deductible, by which customers are liable for damage costs up to 500€. Those actions, though, are highly dependent on customers’ response and consciousness on reporting caused loss.

There are more sophisticated solutions, yet, that rely on particularly technologies that can be integrated in the cars. Besides improving significantly data on accidents and risky driving behaviors, such new technologies can have an important, positive impact on drivers approach to vehicle use and driving patterns.

7.1 Telematics
Recent technological developments brought significant potential for improving risk management and fleet cost optimization.

Such new vehicle technologies have been defined as telematics.

Telematics refers to the combination of the terms telecommunication and informatics coined during the early 80s when the political and business world began to understand the importance that computer technology would have played in the future in every life circumstance.

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In the specific, telematics cover all those integrated systems which enable the sending, receiving and storing of information regarding remote objects, which in this case are cars, via telecommunication devices.

Over the years, technological development has made telematics tools less and less expensive, transforming them from costly solutions to innovative and advanced means to be exploited in fleet management. Nowadays, telematics represent integrated systems including all type of consumer technologies from GPS to Wi-Fi and from mobile phones to Bluetooth. The great advantage brought regards improved information and data on driving behaviors, location of vehicles, route mapping and road type data, and, on a general level, the ability to get a deeper vision on all those behaviors that could increase the probability of an accident.\textsuperscript{102}

Telematics can help fleet and risk managers not only to better identify and separate good vehicle users and risky vehicle users, but could also improve vehicle utilization and optimize fuel costs by gaining data on routes driven or vehicle idle time. There are a variety of applications available in the market that could be integrated in the currently available fleet devices. Some of those applications include: collision avoidance systems, real time warnings and alert systems, sensors able to identify objects, humans included, surrounding cars and estimate the probability of collision given the current driving patterns, alert devices in case the vehicle leaves the lane without the use of turning signals, sensors which activates as soon as a certain speed threshold has been exceeded.

Telematics are partly already integrated in the car-sharing fleets, where they are used to keep track of rentals, kilometers driven, vehicle movements and help in reducing traffic violations as well improve fuel efficiency with an ultimate positive impact on the environment. For instance, car2go has an integrated IT system that does not allow ending the rental when the vehicle is parked in no-permit areas. Vehicles are also equipped with a particular feature called EcoScore. EcoScore was specifically developed to enhance environmental-friendly driving as well as to be an instrument for driver to keep track of their driving behavior. It monitors three main categories while driving: acceleration, cruising and deceleration. On the vehicle’s monitor, the driver can keep track of the smoothness of his accelerations, of his use of the breaks and on the abruptness of his maneuvers.\textsuperscript{103} No specific results have been showed, though, regarding the actual impact of such

\textsuperscript{103} Cf. Montag (2012), p. 2f.
an add-on on users’ driving behavior, even though European studies indicate that drivers are likely to modify their behavior knowing a telematics device has been installed in the vehicle.

According to the a study of the European Commission on the impacts of telematics on road safety and improved driving behaviors, the use of integrated telematics applications such as collision avoidance sensors has led to a 15% increase in the available reaction time which it is estimated to reduce collisions. Moreover, the implementation of accident data recorders on enterprise vehicles has been proven to reduce accident occurrence as well accident severity up to a maximum of 41%.\(^\text{104}\)

Nevertheless, beyond positive aspects, there are major concerns with respect to telematics. Hardware installation, upgrading and switching are primary issues. Furthermore, whether it is true that telematics could provide enhanced data on drivers’ behaviors, they could equally provide a too big data volume, including noisy, unnecessary information. Therefore, another issue regards the customization of the devices to efficiently report the kind of data that is actually needed reflecting different requirements for different fleets. For instance, tracking speeding limits alone is good, but to really be of significance in a risk management strategy that information need to be complemented with information on the location of the event in order to avoid information overload and focus on most critical cases. Finally, privacy concerns have been raised. However, it seems that drivers have quite well accepted those integrated applications, being aware of their safety benefits and emergency assistance among other advantages.\(^\text{105}\)

7.1.1 Telematics and insurance

Telematics have attracted a great deal of attention in the insurance sector too.

Conventional fleet insurance coverage is based on uncertainty as the extent of amount of the claims that will be paid is not known in advance. Moreover, insured companies pay a lump sum premium calculated on historical data and not on actual vehicle usage. One common criticism to conventional fleet insurance premium is that they are based on variable such as age and gender, but not on the current use.\(^\text{106}\)

Telematics, somehow, created a breach in the conventional insurance market by defining a completely new and innovative class of coverage schemes in the motor insurance business. Several new pricing schemes have been developed taking advantage of the technology innovation brought about by the combination of informatics and telecommunication appliances. Among them, the ones that emerged are Pay-as-you-speed motor insurance and Pay-how-you-drive motor insurance. Such innovative pricing methods have the immediate advantage of charging the policy holder in a more efficient way based on the risk he actually carries rather than a lump-sum.\textsuperscript{107}

In the Pay-as-you-speed motor insurance speed tracking devices are installed in the vehicle and the premiums are calculated according to the drivers’ compliance to speeding limits in force.\textsuperscript{108} Pay-how-you-drive is relatively more comprehensive relatively to driving behaviors. It takes advantage of a so-called event-data-recorder (EDR) which tracks any behavioral pattern which could potentially increase the probability of a claim and therefore helps the insurer to calculate premium more accurately reflecting the actual risk of the fleet.\textsuperscript{109} It encourages a double monitoring both from the insurance on the fleet owner as well from the fleet owner on its customer base helping identifying the need for any retraining program.

Given the fairer premium calculation reflecting the actual risk and not an estimated risk profile based on historical data, we would expect telematics based insurance to have a quite large adoption by insurers as well as by fleet owners.

However, telematics based insurance has been adopted so far only in highly advanced insurance markets as in the UK and the US.\textsuperscript{110}

Its adoption, in effect, comes at a quite high cost. It requires investments in vehicle integrated technology infrastructure, high expenditures relatively to wireless data transmission as well as skepticism by insurance providers to invest in telematics based insurance before an accepted technology standard spreads out.

Hence that telematics based insurances a far from being the norm to help improve risk management in the car sharing industry.\footnote{Cf. Reifel et al. (2010), p.5.}

Nevertheless, they could provide a good lesson-learnt for fleet management. Adopting the logic of \textit{Pay-as-you-speed} and \textit{Pay-how-you-drive} pricing schemes, car-sharing providers should increase investments in telematics applications on their vehicles and use the qualitative-improved data for better internal analysis. On one hand, the analysis could improve decision making enabling companies to get better insight on their risk profile, helping in turn to better determine the fairness of the premiums paid. On the other hand, it would definitely help in segmenting customers according to their driving behaviors and take preventive measures. Rewarding and punishing schemes could be developed accordingly for good and bad members.

One positive impact could be the trigger of a mechanism of customer self-selection which could help lowering users’ risk profiles. Knowing that their driving behaviors are more closely and accurately monitored together with the incentive represented by rewarding-punishing schemes can have different effects on the service provider's risk portfolio. Good customers are more attracted to take part to car-sharing programs with the expectation of having better service conditions as a function of their clean driving history. Some high risk customers potentially are pushed to adopt safer driving patterns, while other bad risk customers who are not willing to modify their driving behaviors automatically self-select deciding to exclude themselves from the customer pool by not taking part to the service program in the first place.

Certainly, the above suggestions imply implementation costs for car-sharing enterprises and need to meet customers’ acceptance. Yet, as technology advanced and becomes more affordable, cost savings in terms of reduced claim costs and premiums paid could potentially improve business bottom-line and let the enterprises grow in a fairly safer way.

\subsection*{7.2 Further preventive measures}

The empirical analysis on car2go customer base has demonstrated how young male drivers above all have a quite risky profile when it comes to drive vehicles designated for car sharing use. It raises, though, a problematic issue since the riskiest segment happens to be also the one of the most important segment car-
sharers are trying to attract. Therefore, the exclusion of young drivers is out of question, what is instead advisable is the designing of ad-hoc measures to train and more closely screen this particular cluster of users.

Hereafter, the result is far from being discouraging. Reducing and preventing risky behaviours is not only a matter of monitoring customers. There is also a need to educate them. Programs should be developed to properly train drivers, the earlier individuals are trained the better. The fact that the youngest population cluster is the one identified as the most prone to commit incidents could actually facilitate the effectiveness of driving training programs. Opposite to adult drivers, young users are less spoilt by already established bad habits and, hence, can be approached at the very beginning of their driving history, preventing them from developing inappropriate driving behaviours. Customized driving licence can be developed in cooperation with car-sharing and automotive companies to educate and instruct future customers on the future of mobility.

This is especially true with respect to electric vehicles. Whether it is true that within car2go main drivers of damage costs are non-electric locations such as Berlin and Hamburg, electric cars are a quite a new mobility mode customers need to get acquainted with.

The future of mobility has to be matched with the future driving generation. That is the main rationale behind Daimler’s new electric vehicle driver’s license trial program giving teenagers the chance to get their passenger driving license by practicing in electric Smart Fortwo ED and Mercedes-Benz B-Class Electric Drive.\textsuperscript{112}

The program is also studied to make young drivers right from the start comfortable with car2go driving experience. It complements the conventional driving licence programs with E-mobility concept. Many issues are addressed including e-vehicle acceleration characteristics and the awareness of the silent electric cars.

It doesn’t represent a final solution, but the program is definitely going in the right direction towards a less risky driving approach.

\textsuperscript{112} Daimler Communications (ed.) (2015), p.1f.
Conclusion

Cities are changing quickly and with the same fast pace new mobility needs are emerging. To respond to these emerging trends, modern mobility solutions have been developed. Those innovative solutions are the result of completely new business models whose aim is to simultaneously offer convenience and flexibility, while trying to run sustainable businesses.

The big wave brought about by the so-called sharing economy and the increasing concern for optimizing the use of available resources have put greater focus on the value generated by services offered through the exploitation of physical products rather than on the product itself. This framework facilitated the spread and diffusion of one particular mobility solution, namely: car-sharing.

Car-sharing has attracted the attention of a wide range of business actors, from newly founded companies to established automotive manufacturers interested in reaping the benefits of this new business model.

The model itself bases on the usage maximization of fleets of vehicles distributed across different locations, according to the geographic scope the individual enterprise wants to achieve. The major benefit offered to users is represented by the inclusive fare covering the price of the service. The fee is for the user a variable cost item which is calculated according to the minutes or kilometers driven. It covers all traditional vehicle fixed costs, namely parking, maintenance and cleaning, and most of all insurance expenses.

Insurance expenses have particularly represented a major dilemma for car-sharing providers, compromising somehow the profitability of the business itself due to the high risk of losses and damages characterizing the free-floating car-sharing model. It is unclear if the business itself generates the conditions for the emergence of the so-called asymmetric information problems, extensively described within the insurance sector and typically characterizing environments dominated by uncertainty and unevenly distributed information.

Uncertainty and blurred information is what actually defines the relation of car-sharing service providers with their members. Car sharers do not have complete and direct control over the usage of cars by their customers. This limited monitoring power on driving behaviors reduces also the ability of controlling loss expenses and accident-related costs, which represent a significant share of the total cost.
burden.

Being unable to determine a priori which individuals could turn to be bad customers and those who could on the other hand generate more revenues than losses, companies need to analyze their claims history and get a deeper overview on the features characterizing customers liable of causing damages. The identification of the most common traits of those individuals triggering losses will determine if particular groups of customers are more likely to adopt undesirable driving behaviors a posteriori.

The empirical analysis is supported by real company data, provided by the sector market leader: car2go. The analysis of car2go’s loss history and customer base composition has helped identifying the users’ group with the highest risk profile.

Not surprisingly, young, inexperienced male drivers below 25 years old are estimated to be the ones with the highest probability of generating expensive losses in the future.

The findings have the objective of representing an initial step towards the definition of ad hoc cost mitigation policies. For instance, specific educational and training programs should be developed to train the upcoming drivers’ generation to be better prepared to deal with the emerging new mobility solutions. Moreover, companies themselves should increase their investments in state-of-the-art vehicle technologies, the so-called telematics. Telematics could significantly increase the quantity and the quality of data car sharers can obtained on their members’ driving behaviors. The advantage is not only represented by more accurate information, but information could also be retrieved on real time. This improvement could in turn help jointly define with insurance providers coverage programs based on actual vehicles’ usage rather on risk estimation based on standardized actuarial statistics using historical claim records. The overall result would be an enhanced cost optimization with benefits coming from two sides. Better data on customers’ driving patterns could help control claims costs by more quickly correcting wrong behaviors which, together with more accurately and fairly calculated insurance premiums based on actual vehicle use, can ultimately help significantly reduce both claim costs as well as insurance premiums.

However, effort should jointly be exercised by the car-sharing and the insurance sector. Further studies need to be devoted to better understand how the insurance market can be optimized to more efficiently accommodate the needs of new
market segments, where the traditional insurance schemes could prove to be obsolete, let alone not able to appropriately and efficiently respond to emerging new requirements. New customized solutions have to be developed taking advantage of modern technologies for the coverage of shared vehicles for a joint pursue of efficiency and profitability.
Appendix 1

Conditional Probability\textsuperscript{113}

Being two events $E^1$ and $E^2$ independent events, the probability that both events occur is:

\[ P(E^1 \cap E^2) = P(E^1) \times P(E^2 \mid E^1) \]

$P(E^2 \mid E^1)$ is called conditional probabilities and it computes the probability that the event $E^2$ happens given the occurrence of the event $E^1$.

Therefore, from the previous formula, conditional probability can calculated as follows:

\[ P(E^2 \mid E^1) = \frac{P(E^1 \cap E^2)}{P(E^1)} \]

The above formula bases on specific observations:

1. Conditional probability formula exists as long as $P(E^1) > 0$.
   If $P(E^1) = 0$, then $E^1$ is impossible, then the formula would lose meaning.
2. If $E^1$ and $E^2$ are independent, that the occurrence of one event does not influence the occurrence of the other event, then $P(E^2 \mid E^1) = P(E^2)$.

\textsuperscript{113} Cf. Feller (1968), p.114f.
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