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# A COMPARATIVE ANALYSIS OF MODERN TRENDS IN CARSHARING: WITH REFERENCE TO KAZAKHSTAN

This article presents the results of a systematic literature review on modern trends in the implementation of car-sharing and conducts a comparative analysis of Kazakhstani carsharing solutions to some of the world's most popular alternatives. The findings reveal some socio-economic and cultural barriers for adopting and promoting carsharing services by studying the results of recent literature. It also considers business models and features of various car-sharing services and suggests a P2P(peer-to-peer) model as the main model of the proposed carsharing system, a system architecture of which is presented as well. The main contribution of this article to the research topic is analyzing existing carsharing solutions both in Kazakhstan and abroad, identifying the gaps in the development of carsharing in the country, suggesting the preferred business model, system architecture and finding directions for future research.

**Key words**: carsharing, sustainability, carbon emissions, shared mobility, sharing economy.

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# КАРШЕРИНГТЕГІ ЗАМАНАУИ ТРЕНДТЕРДІ САЛЫСТЫРМАЛЫ ТАЛДАУ: ҚАЗАҚСТАНҒА ШОЛУ

Бұл мақалада каршерингті жүзеге асырудың ағымдағы тенденциялары туралы әдебиеттерге жүйелі шолу жасалады және қазақстандық каршеринг шешімдерінің кейбір әлемдегі ең танымал баламаларымен салыстырмалы талдауы қарастырылады. Ғылыми әдебиеттерді зерделеу арқылы алынған мәліметтер каршеринг қызметін енгізу мен ілгерілетудегі кейбір әлеуметтік-экономикалық және мәдени кедергілерді анықтады. Сондай-ақ мақалада айтылған автомобильдерді ортақ пайдаланудың әртүрлі үлгілері талданады. Бұл мақаланың берілген тақырыпты зерттеудегі негізгі үлесі Қазақстандағы каршеринг сервистерін дамытудағы олқылықтарды және болашақ зерттеулердің бағыттарын анықтау болып табылады.

**Түйін сөздер**: каршеринг, тұрақты даму, көміртегі айналымы, ортақ мобилділік, ортақ қолдану экономикасы.

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**СРАВНИТЕЛЬНЫЙ АНАЛИЗ СОВРЕМЕННЫХ ТРЕНДОВ В КАРШЕРИНГЕ: СО ССЫЛКОЙ НА КАЗАХСТАН**

В данной статье представлены результаты систематического обзора литературы о современных тенденциях в реализации каршеринга и проводится сравнительный анализ решений казахстанского каршеринга с некоторыми из самых популярных в мире альтернатив. Полученные путем изучения научной литературы данные выявили некоторые социально-экономические и культурные барьеры для внедрения и продвижения услуг каршеринга. Также статья анализирует различные бизнес-модели и особенности каршеринга и предлагает модель P2P(peer-to-peer) как наиболее эффективную для предложенной системы каршеринга, архитектура которой также предлагается. Основной вклад данной статьи заключается в выявлении пробелов в развитии каршеринга в Казахстане, путем сравнительного анализа существующих решений по каршерингу с зарубежными аналогами, предложение архитектуры и модель для системы каршеринга в Казахстане и определение направлений для будущих исследований.

**Ключевые слова**: каршеринг, устойчивое развитие, выбросы углерода, совместная мобильность, экономика совместного использования.

## 1 Introduction

Unprecedent development of automobile industry supported by population growth is bringing new environmental challenges to the society. These challenges are seen more evenly in large cities due to ever-increasing urbanization and human mobility. Nowadays urban population has limitless opportunities of overcoming large distances not only in a short period of time, but also with high level of comfort by means of different mobility solutions. This level of mobility is rather a requirement of time than a choice. Thus, to make cities more sustainable world's developed economies are now concerned about implementing the concept of Smart Cities, which, according to the literature, includes following elements: smart government, smart people, smart economy, smart transportation, environment and living"(Razmjoo and et al., 2021). Carsharing as a type of shared mobility is gaining more and more popularity and is one of the key solutions to a smart transportation and consequently to Smart cities. According to consulting agencies carsharing suggests strong new opportunities for automakers, suppliers, and many more mobility players. Consumer survey conducted by McKinsey and Company in 2017 indicate continued growth potential for shared mobility, stating that by 2030 "...of those currently using non-taxi ride-hailing services, 63 percent expect to increase their usage "a lot"in the next two years, and even more (67 percent) say they will do the same concerning car sharing"(McKinsey and Company, 2017). However, the inuence of carsharing in urban mobility is a subject of research. According to corresponding study on this topic conducted in the city of Madrid in 2018, "...it is essential to ensure that the arrival of new carsharing modes lead to more sustainable cities and complements public transport"(Ampudia-Renuncio, Guirao, Molina, 2018). Although the effect of carsharing on economies and smart transportation in general is a subject of further research, authors state that "...car- sharing is predicted to have a transformative effect on the industry. Vehicle

electrication and automation have the potential to reduce GHG emissions and reduce private-vehicle ownership in favor of shared automated vehicles"(Shaheen*, Cohen, Farrar, 2019). Thus, as part of smart transportation understanding motivation, socio-economic factors and identifying areas for development of carsharing is important to implement the concept of Smart cities. This article will discuss some of the current trends in this topic referencing to the development of carsharing in Kazakhstan.

## 2 Methodology and design

The focus of this article is to understand the modern trends in carsharing by looking at different literature. First, definitions of carsharing were examined and differences between some of them were described. A diagram illustrating the types and models of carsharing is created in section 3 with a short description of each of the models described. The next focus of the literature review was in understanding the motivation towards adopting carsharing, socio-economic and cultural factors that affect one's choice in opting for a personal car ownership. A comparative analysis of the few popular carsharing services were examined both internationally and in Kazakhstan.

## 3 Carsharing definition, models, and types

Recent literature uses several terms associated with sharing mobility such as carsharing, carpooling, ride sharing etc. Although some literature uses these terms interchangeably, there is a considerable difference between the first two: (1) carsharing - is the use of cars provided by an individual, a community or a specialized company and (2) carpooling - is the joint and organized use of a car by several individuals to travel (Bulteau, Feuillet, & Dantan, 2019). Transportation research board also refers to carsharing as a service that provides members with access to a fleet of vehicles on an hourly basis (Transportation research board, 2005). Another literature refers to carsharing as "... a form of person-to-person lending or collaborative consumption in a sharing economy, where existing car owners rent their vehicles to other people for short periods of time"(Saurabh & et.al., 2021). Despite the differences, some literature considers carsharing and carpooling as "... a common trend that is transforming the automotive and transportation industries"(European Economic Comission UN , 2020). This article clearly distinguishes between traditional carsharing, where it is considered rather a timely service provided by individuals or companies and a shared use of cars as the means of transport to reach the common destination. Thus, further research in this article is only relevant to traditional carsharing. There are several business models and types of carsharing discussed in the literature. Following figure illustrates existing business models with reference to the type of carsharing provided.

**Source***: Adopted from Goncalves, G.,Santos, D. (2016). One-Way Carsharing Systems: Real-Time Optimization of Staff Movements and Operations. UNIVERSIDADE DE LISBOA INSTITUTO SUPERIOR TECNICO*

Depending on the type carsharing allows: (1) one-way and (2) round-trip services. If free-floating carsharing and peer-to-peer carsharing allows only one-way travels, station based carsharing can allow only round-trip travels as vehicles in this case must be returned to the

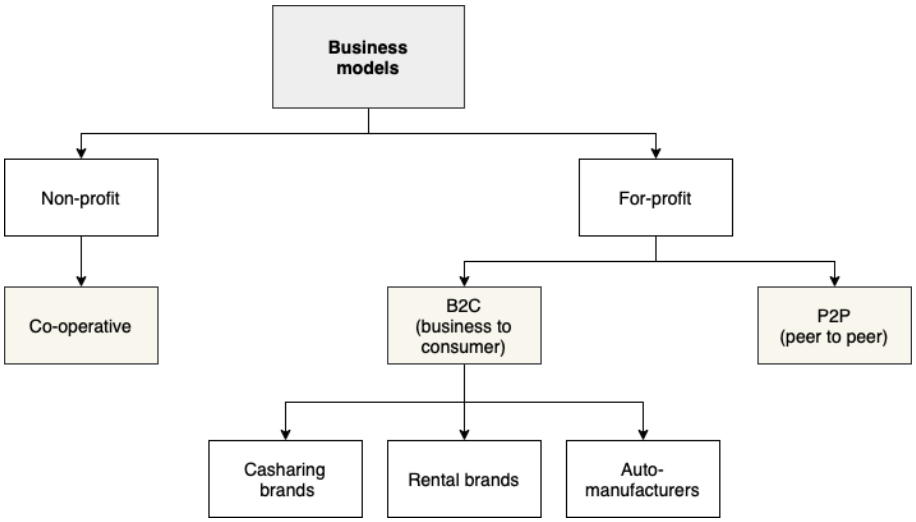


Figure 1: Carsharing models and types

car owner (peer-to-peer) or a station (stationary). Additionally, we distinguish three models: (1) peer-to-peer - is a type of carsharing that offers a shared use of vehicles that belong to an individual to a specific user community. In this type of carsharing, players usually provide a platform to handle the transaction, offer insurance, and equip cars with devices to ensure access; (2) free-floating - relatively new type of car sharing, where customers pick up and return the vehicle in any location within a certain area. This type of carsharing, therefore, is usually practiced as a replacement of a taxi experience within a certain city for short distance travels, whereas (3) stationary carsharing allows users pick and return the vehicle only in the fixed (usually the same) location (Deloitte, 2020).

## 4 Motivation, socio-economic, ecological, and cultural aspects

Although carsharing has gained large popularity in most of the developed courtierscountries there are still non-adopters. Understanding the motivation behind the choice for carsharing services is one of the first steps. Thus, "... gaining insights into the characteristics and motives of adopters and non-adopters of carsharing is important for policymakers and businesses alike to support the wider diffusion of carsharing"(Munzel, Piscicelli, Boon, Frenken, 2019). Regardless of the number of owners of a personal car, more and more inhabitants of the world are beginning to give preference to car sharing services. According to the United Nations Economic Commission for Europe (UNECE), "... this is already a reality in large cities, where, due to excessive traffic congestion, high cost of parking or their lack, the private car as a general phenomenon begins to give way to new forms of mobility"(European Economic Comission UN , 2020). Reducing carbon emissions is one of the most rational reasons for countries to adopt and promote carsharing technologies and services. According to the European Transport and Environment Community "... Transport emissions have increased by a quarter since 1990 and are continuing to rise with 2017 oil consumption in the EU increasing at its fastest pace since 2001.1 Unless transport emissions are brought under control national 2030 climate goals will be missed. To meet the 2050 Paris climate commitments cars

and vans must be entirely decarbonized. This requires ending sales of cars with an internal combustion engine by 2035. Such a transformation requires wholesale changes, not only to vehicles but also how they are owned, taxed, and driven"(European Federation for Transport and Environment, 2018).

Despite ecological benefits some municipalities do not seem to give preference for organizing infrastructure that promote carsharing. For example, in Tokyo "... it has been stated that ride-hailing increases motorized traffic and causes traffic congestion, and those for these reasons, there are areas where ride-hailing is not approved by the municipality of the city"(Ikezoe, Kiriyama, Fujimura, 2021). Based on the results of this study it seems like motivation towards choosing personal car ownership over carsharing is still present even in such high-tech city like Tokyo. The study identified sociological and cultural factors that keep citizens of Tokyo using personal cars. Thus, qualitative indicators that determined the preference for personal car ownership were "emotional factor "convenience factor"and opting for "private space". Although this study has a limitation of observing only 23 cases in Tokyo it clearly illustrates that promoting carsharing services cannot be successful without understanding socio-economic, cultural, and mental aspects that may justify one's choice for the type of mobility. Thus, the results showed that the strength of the emotional factor as a utility of owning a car was more than twice that of the convenience factor. Changing mobility behavior of potential users of carsharing services is stated to be a challenge in another study. Were authors claim that "... one of the main challenges remains to attract mainstream consumers to adopt carsharing services and change their mobility behavior"(Munzel, Piscicelli, Boon, & Frenken, 2019). Some financial implications can also act as a barrier to adopt and promote carsharing. The automobile industry is one of the priority drivers of the economy for several countries. Data show that 6.7% of the total number of jobs in Europe are in the automobile industry. It includes following sectors: (1) direct manufacturing, (2) indirect manufacturing, (3) personal cars, (4) transportation and recent (5) construction. Literature calls such economies "dependent"on automobile industry. It was therefore a reason for some giants of automobile industry like General Motors in U.S. to exit the carsharing market. In case of GM the carsharing service Maven was shut down in 2016.

Nevertheless, some literature states, that "... carsharing provides the potential to reduce the costs of vehicle travel to the individual as well as the society"(B. Caufield, 2021). According to PwC 8% of all US adults have participated in some form of car-sharing economy, with 1% serving as service providers for this new model by carpooling or renting their cars for an hour, day, or week (European Economic Comission UN , 2020). The number of registered carsharing users accounted to more than 2 million people around the world in 2020 (European Economic Comission UN , 2020). In comparison with the increasing number of personal car owners, this figure is insignificant and, therefore, the development of carsharing services require more attention in modern society.

## 5 Carsharing in Kazakhstan: a comparative analysis

Compared to European countries, Kazakhstan is a relatively new adopter of such sharing mobility services. Thus, there is a limited literature about the current state or development of carsharing in Kazakhstan. To contribute to the body of knowledge and understand the state of carsharing in the country a comparative analysis is conducted. It focuses on understanding

the strength and weaknesses of existing carsharing solutions and compares them to European analogs. Table 1 presents the results of the analysis:

*Table 1. A comparative analysis of carsharing solutions: Kazakhstan vs international*

| N | Service provider | Area of Service | Type of carsharing | Model of operation | Website | App |
|---|---|---|---|---|---|---|
| International | | | | | | |
| 1 | Turo | Worldwide | One-way, round-trip | Peer-to-peer | yes | yes |
| 2 | ZipCar | Worldwide | One-way, round-trip | B2C, B2B | yes | yes |
| 3 | Getaround | USA | one-way, round-trip | B2C, peer-to-peer | yes | yes |
| 4 | Enterprise Carshare | USA, Europe, Latin America | One-way, round-trip | B2C, B2B | yes | yes |
| 5 | HyreCar | USA | One-way, round-trip, Business-related rentals | B2C, B2B | yes | yes |
| 6 | Car2go | Worldwide | One-way, round-trip | B2C, peer-to-peer | yes | yes |
| Kazakhstan | | | | | | |
| 1 | Anytime | Almaty | round-trip, short-term rentals | B2C, B2B, free-floating | yes | yes |
| 2 | Rentacars | Almaty, Nur-Sultan | round-trip, long-term rental | B2C, station-based | yes | no |
| 3 | Avis Kazakhstan | Almaty | round-trip | B2C, station-based | yes | no |
| 4 | Almacar | Almaty | round-trip | B2C, station-based | yes | no |
| 5 | Imageauto | Almaty | round-trip | B2C, station-based | yes | no |
| 6 | Pegas Auto | Almaty and Almaty region | round-trip | B2C, station-based | yes | no |

**Note:** Service providers from 2 to 6 are not carsharing services as such but are rather car rental companies.

As it can be seen competition in Kazakhstani carsharing market is not as high as it is in Europe or U.S. Correspondingly, there is only one active carsharing service provider in Kazakhstan (anytime) to this moment (table 1). Unlike car rental services, anytime is a fully

operating carsharing company which offers both web and mobile solutions to its customers which in turn makes it the only competitive carsharing service provider in Kazakhstan. Like ZipCar, Turo and other international operators anytime provides a full technological support to its customers by providing both web-based and mobile solutions to its customers. Another advantage of this service is the level of mobility that it supports by supporting a free-floating model, where customers can pick and drop the vehicle at any convenient station within available zones. However, compared to its international analogs it still has some limitations. If, for instance, international carsharing operators like Turo, ZipCar and Car2Go are available in most parts of European and US cities, anytime is a local based service for Almaty only and, respectively, is not available in any other cities of Kazakhstan. An additional limitation of anytime is that, compared to international analogs, providing a valid driving license only is not enough to use the service. It additionally requires a proof of National ID card, which makes it unavailable to use for non-Kazakhstani citizens. Foreign citizens in turn are more likely to need the carsharing service as mostly they do not own a personal car. Consequently, expanding the areas of service by including another two big cities of Kazakhstan like Nur-Sultan and Shymkent, simplifying the registration process by requiring only a valid driving license, and by which making it available for use to foreign citizens could be an advantage for this platform.

Limitations persist when looking at car rental services, that have been included in this study as analogs of carsharing in Kazakhstan.While popular international analogs offer a wider variety of mobility options by providing both one-way carsharing where a vehicle can be dropped at a convenient location, a round-trip carsharing, when the car is returned to the initial station and free-floating carsharing, where a user has an option of returning the vehicle to any station within available zones all observed car rental services are station-based. This hinders opportunities for carsharing or car rental use as the purpose of carsharing initially is in increasing the possibilities for human mobility by making it more convenient to opt for rental or shared mobility services than owning a personal car. Hence the status of car mobility services in Kazakhstan at the moment does not satisfy the requirements for advanced human mobility as compared to international analogs.

Additionally in Kazakhstan (anytime) free-floating zones are only available within the city while international carsharing operators offer inter-city free-floating options. When looking at the convenience of the use and availability of technology solutions Kazakhstan falls behind by having only one service provider (anytime) with a mobile solution for its' customers. The rest of the observations (car rental companies) only support a web-based solution. Another limitation that can be seen from the table is that all six observed carsharing (and car rental) solutions in Kazakhstan are based in a certain location (mostly in Almaty and Nur-sultan).

Although there is a good deal of car rental services in Kazakhstan most of them operate only around big cities such as Almaty and Nur-Sultan. Some of the rental companies are included in this analysis. Thus, one of the car rental companies (rentacars) offer their services in two large cities (Almaty and Nur-Sultan), and another one (pegas auto) expand their services a little further by including Almaty region as well. Above mentioned car

rental services are similar to station-based carsharing solutions, with considerable differences: (1) companies offering car rental services often do not provide a full range of technical solutions and usually limit with websites only; (2) they operate during working hours only, consequently, do not provide a 24/7 customer support. There are also other companies, that have not been included in this analysis like autoprokat.kz, which offer a peer-to-peer based solution for the customers who want to rent their car. In such cases a car rental company acts as a platform where customers can offer their cars for rental in a way traditional car rental works. Renting a personal car to such companies offer customers a possibility of renting their cars for long periods. However, this has certain limitation too. For instance, renting a personal car to companies in a discussed manner limits one's ability to control and manage their cars. Management and control over the use of the car in such cases totally belong to a company. One of the perspective companies was "Doscar club startup based in Almaty, which also offered car rental services, but the service has not been updated since July 2019. It had around 5000 users offering some advantages to its customers like a non-key access to cars, per/min and per/hour options of rental, comfortable rates on rental and cost reduction by including the petrol and carwash price in the service cost. According to the data available there were approximately 20 cars available in Almaty. Although this carsharing solution has many advantages over some other alternate services there are some disadvantages like limited number of available vehicles, and no up-to-date data on the current state of the service.

## 6 Peer-to-Peer app design

Having considered the business models and features of various car-sharing services, P2P was chosen as the main model of the proposed carsharing system. The P2P business model will allow to deploy the service without the need to purchase a fleet of cars and their further maintenance and rent parking spaces. In this section, a high-level structural model of the system modules is presented both from the side of the user and from the side of the host (returning the car) (Figures 1 and 2). The modules are sorted by priority, how critical is their inclusion in the minimum viable product (MVP).
The following diagrams show the use cases that each actor can do.

## 7 System architecture design of proposed system

Figure 4 demonstrates system design of proposed system. The main actors like Customer, Staff, Host are included in the system design architecture. Also, the back-end server, database, load balancer can be seen as a part of the system design. The Machine Learning (ML) server and middleware API which connects the backend server with ML server is also an essential part of the system.

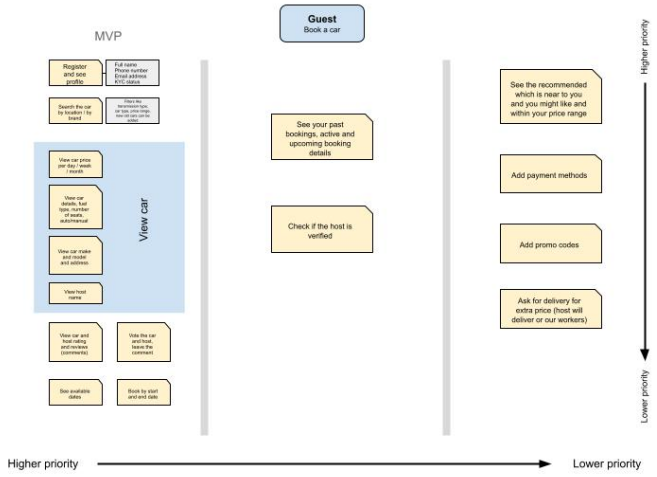


Figure 2: Use cases that Guest(customer) can perform

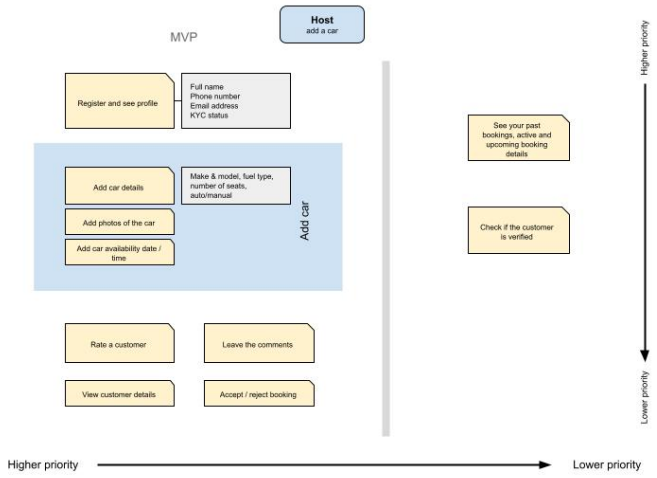


Figure 3: Use cases that Host can perform

## 8 Discussion and future research

Despite the difference in the state of carsharing between international players and Kazakhstan carsharing services are more likely to gain larger recognition in the coming years. Since the need for human mobility is growing and governments are looking for more sustainable solutions to human mobility the future of carsharing market is largely positive. However, there is a lot more that must be done in terms of creating a supporting urban infrastructure for carsharing solutions, including the creation of normative documents regulating these services in Kazakhstan than internationally. According to some of the world's reputable consulting agencies technology will revolutionize and disrupt the car sharing market.

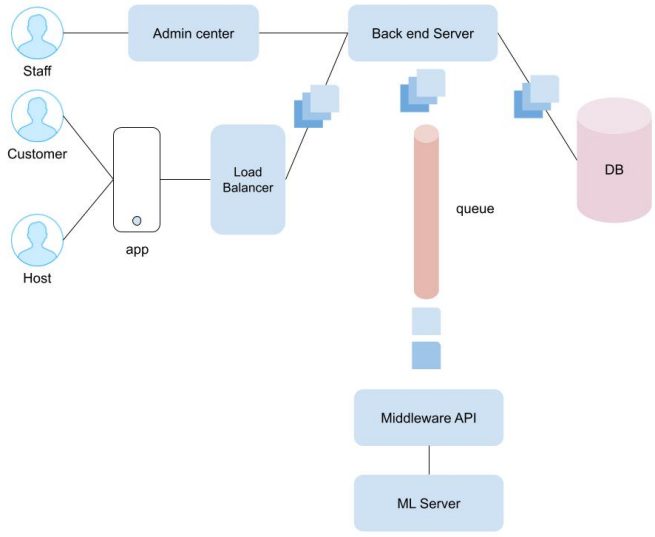


Figure 4: System architecture

Different smartphone solutions are expected to improve the use of carsharing services. Hence, Deloitte states that "...the future will further transform from automobiles to automobility, which will unleash new levels of convenience and efficiency for all road users by promoting the relationship between cars, infrastructure, and users"(Deloitte, 2020). A recent case study on Netherlands have stated that "...the increasing diffusion of carsharing in recent years is supported by technological innovations like smart keys, GPS services, as well as the widespread use of smartphones"(Munzel, Piscicelli, Boon, Frenken, 2019).

However, the degree to which citizens are likely to opt for carsharing usage highly depends on how supportive the government policies are and if the sufficient infrastructure was created. Thus, for most of the countries a carsharing is still a niche phenomenon. A study of 58 households in Norway states that "...policies should combine Electric Vehicles (EVs) and car-sharing, e.g., in Oslo, the focus of promoting EVs should include shared EVs, and in Rotterdam, improved charging infrastructure would be effective"(M.C.Svennevika, Dijkb, Arnfalkc, 2020).

The studies show that successful projects in carsharing around the world, including those initiated exclusively through private initiative, have been supported and facilitated by government agencies and built on a solid regulatory framework. Another key success factor is a well-chosen sustainable business model and the availability of investment opportunities (European Economic Comission UN , 2020). This is supported by another study that suggests that to promote the carsharing culture "...regulation should focus on shaping favorable conditions for a connected multi-modal transportation system instead of specific regulations for each carsharing business model"(Munzel, Piscicelli, Boon, Frenken, 2019).

Although Kazakhstan's carsharing market is developing there are many limitations observed as a result of a comparative analysis. Thus, different factors might affect the

adoption and development of carsharing in Kazakhstan:

- in comparison with European countries, the distances between cities in Kazakhstan are larger and even if carsharing develops, it is more likely to occur in large cities (Nur-Sultan, Almaty, Shymkent);

- the regulation of carsharing by normative documents remain limited, so a clear understanding of how carsharing service providers operate has not been formed. In this regard, some data is provided by the UNECE report (European Economic Comission UN , 2020);

- in comparison with numerous studies carried out in some of the world's biggest cities like Tokyo, Paris etc. we can observe the lack of empirical data for Kazakhstan on the motivation, limitations,and potential of carsharing. This limits the development of this type of service.

These outcomes might be limited with the scope of the study since for this article only few cases were observed from both local and Kazakhstani carsharing providers. However, it certainly illustrates the visible difference in the status quo of carsharing between early adopters and Kazakhstan. There is little data available on what is the motivation towards personal car ownership versus carsharing, as well as socio-demographic and cultural factors that have never been accessed in the literature for a national context. This can be a direction towards further research on this topic. As a suggestion focus group interviews could be conducted with all the beneficiary of carsharing services, including potential customers and government parties. This can give a bigger picture of the future of carsharing in Kazakhstan and suggest ideas for improvement of the current status quo. Finally, as studies suggest "...understanding the effects of carsharing when combined with other existing travel modes is an important pre- requisite for decision-makers for them to be able to positively utilize the benefits of carsharing services"(Matowski, Pribyl, Pecherova, 2021). Therefore, future empirical studies must be conducted on behavioral patterns of carsharing adopters and non-adopters in Kazakhstan, including the research of above-mentioned limitations.

## 9 Acknowledgements

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