

# Car-Sharing Development – Current State and Perspective

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The article presents the development of urban car-sharing systems. In recent years we have observed substantial increase in the number of such systems implemented all over the world. The number of users has also been rapidly growing which translates into the impact car-sharing services have on transportation behaviour. Additionally, the process contributes to changes of the modal split. The analysis presented covers systems in operation in Europe, Asia and North America. The article is divided into two parts. The first one presents historical development of car-sharing systems, whereas the second, prospects for their development in 2020-2025.

**Keywords:** car-sharing, transport systems.

## 1. INTRODUCTION

Considering the growth of transport demand due to expanding populations and the pressure on time efficiency, contemporary cities have been encountering an increase in periodical and, in extreme cases, permanent overload of their transport networks. Therefore, congestion has to be examined together with other negative transport related factors, factors which have a significant impact on the environment. They include, inter alia, the growth of the noise level and emission of pollutants, as well as consumption of energy (Pawłowska B., 2013). Yet another challenge is the shortage of capacity for the expansion of the transport system resulting in other barriers, e.g. limited parking space. Considering those constraints, the negative impact can only be reduced by making organizational and infrastructure changes, as well as promoting environmentally-friendly behaviour and taking the environment into consideration while planning trips (incl. Banister D.; 2008, Clean Power for Transport, 2013; Galińska B., 2018; Jacyna M. et al.; 2013; Sierpiński G., 2014; Sierpiński G., 2017; Tundys B., 2017; Turoń K. et al, 2015; Wasiak M., et al., 2017; White Paper, 2011; White Paper, 2017).

Cities have been considering various improvements. The US experience of the early 20<sup>th</sup> c. shows that the extension of the transport network by adding lanes or building additional carriageways is not a desired solution. Improvements achieved that way are short-term only, and very quickly people travelling change their behaviour until the new transport system capacity is exhausted. Therefore, more comprehensive solutions are needed, such as changes to the organization of traffic and integrated infrastructure schemes that concentrate on rebuilding of the existing transport system rather than expanding it (Mindur M., 2017). Technological advances (Mindur L., 2014) and organizational changes result in new forms of transport, and existing ones are improved and revised to correspond with user demand. It seems that this is the only approach that can change urban transport systems for the better.

Cities typically meet transport needs through their public transport systems. This particular form of transport is designed to integrate passenger flows, since it enables to travel along specific routes and in line with predefined timetables. However, dynamic public transport management concepts can also be found, as described in: Celiński I. and Sierpiński G., 2014). At the same time, due to diversity of needs, it is hardly possible

to satisfy demands of all transport users. For example findings from several studies on public road transport in middle size cities in Poland have shown the misfit between the supply and demand for public services, as presented in: (Pawęska, 2013) While bearing specific groups of users in mind, cities set up or allow for specific sharing services to be established. These services include bike-sharing, a bike rental system, and car-sharing, a car rental system often based on electric vehicles. Both solutions are designed to reduce the negative impact of transport on the environment, as well as space occupied by vehicles, e.g. private passenger cars (incl. Chen F. et. al., 2018; Czech P. et al., 2017).

The article focuses on the development of urban car-sharing systems which have been attracting an increasing number of users. Consecutive chapters of the article present the background of specific car-sharing systems and their current status. The article contains a formal forecast presenting prospects and possibilities for reaching a desired level of development in 2020-2025. The analysis presented in the article covers systems operating in Europe, Asia and North America.

## 2. CAR-SHARING

Car-sharing, as a model complementing the urban transport service, is based on a short-term rental of cars offered by operators in urban areas. Its concept is similar to car hire systems with the only difference that cars can be hired for less than an hour (incl. Cervero R., 2003; Cervero, R. and Tsai, Y., 2004; Cervero, R. et al., 2007). Car-sharing is one of opportunities that fits into the idea of sharing economy (COM 288, 2016). According to that idea, business models are based on using popular online platforms to provide short-term use of services or goods (COM 288, 2016). The activity of the sharing economy is manifested in the provision (or hiring) of goods and services to others through an online platform or a mobile application (COM 288, 2016). According to that principle, car-sharing is an alternative to one's own car with secured availability and maintenance. (Britton E., 2000; Turoń K. et al., 2017).

Initially, car-sharing systems result out of the need to own a car while encountering the shortage of funding to buy one (Shaheen S. and Cohen A. P., 2007). Quite frequently, those systems developed as social initiatives implemented by associations of people interested in sharing a vehicle. In time and with the development of new

information technologies, city car rental systems evolved towards a new concept. Nowadays, car-sharing systems, operating in line with the idea of the sharing economy, are referred to as Transport 4.0 (Polish portal of innovation, 2018).

While presenting car-sharing systems, we distinguish three main types (incl. Ciari F. et al. 2014; Ferrero F. et al., 2018; Nourinejad M. and Roorda M., 2015; Shaheen S. et al., 2015):

- stationary/classic (round-trip) car-sharing – when we can rent a car and return it at one and the same location,
- one-way station based car-sharing – when we rent a car at one station and return it in another; this, however, is limited to different hire and return stations established by the same system operator,
- free-floating car-sharing – when we rent and return a car at any accessible location in the city.

The literature also defines additional car-sharing solutions which are a combination of main types referred to above (Firnkorn J. and Müller M., 2011). However, regardless the way we hire and return vehicles in the city, we can distinguish two groups of car-sharing fleets (Ferrero F. et al., 2018):

- the combustion based ones, which consist of vehicles with classical either petrol or diesel engines, and
- the green ones, which comprise vehicles that are an ecological alternative to classical fleets, comprising chiefly electric or hybrid cars.

Examples of cars used in car-sharing systems are presented in Figure 1.



Fig.1. 'Green' vehicles with electric engine used in Warsaw-based car-sharing system.

*Source: developed by authors.*

## 3. CAR-SHARING – ORIGIN

Although car-sharing is a new concept for many cities (Polish cities included) and frequently

described as innovative, the first written records about it in the literature are dated back to 1948 (Doherty M.J. et al., 1987). At that time, one of Zürich-based housing cooperatives known as ‘Sefage’ (or *Selbstfahrgemeinschaft*) offered its clients a short-term rent of cars (Doherty M.J. et al., 1987). Later, in the 1970s, further initiatives were gradually tested in other European countries. They were, however, short living practices, based initially on making several cars available to users. They were tested on clients who had shortage of money to buy their own car. At the end of 1980s, in Europe, the number of car-sharing projects increased and some of them actually succeeded (Shaheen S., 1999). According to the literature, about 200 car-sharing organizations operated in 450 European cities, including Germany, Austria, Switzerland, Italy, Great Britain, the Netherlands, Sweden, Norway and Denmark (Shaheen S., 1999).

The selected initial car-sharing programmes in operation by the end of 1990s in Europe are presented in Table 1.

Table 1. Car-sharing history in Europe.

Established	Country, city	Car-sharing project's name	Fleet on establishing
1948	Switzerland, Zürich	Sefage	n.a.
1971	France, Montpellier	Procotip	35
1973	Holland, Amsterdam	Witkar	35
1976	Sweden, Lund	Bilpoolen	n.a.
1977	England, Suffolk	Share-a-Car Service	n.a.
1983	Sweden, Örebro	VivallaBil	5
1985	Sweden, Gothenburg	Bilkooperativ	n.a.
1987	Switzerland, Zürich	ATG Auto TeiletGenossenschaft	n.a.
1987	Switzerland	ShareCom	n.a.
1988	Germany, Berlin	StadtAuto Berlin	300
1993	Germany, München, Frankfurt	Lufthansa Airlines car-sharing	n.a.
1993	Switzerland, Zürich	CarShare – Swissair	n.a.
1997	Switzerland	Mobility Carsharing Switzerland	1200
1997	France	Praxitele	50
1997	Germany	Volkswagen car-sharing	n.a.
1999	France, La Rochelle	Liselec	50

Source: author's own collaboration based on (Britton, E., 1999; Civitas Project, 2018; Doherty, M., J., et al,

1987; Eltis, 2018; Millard-Ball, A., 2005; Muheim, P. and Reinhardt, E., 1998; Shaheen, S. et al., 1999; , Shaheen, S.; Cohen, A.P., 2013, *Straitstimes Portal*, 2016; Tiffany Stone Portal, 2013; Walb, C. and Loudon, W., 1986; Young, R, 1997).

Initial pro car-sharing projects started in Northern America in 1983 when the City of West Lafayette, Indiana, the US, the first car hire known as Mobility Enterprise was established (Doherty M.J., 1987). However, a rapid increase in car-sharing took place in 1990s (Shaheen S., 1999). Major US car-sharing organizations that were in operation until the end of 1990s are presented in table 2.

Table 2. Car-sharing history in North America.

Established	Country, State, city	The name of the car-sharing project	Fleet on establishing
1983	United States, Indiana, West Lafayette	Mobility Enterprise	n.a.
1983	United States, California, San Francisco	Short-Term Auto Rental (STAR)	n.a.
1994	Canada, Quebec City	Auto-Com	34
1995	Canada, Montreal	CommunAuto	32
1997	Canada, British Columbia	Cooperative Auto Network (CAN)	14
1997	San Francisco	City CarShare	8
1997	Canada, Victoria	Victoria Car-Share Co-Op	5
1997	United States, Missouri, Rutledge	Dancing Rabbit Vehicle Cooperative (DRVC)	3
1998	Canada, Toronto	AutoShare-Car Sharing Network	8
1998	United States, Colorado, Boulder	CarShare Cooperative	1
1998	United States, Oregon, Portland	CarSharing Portland	11
1998	United States, Washington, Olympia	Olympia Car Coop	1
1999	Oregon, Corvallis	Motor Pool Co-O	n.a.
1999	United States, Illinois, Chicago	ShareCarGo!	12-14

Source: author's own collaboration based on (Britton, E., 1999; Civitas Project, 2018; Doherty, M., J., et al, 1987; Eltis, 2018; Millard-Ball, A., 2005; Muheim, P. and Reinhardt, E., 1998; Shaheen, S. et al., 1999; , Shaheen, S.; Cohen, A.P., 2013, *Straitstimes Portal*, 2016; Tiffany Stone Portal, 2013; Walb, C. and Loudon, W., 1986; Young, R, 1997).

From a historical point of view, the last to witness the growth of car-sharing projects was Asia. According to the literature, the first car-sharing projects in Asian countries appeared in the late 1990s. The initial urban car-sharing businesses in Asia are presented in Table 3.

Table 3. Car-sharing history in Asia.

Year	Country, city	The name of the car-sharing project	Fleet
1997	Singapore, Upper Bukit Timah	NTUC INCOME Car cooperative	4
1998	Japan, Motegi	Intelligent Community Vehicle System (ICVS)	n.a.
1999	Japan	Crayon	35
1999	Japan	Inagi EV-Car Sharing	50

Source: author’s own collaboration based on (Britton, E., 1999; Civitas Project, 2018; Doherty, M., J., et al, 1987; Eltis, 2018; Millard-Ball, A., 2005; Muheim, P. and Reinhardt, E., 1998; Shaheen, S. et al., 1999; , Shaheen, S.; Cohen, A.P., 2013, Straitstimes Portal, 2016; Tiffany Stone Portal, 2013; Walb, C. and Loudon, W., 1986; Young, R, 1997).

The first car-sharing systems were test projects which ended their lifetime after a couple of years. A major development of car-sharing started in 2000 with the arrival of organizations which provided short-term car rental. At that time global leaders started their operation, including Zipcar and Flexcar in the US, City Car Club (now Enterprise Car Club) in Great Britain (Shaheen S.A, and Cohen A.P., 2013).

#### 4. CAR-SHARING – CHANGES IN RECENT YEARS

In further consecutive years, car-sharing

became increasingly popular. In 2008, in Europe, car-sharing started to be offered by traditional car rental companies, such as Hertz, and then car manufacturers, e.g. Daimler and car2go (Civitas Project, 2018). Already in 2009, car-sharing systems operated in 14 European countries (Civitas Project, 2018).

Later, car-sharing systems entered international markets and gradually attracted more interest in Europe, Asia and North America. According to the report of ‘Innovative Mobility Car-sharing Outlook: Car-sharing Market Overview, Analysis, and Trends, Winter 2016’, in 2014, the one-way car-sharing systems operated in 33 countries with about 4.8 million users and 104,000 vehicles (Shaheen S., and Cohen A., 2016). The systems reached their peak interest in Europe in 2006-2014 (based on data from Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland, Turkey, the United Kingdom) (Shaheen S., and Cohen A., 2016). Europe accounted for 46% of the global car-sharing business. North America came second (data from Canada, Mexico, and the United States) with 34% of the global car-sharing business and 23% of the fleet (Shaheen S., and Cohen A., 2016).

In 2006-2014, Asia recorded the most rapid growth in the number of users registered with car-sharing systems (data from China, Japan, Malaysia, Singapore, and South Korea) (Shaheen S., and Cohen A., 2016). The data are presented in Figures 2 and 3.

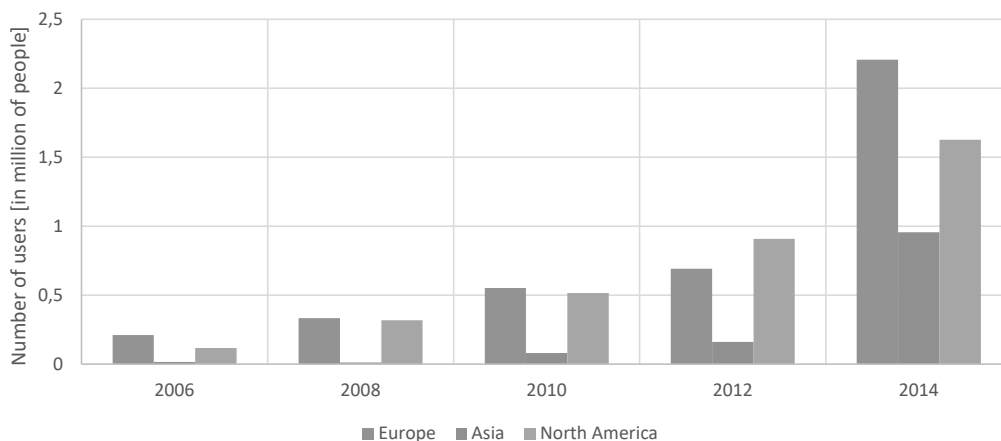


Fig. 2. Number of car-sharing users registered in Europe, Asia and North America in 2006-2014. Source: author’s own materials based on Shaheen S. and Cohen A., 2016.

Today, regardless the continent (Europe, Asia, and North America), we can observe a significant development of car-sharing systems. In Europe, Germany is the leader. In the early 2018, car-sharing systems operated in 677 German cities (Fleet Europe webpage, 2018; Carsharing.de webpage, 2018), whereas the number of registered users was in excess of 2,000,000 (Carsharing.de webpage, 2018), which indicates a significant increase in the development of car-sharing systems all over Europe comparing with 2014.

As regards the current status of the Asian market, it is worth mentioning that in 2017 in Shanghai alone the number of users was 1.2 million (China Daily webpage, 2018). Moreover, in 2017, the estimated number of vehicles rented in Beijing, Shanghai, Hangzhou, Shenzhen, Changsha, Wuhan etc. exceeded 26,000 (Berger R., 2017).

In 2017, the North American market recorded over 500,000 users in Canada, who shared more than 7 thousand cars, whereas the United States had 1,505,447 users and over 17 thousand cars, and Mexico 10,127 users and 39 cars (Shaheen S. et al., 2018).

in the modal split towards car-sharing are very important. They result from the saturation of the transport networks with vehicles and the lack of possibility to add other means of transport. The expected growing interest in car-sharing systems will have its major impact on the role of other modes of transport in cities as well. Figure 4 presents a forecast for the increase in the number of cars used in car-sharing in China alone. Variables presented are based on real data and a polynomial curve. Another important component of the development is the investment in electric vehicles by car-sharing operators in China.

Figures 5 and 6 present a forecast for the number of car-sharing users in Europe and in the world. Forecast may differ depending on the data source. Nevertheless, the numbers are expected to grow. Equations underlying polynomial curves support the expected growth in the years to come. Indicators, such as  $R^2$ , confirm that trends determined are close to the actual growth.

Based on Statista.com webpage, in 2025, the car-sharing systems are expected to meet transport demand. However, the saturation of the market may not necessarily mean that the trend is brought to a halt. It may only reduce its pace.

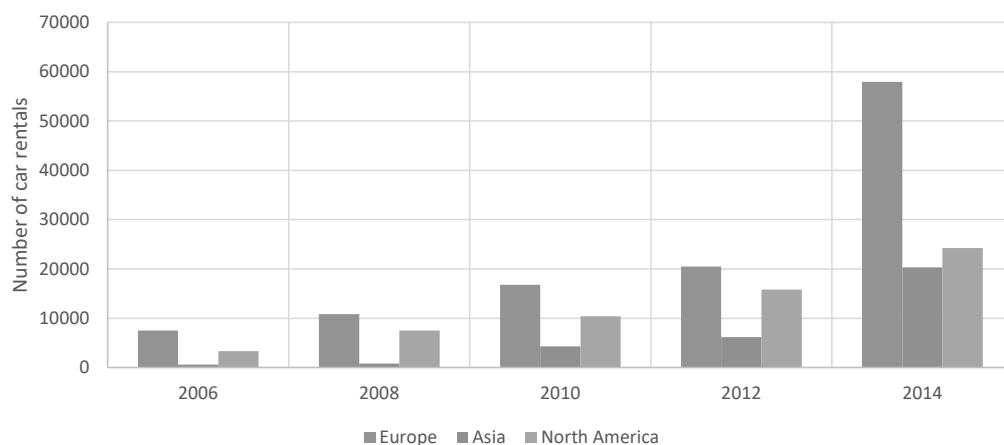


Fig. 3. Number of cars rented via car-sharing systems in Europe, Asia and North America in 2006-2014.

Source: author's own materials based on Shaheen S., and Cohen A., 2016.

It is worth referring to the development of car-sharing on emerging markets. Such markets include Brazil, China, India, Malaysia, Mexico, South Africa and Turkey (The city fix Portal webpage, 2015).

## 5. CAR-SHARING OUTLOOK

Considering the current rapid development of car-sharing systems, it is interesting to examine their future development. In this context, changes

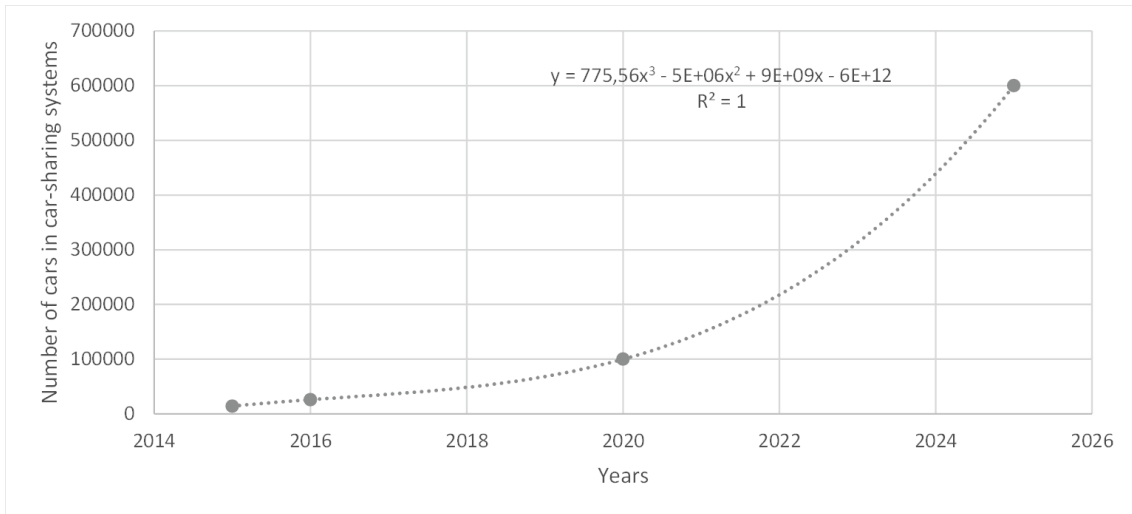


Fig. 4. Expected increase in the number of car-sharing vehicles in China.  
 Source: author's own materials based on Berger R., 2017.

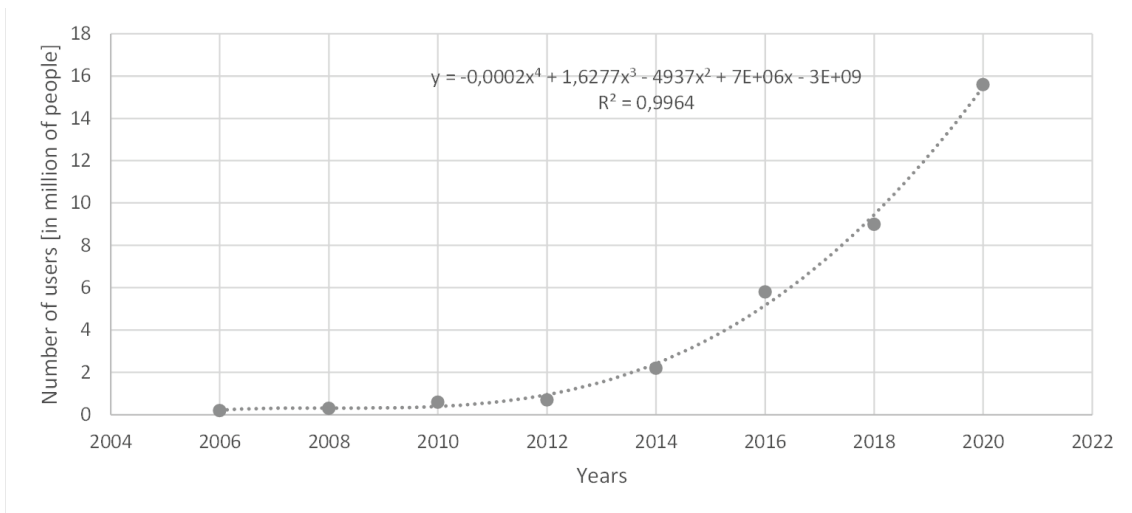


Fig. 5. Expected increase in the number of car-sharing users in Europe.  
 Source: author's own materials based on Car-sharing in Europe, 2017.

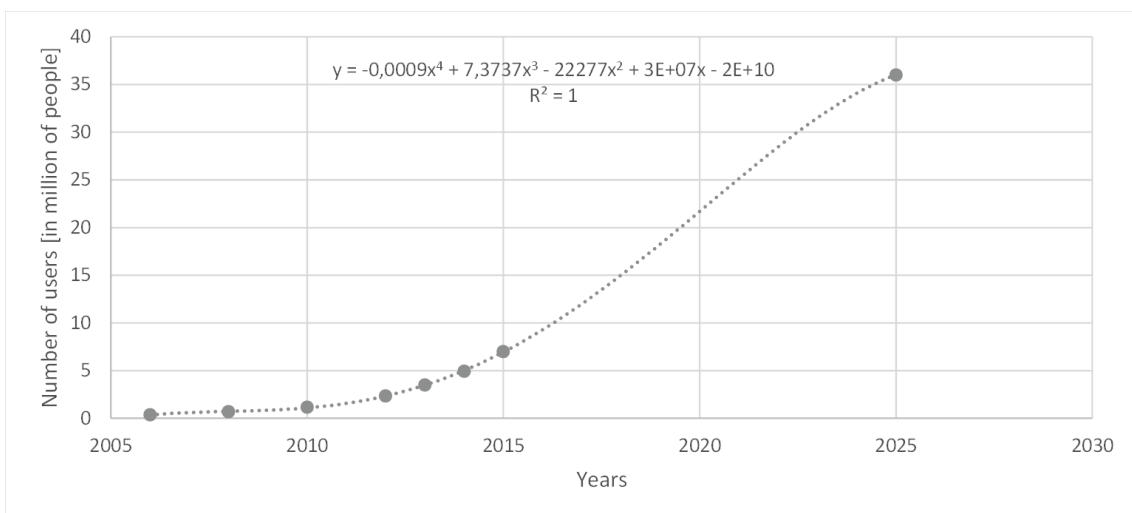


Fig. 6. Expected number of car-sharing users in the world.  
 Source: author's own material based on Statista.com webpage, 2018.

## 6. SUMMARY

In recent years, based on observations of the market, we can see a significant growth of car-sharing as a form of transport. Although, as yet, no figures are available regarding the development of car-sharing systems in 2017 and 2018 in the world, based on partial information from operators in Europe, Asia and North America, the major growth in the number of users registered and the fleet is remarkable. Comparing with the first car-sharing projects and car-sharing systems in operation in 2006-2014, the interest in those systems increased tremendously.

It should also be mentioned that car-sharing has become increasingly popular on emerging markets, such as Brazil, China, India, Malaysia, Mexico, South Africa and Turkey.

Regardless its organizational form, car-sharing helps reacting to the actual growing demand among users. Monitoring of daily rentals and their duration, as well as several other parameters, should help reacting adjusting the number of vehicles available in the car-sharing system. At the same time, we should remember that it cannot be the only form of transport available in a city. Due to the limitation of space in a city, urban areas need to be tuned to the needs of inhabitants while deviating from the automobile oriented concepts (Grzelec K. and Birr K., 2016; Stanley J., 2014; Turoń K. et al., 2017). Therefore, it is desirable to develop transport chains and incentives to cover a major part of our trip using public transport. Such a combination may reduce congestion in city centres (Hebel K. and Wotek M., 2017; Lejda K. et al., 2017) and contribute to the reduction of the negative impact of transport in cities. We should remember, however, that keeping the balance is the foundation of sustainable urban development, and initiatives such as car-sharing, may become one of its main features.

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