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## CAR SHARING AS AN ELEMENT OF SUSTAINABLE URBAN MOBILITY: SOME CONCLUSIONS FOR POLISH CITIES

### Abstract

Passenger car has influenced the development of urban space and results in the consolidation of unreasonable division of transport tasks. The traditional model of its use causes that on a daily basis it is used extensively, contributing, among others in increasing the demand for parking spaces. Car sharing creates the opportunity to increase the efficiency of car usage. Technological developments (teleinformatics, electromobility, vehicle autonomy), behavioral changes, and environmental conditions are the reasons for the emergence of new types of car sharing that allow new stakeholders to be included in the business model. Research conducted in US and Western European cities shows that car sharing has significant potential for replacing some private cars as well as a faster increase in the number of electric vehicles.

**Keywords:** car-sharing, transport market, sustainable urban mobility

### Introduction

Up to now, the passenger car was opposed to sustainable forms of urban mobility, including public transport, bicycle and pedestrian travel. An analysis of the distribution of journeys in Western European cities leads to the conclusion that the measure of the sustainability of urban travel is the ratio of the sum of travel in a sustainable way to the journey made with the use of a passenger car. Without arguing with fact, that there is rather a similar share of passenger cars in the modal split<sup>1</sup> of most

<sup>1</sup> Urban modal split is defined as the percentage share of each type of trip expressed in number of trips made within the territory of a given city. It usually covers cars, public transport, cycling and pedestrians, although that last category lacks of common, unified definition of trip (according to its destination, time and distance). The unit is a trip rather than passenger-km in order to create a common scale of mobility that differs substantially when pedestrian and motorised trips are taken together.

European Union cities, the important difference is a modal split structure. Central Eastern cities still held strong market position of public transport, while Western cities present higher share of cyclists (Wołek, 2009). While in the “old” Member States, passenger cars have gained a dominant position in the 70s and 80s, in countries that joined the EU in 2004 and later, the process gained momentum after accession as the dynamic of motorisation growth accelerated (Figure 1).

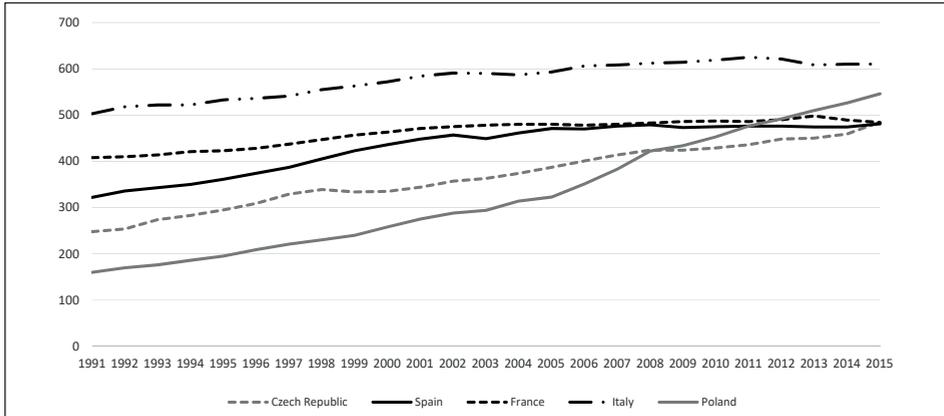


Figure 1. Motorisation index in selected European countries 1991–2015 [cars/1000 inhabitants]  
Source: (own elaboration based on the Eurostat)

The most important challenge is posed by transport congestion and related costs, the burden of which is inflicted upon all customers of a given urban system. It largely falls to local authorities to reduce and counteract these effects (Wołek, 2016). But there are many other serious negative impacts of mass motorization, including pollution, traffic accidents, upstream and downstream effects (covering all effects before and after the utilization phase), climate change, land use patterns and noise. The last category is difficult to measure as it includes many sub-impacts like disturbance of social communication, concentrated working, recovery and sleep phase and reduction of activities leading to annoyance, loss of efficiency and permanent modification of behavior. Another category of traffic noise impact is that it disturbs autonomic functions causing multifactorial conditioned chronic (cardiovascular) diseases (Becker, Becker, Gerlach, 2012).

The car is seen as a convenient alternative to urban transport. Figure 2 shows the evolution of main reasons for the choice of a car in urban journeys by the inhabitants of Gdynia in Poland. The predominant factor in 2015 was the greater convenience of using the car and the shorter travel time. The factors evolved for last years – they were the same in 1998 but their order has changed.

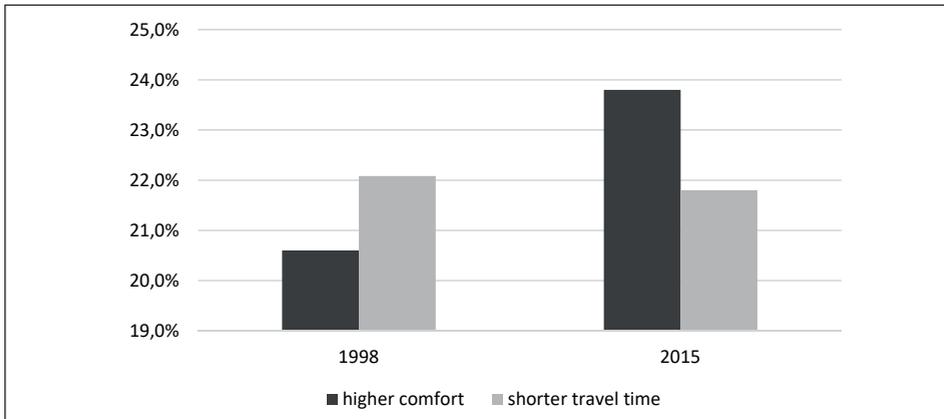


Figure 2. The predominant factors determining car over public transport in Gdynia in 1998 and 2015

Source: (own elaboration based on: *Preferences and transport behaviour of Gdynia's citizens. Marketing research report 1998, 1999* and *Preferences and transport behaviour of Gdynia's citizens. Marketing research report 2015, 2016*)

## 1. Shared mobility – new trend within mobility market

Shared mobility impacts urban transport market with new business models and with new services. The impact scale differs as different are services and their customers. Main factors powering development of shared mobility services are of technological (IT, autonomous vehicles, electromobility), societal (networking, to “use” instead of to “have”), environmental (improvement of quality of life, urban environment) and economical (circular economy, green economy) origin.

According to new business models accelerated by technological development, a “disruptive business” description is widely used. Its disruptive power affects existing, so called “traditional” business models that are strongly endangered by rapid development of technology (creation of new products, new pricing schemes, new forms of delivery), prosumerism and societal behavior. Although “disruptive” has a pejorative context, it is being used in many official documents (i.e. Siemens Annual Report, 2016, that states: “The markets in which our businesses operate experience rapid and significant changes due to the introduction of innovative and disruptive technologies”) (Siemens, 2016, p. 27).

Among three main trends on society and market, “emerging new mobility businesses along with changed values in car ownership (i.e. ride sharing)” were underlined in recent official publications of Toyota Motors (Toyota, 2016, p. 22). The concept of shared mobility brings new forms of urban mobility market organisation.

European urban mobility market is quite complex and its supply side represents a variety of different stakeholders and services. According to expected impacts

of shared mobility at urban scale, main findings of International Transport Forum's Corporate Partnership Board are as following:

- creating the right market conditions and operational frameworks is important to benefit from shared mobility;
- there are significant environmental advantages of shared mobility;
- the impact of shared mobility on the car industry;
- public authorities should not lose control over the deployment of shared mobility systems. They should be prepared for anticipation of their impacts as well.

But the most debatable and controversial thesis of the report is that "shared mobility will radically change public transport and most traditional bus services will disappear" (Shared Mobility. Innovation for Liveable Cities, 2016, p. 9).

The shared-mobility services can be structured into:

- bike-sharing;
- car-sharing;
- carpooling;
- ridesourcing, including Transport Network Companies (i.e. Uber and Lyft). Some of aforementioned services were widely known before shared mobility concept has arisen, mainly traditional carpooling, bike-sharing and car-sharing.

Carpooling and carsharing are based on car sharing between people who travel to work together by one vehicle. Carpooling involves passengers riding in each other's cars interchangeably, whilst in terms of carsharing only one car is in constant use and passengers split the cost of travel between them (Hebel, Wolek, 2017). Ridesourcing services are based on use of online platforms to connect passengers with drivers and automatization of reservation, payment and customer feedback (Feigon, Murphy, 2016, p. 5).

## 2. Car sharing as an element of sustainable urban mobility

Car sharing is a quite old scheme, but recent development in technology accelerated its qualitative and quantitative development. Being rather a collection of local grassroots organizations it has emerged to worldwide industry (Shaheen, Mallery, Kingsley, 2012, p. 71) with new stakeholders powered by technological and societal development.

There are two main general schemes of car sharing, namely station-based (one-way, "traditional") and free-floating. The first one has long tradition in Europe. The user is forced to pick the vehicle up at a given station (also using smartphone apps). The vehicle should be returned to any station of the system. Free-floating scheme means that registered users are searching vehicles which are located mainly in the most popular areas (i.e. business areas, city centers, etc.). The vehicle could be left in any place within defined area. Cars are parked at public lots.

The mixed system includes the features described above which means that in the central area it works as a free-floating, whereas in the outer districts it is typical station based. Other form of car-sharing is peer-to-peer car-sharing. It consists

in shared use of privately owned vehicles operated by a third-party organization (i.e. Getaround) (Terrien, Maniak, Chen, Shaheen, 2016, p. 21).

The ownership structures of one-way carsharing models are different, from “exclusive” private companies (car2go by Daimler, the first car producer carsharing system established in 2008) to joint-ventures (i.e. Drive Now – an agreement between Sixt and BMW). Peer-to-peer car sharing (called “personal vehicle sharing”) is the most collaborative form of the scheme. The whole spectrum of business models is more diversified as “traditional” companies are enriching their services – i.e. Hertz and IKEA developed a service for IKEA Family members by offering a convenient hourly van rental service to take IKEA customer’s shopping home.

Automaker companies are also developing their own systems, with car2go to be named. It is a subsidiary of Daimler AG providing carsharing services in European and North American cities. The company offers exclusively Smart Fortwo and Mercedes-Benz vehicles and features one-way, point-to-point rentals. As of end of 2016, car2go is the largest carsharing company in the world with over 2 000 000 members, 14 000 vehicles, operating in 30 cities (car2go website).

The car-sharing market segment fuelled by innovative solutions, transformation of lifestyles and sustainable policies of public authorities is expected to grow from 1.1 bln USD in 2015 to 6.5 bln USD in 2024 (Navigant Consultants website).

### **3. Impact of car-sharing on urban mobility: selected examples**

There is a little evidence on share of carsharing in modal split of European cities. One of the exceptions is Dublin with 4% share in its modal split, by the way strongly dominated by car in 2009 (49% car, 21% public transport, 4% bike, 13% walk) (Caulfield, 2009, p. 527).

An interesting example of integrated individual and collective transport on municipal platform is German city Osnabrück. A “traditional” carsharing scheme was introduced in 1994 in cooperation of local carsharing company and municipal public utility company Stadtwerke Osnabrück. Currently, two types of services are being offered, respectively flexible (flow>k) and stationary, one-way carsharing (stat>k). The station-based scheme was not negatively affected by the introduction of flexible carsharing in Osnabrück – the flow>k (Public Transport International, 2015, pp. 32–34).

Public transport monthly tickets owners pay a one-time registration fee for the flexible carsharing and save the registration fee of 49 EUR for one-way carsharing scheme in Osnabrück. These schemes are main alternative to the taxi services. The users of carsharing are also free from parking fees in certain part of the city. In a short time of its operation, the system attracted more than 2200 customers. The city is combining the system development with an expansion of euro-five zone, making carsharing more attractive to its citizens. Thanks to carsharing in Osnabrück, 280 cars were not purchased or abolished (Dillman, 2016).

Apart of its environmental advantages, one vehicle of carsharing system is expected to free 19 parking spaces. According to the German study ordered

by Bundesverband Carsharing (twelve large cities surveyed), a carsharing vehicle replaces between 8 and 20 private cars. The car abandonment behavior increases with the age of the customers which is opposite to societal trends observed within "Mobility in Deutschland 2013", where a growth of motorization among older population groups was reported (Neue bcs-Studie).

New research on carsharing impacts shows that more than 40% of German households decreased car usage after joining the scheme, while less than 10% – increased (Nehrke, 2016).

In Berlin (Germany), among strong market position of public transport and cycling (respectively 26% and 13%, 32% by car, 1% by taxi and 29% pedestrians, 0,1% of travels was made by three free-floating car-sharing systems (Car2Go, Drive Now and Multicity). Average distance made by free-floating carsharing system was 5.8 km and it was comparable with taxi (6.4 km). More interesting fact is that daily level of demand risen from 18 and peaked at 21 o'clock, clearly showing its complimentary role to other modes of transport in the city (Brockmeyer, Frohwerk, Weigele, 2014, pp. 13–17).

Autolib' is a one-way (station-based) carsharing system in Paris, operating since 2011. It offers electric cars operated by Bolloré Group. Vehicles are powered by modern Lithium-Metal-Polymer battery, enabling for 250 kms between charging. Autolib' has noted 17 500 rentals daily in 2015. More interesting, the peak rentals exceed 23 000 on weekdays.

Autolib' is a part of a public service delegation contract. The system includes Paris and 90 neighbouring municipalities. The Autolib' owner, Bolloré Group is expanding its business model. Next e-carsharing systems were opened in Lyon and Bordeaux (2013) and Indianapolis, USA (2015).

Results of research conducted in 2013 on round-trip-carsharing in France showed drop in the ownership and intensity of use of private car, increase of all the alternative to individual car. Important finding was the fact, that round-trip car sharing can be treated as a part of sustainable mobility policies (FNCS, 2013). The study conducted in 2013 has revealed that Autolib' subscribers are more educated and their income is higher than the average but it should be noticed that it also attracted students (8% of subscribers). Although the system attracts mainly occasionally users, analysis of frequency of use means that "the use of Autolib' for commuting is found to be sizeable (6% commutes regularly with Autolib', whereas almost 1/3rd does it often)" (FNCS, 2013). 1/4 th of Autolib' users have a negative perception on public transportation due to its less practical and less comfortable features in comparison to carsharing. Autolib' has an impact on decrease of car traffic, replacing 3 individual cars and freeing 2 parking slots. After subscription, the motorisation rate decreased by 23% among Autolib' users. Autolib' affected transport behavior of its users in a more complex way, reducing demand for cycling by 25%, for public transport by 18% and for walking by 7%. There was also strong reduction in taxi use – more than 2/3rd of Autolib' users declared that they have used taxis less. Probably, the market change could be expected in relations between carsharing and taxi – Autolib' responds to similar needs in a more flexible, cheaper and convenient way (density of stations as the crucial factor determining

its accessibility). The conclusion of the research conducted in 2014 was that “Autolib’ pushes its users towards individual transport modes” and “leads to a decrease in kilometres driven with a car but but to a more frequent car use for daily trips”. A market research company CSA’s estimation is that thanks to Autolib’, in first two years of the service’s existence, purchase of more than 11 500 conventional cars in the greater Paris region had been avoided (or cars were sold).

#### 4. Potential of car-sharing in replacing private cars

There are a variety of studies presenting results of car-sharing implementation. The final effect depends among others on:

- existing modal-split of the city;
- integration with other instruments of urban transport policy (parking management, green zones, etc.);
- type of the car-sharing scheme;
- scale of the system;
- barriers of entry (formalities, costs).

Table 1 presents findings of the selected studies on different car-sharing systems in Europe and North America. The number of cars removed per car sharing service differs from 3 to 20, although it is difficult to find an average number due to features named above.

Table 1. Impact of selected car sharing schemes on passenger car ownership

System	City	Year	Privately owned vehicles removed per car-sharing vehicle
Philly Car Share (currently operated as Enterprise CarShare)	Philadelphia (USA)	2002	7
12 cities in Germany		2013	8 to 20
Autolib’	Paris (France)	2014	3
Cambio	Bremen (Germany)	2015	15
Free floating system	Munich (Germany)	2016	4.0–7.8
Car2go	Calgary, Vancouver (Canada), San Diego, Seattle, and Washington, D.C. (USA)	2016	11

Source: (own elaboration)

#### Summary and Conclusions for Polish cities

- 1) Car-sharing supported by technological and societal change creates a new role for car in the modern city. Although car-sharing is a well-known scheme, it evolves from car-clubs to peer-to-peer carsharing or worldwide systems operated by car automakers.

- 2) Case study analysis and review of research show that carsharing is the most effective when it is integrated with other instruments of urban transport policy such as parking policy, green zones management and public transport system.
- 3) Polish cities face spectacular growth of individual motorisation and its growth seems to be irresistible with separated actions focused on mitigation of its impact on the urban environment. Car-sharing could play a supportive role, but city and transport authorities should strive for its integration, avoiding competition with sustainable forms of mobility, mainly cycling and public transport.
- 4) An important issue is that car-sharing brings a short-term perspective for mass deployment of electric cars. In such case, additional cost of electrification should not burden the user but should be a part of a more complex, innovative business model.
- 5) The efficiency of car-sharing systems will be greater for these cities, the more they will integrate it into the main objectives of sustainable urban mobility (sustainable parking, green zones, tax policy on eco-vehicles, and integration with public transport).

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