

# Chapter 18

## Operations Planning in Carsharing Systems: A Literature Review of Problems, Issues, and Solutions

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### ABSTRACT

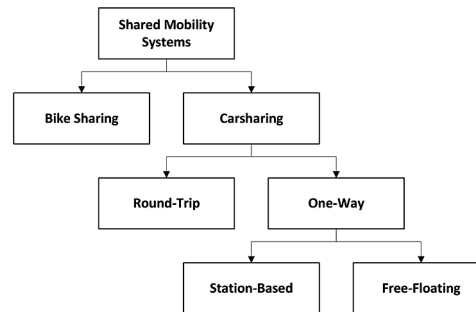
*Shared mobility systems such as carsharing provide significant social and environmental benefits by reducing the number of vehicles used in the urban transport network. The carsharing systems are facing many challenges from the design to operation stages. In the design and strategic management level, it is important to find the best location for the stations, a minimum number of vehicles and a minimum number of operating staff, and in the operation stage, the most important problem is to relocate the vehicles moved by the members among the network to maximize the satisfied demands while the system is still economical. Effective and efficient optimization technology that can respond to user's demand is one of the necessary components for a successful carsharing system. The authors survey the related operations research models in the academic literature proposed to model different aspects of carsharing systems from a strategic and operational point of view to find the gaps and propose opportunities for new research.*

### INTRODUCTION

Shared mobility system is generally defined as short-term vehicle access among a group of members who share a vehicle fleet that is maintained, managed, and insured by a third-party organization (Shaheen, Chan, & Micheaux, 2015). As an alternative transportation solution, shared-use mobility in the forms of carsharing or bike sharing grabbed the attention of experts to face the known problems of traffic congestion, air pollution and vehicle related accidents (Omrani, Awasthi, Ion, & Trigano, 2009; Almeida, Silva, & Leite, 2017).

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Figure 1. Different types of shared mobility systems



The shared-use mobility is typically provided through self-service vehicle access on a 24h basis for short-term trips. Rates include fuel, insurance, and maintenance. There are several models: roundtrip car or bike sharing (vehicles are accessed and returned to the same location), peer-to-peer carsharing (shared use of privately-owned vehicles operated by a third-party organization), one-way vehicle sharing, and a few other methods (Shaheen, Cohen, & Jaffee, 2018). Different types of mobility shared systems shown in Figure 1.

Car-based shared mobility systems are divided into two main categories: Round-trip and One-way systems. Round-trip carsharing systems are defined as schemes providing short-term access to a vehicle for members. The system has fixed locations for vehicle pick-up and the members can have access to cars with prior booking. The users must return the car to the original pick-up station according to their confirmed itinerary. A rapidly emerging mobility sharing system is one-way carsharing, which does not require users to return a vehicle to the same location from which it was accessed, thus allowing users to make one-way trips. Technology has played a major role in the growth of one-way carsharing, including smartphone applications, keyless vehicle access, in-vehicle and mobile global positioning system (GPS) receivers, and hybrid and electric vehicles (EVs). One-way carsharing presents unique challenges, such as vehicle rebalancing and parking management. Free-float carsharing system is very close to one-way systems in definition. The main differences in the working principle of free-float carsharing when comparing with classic one-way carsharing are: (a) Pick up / drop off a car is possible freely in a defined zone of a city, as cars have no fixed positioning, (b) Booking is just possible on the spot, preferably by smart phone app showing the position of the next available cars (but this is also feasible via internet or by phone call), and (c) The renting duration is fully flexible and does not need to be indicated when booking. Renting ends when dropping off the car.

In this survey we have focused on one-way carsharing issues and solutions.

## BACKGROUND AND REVIEW PROCESS

### Historical Background

One-way carsharing began in Europe in the 1970s through experimental programs. The earliest small-scale carsharing system known as Sefage was founded in Zurich, Switzerland in 1948. This system along with Procotip which was launched in 1971 in Montpellier, France, Witkar which was opened in Amsterdam

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