# ENAC / PROJET DE MASTER 2018
# SECTION DE GÉNIE CIVIL

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

## Demand shifting mechanisms

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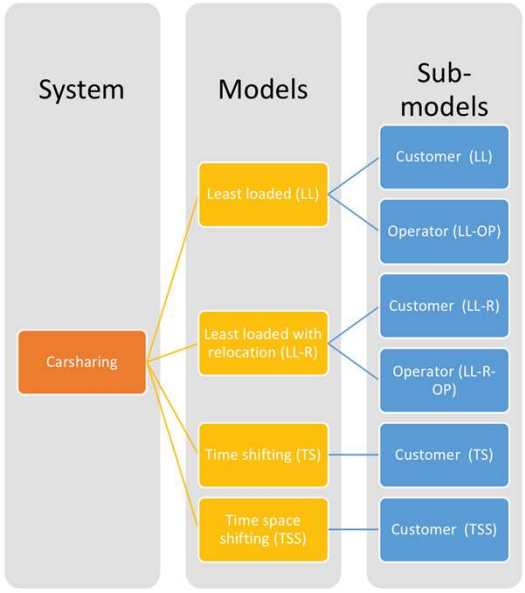
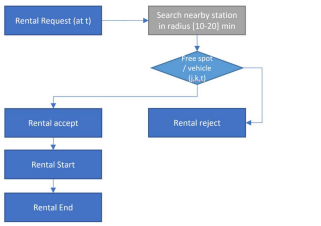
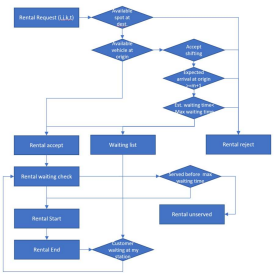
Since its creation in 1948, car sharing systems have always became more current worldwide. They represent a solution to congestions, parking issues as well as environmental pollution. This study aims at developing a new operational management of a one-way station-based car sharing system. A large database from the operating car sharing system of the French city of Grenoble is used to test our models. The system operates with electric cars. Relocation of vehicles as well as space shifting, commonly known mechanism of the literature will be evaluated. In addition, we developed a model allowing us to test the mechanism of time shifting, which has never been done before. An event based simulator built in C# helps us to measure and compare the mechanisms. Results show that a relocation of vehicles is the most efficient solution. Space shifting displayed successful results as well. Time shifting has not yet been able to challenge the performances of the latter.



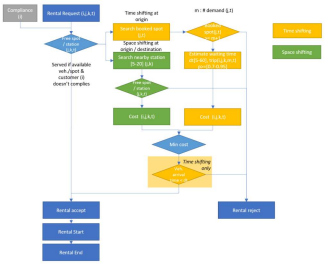

## Event based simulator




Least loaded policy operator oriented (LL-OP)



Time shifting policy customer oriented (TS)

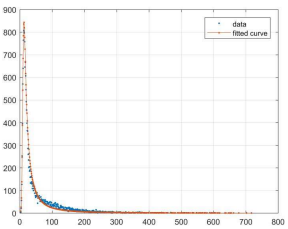


Relocation policy with least loaded mechanism for a customer oriented model. (LL-R)

## Case study

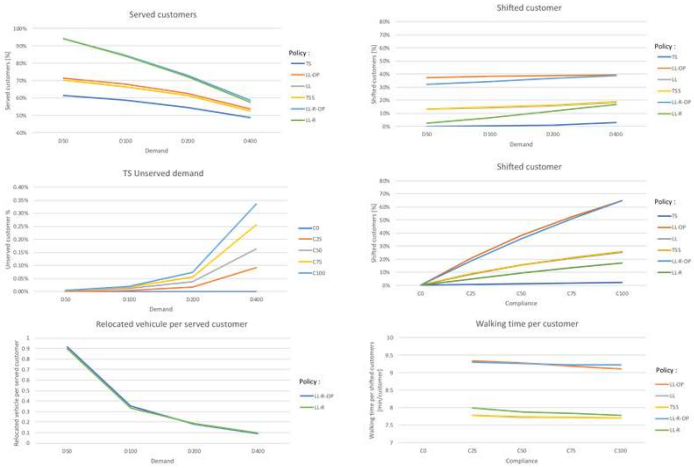
- 20000 datas
- City of Grenoble
- One way car sharing
- Electric vehicles

Electric vehicle "I-road" by Toyota




Burr distribution fitting the trip length frequency

## Results




Relocation policies optimize the available resources by improving the level of service. The feature allowing the system to anticipate the bookings of users renders the operator even more efficient.

Least loaded policies prove to be relatively efficient. The operator is able to redistribute clients within nearby stations. Even a small proportion of acceptance by customers can make the difference on the overall system.

Time shifting policies have shown the least satisfying results in terms of system efficiency. TS and TSS do not seem to improve the overall functioning of the system. However the rate of occurrence of time shifting events is small, making it difficult for results to be representative.

A combination of both time and space shifting, TSS, could be complementary. A situation where customers are shifted in time in the nearby station when a space shifting is not possible seems promising. This could expand the range of possibilities to better serve customers, resulting to better connections between arrivals and departures and leading to a higher number of trips per vehicle.