Conclusions and Future Trends: From Ownership to Sharing

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Abstract In this chapter, we summarise the main "lessons learned" that originated from the study and the onsite experimentation within the Green Move project. These are presented under the form of brief "guidelines" that may represent launching pads for a complete engineering of an advanced system of vehicle sharing. In the (relatively short, a little more than two years) duration of the project, the technologies and experiences of vehicle sharing underwent a noteworthy evolution which in any case appears to be in line with many of the points analysed. The remarks presented in this chapter represent a contribution for identifying the conditions, related to both the service model and the technology, for shifting from car ownership to vehicle sharing: providing this option to citizens is an essential aim that each city has to pursue as a first step for becoming a smart city.

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1 The Future of Sharing Mobility

The future of sharing mobility will be influenced by several drivers; focusing particularly on recent (in the 2010s) trends, the following factors can be identified as particularly important contributors (Luè 2015).

- Venture capital markets have become increasingly focused on personal mobility, making available larger pools of capital with which to support development of the "back-end" of Mobility as a Service (MaaS) networks.
- The maturation of Information and Communications Technology has proven to be a major catalyst for the growth of MaaS.
- Peer-to-peer markets have emerged as part of the wider (i.e. aside from transport) sharing economy.
- There has been a clear generational shift (Lee-Gosselin 2017) in policy preferences across all levels of government in Europe (local authority through to pan-European), with attitudes (and consequent policies) evolving towards increasingly negative views of provision for growth in private motorised transport.
- There has also been a generational shift in access to economic resources, with younger adults (the age group that uses sharing mobility in different ways, time windows, etc.) in many European countries having consistently lost ground economically in the 2000s relative to older age groups.
- Finally, the attitudes and actions of specific entrepreneurs to directly challenge both incumbents and policymakers in the urban mobility space have been the key to service innovation.

The future development of car sharing will depend not only on the above factors, but also on the potential influence of disruptive elements. One example is the introduction of fully autonomous vehicles, which is likely also to boost vehicle-sharing deployment as it would enable the ability to re-position the vehicles to where and when demand is likely to be high, without the cost of human intervention (Le Vine et al. 2014).

2 The Green Move Solution

Green Move has been able to anticipate some of these drivers, creating a flexible solution, with the following characteristics:

- **Wide vehicles portfolio**. Green Move has been created as a multi-vehicle system, with the integration of different classes of vehicles. The system has not been developed for a small number of new vehicles, but with an inclusive logic that can permit any manufacturer easy adaptability and integration in the system of its own vehicles through the installation of a small electronic dashboard (the "Green e-Box").

- **Interoperability**. This is a fundamental characteristic of the project. In close analogy with the Internet, all vehicles of the system (like every Internet hub) may differ by size, cost and structure, but must respect a system "protocol", shared and standardised, which allows the access to the network (the sharing system) and guarantee complete interoperability.
- **Ownership of the system. In accordance with a MaaS perspective**, Green Move was created and planned as a distributed system. The system may comprehend a series of subsystems (vehicles and recharging stations) belonging to different organisations and companies; vehicles and recharging stations are "standardised" in their interfaces (computer, electric, mechanic) and therefore completely interoperable (each vehicle may be hooked up to each docking station).
- **Business model**. Within the scope of the designed system, a number of various business models may coexist. For example, vehicles were made available by a public administration for its citizens (with the payment of a flat-rate annual tariff), by a company for its employees (for transfers between branches or from stations to the company), by an airport vehicle-rental company, by a hotel or a trade organisation for its clients, etc. Each actor is free to purchase the vehicles (upon which to impose their own limits and rates) and to contribute to the network by installing their own recharging stations; the only condition is the conformity of the system standards, in terms of access to the vehicles, protocols for data exchange, power points.

According to these principles, the next sections summarise the main remarks that emerged during the project.

2.1 Service Model

Adequate service model design is an essential aspect, in which different elements have to be taken into consideration in order to implement an electric vehicle-sharing service that is both efficient and able to address the user's needs. The following are some of the main characteristics that an efficient electric vehicle-sharing service should have.

- **Capillarity**: the vehicles and the docking stations must be easily reached by the user by foot, for guaranteeing a level of capillarity comparable to that of privately owned cars. The recharging stations have to be placed near the main mobility generators and LPT stations, in order to guarantee an effective intermodality and efficient synergy with public transport: this permits a broadening of the area of use from residents to commuters and to city-users.
- **Interoperability**: the interoperability among different services regards tariff integrations with the LPT and among the various car-sharing operators; it should be stimulated and sustained by the local public administration, the stakeholder able to encourage this integration.

- **Annual rate**: this is one of the main obstacles to registration; the user does not know how often he will use the service and is reluctant to adhere thereto if the entrance fee is too high. A low (or zero) annual fee enhances the growth of a potential user base that may determine a rapid attainment of critical mass of users.
- **Pricing system**: this must be clearly defined and easily customised in function of the user's profile, for allowing the broadest range of uses possible. In an electric vehicle-sharing system, in particular, the pricing system based on time seems to be more consistent than one based on distance covered.
- **One-way trips**: in this type of service customers can return the vehicle to a different place than it was accessed. This offers users a fundamental chance to undertake "one-way" journeys, especially if aimed at business clients or occasional travellers. More flexibility is guaranteed by free-floating services, even though, for electric car sharing, the recharging stations must be present and reallocation for recharging can request remarkable effort in terms of management and costs.
- **Balancing of the fleet**: one-way services, in general, and free-floating ones, in particular, need to rebalance the fleet: this may occur through reallocation mechanisms, possibly performed both by the users (acting on reward) and by the operators (through dedicated staff).
- **Range of vehicles**: the availability of a wide range of vehicles (cars, but also electric quads, scooters and bikes) allows services to satisfy different user needs: this may be facilitated by guaranteeing the interoperability between different operators (e.g. interoperability among car-sharing operators with different types of vehicles, bike- and scooter-sharing services, etc.) and through the introduction of peer-to-peer services.
- **Technological and service standards**: the great dynamism of the vehicle-sharing market seems to suggest the adoption of standards, to foster the integration of different systems together.
- **Booking system**: this is one of the key mechanisms of an advanced vehicle-sharing system. The range of options is wide (one-way, two-way, immediate booking or short-/medium-/long-term booking, with/without limits of use, etc.). The more flexible the booking process, the higher the probability of being able to satisfy the user's needs.
- **Alternative models**: as well as a "generic" car-sharing service, there are also alternative systems, such as community car sharing, the peer-to-peer car sharing. These services can work in synergy with traditional services, helping to satisfy specific niche needs.

2.2 Technology of the System

Technology plays a fundamental role in allowing designed service models to have a real application in practice. One of the main points of the project is the hypothesis

that the user may access the system exclusively using his personal device and the software applications installed on it, without further intermediaries. Today this appears realistic, as the availability of mobile devices (smartphones and tablets) is such that the potential users of the system have access to them on a daily basis. This scenario was perhaps—at the beginning of the project—optimistic, but it quickly became realistic due to the huge evolution of the technological context in which the Green Move project has operated. Given the high dynamism of said context, it appears to be crucial that an innovative system be designed so as to avoid anchoring it to specific technologies, instead favouring the possibility of constantly modifying and updating the technologies on which the system is based. This may be obtained in a variety of ways, listed below.

- **Interoperability**: this is the possibility to ease communication between the components of which the system is made up; this makes it easier to integrate within it new components and technologies (in the moment in which these became available) and enriches the system of new functionalities, (also) acquired by third parties.
- **Open platforms**: building the system on the most possibly open and standard platforms and technologies (meaning they are independent of specific suppliers) makes it easier to keep it up to date and takes advantage of the innovations, which is particularly important in the interaction between the system and the vehicles.
- **Involvement of the manufacturers**: standard procedures allowing users to interact with the vehicle independently from the manufacturer are not always available. Standards such as On-Board Diagnostics (OBD) are a first step in this direction, but they are not yet rich enough to be the basis for a vehicle-sharing system. Without such standards, it is crucial to be able to involve vehicle manufacturers in the development of sharing system, in order to obtain suitable interfacing mechanisms.
- **Charging points**: similarly, to the interaction between system and vehicles, that with the docking systems should also occur as soon as possible through open standard mechanisms, which at the moment is not possible. In the near future, we can predict a quick increase in the distribution of charging points, which should give a significant push towards their standardisation.
- **Ease of (re)configuration**: The Green Move solution is in continuous evolution, not only technologically, but also for what concerns the needs and preferences of involved actors (users, institutions, vehicle suppliers) or the related regulations. Hence, the ease of reconfiguration (in terms of constraints on the use of vehicles, mechanisms for the monitoring and management of the fleet, services offered to the users, etc.) must be one of the main aims pursued by the system.
- **Software development practices**: for a complex system, such as Green Move, it is important to adopt software development standards that are solid and strict, taking care to suitably document the choices made. The system is by its nature heterogeneous and must be developed by a team with a broad range of skills,

including server-side programming, code development for mobile devices, embedded control unit programming, but also development of electronic devices to manage the interfacing with the low-level components of the vehicles.

- **Security (of data and networks)**: a system like Green Move is greatly distributed and involves continuous and important interactions between components that are connected through telematics networks: it must therefore be planned while constantly keeping in mind security matters. In this regard, the exposure of the system to computer attacks should be minimised, for example by avoiding to keep unnecessary functionalities and services active.
- **Solidity**: the need for solidity of planning/realisation is not confined to software components. When physical devices lie at the heart of the system (e.g. the Green e-Box), it is of the utmost importance that they are also solid from the physical point of view, considering the fact that they may operate in insufficient environmental conditions (very high or very low temperatures, adverse atmospheric conditions, damp, etc.).

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