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Multifunctional Cabin Combines Mobility with Living - Project LiMo

(Sustainable Urban Living and Mobility Concept)

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Abstract

Getting stuck in a traffic jam by car and then not finding a parking space? That's a horror scenario for every car driver!

How easy would it be in a fairytale world? If there is no parking space at your destination, you would simply conjure the car away and then conjure it back when it is needed again. 'Magic away and magic back' is the basic idea of LiMo translated into reality. A parking space is no longer needed because the vehicle 'dissolves' at its destination. It disassembles into its cabin and chassis modules. The cabin disappears 'as if from the ground' by lifting off and docking itself to its own home. The chassis virtually disappears because it can be parked to save space.

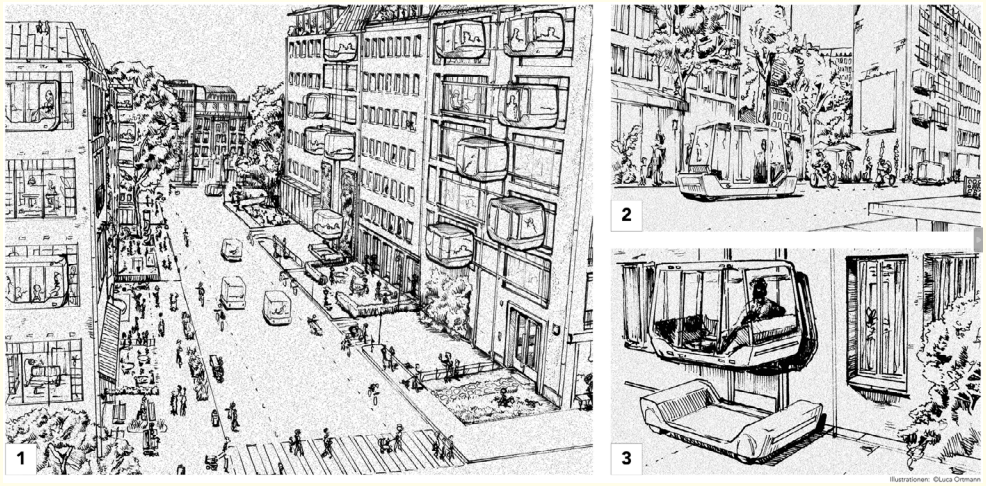
LiMo is a completely new living and vehicle concept with the potential to revolutionise urban mobility. It combines the advantages of a private car (own passenger compartment) with the traffic-related benefits of car sharing - all this in a convenient (barrier-free), sustainable (parking spaces become green spaces!) and cost-effective (no underground car parks required) way. The focus is on a multifunctional cabin that is used around the clock, either as a vehicle cabin, as a lift cabin or as a living space extension (mini conservatory).

Keywords: car sharing; sustainable urban mobility; modular vehicle concept

Introduction

Our cities are characterised by wide streets, multi-lane main roads and space-consuming intersections; necessary to cope with the high volume of traffic, which is mainly caused by private car traffic. The mobility of the future must fulfil a wide range of requirements such as sustainability, user-friendliness and reduced land consumption. Promising approaches include modular concepts with a separation of 'utility cabin and chassis' as proposed in [1] and [2]. But how can urban living be combined with individual mobility? Could the cityspace perhaps look like the left illustration in Figure 1? - No cars and no car parks, but lots of new living space.

LiMo aims to combine living and mobility in a practical, cost-effective and sustainable way - with a vehicle concept that (virtually) no longer needs a parking space. How can this work? When a vehicle is no longer in use, it has to be parked somewhere. The trick as to why it still works is the modular design of the vehicle cabin and chassis. If the cabin and chassis can be separated, there are interesting options for parking both the cabin and the chassis. The cabin is not only a vehicle cabin, but also a lift cabin and, above all, part of the flat, i.e. most of the time the cabin hangs on the building like a kind of glazed balcony (mini conservatory), as illustrated in Figure 1.



1. The cityspace with LiMo. 2. LiMo on the road. 3. The cabin lifts off.
Figure 1: Illustration LiMo ©Ortmann.

Holistic design

The LiMo concept developed at Esslingen University of Applied Sciences consists of a multifunctional cabin that can not only be integrated into different transport systems (road, rail, cable car), but also offers significant additional benefits in conjunction with the building (Figure 2). If you want to be individually mobile, you can use an app to book a chassis that travels a short distance autonomously and waits until the cabin and its occupants descend via a sophisticated rail system, dock and travel to the desired destination [3].

The cabin is modelled on a small cable car gondola. It can be integrated into a cable car network or a cable car system. Even helicopter transport would be conceivable. The cabin can be individually equipped and furnished, not only as a light-flooded additional living space, but also as a mobile home office, for example. If the cabin has to be parked away from the building, an inexpensive parking tower (Figure 2, rear centre), which essentially consists of the vertical and horizontal rails that are also required for transport on the building, is sufficient [3]. If you want to travel in your own cabin, transport by rail is a good option. Thanks to its compact dimensions (2.1x1.2x1.6), two cabins fit next to each other and two on top of each other (Figure 2, rear). The cabin is made of double-walled recyclable material in sandwich construction (heat and sound insulating).

According to the car-sharing principle, only about 2 chassis are needed on average for 10 cabins. The chassis is leased and comes, for example, from the depot of a service provider who takes care of logistics and infrastructure (space-saving parking, battery charging, etc.). The current development stage is based exclusively on technology that is available at low cost and fulfils the requirements of vehicle category L7e (m≤450 kg, P≤15 kW, no airbags, no lane departure warning or emergency braking assistants and no crash tests required for road approval). The market launch could therefore take place as early as 2030.

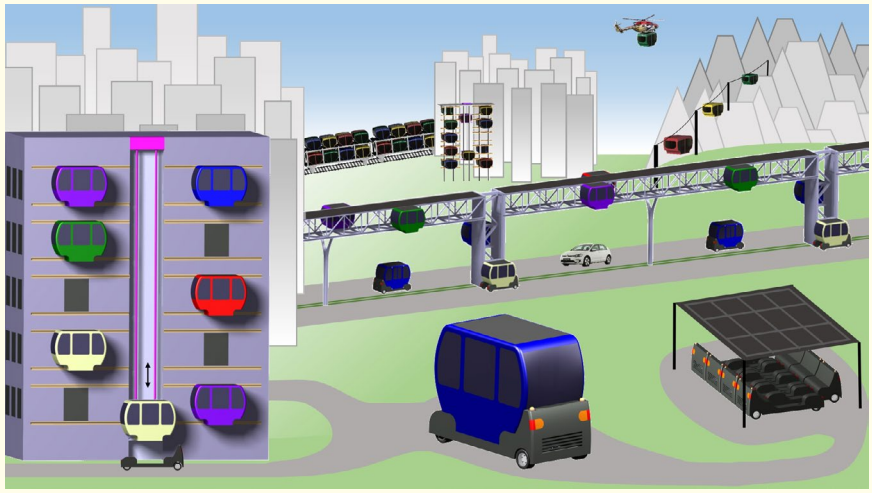


Figure 2: CAD design LiMo ©Tai.

Although the building must also be equipped with a rail and lift system [4], the central lift and corridors to the flats are no longer required. LiMo 2030 thus becomes a holistic concept that ensures individual mobility in urban areas even if cities become car-free (by decree) or 'car-poor' (due to a lack of parking spaces and high parking fees) in the future.

Prototype

The cab design must not only match the chassis, but also the building. There is undoubtedly still room for optimisation here. Nonetheless, the first prototype is being manufactured according to the design in Figure 2; made of wood to reduce the manufacturing costs (Figure 3).

Figure 3: First prototype, ©Ossendorf.

Cost-benefit analysis

The following 'urban development scenario' is analysed in a project study: Comparison of 3 new neighbourhoods to be planned with the same number of inhabitants and the same land consumption for exclusively the following individual mobility concepts:

1. Conventional (approx. 1 private car per 2 inhabitants).
2. Car sharing.
3. LiMo 2030.

The results can be summarised as follows:

Parking space requirements

With car sharing, the number of parking spaces can be immediately reduced by around 80% compared to private cars, based on the assumption that 1 car sharing vehicle replaces around 5 private cars [5]. Compared to car sharing, the parking space for the LiMo 2030 vehicle is reduced by 67% (cross-parking) and for the chassis by as much as 80% (see Figure 2 right). With regard to the additional green space gained, the comparison becomes more complex, as the scenario with only private cars can also be imagined in such a way that all parking spaces are 'underground', which, however, drives up the costs enormously.

Costs

Car sharing is becoming increasingly popular. Studies indicate a cost advantage for car sharing if less than 10,000 km/year are driven [5], which is very often the case in urban environments with a dense public transport network. The flexibility of use (car size as required) and the elimination of fixed costs (tax, insurance, maintenance, etc.) are seen as advantages.

The comparison with LiMo 2030 remains unclear because the costs for the chassis, car and lift system can only be estimated. In an initial approach, it is assumed that the costs for the lift and rail system for the 'LiMo building' are roughly the same as the costs for a central lift within a building. This does not include the space required for the lift shaft and corridors, which are not required in the 'LiMo building' as access to the flat is via the external lift system and otherwise only emergency stairs are required at the rear of the building.

Depending on the equipment, the costs for the cabin (CCa) are estimated at between 8,000 and 15,000 euros and the costs for the chassis (CCh) at around 15,000 euros. The study is designed in such a way that all values can be entered variably, so that the more precise the initial data, the better the calculation. The total costs (TC) for a 'LiMo set' (consisting of cab and 'proportionately' the chassis) are therefore between 11,000 and 18,000 euros (TC=CCa+1/5*CCh), i.e. significantly lower than a conventional city vehicle. The comparison becomes particularly interesting when the cabin area is counted as 'additional living space'. In many cities, the price per square metre for flats is over 5,000 euros per m^2. With an additional approx. 2.5 m^2 of cabin floor space, that would be at least 12,500 euros. The bottom line is that LiMo is almost free!

Benefits

The topic of benefits is complex because benefits are difficult to define and can hardly be quantified as a monetary advantage. Young people don't mind travelling to a car park or car sharing station that is further away. Older people or people with restricted mobility, on the other hand, appreciate the advantage of being able to get from their home to the LiMo cabin at ground level. Accessibility in the mobility chain is of particular importance here. This starts with barrier-free boarding and ends with the convenience of not having to change from the lift to the vehicle, or from the vehicle to a cable car or suspension railway system or the train (for longer journeys). You simply remain seated or lie down (seats can be pulled out).

If you look at the utilisation rate of the subsystems, you can see the following: The LiMo cabin is in use 24/7, i.e. constantly, either as an additional living space, as a lift or as a 'mobile' cabin. The chassis is operated in car-sharing mode and is also frequently in use, in contrast to a private car, which has to be parked for an average of 23 hours a day [5], often associated with inconvenience and costs.

Conclusion

LiMo is an exciting concept, from the idea of combining living with individual mobility, to the technical realisation and the final design. A cost-benefit analysis has also shown that LiMo has decisive advantages compared to both private cars and car sharing.

LiMo is not only interesting for houses with more than 5 floors, because the lift can be dispensed with here, but also for residents of smaller houses without a lift, who can enjoy the benefits of an 'external lift' via LiMo. A senior citizens' residence, for example, is a good place to start, as the benefits are particularly great here. The initiative for this could come from a housing association.

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