Identification of Strategies How Urban Air Mobility Can Improve Existing Public Transport Networks

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I. Introduction

Recent years have opened up opportunities for a large number of new mobility service offers. On the one side, increasing digitalization gives rise to sharing concepts and real-time information provision, enabling Mobility as a Service (MaaS). On the other side, technological advancements enable the provision of completely new modes like autonomous cars. Similar to the concept of shared autonomous vehicles, Urban Air Mobility (UAM) provides on-demand transport services with autonomous passenger drones. Currently, more than 70 companies are conducting UAM-related research and are attempting to make the first vehicles fly. As the UAM vehicles are assumed to require dedicated infrastructure for take-off and landing, there are certain capacity constraints to the service. Due to that UAM builds on a mobility system that already incorporates modes with large capacities. Therfore, public transport (PT) is still an essential part of the urban transport system enabling efficient mobility for a growing number of passenger; especially considering that decreasing PT demand leads to a less attractive PT offer, due to fewer PT lines, lower frequencies and less investments enabling a state-of-the-art transport service. This research is thus aiming at identifying strategies to introduce UAM as a complement rather than a substitute to existing public transport.
The paper proceeds as follows: firstly, the prerequisites for a successful integration of UAM into existing PT networks will be identified and assessed with regard to their feasibility. This is achieved by a thorough assessment of existing literature on measures applied to enable MaaS. In the following, the authors develop UAM network scenarios that clearly show the aim to complete and not compete with existing PT, illustrating the inter- and intra-city deployment of UAM. Possible impacts of an efficient UAM integration into existing PT will be derived from empirical findings that existing literature shows. The discussed impacts will include changes on the PT service, not only on the city's transport system in general but also on UAM compared to a system independent of other modes. The research will conclude with a discussion of the findings and the possible options and limitations.

II. Prerequisites for an Efficient UAM Integration to the Existing PT Network

To generate a UAM network that has the potential to be integrated with current existing PT network, necessary prerequisites for successful integration have to be defined. Looking into the existing literature on MaaS and car sharing key requirements for enabling these services a lot of findings can be transferred to UAM. Linking the findings of Huwer (2002)[1], Huwer (2004)[2], Kamargianni et al. (2016)[3], Kamargianni and Matyas (2017)[4] and Li and Voege (2016)[5] several aspects regarding intermodal integration have been identified:

- Physical integration and spatial linkage: intersection of different modes at a given location. Intends to shorten distances between connections and facilitate the usage
- Fare integration: one ticket for all parts of a multi-modal journey (e.g. car-sharing or UAM as an add-on for annual PT tickets)
- Service integration: one customer service for all modes that are part of the intermodal service
- Platform integration: a single application or online interface that can be used to access information about the modes included in the service
- Data exchange: the included services allow real-time data exchange

III. Creating Scenarios to Complete PT

The research aims to obtain PT as the main mode providing large capacities, especially during peak hours. Thus, service scenarios for UAM enabling a completion of existing PT rather than creating competition with existing PT lines are developed.

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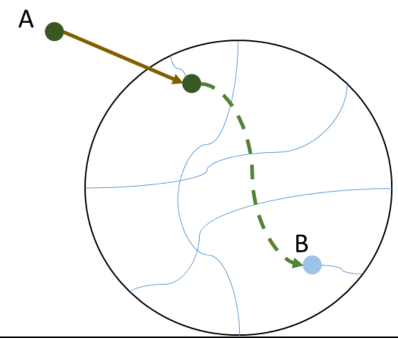
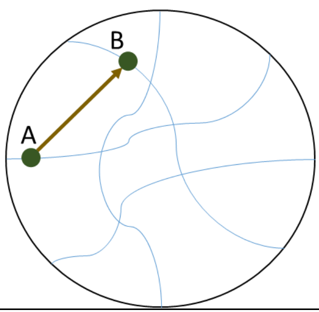
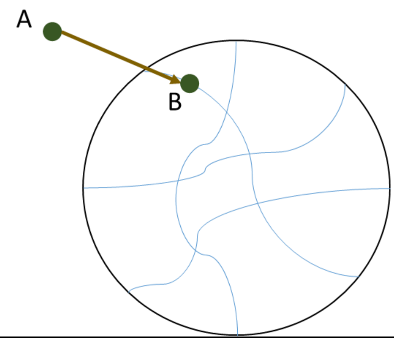
Table 1 provides insight into the three developed scenarios. These can be distinguished into two cases, namely the feeder concept for UAM and a concept improving existing PT networks by supplementing poor connections of current PT lines.

Table 1: UAM service scenarios

Feeder concept	**PT Improvement**	
Inter-city case	Intra-city case	Inter-city case
		
UAM acts as a feeder connecting two vertiports located in different cities. Vertiport can be part of, e.g. multimodal mobility stations, providing a chance for the integration of UAM and the current existing PT lines.	UAM directly connects two vertiports (as part of multimodal mobility stations), reducing the efforts transferring between different PT lines and supplementing the current existing PT lines.	UAM directly connects two vertiports (as part of multimodal mobility stations) of different cities, which contributes to the development of the current existing inter-city PT system.
PT network	UAM route PT route	Destination point Vertiport

IV. Possible Impact

Empirical studies on existing modes have shown that efficient integration can promote usage of all included modes. Akin (2006)[6] found that the integration of bus lines and mini bus lines with a metro line doubled the ridership-over-capacity ratio on the metro line while at the same time massively decreasing operating costs of the bus operator. Yet, studies have also found that the concept of park and ride, which is comparable to the UAM service scenarios we propose, does not always only benefit the existing transport systems. In 1991, Dickins[7] already showed that even though park and ride profits commuters massively, it does not reduce congestion on roads due to induced demand. These findings go in line with Parkhurst (1995)[8] who states that some of the demand for park and ride stems from travellers originally using other modes than car only.

Therefore it is essential that this research generates insight on the current travel behaviour of the potential UAM users and whether integrating UAM and PT truly promotes PT usage instead of shifting demand away from it.

V. Results and Discussions

This research evaluates options to integrate UAM and PT in an efficient way that does not lead to a massive decrease in PT demand. Some prerequisites for the successful mobility integration are firstly assessed. Building from that the authors developed three different service scenarios that UAM to complete and not compete with existing PT. Yet, it is important to thoroughly evaluate potential induced demand and modal share shifted away from other modes.

VI. Acknowledgements

This research was funded by the Bavarian Ministry of Economic Affairs, Regional Development and Energy.

References

1 Huwer, U., "Kombinierte Mobilität gestalten: Die Schnittstelle ÖPNV – CarSharing," Kaiserlsautern, 2002.
2 Huwer, U., "Public transport and car-sharing — benefits and effects of combined services," *Transport Policy*,

vol. 11, 2004, pp. 77–87.

3 Kamargianni, M., Li, W., Matyas, M., and Schäfer, A., "A critical review of new mobility services for urban transport," *Transportation Research Procedia*, Elsevier B.V., 2016, pp. 3294–3303.

4 Kamargianni, M., and Matyas, M., "The Business Ecosystem of Mobility-as-a-Service," *Transportation Research Board (TRB) Annual Meeting*, Washington DC: 2017.

5 Li, Y., and Voege, T., "Mobility as a Service (MaaS): Challenges of Implementation and Policy Required," *Journal of Transportation Technologies*, vol. 7, 2017, pp. 95–106.

6 Akin, D., "Model for Estimating Increased Ridership Caused by Integration of Two Urban Transit Modes Case Study of Metro and Bus – Minibus Transit Systems ," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 1986, 2006, pp. 162–171.

7 Dickins, I. S. J., "Park and ride facilities on light rail transit systems," *Transportation*, vol. 18, 1998.

8 Parkhurst, G., "Park and ride : could it lead to an increase in car traffic ?," *Transport Policy*, vol. 2, 1995, pp. 15–23.