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Quantifying the effects of activity concentration at airports on public transport using an iterative reduction procedure

Hermann Orth*, Ulrich Weidmann

ETH Zürich, Institute for Transport Planning and Systems, Stefano-Franscini-Platz 5, 8093 Zürich, Switzerland

Abstract

Airport locations are increasingly the place of non-aeronautical activities. This is driven by airport operators seeking non-aeronautical revenues and real estate investors attempting to profit from major airports as high value locations. The resulting higher densities lead to more travel to and from the location. Travellers induced by non-aeronautical activity are likely to behave different than those induced by aeronautical activity. Consequently, there are potentially not only more, but also more public transport prone travellers. This can improve the viability of operating high quality public transport services. However, as demand of the different traveller groups is likely distributed differently, it also needs to be studied whether the superimposed demand affects the peaking behaviour of travel demand in a beneficial, balancing, or negative, exacerbating, way.

For the analysis, an iterative reduction procedure is proposed that begins with a network of highest quality services. Considering demand elasticity and minimum loads to viably operate a service, network elements are degraded and demand is recalculated iteratively until only viable services remain. This procedure is applied to a case study of Zurich, where large scale commercial activities and a public transport hub are located at the airport. It was found that the non-aeronautical development already contributes decisively to public transport use and without it, severe service reductions might be necessary. Furthermore, the compound demand distribution is more even than that of the individual traveller groups, resulting in a landside transport hub that can be operated more efficiently than facilities in conventional locations. Future growth of the airport location will increase this effect and further service expansions may become an attractive option.

It is concluded that the high connectivity of airport locations is an opportunity to drive development patterns conducive to public transport use. In addition, airports can be efficient locations for transfer centres as there, if their locations are suitable, sustained high demand with less variation throughout a day allows for a better utilisation of services and facilities.

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* Corresponding author. Tel.: +41 44 633 3109; fax: +41 44 633 1057.

E-mail address: hermann.orth@ivt.baug.ethz.ch

1. Introduction

There is an ongoing growth of commercial and business developments that are not directly or not at all induced by the aviation activity at airport locations, referred to as *airport cities*. Drivers of this development are airport operators striving to become less dependent on aeronautical revenue (Graham, 2009) and real estate developers, both attempting to profit from the high value and well-accessible location of major airports. As such activity centres continue to grow, urban-like patterns emerge (Kasarda and Lindsay, 2011) and they become central locations for the region around the airport, and, consequently, focal locations for transport demand in the airport region. At the same time, the situation of providing public transport services at airport locations is oftentimes a difficult one (Coogan, 2008). Even though many airports and planning authorities include higher ground access public transport shares in their strategies, mode shares and utilisation are oftentimes low.

In this light, the development of airport cities may bring about improvements to the prospect of operating public transport services at airports through beneficial changes in ridership volume and distribution: A study by Orth et al. (2015) showed that the additional travellers significantly increase passenger loads. Furthermore, the non-aeronautically induced travel occurs at conventional commuting time periods, when aeronautically induced travel is low. The resulting situation is therefore seems to be one with markedly higher overall public transport passenger numbers and less demand variation throughout the day. This can improve the viability of offering such services since only with sufficiently high utilization can public transport networks be operated efficiently (Lee and Vuchic, 2005).

The goal of this research is to study this in further detail and determine whether the development is beneficial or detrimental to the prospect of operating public transport services at airport locations and if there is a potential additional gain for trips not only to and from the airport location. For the analysis, a procedure is developed that identifies services that can be viably operated to the airport location considering the number, distribution and mode choice of public transport passengers. This procedure is then applied to the Zurich, Switzerland, case study in order to analyse the impacts of non-aeronautical development at the airport location on the public transport access system.

The following section of briefly reviews the relevant literature in airport city planning, airport access planning and the operation of public transport services. Section 3 describes the research question and the method. Section 4 introduces the case study and shows the analysis and findings. Section 5 concludes the work, including a discussion.

2. Literature Review

The concept of the *Airport City* as a commercial centre at the airport location is discussed in detail in Freathy (2004) and Güller and Güller (2003). As profit margins of the aeronautical activities are in decline, if not even absent, airport operators seek revenue outside of their classical business (Graham, 2009). Part of these strategies are large scale commercial developments at the airport location. Driven also by other investors attempting to profit from the airport locations, the results can be as striking as in Amsterdam, where floor space at the airport has become more expensive than downtown (Schaafsma, 2003). A wider impact of such developments, where airports act as catalyst for a whole region, is addressed by Kasarda and Lindsay (2011) who coined the term *Aerotropolis*.

The airport access literature focuses on passengers and, to a smaller extent, employees. Especially major airports are interested in elevating the share of passengers using public transport in airport access and egress. A review of practices and lessons for this goal can be found Leigh Fisher Associates et al. (2002) and Coogan (2008). More in-depth studies of airport access mode choice behaviour are the subject of e.g. Budd et al. (2014), Humphreys and Ison (2005), as well as Gosling (2008) for a review of airport access mode choice models. Gelhausen et al. (2008) extends the problem with the inclusion of airport choice. Commonly used methods for mode choice are multinomial logit (MNL) and nested logit (NL) models. Despite potential shortcomings of MNL models when alternatives are similar, as discussed by e.g. Ben-Akiva (1985), the complexity of airport access mode choice oftentimes permits sensible use of MNL models as done by e.g. Hansen and Monteiro (1996), Hess (2010) and Tam et al. (2008).

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