



Baggage dissociation for sustainable air travel: Design study of ground baggage distribution networks

Sarah Al-Hilfi^a, Hao Yu^b, Pavel Loskot^{c,*}

^a University of Basrah, Basra, Iraq

^b UiT, The Arctic University of Norway, Narvik, Norway

^c ZJU-UIUC Institute, Haining, China

ARTICLE INFO

Keywords:

Air transport
Baggage service
Distribution network
Travel experience

ABSTRACT

Dissociation of passenger travel from baggage delivery has been proposed as one of the radical innovations in future air travel. This concept is still relatively new and largely unexplored, so there are many issues that need to be resolved. For instance, a complete end-to-end baggage dissociation will require the ground distribution networks to deliver passenger luggage to and from the departing and arriving airports. This paper proposes to design such networks as the existing parcel delivery networks. In particular, baggage sorting centers (BSCs) can serve as local hubs for creating a scalable, multi-level topology of the delivery network in order to manage baggage flows in a given geographical area around the selected airports. Assuming the population density as a proxy for estimating the baggage delivery service demands, the optimum locations of BSCs are determined by formulating and solving the standard p-median and the maximal covering location problems. The numerical results were obtained for Greater London, and also for the whole UK assuming all its major civilian airports. The Greater London area could be served by 36 BSCs to achieve a full service coverage. The 90% service coverage of the whole UK can be achieved by about the same number of BSCs, provided that the coverage distance is increased. In practice, the actual number of required BSCs crucially depends on the operational and capital costs, and the maximum processing capacity of each BSC. These findings have direct implications on the long-term planning and innovations in future air transport.

Introduction

The largest and the busiest airports are struggling to meet the increasing travel demands, since they were dimensioned to handle a certain maximum number of arriving and departing flights per day (Snowdon et al., 1998). Even at busy airports, the number of flights and passengers and the luggage volumes vary substantially in the course of the day as shown in Fig. 1 for the case of four main London airports in the UK. The busy hours with peak demand for the airport services determine the required airport capacity. Moreover, costly delays negatively affect the travel experience (Zhang & Zhang, 2006; Wang and Loo, 2019), which has a significant impact on sustainability of airports and air transport in general (Li & Loo, 2016). For instance, the baggage delivery systems at airports had to handle 4 billion travelers and 4.27 billion luggage in 2018 alone (SITA, 2019). Moreover, there will be more than 20 airports operating near their capacity limits by 2035, compared to only 3 such airports in 2012 (Dg Mobility and Transport,

2015).

A new concept of dissociating passengers from delivery of their luggage has been recently proposed as a possible solution to lacking airport capacity. The idea originated in one of the Baggage Working Group meetings of the International Air Transport Association (IATA) in 2013 (Loskot & Ball, 2015). The baggage dissociation envisions future air travel when passengers will be incentivized to travel independently of their heavy luggage (Al-Hilfi et al., 2018). The ultimate aim is to send heavy luggage from the point of departure to the final destination using separate delivery channels. Passenger luggage would be collected from their premises shortly before their departure to the airport, or passengers could drop their luggage at the baggage collection points established, for example, in local supermarkets and post offices. The luggage should be delivered to the final destination shortly after the arrival of passengers. Such end-to-end baggage dissociation will require not only providing many new baggage delivery services around and at the airports, but also allocating extra capacity to allow delivering baggage on

* Corresponding author at: ZJU-UIUC Institute, 718 East Haizhou Road, Haining, Zhejiang 314400, China.

E-mail address: pavelloskot@intl.zju.edu.cn (P. Loskot).

<https://doi.org/10.1016/j.trip.2023.100797>

Received 24 September 2022; Received in revised form 2 March 2023; Accepted 7 March 2023

Available online 16 March 2023

2590-1982/© 2023 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).