Managing delays and incidents at intermodal airport hubs in a more efficient way

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Outline

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1. Background and Objective (1)

Delays due to missed connections at an airport, train station or other transportation hub are not only annoying, they also cause **individual** and **overall economic costs**.

Travelers may experience **individual stress** and **uncertainty**. Also, travelers may incur **costs** due to missed business appointments or lost vacation time.

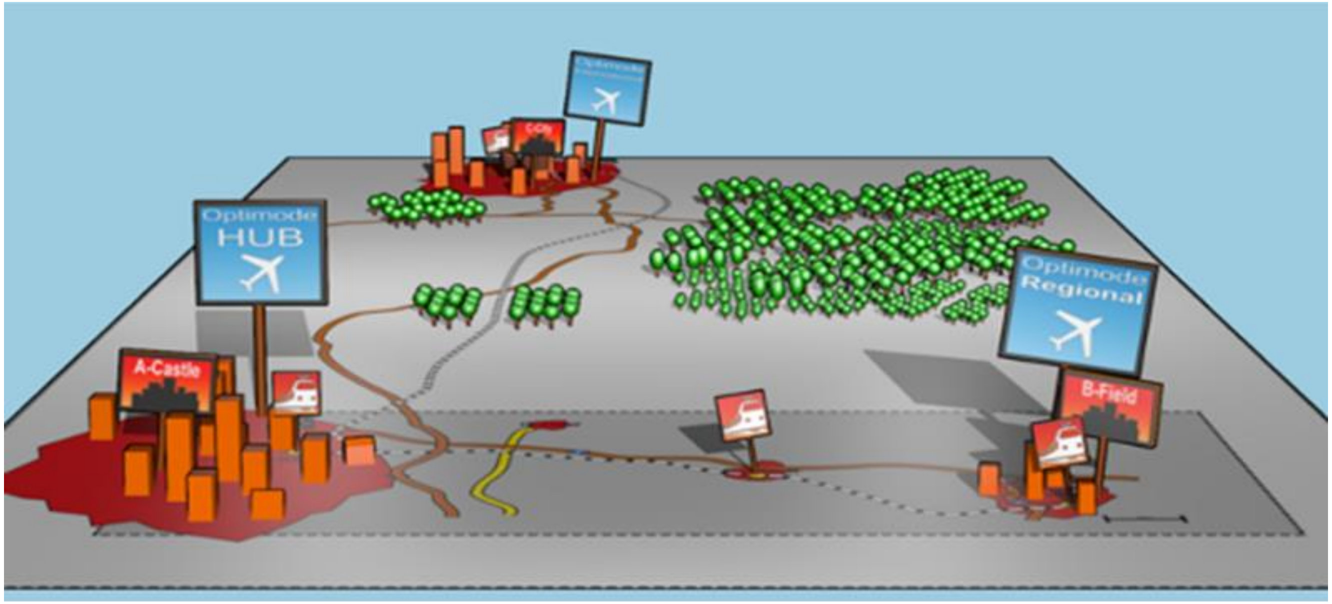
1. Background and Objective (2)

Moreover, delays also frequently entail higher costs for **transport companies** operating at an intermodal hub airport, e.g. for **additional employees**, for **rebooking** or for **compensation payments** on the basis of passenger rights regulations, or even the **loss of revenue**.

The **objective of our research** is to analyze the pros and cons of **different delay management approaches** at an intermodal hub airport in terms of traffic and economic effects for all stakeholders involved.

2. Methodology (1) – Modelling World

Figure 1: Modelling World



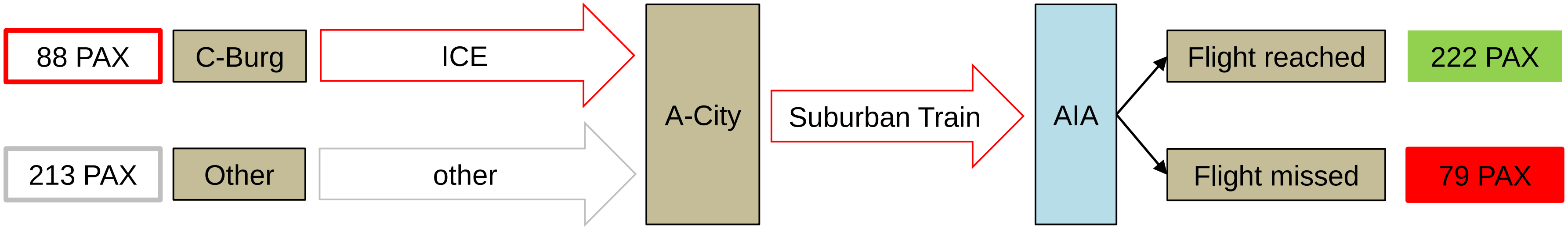
Source: DLR Transition Final Report (2022).

Within our study, **microsimulations** of the individual **processes and sequences at selected transport hubs** such as train stations and airports were conducted. This way, **traffic impacts of different delay management options** were modelled.

2. Methodology (2) – Traffic Scenarios investigated

In our paper, we examine **three scenarios**: Reference scenario (S0), Incident scenario (S1) and Cooperation scenario (S2).

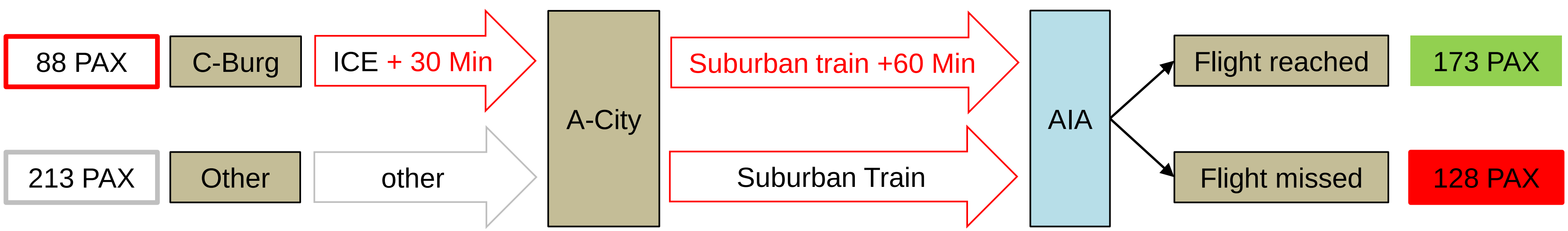
Reference scenario S0: 301 passengers travel to AIA airport by the suburban train. 88 of these 301 passengers have previously taken the ICE from C-Burg to A-City to catch the suburban train to the airport. All 301 passengers of the suburban train want to reach three different flights. Even in the reference scenario, 79 passengers miss their flight, according to our modelling results. This is due to the circumstance that in reality some travelers are too optimistic in their time planning.



2. Methodology (2) – Traffic Scenarios investigated

In our paper, we examine **three scenarios**: Reference scenario (S0), Incident scenario (S1) and Cooperation scenario (S2).

In **Incident scenario** S1, a disruption in the operating service causes the ICE and its 88 passengers an arrival which is half an hour late in A-City. As a result, the connection between the suburban train to the airport is no longer possible. A total of 128 (79+49) passengers from this train are stranded at the airport.



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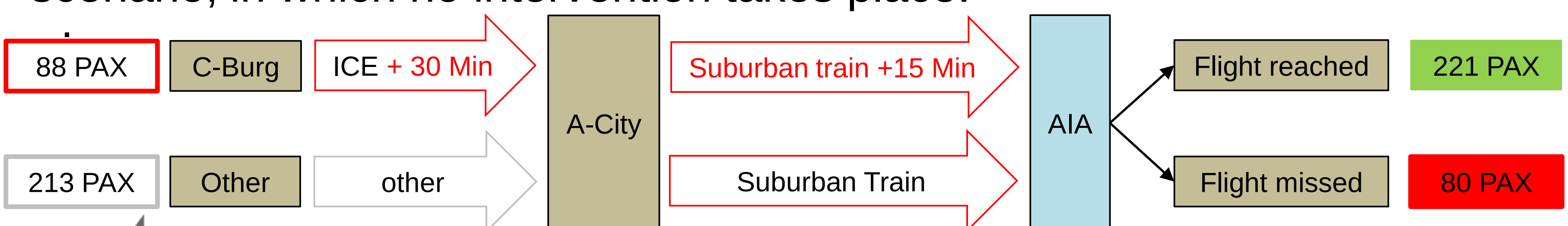
2. Methodology (3) – Traffic Scenarios investigated

In **Cooperation scenario** S2, there is an intermodal delay management system with the goal of minimizing delays. We assume that the suburban train missed due to the delay of ICE now waits for the arrival of the transferring passengers. This could help at least some of the 88 passengers to reach their connection after all.

Now, the **suburban train** to the airport **waits 15 minutes** before departing from A-city and reaches the airport station 15 minutes late as well. As a result of this management intervention, the transfer passengers of the delayed ICE train reach the suburban train to the airport that is waiting for them. Although a total of 80 passengers still miss their flight, this is 48 passengers less than in the S1 Incident scenario, in which no intervention takes place.



2. Methodology (4) – Economic impacts

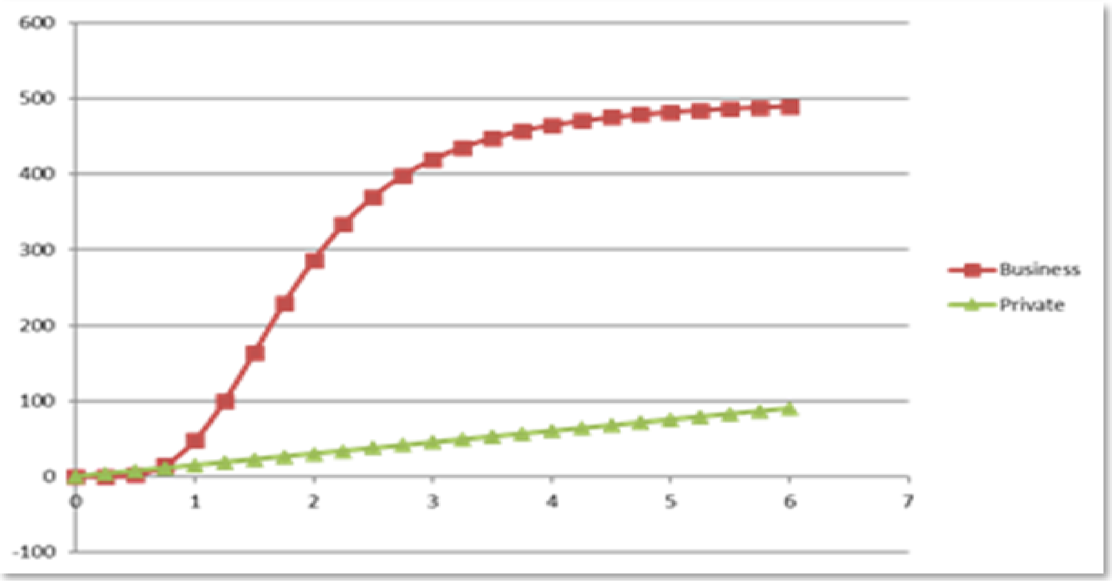
From a **traffic point of view**, the Cooperation scenario leads to an overall shorter delay across all considered routes. However, which **economic effects** are associated with such management measures for reducing delays at the intermodal transportation hub?

Economic effects can be relevant for **all main stakeholders** at a **transportation hub**: the travelers, the operator of the suburban train(s), the operator of the ICE train(s), the security control at the airport, the airlines involved, the ground handling services and the airport shops, generating so-called non-aeronautical revenues.

To estimate these economic effects, we developed an **overall economic evaluation function**. This function, on the one hand, takes the economic effects triggered by management measures on **company level** into account. On the other hand, the damage incurred by **travelers** in the event of a delay is considered.

2. Methodology (5) – Economic impacts

Figure 2: Value of Time (VoT) function for business and leisure travelers (schematic)



Source: DLR Transition Final Report (2022)..

For generating empirical data for this function, a literature review and an online-survey have been conducted by the authors.

3. Economic Effects of Intermodal Delay Management (1)

In the **Incident scenario** investigated, 128 of the 301 travelers experience a delay due to missing their flight. According to our VoT estimations, this also leads to a **monetary delay loss** of **920 Euro** in total for eight of those travelers affected. As a result of the cooperative problem-solving in the **Cooperation scenario** S2, only 80 people experience a delay and five people suffer a total loss of **240 Euro**.

In the **Cooperation scenario**, the **suburban train operator** incurs **30 Euro** in additional costs due to the 15-minute delay in departure. The operator of the **long-distance train** incurs additional costs of **256 Euro** due to the delay. There are **no cost effects** for the **airlines and ground handling** in the example investigated. **Airport security** incurs an additional **180 Euro** in the Cooperation scenario due to the three additional airlocks. The **non-aeronautical revenues** of the shops decrease by **528 Euro**.

3. Economic Effects of Intermodal Delay Management (2)

Table 1: Total Damage by Stakeholder Group in Scenarios investigated, in Euro

Stakeholder at Transportation Hub:	Incident Scenario S1	Cooperation Scenario S2
Travelers	920	240
Operator suburban train	0	30
Operator long-distance train	256	256
Airlines	0	0
Groundhandling	0	0
Airport security	0	180
Non-Aviation Revenues (shops)	-563	-528
Total Damage (Euro)	**613**	**178**
Total Delay (Min.)	8.710	4.070

Source: DLR. Cost estimation for airport security on the basis of average personnel costs For employees in the security area. Cost estimation for operator suburban train and operator long-distance train on the basis of Scheier et al. (2018).

4. Conclusions

Our main results indicate that a **coordinated intermodal delay management** at hub airports can offer **traffic and economic advantages**, compared to the previous, uncoordinated management of delays at such hubs. In principle, these benefits apply to all major transport and other companies operating at an intermodal hub airport and to the travelers themselves.

However, **not every single delay management measure** will result in **benefits for all stakeholders**. Rather, one measure may result in benefits to Stakeholder A, while another measure may result in benefits to Stakeholder B, etc. In the sum of all management decisions in a given period of time **benefits** should be achieved for **all stakeholder groups involved.**

Thank you very much for your attention!

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