From Ride Quality to Elasticity Estimation: A Planning Workflow for Urban Air Mobility Use-Case Simulation

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For Urban Air Mobility use-case planning, the decisive question is not only whether an aerial mobility service is technically feasible, but whether it can generate realistic demand potential within an existing multimodal transport system. This potential depends on current travel demand, the attractiveness of the new offer compared with available alternatives, user acceptance, possible modal shifts, and additional demand induced by improved accessibility, comfort, reliability, or perceived convenience. Previous studies show that airport-access mode choice is influenced by travel time, cost, reliability, transfers, and service quality, while airport-specific constraints such as luggage, early or late departures, and peripheral airport locations further complicate decision-making [1–5]. Existing elasticity values are often broad, context-dependent, and not directly transferable to innovative mobility services, limiting their use for early-stage planning and potential estimation [3,4].

This contribution presents a planning-oriented workflow for comfort-informed elasticity estimation developed within the Sustainable Mobility for Airport Connectivity project. The workflow is intended as a complementary planning layer for use-case simulation and transport model enhancement. It does not replace established mode-choice models or traffic simulation tools, but provides an interface between user research, perceived-comfort simulation, validation with measurement data, acceptance modelling, and later elasticity estimation. The central idea is to relate the potential of a new mobility offer to existing corridor or airport-catchment demand, users' willingness to consider the offer, and the service attributes that may trigger or limit a shift from existing modes.

The workflow consists of three methodological blocks. First, revealed-preference and stated-preference data are used to characterize current airport-access behavior and hypothetical reactions to future mobility options. Building on the demand-side constraints outlined above, this block provides the behavioral basis for existing choices, stated trade-offs, and acceptance thresholds for new transport services. Related project work has shown that airport access is not only a matter of speed or price, but also of reliability, luggage handling, transfer burden, and perceived convenience [1]. Second, perceived comfort is modelled using mode-specific ride-quality indicators and validated against available measurement data. For established transport modes, reference data are collected from rail services, bus travel, private car travel on different road types, and conventional as well as electric passenger cars. For aerial mobility concepts, a six-degree-of-freedom flight simulation is used to reproduce representative air taxi motion under route-specific manoeuvres and atmospheric disturbances. Turbulence and disturbance inputs are introduced to generate realistic translational and rotational accelerations, which are compared with measured data from drone and helicopter operations. This simulation-and-validation step forms a key contribution of the workflow, because future Urban Air Mobility services cannot yet

be evaluated through large-scale passenger operation. The resulting motion profiles are translated into ride-quality and perceived-comfort indicators, considering combined vibration and noise exposure in line with aircraft ride-quality approaches such as the NASA discomfort index [6]. Third, the resulting transport, comfort, and acceptance-related inputs are organized in a response-surface-based planning layer. This compact representation describes how combinations of service attributes may influence potential demand responses and later supports elasticity estimation for selected user segments, service configurations, and route types. The elasticities are therefore not presented as final results, but as planning-relevant outputs enabled by the proposed workflow.

A specific focus is placed on ride quality because comfort can change the practical interpretation of otherwise similar transport offers. If two alternatives provide comparable travel times and costs, users may prefer the more comfortable, less stressful, or more predictable option. Conversely, if comfort, perceived safety, or reliability are highly valued, higher costs or longer access times may still be accepted. This is particularly relevant for Urban Air Mobility, where travel-time benefits may be counterbalanced by unfamiliarity, perceived risk, vertical access requirements, automation, or dynamic flight characteristics.
The main result presented is the workflow itself and its role as a planning aid for innovative mobility offers under uncertainty. Preliminary project findings indicate that comfort-related indicators can be simulated, measured, and formulated in a way that is compatible with transport planning and scenario assessment. They further suggest that response-surface representations are suitable for exploring non-linear trade-offs between cost, time, availability, ride quality, and acceptance without exposing the full behavioural model. This supports robust potential estimates before final demand forecasts are available.

The proposed approach provides a transferable structure for integrating user acceptance and comfort information into transport planning workflows, especially when new mobility services cannot yet be observed in real operation. For public authorities, infrastructure planners, and mobility providers, it can help prioritise service concepts, compare alternatives, and define scenarios for detailed simulation. Comfort-informed elasticity estimation can therefore bridge behavioural research, ride-quality assessment, transport modelling, and the practical planning of future multimodal mobility systems.

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Biography

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