Popular science summary (in English)

Improving the effectiveness of contemporary public transport (PT) systems in context of travel reliability and comfort aspects.

Background and research motivation. **Public transport (PT)** systems are nowadays key to satisfy the ever-growing mobility needs that result from sustained urbanisation and socio-economic developments. Increased PT service reliability and capacity are crucial to attract greater ridership and provide efficient mobility - especially after the COVID-19 pandemic crisis which has raised passengers' concerns of travel safety and overcrowding. However, benefits of improved PT reliability or capacity may not be properly appraised due to insufficient behavioural evidence and analytical underpinning. As a consequence, the effectiveness of potentially much-needed but costly PT investments may be seriously underestimated. These challenges are often observable in urban, regional and (inter)national transport planning dilemmas, for instance:

- *What should be the ultimate scope of a national high speed rail project?*
- *Would a new metro or tram system effectively relieve transport congestion problems in a given city?*
- *How to justify a costly PT network upgrade which does not cut mean journey times but reduces their variability, and thus mitigates delay risks?*

Project objectives. This project aims to improve planning and operations of modern-day PT networks, considering passengers' travel preferences and simulations of PT reliability, capacity and comfort impacts. Project focus is both on short-range, urban PT services (in cities and agglomeration areas), as well as long-range and intercity PT travel (regional and/or national transport). Objectives can be summarised by following research questions:

- What is the propensity to use PT services in urban or intercity journeys, considering the modern-day, post-COVID user preferences of travel time, cost, reliability and comfort (crowding)?
- How to simulate the implications of PT reliability and comfort upon travel behaviour and service performance in state-of-the-art tools (macro- and microsimulation models) used for transport analyses?
- How these research tools and insights can improve the quality of PT reliability, capacity and/or travel comfort appraisal, and help plan more effective PT network investments and management policies?

Research description. Analytical methods used in this project leverage on knowledge from multiple fields such as: transportation planning, behavioural economics, computer and network sciences, mathematics and physics, machine learning etc. Research agenda consists of 3 principal work packages:

- Firstly, stated-preference travel surveys will be designed and conducted among PT users - to examine how the passengers' travel decisions in urban and intercity PT trips are nowadays shaped by their attitudes and preferences towards key travel attributes (time, cost, comfort, reliability).
- Secondly, impacts of PT travel reliability and comfort will be incorporated in state-of-the-art PT simulation tools - to reproduce the passengers' travel decisions and resultant network performance in both aggregate (macroscopic) and disaggregate (microscopic) PT modelling approaches.
- Thirdly, analytical tools and evidence from previous project stages will be applied to real-world PT network models - to formulate conclusions on the added-value of PT travel reliability, capacity and/or comfort in network planning and operational management policies.

Main expected outcomes. Project aims to deliver an impactful contribution towards the state-of-the-art developments in public transportation (PT) research. Empirical findings shed light onto the post-COVID changes in travel behaviour and factors that influence the willingness towards using the PT services. Simulation models provide an updated toolset for understanding the PT system phenomena associated with travel reliability, capacity and comfort, and for evaluating their effects for passengers, operators and policymakers (e.g. travel experience, service utilisation, network efficiency). Finally, all these research insights enable a more informed, accurate and effective PT planning and management. Analytical outputs can provide a much-needed decision support in strategic and operational planning of local, urban-area and long-distance PT networks. Thanks to these, major transport policy challenges could be addressed more effectively, e.g.:

- *Can new rail or tram projects result in extra, hitherto unexposed benefits in Polish cities or regions?*
- *Can we expect a higher effectiveness of certain PT investments and management interventions?*
- *How to counteract the modern-day PT ridership decline and transport exclusion problems?*
- *How to shape attractive, reliable, high-capacity and climate-friendly mass transportation systems?*