FinEst Centre
for Smart Cities

SMART CITY CHALLENGE 2024
Solution idea for the city challenges

Solution Idea Title: Adaptive Unit Mobility Footprint Analytics
Planned pilot project duration: 24 months
Main contact/-s: Anniki Puura (anniki.puura@taltech.ee, +372 53 822 136) & Helen Sooväli-Sepping (helen.soovali-sepping@taltech.ee), FinEst Centre for Smart Cities (Tallinn University of Technology)

1. Which urban challenge or problem are you planning to provide a solution to?

The proposal responds to the challenge **"Empowering Citizens to Change Mobility Habits"**

Mobility decisions depend both on individuals' routines and preferences (e.g., where they live, work or study, which services they use, which transport modes they prefer) and on what their immediate surroundings enable (e.g., the accessibility, connectivity, infrastructure and services available in their urban unit). Many existing planning frameworks (e.g. city-wide SUMPs) treat the city as a uniform whole, thus overlooking variation between districts, neighbourhoods, campuses or even individual buildings, and neglecting what mobility practices look like for people in those specific places. This is especially problematic in rapidly developing areas such as Hundipea in Tallinn, where new urban functions, services and demographics emerge gradually, producing localised mobility patterns that differ substantially from city averages. The same applies to campuses like TalTech, where thousands of students and employees generate building-specific mobility flows. Because current tools fail to connect individual choices with local context (including equity and accessibility of services and transport), demand-driven mobility planning remains detached from the real drivers of mobility demand, behavioural change and emissions reduction. Cities in other countries are likely to face similar gaps.

2. The solution you are proposing

Based on the challenge above, there is a need for a solution that enables local units and their stakeholders to define unit-level mobility strategies and implement concrete actions, while remaining aligned with city-, national-, and EU-wide mobility and sustainability objectives. Therefore, we propose **Adaptive Unit Mobility Footprint Analytics** (AUMFA) – a data-driven, multi-scale framework that produces mobility-footprint profiles for spatial units ranging from individual buildings and campuses to neighbourhoods, districts and entire cities. The system combines spatial and mobility data with contextual information about infrastructure and accessibility. It makes results accessible not only to planners, but also to other stakeholders, including citizens, to offer transparency, empowerment and actionable insights. The framework works roughly in three stages. First, it integrates spatial data (e.g., land-use, buildings, services, transport infrastructure) with empirical mobility data (e.g., public-transport logs, anonymised mobile-positioning or other movement data). Second, it derives for each urban unit a set of indicators describing what that place "enables" – how accessible it is, how well connected, what transport modes and services are within reach. Third, it computes a "mobility footprint profile" for each unit while

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capturing typical travel demand, modal split (e.g., public transport, walking, cycling, private vehicle), travel distances and inferred environmental impact (e.g., emissions). The results are then made available through a user-oriented interface, allowing users to see how the built environment, infrastructure, and everyday mobility behaviour interact. It therefore empowers individuals and communities by giving them insights into their mobility footprint, as well as the structural constraints and opportunities in their immediate surroundings. In doing so, it supports demand-driven, equitable and sustainable mobility planning grounded in their lived realities.

3. Innovation and piloting of your pilot solution.

Existing solutions? Existing frameworks and tools for urban mobility and emissions planning, for example MobiliseYourCity Emissions Calculator and the EcoMobility SHIFT+ methodology, provide useful guidance at city- or national-scale. They support greenhouse-gas inventories and broad transport-planning scenarios. Yet they operate at aggregated spatial levels, which means they cannot fully capture variation between individual buildings, campuses, neighbourhoods or districts or link mobility demand and emissions to local infrastructure, service access or urban form. By contrast, frameworks such as Mob Insight have shown how neighbourhood-level features (amenities, land-use, services) can be used to model mobility flows between areas. Moreover, extensive empirical research demonstrates how mobility data from diverse sources can be used to reliably analyse both individual-level mobility behaviour and spatial-unit modal split or travel-pattern distributions, providing a solid foundation for our approach. By building on and extending these methods and research available, our framework aims to deliver building- or campus-scale “mobility footprints,” offering more detailed, place-sensitive insights than existing aggregated tools.

What is the innovation? Our proposed framework introduces several improvements that strengthen unit-level mobility planning and related developments, as well as empower citizens connected to the unit to change their mobility habits. First, it produces mobility-footprint profiles at very fine spatial granularity (e.g., buildings, campus zones, neighbourhoods or districts), which exposes spatial heterogeneity and helps identify “hotspots” of high mobility demand, poor accessibility and elevated emissions. Second, it merges empirical mobility data (e.g., transit logs, anonymised movement data, counts) with contextual data (e.g., land use, service and amenity distribution, transport infrastructure and connectivity) to show how the surroundings shape mobility behaviour and environmental impact. Third, it provides a user interface accessible to planners and community stakeholders (including citizens). This interface enables local users to view footprint data for their unit, gain awareness, and make informed mobility choices, enabling them to reduce their footprint. Fourth, the design supports multi-scale aggregation and systematic comparison using interoperable data standards. This makes it possible to transfer the methodology and use the tool in other cities or contexts, allowing also cross-city analysis and shared learning.

What is needed for piloting? Participating cities or campus units (e.g., districts or campuses) must supply basic spatial datasets and some form of mobility data. Strategic documents must also be collected from each context to ensure alignment with the defined strategic goals. Institutional cooperation is required from municipal or campus authorities, transport operators, building managers and community stakeholders, to allow data access and engage with the pilot.

How does it work? The pilot is structured for over 24 months. Its first six (6) months will focus on data collection, integration and generation of baseline footprint profiles for selected pilot units. The next twelve (12) months will cover deployment, stakeholder engagement, interface rollout, user feedback, and validation of footprint estimates. The final six (6) months will focus on refining methods and interface, documenting processes and data-governance practices, and preparing a transfer-ready version of the tool with guidelines for replication in other districts or partner cities.

Project team and capabilities: The project team draws on expertise from Tallinn University of Technology and the FinEst Centre for Smart Cities. **Dr. Anniki Puura** brings specialist knowledge in mobility analysis, data handling and methodological development for multi-scale mobility assessments. **Dr. Helen Sooväli-Sepping** contributes strategic insight in sustainability governance, green transition, team leadership and participatory practices, ensuring alignment with urban policy frameworks, EU climate objectives and long-term planning. To reinforce the project's interdisciplinary foundation, international scientific partners will support social, urban, and technical dimensions of mobility research. **Dr. Olena Holubowska** (University of Neuchâtel, Switzerland) offers expertise in the social aspects of daily mobility and behavioural drivers of movement. **Dr. Andrew Renninger** from the Centre for Advanced Spatial Analysis (CASA), University College London, brings advanced knowledge of urban dynamics, spatial modelling, and human movement analysis. CASA is a globally recognised research centre specialising in urban analytics, geospatial simulation, and the development of innovative data-driven methods for understanding cities. **Dr. Kamil Smolak** (Wrocław University of Environmental and Life Sciences, Poland) contributes strong technical capabilities in mobility data processing and the development of analytical tools. These core competencies are complemented by collaboration with **partner cities**, including at least one international location, which supplies contextual knowledge and access to local datasets. In addition, a **software developer** will handle technical implementation and integration of analytical components, and a **service designer** will ensure the final product is accessible and user-friendly for stakeholders and end users.

4. Expected impact of your pilot solution.

The proposed pilot will reveal, at building and campus level, where mobility-related emissions and travel demand originate and how these depend on local infrastructure, service provision and mobility patterns. When aggregated to district or city scale, these insights will allow planners to identify where interventions are needed (for example where connectivity is poor, services are badly located, or transport infrastructure is inadequate) and tailor measures to reduce emissions and improve accessibility. For residents, students or employees, the tool will provide transparent information about their unit's mobility footprint and suggest realistic low-carbon travel alternatives, supporting informed choices and potentially encouraging shifts toward walking, cycling, public transport or shared mobility. For cities and campuses, the framework offers a basis for evidence-based, context-sensitive planning and consistent mobility reporting in line with climate, sustainability and resilience goals. By enabling comparison across participating cities, the methodology supports shared learning and the transfer of effective mobility measures between different urban contexts. Finally, by improving accessibility, reducing reliance on private cars and promoting active or public transport, the project helps foster healthier, more liveable urban environments – with lower pollution and traffic burden, improved air quality and potential public-health benefits.