mobil.TUM 2024 – The Future of Mobility and Urban Space, April 10-12, 2024

Suburban dream vs. climate-friendly transport? Assessing the transport and environmental implications of urban sprawl development in Polish cities.

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Keywords: *urban sprawl, transportation modelling, climate adaptation, traffic emissions*

This work addresses the following topic(s) from the Call for Contributions:
(Please check at least one box)

☐ Placemaking to integrate urban spaces and mobility
☒ Promoting sustainable mobility choices in metropolitan regions
☐ Governing responsible mobility innovations
☐ Shaping the transition towards mobility justice
☒ System analysis, design, and evaluation
☐ other: _____

Extended Abstract

Problem statement

Socio-economic growth contributes to rapid urban development of numerous cities and metropolitan areas. The downside of this process, however, are major and recurrent transport and environmental externalities arising from urban sprawl development. As a result of uncontrollable urban planning, cities suffer increasingly from congested and ineffective transportation systems, increased air pollution levels and deteriorating quality of urban life (Lee, 2020; Pan et al, 2020; Sarkodie et al, 2020). To address this conundrum, an integrated land-use, transport and environmental planning approach is needed (Bart, 2010).

Research objectives

The scope of our research concerns the nexus between: land-use, transport and environmental modelling (LUTEm). The LUTEm framework aims to investigate the implications of land-use development policy upon transport system performance and air pollutant emissions in urban areas. As our case studies, we select a number of large and middle-sized cities in Poland. Main research questions of this study can be summarised as follows:

1) How has the rapid urban development of the past 20 years affected the transport sector performance and its environmental footprint in Polish cities?
2) What are the ramifications of long-term land use projections (incl. further urban sprawl risks) upon future effectiveness of transport systems?
3) How can the integration of land-use and transport infrastructure policy lead to synergical benefits in urban transport sector and minimise emissions?

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Methodological approach

To fulfill our research objective, we apply an integrated land-use, transport and emission modelling framework (LUTEm). The LUTEm approach combines the following analytical approaches:

1) Land use and transport interaction (LUTI) model. Macroscopic, multimodal transport models are applied to simulate the impacts of land-use and population projections, travel behaviour models etc. upon resultant travel flows in urban network (private and public transport modes) (Ortuzar and Willumsen, 2011). We utilize here the strategic transport models of case-study cities, including the Greater Warsaw Transport Model MTAW (Warsaw Municipality, 2016), which are extended with GIS-based analyses of past, current and future land-use development data within urban areas.
2) The road emission model NERVE, is a customized modelling tool for calculating the exhaust emissions from road traffic (Grythe et al, 2022). The NERVE model is applied to assess both emissions of climate gases and air pollution produced by transport sector within urban areas, and under different scenarios.

(Expected) results

Using the above proposed approach, we firstly assess the consequences of recent urban development in case-study cities, whose dynamics were accelerated by socio-economic growth since the 2004 Poland accession to the EU, but simultaneously characterised by relaxation of urban planning laws. Consequently, while new transport investment has brought certain benefits, these were often short-lived and eventually overshadowed by rising traffic congestion and induced traffic phenomena (Lewis, 1977; Mogridge, 1998; Drabicki et al, 2020). A fundamental contributor has been the ever rising suburbanization problem, increasing the pressure upon suburban lands and connected traffic networks, and hence – associated greenhouse gases' and air pollution emissions' increase.

Our preliminary analysis indicate that this picture is likely to become amplified in the near future without substantial shifts in the development paradigm of Polish cities. Forecasts show that rising travel speeds of up to 20% (thanks to new road or public transport infrastructure) will be, paradoxically, accompanied by an analogous increase in mean travel times (due to greater travel distances). Consequently, any potential transport or environmental benefits of new transport projects will be inhibited by (ever sustained) urban sprawl developments. In subsequent LUTEm analyses, we will investigate and formulate scenarios where long-term reorientation of land-use policy can reverse these negative trends. The findings will provide insights into optimizing efficiency of the transport sector (including individual travel experiences and overall system effectiveness) as well as contributing to climate change mitigation – thus fulfilling the objectives of sustainable, integrated transport and urban planning.

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