INTEGRATION OF LUTI MODELS IN SUSTAINABLE URBAN MOBILITY PLANS

GAVANAS N.[1], POZOUKIDOU G.[2] and VERANI E.[1]

[1]Transport Engineering Laboratory, School of Civil Engineering, Aristotle University of Thessaloniki, University campus, Faculty of Engineering, 54124 Thessaloniki, Greece,
[2]School of Spatial Planning and Development, Aristotle University of Thessaloniki, University campus, Faculty of Engineering, 54124 Thessaloniki, Greece,
E-mail: gpozoukid@plandevel.auth.gr

ABSTRACT

Literature review suggests an increasing number of Land Use and Transport Interaction (LUTI) models applied in policy analysis and support of urban land use, transport and environmental planning. In this context, LUTI models are considered to be a tool for the development of scenarios during the preparatory stage of Sustainable Urban Mobility Plans (SUMPs). The SUMP can be defined as a strategic planning framework, proposed by European Commission, for planning and design an urban multimodal transport system, which combines multi-disciplinarily, policy analysis and decision making. The set of objectives pursued by the SUMP concise with the main pillars of sustainable urban mobility, i.e. accessibility for all, safety and security, emissions and energy consumption, efficient and cost-effective transport and upgrade of urban environment.

Based on the overall conceptual and methodological framework of LUTI models (Geurs and van Wee, 2004), the scope of the proposed research is the investigation of the prospect to fully integrate a LUTI model into contemporary transport planning framework and, more specifically, to the SUMP cycle. The paper focuses on the configuration of the integration pattern, according to which a LUTI model may evolve and interact with the planning process throughout the eleven elements of the SUMP, as well as the evaluation of the benefits and drawbacks from the implementation of the proposed pattern to the enhancement of the SUMP and the overall promotion of sustainable urban planning.

Keywords: Land use and transport integrated model, sustainable urban mobility plan, integration, interaction, evaluation

1. Introduction

The land use system illustrates the spatial organisation of the network of socio-economic activity and describes the physical separation between them. Overcoming this physical separation is the overall objective set with the development of the transportation system which, at the same time, leads to new mobility and accessibility conditions that may create new time-space relationship between land-uses (Rodrigue, 2013). Besides, transport infrastructure consumes a significant part of the available space, especially in urban areas, while it may produce fragmentation and segregation effects (EEA, 2013 ; Seiler and Folkenson, 2006).

The analysis of the interaction between the two systems: transport and land use is nowadays established as a core issue of mobility planning due to the emergence of the concept of sustainable mobility. In opposition to conventional urban transport planning, where the increasing demand in mobility is coped with the constant increase of infrastructure, sustainable urban mobility planning is a more holistic approach that aims at the maximisation of the efficiency of the transportation system and the minimisation of externalities, i.e. the environmental degradation.

The investigation of the interaction between transport infrastructure and spatial development is based on two different methodological approaches (Pitsiava-Latinopoulou and Zaharaki, 2004):

(a) The studies 'before' and 'after' the construction of a transport project and (b) The Land Use and Transport Integrated (LUTI) models. A LUTI model is a tool for supporting strategic planning through the estimation of trends in locational choices and the forecast of land use patterns by combining features such as mobility patterns, socio-demographic characteristics, industry allocation, geomorphological and environmental factors, availability of urban networks and finally institutional and policy frameworks (Pozoukidou, 2010). Recently LUTI models have re-acquired the attention of scientific community in terms of their role in strategic transport planning process, since they considered to be the most appropriate tool and methodology in achieving an understanding of the cause effect relationship between transport and land use system.

At the same time European Commission (EC) promotes the aforementioned sustainable planning approach for urban mobility in the framework of Sustainable Urban Mobility Plans (SUMPs) (European Commission, 2013). A SUMP is a strategic plan for the urban multimodal transport system that combines inter-disciplinary planning and policy analysis with decision making. Its objectives coincide with the components of sustainable mobility, i.e. accessibility for all, efficient and affordable mobility services, enhancement of safety and security, decrease of emissions and improvement of energy efficiency and upgrade of the urban environment. More specifically, it covers the whole planning process from the preparatory and goal setting stages to the elaboration and implementation stages through a series of elements that correspond to the specific objectives of the plan, each comprising a set of activities. The plan unravels in a circular pattern concluding in the setting of the basis for the conduction of the next SUMP (Bührmann *et al*, 2013).

The SUMP guidelines propose the combination of the appropriate techniques, such as quality management and benchmarking, and tools, such as indicators and models, for the successful conduction of the activities and the fulfilment of the requirements of each element. Towards this purpose, the use of LUTI models is suggested during the preparatory stage of the SUMP as a tool for the analysis of strategic scenarios regarding the impact of the transportation system on locational choices (Bührmann *et al*, 2013).Based on this suggestion, the objective of the current paper is the investigation of the integration of a LUTI model into the SUMP cycle.

2. Integration of a luti model in a sustainable urban mobility plan

2.1. Brief description of a SUMP

The structure of a SUMP is presented schematically as a cycle, covering the process of strategic planning from the preparation to the implementation and final evaluation. The cycle of SUMP includes the following stages: a) Preparing well, b) Rational and transparent goal setting, c) Elaborating the plan and d) Implementing the plan, and identifying the corresponding milestones, i.e.: a) Analysis of problems and opportunities concluded, b) Measures identified, c) SUMP document adopted and d) Final impact assessment concluded. Each stage comprises a set of elements that include a number of activities which are essential in order to overcome the corresponding milestone. In this way, the SUMP is concluded with the update and review of the implementation results and the identification of the key-features that will lead to the conduction of another SUMP cycle.

2.2. Description of the LUTI model integration framework

The proposed framework for the integration of a LUTI model into the SUMP cycle is based on the scope of maximising the potential contribution of a land use model to the successful conduction of the aforementioned activities. The overview of the framework is presented in fig.1. There are four (4) phases which formulate the proposed LUTI integration framework corresponding to the four (4) stages of the SUMP cycle and eleven (11) actions which are connected to the appropriate activities of the eleven (11) SUMP elements. More specifically, either the outcome of an Activity of the SUMP cycle (from here after referred to as SUMP Activity) can be used as input for the corresponding action for the integration of the LUTI model (from here after referred to as LUTI Action) or a LUTI Action can provide outputs for the support of a SUMP Activity, as described in the following sub-sections.

Phase 1 - Predictive (Strategy oriented): The first phase of the proposed integration framework aims at the selection and preparation (adjustment) of the appropriate LUTI model and the development of the strategic scenarios. The results from the deployment of strategic scenarios are expected to support the analysis of problems and opportunities, according to the SUMP's first Milestone.

The first LUTI Action is the definition of the model's scope in relation to the needs of the specific study. This action depends on the following SUMP Activities:

- 1.1 - aiming at the understanding of which sustainable mobility principles will be adopted by the plan and how,
- 1.2 - involving among others the analysis of the transportation and land use policy priorities which should be taken into account by the model, and
- 1.6 - aiming at the definition of the network of stakeholders from different transport related sectors.

The next action refers to the selection of the most suitable model and its adjustment to the plan's purpose. The action depends on the aforementioned scope as well as on the SUMP Activity 1.5, i.e. the setting of the plan's timeline, which will define the time dynamic characteristics of the model and the desired time reference of the short-term and long-term forecasts.

After the selection of the most suitable LUTI model, the formulation of strategy based scenarios, i.e. a series of scenarios based on the strategic approach of the plan as suggested in SUMP Activity 3.2, takes place (Bührmann *et al*, 2011). However, in order to formulate resilient and realistic scenarios, one should take into close consideration the analysis of problems and opportunities, conducted during SUMP Activity 3.1.

The final action of this phase is the assessment of the strategy based scenarios, which are expected to lead to generic forecasts of the urban development patterns according to the examined urban mobility strategies. These forecasts can be exploited in the context of the SUMP Activities 4.1 and 5.1, which aim respectively at the identification of the strategic directions and the setting of specific priorities for sustainable urban mobility planning. Moreover, the demonstrative capabilities of the model can create a space for discussion among the stakeholders and the public (SUMP Activity 4.2).

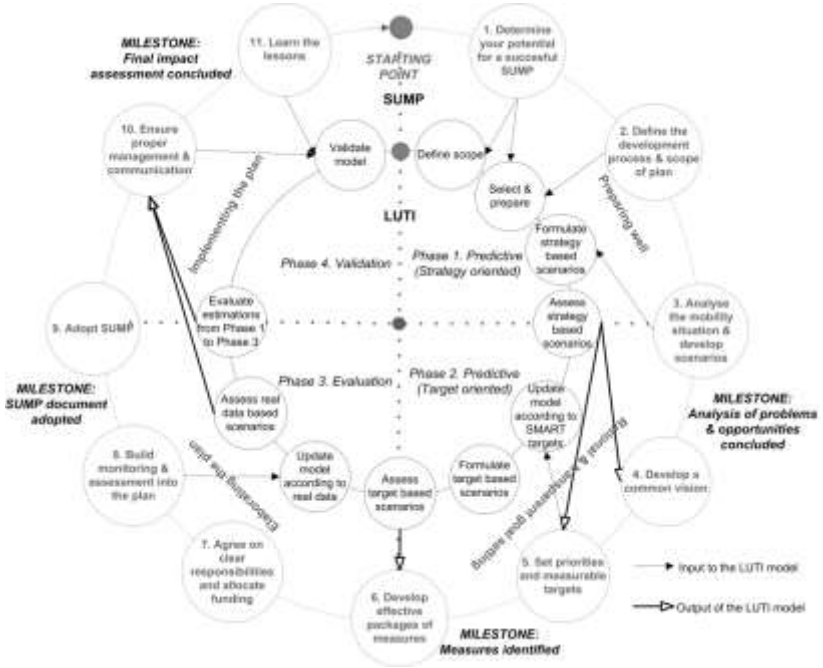

Figure 1: Framework of a typical LUTI model integration to the SUMP cycle

Phase 2 - Predictive (Target oriented): During the second phase, the LUTI model can be updated according to the quantified targets set by the second stage of the SUMP in order to provide more detailed forecasts of the way that the selected measures for the enhancement of urban mobility are expected to affect the land use system. In this way the model can contribute to the SUMP's second milestone, i.e. the identification of the suitable measures.

Specifically, the SUMP Activity 5.2 has the objective of developing a series of Specific, Measurable, Achievable, Realistic and Time-bound (SMART) targets through the selection and formulation of a set of indicators. The corresponding LUTI Action aims at the model's update according to these targets so as to be able to produce estimations of indicator values (especially the ones related to the impact of transport on land use) in different time projections. After the formulation of scenarios based on the appropriate combinations of transport related measures and interventions, the target based model can be used to estimate the impact of these measures on the land use system and support the decision making of SUMP Activity 6.1 for the identification of the most effective measures.

Phase 3 - Evaluation: The specific phase aims at the update of the LUTI model according to the real data derived from the regular monitoring of indicators during the stage of the SUMP's elaboration and the provision of accurate estimations that can be used to check the progress during the stage of the SUMP's implementation and the milestone of the adoption of the plan's document.

The SUMP Activity 8.1 refers to regular monitoring of a core set of measurable indicators for the evaluation of the plan's elaboration. These measurements can be used as input in the LUTI Action for the update of the model. Then, the updated model can be used for the reassessment of the target based scenarios according to real data. The estimations from the reassessment can provide useful conclusions on the progress of the plan's implementation and the achievement of its objectives concerning mainly the goals related to urban development. Furthermore, the review of the model's assessment results during the strategic, target and real data based scenarios should be made in order to evaluate the progress of the plan towards the achievement of land use related objectives.

Phase 4 - Validation: The objective of the phase is the overall validation of the LUTI model in order to contribute to the SUMP's last milestone, i.e. the conclusion of the final impact assessment, and to make the necessary changes and adjustments for its implementation in the next SUMP. Towards this purpose, the results and conclusions from the following SUMP Activities,

- 10.3 - Check progress towards achieving the objectives,
- 11.1 - Update current plan regularly,

should be embedded in the LUTI Action for the model's validation. This process will ensure that the model will keep up with the whole SUMP cycle and be prepared for future use.

3. Conclusions

This paper demonstrates that LUTI models could be integrated in all four phases of the SUMP process, as tools for analysis, synthesis, and testing of alternative mobility plans. Thus, integration of a LUTI model into the SUMP cycle constitutes an important success factor in achieving SUMP's strategic goals. In conclusion, we would like to highlight that the importance of integrating LUTI models into SUMPs, lies into the fact that assessing the impacts of alternative mobility plans on locational choices, has been the essence of the much desired and discussed interdisciplinary approach in sustainable transport planning. Therefore the opportunity and challenge of doing so is lying ahead of us.

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