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Research Paper

Concept of an open-access travel demand modeling platform

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ABSTRACT

Travel demand models have an increasing role in decision- and policy-making. The prevailing practice of modelling raises some concerns, main limitations being of human and technical nature– adopting advanced models requires skilled professionals and resources. This paper introduces an open-access modelling concept, which is designed to overcome these barriers. The concept centralizes the bulk of model-development and application tasks, leaving only the coding of proposed project scenarios to the user. This way skilled professionals and the resources necessary for data-intensive models can be concentrated on regional model-building. Planners and policy-makers can access a valid model through open interfaces, where they can define scenarios and evaluate them without intensive model-building tasks and large-scale data collection.

This open-access concept – developed by a single organization – provides an access to a theoretically sound model to a wide array of users, where advanced techniques are implemented. Besides overcoming concerns of resources, expertise or data, and eliminating the reluctance to adopt advanced models, another great advantage is that the same model can be used through a controlled user interface by different organizations making results comparable.

Project ETRAFFIC is a conceptual framework for implementing an open-access modelling platform – funded by the Hungarian government. The prototype of the implementation is under development.

1. Introduction

Travel demand forecasting enables formal testing of policy scenarios and provides decision-makers a basis for comparing costs and benefits of tested alternatives (Meyer and Miller, 2001). Most decision-makers and policy-makers recognize travel demand modelling as a crucial element of the overall transport planning process. Despite the increasing role of travel demand models, outdated models are still in use or modelling is completely omitted in decision support, usually due to the lack of resources, expertise or data (Hatzopoulou and Miller, 2009). The main limitations of a good modelling practice are of human and technical nature: contemporary transport planning requires skilled professionals and theoretically sound modelling techniques with competent software implementations (Ortúzar and Willumsen, 2011).

Travel demand modelling practice in some countries raises some concerns and questions. According to a web-based survey of the Transportation Research Board the most cited barriers of model improvement were staff, budget and reluctance to switch to more complicated and data-intensive tools (TRB, 2007; Hatzopoulou and Miller, 2009). Although policy-making and planning organizations are aware of the need for using advanced models – as integrated land-use and transportation models or activity-based models – they have limited capabilities to apply them on a large scale. They are reluctant to adopt advanced models because they perceive them as yet unproven (Davidson et al., 2007). The study of Shepherd et al. (2006) also highlighted that resources and skills are major concerns for adopting advanced models.

Overcoming the major barriers – staff expertise and data resources – related to adoption of advanced models would improve project evaluation. Policy-making and planning organizations build their own model separately, often duplicating each other's work as different projects might require similar spatial and temporal scope. Theoretical consistency of some of the models could also be an issue. Furthermore forecasts based upon models built on different scientific or technical assumptions, designed for different geographical areas and time periods, using different resolution and data, are non-comparable.

Financial estimations of a project usually depend on the accuracy of travel demand forecasts. Thus accuracy of a forecast has considerable importance in effective allocation of governmental funds. Different organizations have different models with different spatial coverage, time span, economic scenario, etc., which makes objective comparison – consequently fund allocation, project ranking and scheduling – difficult.

The aim of this paper is to introduce an open-access modelling

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concept, which provides a framework for the modelling practice in order to handle the difficulties mentioned above. This open-access concept – developed by a single organization – provides an access to a theoretically sound model to a wide array of users, where advanced techniques are implemented. Besides overcoming concerns of resources, expertise or data, and eliminating the reluctance to adopt advanced models, another great advantage is that the same model can be used through a controlled user interface by different organizations making results comparable.

The paper is organized as follows. After this introduction, principles of the open-access modelling concept are presented. Following, components of the framework are described in detail and a possible implementation is described. Later, effects of the concept on the modelling practice are detailed through case studies. Finally conclusions are drawn.

2. The open-access travel demand modelling concept

2.1. The general concept

The open-access modelling concept presented in this text handles the modelling process by two modules: model development and model application (Fig. 1). The idea is that the most demanding tasks of development, implementation, calibration and validation, data collection and model update – which create the strongest barriers in practice – should be removed from the daily tasks of project evaluation. Model application is integrated with the model and the synthesis of the two modules is provided as an open-access service. Users of the service need not be concerned about these tasks, as they only have to revise the economic environment of the forecast and define scenarios – modifications of the base network.

Model development is accomplished by a design team – consisting of modelling experts. Tasked with the competent implementation of advanced, theoretically sound modelling techniques, they also update and maintain the databases, and are responsible for repeatedly obtaining all necessary data for model inputs and forecasts. The team is also responsible for the validity of the model, performing regular validity checks and evaluations.

This concept gives more value to the users than usual modelling tools and concepts, because with the modelling implementation it already contains the majority of input data as well (e. g. land use, population, economic variables, road network etc.), thus users do not have to collect, analyze and code them. Beside the built-in data the concept gives significant flexibility to the users, because most parameters can be changed. However, users do not need to parameterize the whole model, they can focus on the set of variables which are important for the analysis of the given task.

2.2. Model development

The core of the model development module is a transportation forecasting model. Depending on the intended use, any types of models can be implemented herein, e.g. the four-step or activity based travel demand model, a modal split model etc. however an integrated land-use and activity based transportation model is suggested.

Different planning or forecasting tasks require different resolution. Consequently the model should consist of different layers; each layer having different spatial resolution, a different depth of detail and is customized to perform different tasks, e.g. local or regional planning. To provide consistency between these layers, upper levels (with less detail) are aggregates of the bottom layer (highest resolution) thus the model would require the coding of a single highly detailed layer. All the other, less detailed layers are produced by the aggregation of the data of the highly detailed layer, where the methods of aggregation and the necessary spatial correlations between layers of different resolution are part of the model. Users will work with the layer suitable to their actual modelling task. Although network coding is through arbitrary modelling tools, it is suggested to implement it with a well-known software as VISUM or EMME, but any modelling or GIS software can be used as well.

Since the proposed model of the framework should be capable to handle transportation planning tasks on national and local levels, it must incorporate all possible modes of transport available. To provide adequate basis for a local study temporal resolution also have to be enhanced to model not just average daily volumes but peak and off-peak periods or even traffic demand defined by the hour.

The model development module can be continuously upgraded if necessary, in order to implement the new advances in transportation modelling theories. This way the model always contains the most advanced and theoretically sound modelling techniques with competent implementation.

Calibration and validation of the model is done in this module as well. Built-in evaluations and checks for every modelling step and for the overall model assure the forecasting ability of the model. Continuous validation covers evaluations and checks that are repeated on an annual basis. Results generated by users are also checked against

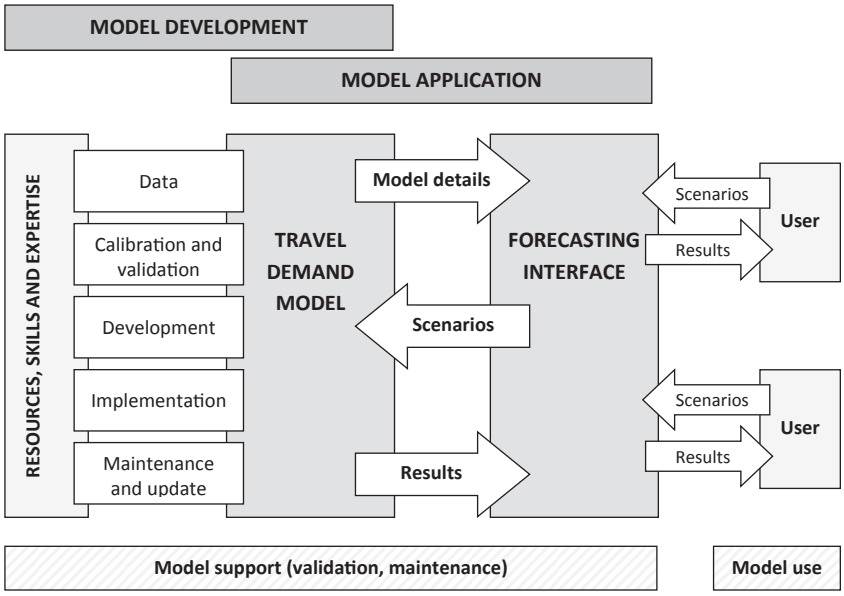

Fig. 1. The open-access travel demand modelling concept.