Transport Policy 49 (2016) 20–29

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Making land use – Transport models operational tools for planning: From a top-down to an end-user approach

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ARTICLE INFO

Article history:
Received 16 March 2015
Received in revised form
4 March 2016
Accepted 9 March 2016
Available online 29 March 2016

Keywords:
Land use and transport integrated models
Planning support system
Planning practice

ABSTRACT

Land Use and Transport Integrated models (LUTIs) are promising approaches for urban planning. There is large literature describing their technical architectures or using them in various scientific contexts. Yet little attention has been paid to expectations of practitioners (planners) and to the operational use of such models. The gap between lab application and operational use for planning practice is still to be filled. We shed light on what would make them definitely accepted and more used by planners to evaluate a range of urban and transport policies. In addition to literature review and our own experience dealing with urban planning agencies, we have interviewed different types of end users in France to identify their motivations and barriers to use LUTI models. The results show demand for a far more bottom-up oriented approach: the models should consider objectives and general needs of end users to live up to their expectations. Only a closer collaboration between modelers and end users, and more efforts to integrate modeling into urban planning, will make LUTIs considered as relevant approaches.

1. Introduction

This article aims at improving the understanding of conditions under which Land Use and Transport Integrated models (LUTIs) would be accepted and used by planners and practitioners. We conducted a qualitative survey among French practitioners about their experience and expectations regarding LUTI modeling, in order to complete and support our reflection based on the literature and our own experience as modelers. The rationale behind the survey is: to make clear the requirements on LUTI models from an end-user perspective; to understand to which extent such models may complement other planning approaches from an empirical standpoint; to help organizing fruitful top-down and bottom-up relations between LUTI developers and end-users.

A large literature is dedicated to these models. Contrary to classical and widely used traffic models, which consider the urban structure as an exogenous input to simulate the mobility system, LUTIs simulate both the land use system and the transport system, as well as their interactions. All LUTI models represent the evolution of different markets (land, housing, transport, labor) but differ in terms of modeling theories and methods, e.g. aggregated or agent based, based on market equilibrium or dynamic processes (Jin and Wegener, 2013). Some articles present their main features and propose a review and a classification (Simmonds et al., 1999; Wegener, 1994, 2004; Batty, 2009; Iacono et al., 2008). Others present the existing models in line with different frameworks (Hunt et al., 2005; Silva and Wu, 2012), their application to territories (Feldman et al., 2009; Lautso et al., 2004; Gayda et al., 2005; Sustaincity, 2013) or their historical development (Simmonds and Feldman, 2007). Theoretical issues are also debated, Jin and Wegener (2013) and Anas (2013) for example discuss equilibrium and the evolution towards more dynamic modeling. Other articles compare applications of different models (Hunt et al., 2001).

This literature has been useful to develop and improve modeling principles and illustrates what we can theoretically expect from the models to inform policymakers. However it says little about the frequency of their use, their maturity for operational use and their potential impacts for planning and decision making. The discussion is generally oriented towards technical and theoretical features, and the question whether the model can support an actual planning decision is poorly considered. In other words, the main question addressed is how these models are representing the different aspects of urban systems, including a discussion on the

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http://dx.doi.org/10.1016/j.tranpol.2016.03.005
0967-070X/

advantages and limits of each modeling solution, based on theoretical analysis. Hunt et al. (2005) for example aim at providing with a more practical evaluation of the current modeling framework as a guide to practitioners. Yet, they mainly focus on the formal characteristics of the modeling frameworks and the way they represent the different dimensions of urban systems. A concrete discussion on how these models were used and on the practical difficulties of modeling is missing and the suggested improvements are not taken from practice but from an ideal model.

Generally, applications are presented as evidence that the model is a useful tool, but they rarely take the planners' practical needs into account. As observed by Vonk et al. (2005) and Wegener (2011), the Planning Support System (PSS) and LUTI modeling community is often focused on academic issues, with a "strong emphasis on the supply side" (Vonk et al., 2005, p. 1) and a lesser concern to investigate the practical and operational use of models by practitioners.

Whether these models can be operational and under which conditions they can improve planning methodologies and policy design are important issues that must be discussed in detail. Originally the objectives of LUTIs were twofold (Batty, 1979; Batty, 2009; Klosterman, 2012; Lee, 1994):

1) improve, develop and test a theory for urban systems;
2) improve policy design and planning methodologies;

We still lack research on the latter. Even if some elements are available based on the experience of planners, researchers (Lee, 1973, 1994; Klosterman, 2012), or modelers (Waddell, 2011; Timmermans and Arentze, 2011), this discussion is only occasionally the main purpose of the article and rarely based on a dedicated methodology.

Lee (1973,1994) was one of the first to discuss LUTIs from an operational planning view, pointing out the inherent difficulty of using complex modeling tools to feed a decision making process. Klosterman (1994a,1994b) and Wegener (1994) also highlighted this point. Wegener (2011) discussed the disaggregation trend in modeling and the technical difficulties of using micro-simulation modeling in planning. Waddell (2011) described the many challenges – technical and non-technical – of transferring modeling tools from academic research to planning agencies, and explained what has been undertaken for Urbansim development to increase the appropriation by end users. Timmermans and Arentze (2011), inspired by their own experience of modeling, analyzed the links between research and urban planning. Klosterman (2012) discussed the nature of modeling, using the simple/complex model opposition.

Noteworthy contributions also come from the PSS literature, even though they are not focused primarily on LUTIs. Vonk et al. (2005) investigate the bottlenecks blocking a wide usage of PSS (including LUTIs and other tools) with a survey of people involved in PSS (mainly academics and researchers). This paper incited us to use a similar approach specific to LUTIs, with more details on the use of the model and a focus on local authorities. Brömmelstroet and Bertolini (2008) shed light on obstacles that explain low levels of use. They also explore the planning process to understand which type of methods and tools would best fit as a planning support. They clearly show the necessity to connect end users (State transport services, local transport authorities, planning agencies, consultancies) and modelers through specific procedures and tools. Based on the "knowledge use" literature, Gudmundsson (2011) provides a framework for understanding the gap between transport modeling efforts and planning needs, and potential ways to diminish this gap. He underlines the need to carefully match policy expectations with the outputs the model can provide. Other works worth noting are Still et al. (1999) and Ewing and Bartholomew (2009) who address the practical use of LUTIs with an assessment of the different methodologies used to inform planning.

As highlighted by Klosterman (2012, p. 1), modeling "reflects more fundamental assumptions about the limits of science, the role of the public, and the nature of planning", and requires thinking in terms of policy making and not only in terms of technical issues. Although LUTIs greatly improved during the last two decades, they are not yet widely disseminated. End users still seem indecisive about using them. As a result, they are primarily considered as research objects. The gap between lab application and operational use for planning practice is still to be filled (Wegener, 2011; Silva and Wu, 2012; Brömmelstroet and Bertolini, 2008; Aashto, 2007; Nguyen-Luong, 2012). Thus we still need to better understand how LUTIs are currently used, the barriers to their practical use and how they could better inform planning decisions and transport policies in practice. Doing so should help us identify the priorities for a LUTI agenda.

The rest of the paper is organized as follows. Section 2 defines our overall methodology. In the third section, we describe the current level of LUTI's practical use in France as well as in Europe and in the United States. In the fourth section, we specify the different purposes of using a LUTI and the type of the expected value added. The fifth section addresses the obstacles facing practical LUTI use and suggests some ways to overcome these difficulties. We draw our conclusions in the last section.

2. Overall methodology

A survey with 20 questions about urban modeling practice and demand for LUTI models was prepared. Hardy's survey (Hardy, 2011)[1] was used as a basis for several questions, and has been adapted to our own purpose. Our survey was sent to 30 French modeling practitioners[2] (mainly in transport field) between summer and autumn 2013. We received answers from 15 of them. They constitute a representative panel of the types of relevant stakeholders (consultancies, State departments, local authorities and planning agencies). To improve the quality of the survey and facilitate the process, the sample was targeted in this way: 1) a good level of modeling and the possible presence of innovation; 2) a diversity of actors; 3) when possible, existing contacts with researchers of the CITIES project consortium[3]. Of course, this strategy[4] may introduce a bias, for example, toward an overestimation of the interest that LUTIs represent for the whole planning community, because we speak with transport modelers. Yet this does not necessarily mean that they are proponents of LUTI modeling. In any case, the results of the survey should be at

[1] Hardy developed it for US practitioners from the American Association of State Highway and Transportation Officials (Aashto, 2007) and the Association of Metropolitan Planning Organizations. The purpose was to explore the "role that a simpler transportation and land use modeling approach can play to support decision-making within metropolitan planning" (Hardy, 2011).

[2] The 30 French modeling practitioners were chosen all over France. We chose the most advanced organizations in terms of modeling, i.e those with the biggest likelihood to have an understanding and opinion about LUTI modeling, which is useful for our research.

[3] The CITIES project's ambition is to foster the use of LUTI, by developing methodologies and tools to facilitate their use (mainly numerical methods to help calibration and validation). The consortium includes mathematicians and computer scientists, most of French LUTI modeling teams and end users (planning agencies). Different LUTI are used (Urbansim, TRANUS, Pirandello). The project is financed by the French research agency (ANR).

[4] Via the choice of the interviewees (of whom a large part have connections with the researchers) but also because of the survey principle itself (where people who feel more concerned by the object of interest are more willing to answer).