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Working from Home: Modeling the Impact of Telework on Transportation and Land Use

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Abstract

More and more employees work at least part of their working hours from home. While this reduces the number of work trip, the time saved on commuting may be used for additional non-work trips or longer trips, often in the off-peak hours. In the long-run, the option to do telework also reduces the constrain to life in relative proximity to the workplace, and thereby, may induce urban sprawl. Vice versa, long commute times from home to work may trigger employees to request the option to telework. The research presented in this paper proposes a modelling concept to microscopically simulate the decision to telework, the resulting travel demand for work and non-work trips, and household relocation. By explicitly representing a travel time budget for every household, the tendency to add non-work trips is modelled endogenously for teleworkers. A model for household relocation explicitly accounts for the travel time to work, and this constraint is loosened proportionally to the number days of telework per week.

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1. Introduction

For certain professions, it has become popular to work at least part-time from home. Telework allows more flexible schedules, may reduce the burden on commuting and may also offset costs for office space for the employer. According to the German federal statistics bureau, almost every other employee works at least occasionally from home, and 10 percent of all German employees work regularly from home. In the European

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context, Germany's share of teleworkers is just below the average, with the Czech Republic and Denmark leading the list of teleworking countries with 15.2 percent and 14.4 percent, respectively (Welz and Wolf, 2010).

The impact of telework shows a two-sided sword. On the one hand, teleworkers do not need to commute to their work place, at least not on a daily basis. Thereby, many trips can be eliminated, particularly during peak hours. On the other hand, empirical studies have shown that, at least in part, teleworkers compensate by making additional other trips. They may decide to go shopping at a grocery store further away because they have "saved" the time they otherwise would have spent to travel to work. Last but not least, housing locations may be affected. While traditional workers will search for housing locations within a reasonable distance to work, teleworkers are more flexible in housing search and often will select more remote areas, where housing is cheaper. Those areas, however, tend to be more car-dependent.

Transport modelling is a powerful method to understand what-if relationships. It allows transport planners to understand the impacts of telework policies in a simulation environment before telework becomes more mainstream. Transport modelling also allows to test the effects of possibly costly policies and infrastructure projects before they are implemented in reality. Existing operational models are insufficiently prepared to reflect the impacts of teleworking on transport demand as they are unable to model rebound effects of teleworkers who engage in alternative travel if they do not need to commute to work. This research aims at filling this gap and at developing approaches to model the impacts of telework on transport and land use.

2. Literature Review

The impacts of telework are ambiguous. For example, Mokhtarian (2004) found that telework may reduce vehicle-kilometres travelled by eliminating commute trips, though at the same time teleworkers may compensate commute-time savings with additional recreational travel. Mokhtarian and Varma (1998) found that telework reduced vehicle-miles travelled by 11.5 percent, even though the number of person trips increased slightly on telework days. Kitou and Horvath (2003) concluded that telework may lower selected emissions because of reduced commuting, however, some emissions (in particular N₂O and CH₄ emissions) may increase because of added activity at home. In addition, the theory of constant travel time budgets (Zahavi, 1982; Zahavi, 1979) suggests that many teleworker could use the commute time saved through telework to do other trips, such as driving a longer distance to the preferred grocery store or making additional leisure trips. Furthermore, workers who only need to visit the office one or two days a week may decide to move further away from their workplace to enjoy lower housing costs or a larger house, which may offset any travel savings from telecommuting.

Integrated land use/transport models have been developed since the 1960. Initial approaches, such as Lowry's Model of Metropolis (Lowry, 1964) or the DRAM/EMPAL model (Rosenthal et al., 1972), were fairly coarse and not based on behavioural theory. Later models can be grouped into two approaches: bid-rent models and discrete choice. The bid-rent theory was introduced by Alonso (1964) and states that land prices are an immediate result of the bid-auction process between land owners and land users. In contrast, the discrete choice approach -initially developed for housing choice by Nobel Laureate McFadden (1978)- models land being bought or rented with no instant effect on the price. Rather, urban development is driven by utilities for land owners and land users and discrete decisions are modelled. Martínez (1992) compared the two approaches and concluded that both lead to very similar results. Good overviews of operational land-use/transport models are given particularly by Hunt et al. (2005), Wegener (1994; 2004) and Timmermans (2003).

3. Integrated Land-Use Transport Modelling

The transport system (shown on the top of Figure 1) provides travel times under current congestion, which is used in land use models (bottom half of Figure 1) to assess the desirability of locations. Based on where people live and work, demand for travel is derived which leads to updated congestion, and hence, travel times. This feedback cycle is represented explicitly in this research. Workers who telework have different travel behaviour, and thereby, different housing preferences. The full representation of the land use/transport feedback cycle helps understanding the impact of telework on transportation and land use.

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