PRELIMINARY RESULTS FROM AN INTEGRATED TRANSPORTATION AND LAND USE MODELS PACKAGE

STEPHEN H. PUTMAN
Associate Professor, Department of City and Regional Planning,
University of Pennsylvania

ABSTRACT

This paper describes the results, to date, of an effort to integrate a land use model with a transportation network model for the purpose of analyzing the interrelationships of transportation facility development and land development. In the system which has been developed each model provides input to, and receives feedbacks from, each other model. To the author's knowledge, the effort described here represents the first successful attempt to develop and test an integrated model package involving these reciprocal relationships. The results obtained from preliminary runs of this package should be of considerable interest to both transportation planners and land use planners. With this integrated system it has been possible to observe the interrelationships, and in particular the feedbacks, between land use and levels of traffic on the networks. Preliminary results indicate that congested networks produce tendencies toward metropolitan centralization. Attempts to relieve congestion seem to produce metropolitan decentralization and increased travel which lead, in turn, to metropolitan sprawl and increased spread of congestion.

Introduction

It is common knowledge that in the past two decades there has been enormous public investment in highway construction. This same period has also witnessed large scale shifts in population from rural areas to urban areas; and within the urban area, from center-city to suburb. Even without attempting here to define the explicit causal relationships between these two developments, it is possible to describe a related phenomenon which is the focus of the research described here. This phenomenon is observed, not infrequently, when the construction of a new section of roadway is followed, all too soon, by very heavy usage and subsequent congestion. Specifically, the nature of this process seems to be that: a) Due to the inadequacy of existing facilities a decision is taken in a metropolitan area to improve transport facilities (usually by road building) for a particular
part of the area. Then b) assuming that the decision is approved, in anticipation of the new roadway, land developers and/or speculators become involved with properties near the proposed route. As construction of the facility begins, some homeowners and businesses may consider and even act upon location or relocation decisions. (We do not refer here to relocation forced by the facility construction.) Upon completion of the facility, additional location decisions are made. Finally c) a relatively short time after completion of the facility, the demand for its use greatly exceeds the demand which existed prior to the decision to construct it. Consequently the design capacities are soon reached and often exceeded, resulting in congestion and premature obsolescence of the facility. While this is a rather generalized description of a very complex process, it is reasonably accurate. The principal question addressed by this research is whether it is feasible, via integrated transportation planning and land use planning, to avoid or ameliorate the occurrence of this particular phenomenon in the future. Further it was the intention of the research described herein to analyze this process and to determine whether a) balanced development of transportation facilities and land use is feasible, and b) if it is feasible, what means are available to accomplish it.

There is considerable evidence indicating that the demand for highway travel is rather sensitive to changes in highway capacity. This sensitivity, as described above, frequently results in heavy utilization and congestion of new facilities soon after their construction. It might be argued that the solution to this problem is to construct more facilities. It is possible that at some point, if this policy were followed, an equilibrium situation would indeed be reached. This conclusion can be supported by asserting that the elasticity of demand for highway travel is finite. However, if the “population” generating that demand continually increases at the same time, it is not clear that the total demand can easily be satisfied in this manner. The limit of this strategy, at the extreme, would be reached when so much land is converted to roads that land development for other purposes is restricted, with a consequent limit on trip generation and road use. It is obvious that this “equilibrium” is not the desired solution and is hopefully not feasible in any case. It will therefore be necessary to analyze possible “intermediate” solutions.

Any potentially feasible solutions discovered by these analyses will require evaluation. This evaluation, leading to a definition of feasibility, would undoubtedly involve measures of private and social costs, and measures of the disparities between them. Such costs could include user’s costs (e.g. operating costs, taxes, or tolls), pollution (of all types), costs of relocation of activity, societal costs of activity dispersion, and costs of disruptions caused by the construction process, all of which are associated