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4

Southeastern Wisconsin Regional Planning Commission Study

INTRODUCTION

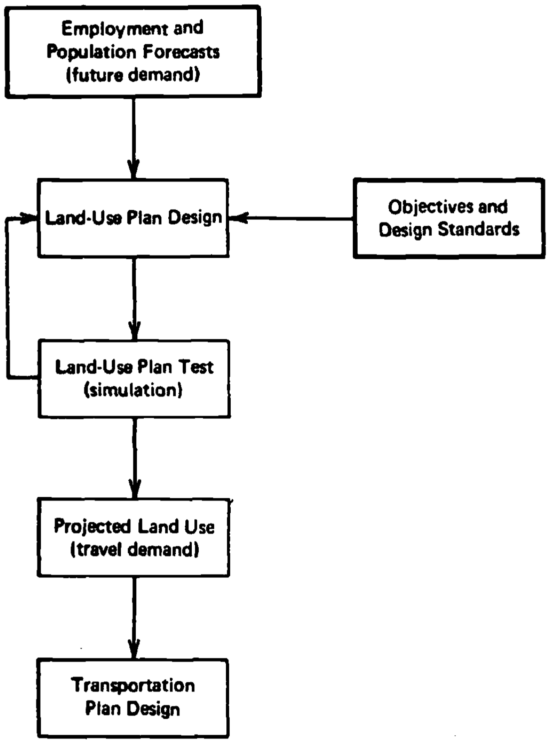
THE SOUTHEASTERN WISCONSIN Regional Planning Commission (SEWRPC) is an advisory commission charged with the study and planning of the physical facilities of the region. The regional land-use–transportation study, initiated in 1963, followed the planning sequence shown in Figure 4. As can be surmised from this figure, the Southeastern Wisconsin spatial allocation models are not meant to be pure forecasting models. Rather, the models are intended to be part of the planning process. Their role is to test the feasibility of alternative design plans, identify significant policy variables, and make explicit the important feedbacks in the system.

The first step in the planning sequence was the projection of regional employment and population. Two sets of projections were produced for this purpose, each using a different methodology. The first was a conventional forecast developed by dividing the regional industries into dominant and subdominant, and then examining and forecasting growth of the dominant industries in detail. The Commission also developed a complex regional economic simulation, which forecasts employment by categories.[1] The employment forecasts were used to estimate future population and land-use requirements.

The second step is the development of a land-use plan. The Southeastern Wisconsin Regional Commission is in the process of

[1] The model is an input-output model structured from the work of S. Chakravarty, *The Logic of Investment Planning,* Amsterdam, 1959.

Figure 4
Southeastern Wisconsin
Land-Use — Transportation Study Planning System



Source: Adapted from Southeastern Wisconsin Planning Commission, Technical Report No. 3.

building a design model that would produce an optimal land-use configuration on the basis of stated land requirements, some broad objectives, and specified design standards. Work on this model is continuing in anticipation of its use in future planning. Meanwhile, a more conventionally structured land-use plan has been incorporated into the actual planning.

The Commission tests the feasibility of any land-use plan by means of a dynamic land-use simulation model that its staff developed. This model, which will be discussed in detail later, is intended to simulate land development within the region. The simulations provide tests of the plan and assist in identifying the control variables that will be required in order to implement the plan. In addition, the model can be used to forecast future land development under alternative policy assumptions. The dynamic feature of this land-use simulation differentiates it sharply from the more traditional single-stage forecasts.

Conventional methods are used to derive trip generation and modal split from land use. This information is used to develop a transportation plan which feeds back on the land-use simulation by altering the access time to both employment and commercial centers. Continued iteration between the transportation plan and the land-use simulation results in a transportation system that satisfies the land-use plan.

METHODOLOGY

The land-use simulation model is dynamic and behavioral. Land is divided into five sectors by use: residential, services, industrial, special, and agricultural. The residential sector is the model's prime mover. The service sector, which includes all land use that is dependent on access to residential or industrial land, simply reacts to changes in residential and industrial location. The industrial sector roughly corresponds to the traditional basic industries. Special land use includes all exogenously introduced nonindustrial land use. It consists mostly of highways, parks, and other government uses. Location of employment in both the industrial and special sectors is taken as exogenous to the model. Agricultural land use is taken as a residual after the other four sectors have been determined.

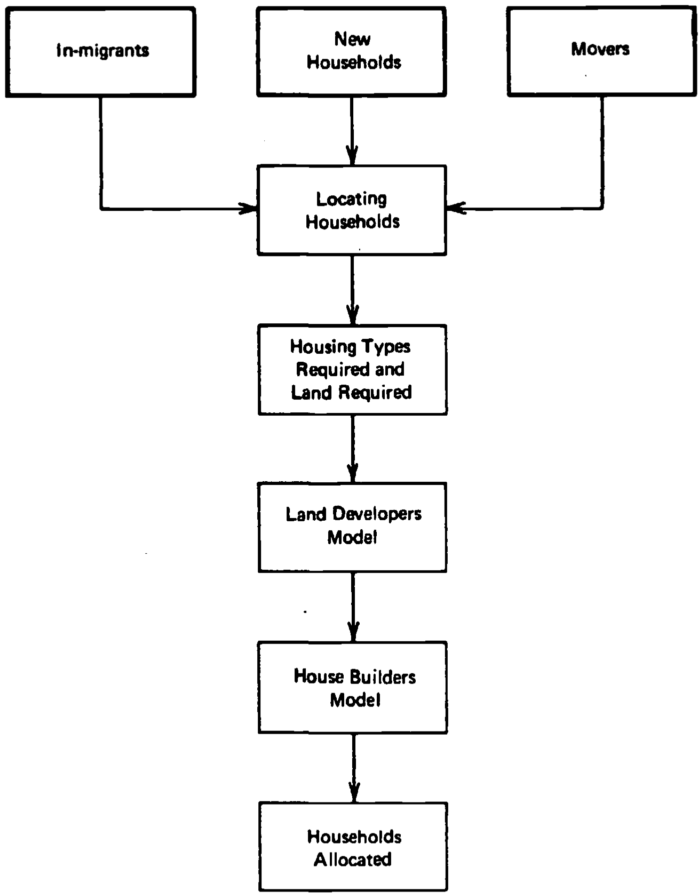
Residential Land Use

Residential land location is depicted as resulting from three related decisions. Without specifying order or causal relationships, these decisions are: (1) the land developer's decision to develop land for residential use; (2) the housing builder's decision to construct dwelling units on the developed land; (3) the householder's decision to rent or buy the constructed dwelling units.

The model's logic is predicated on the assumption that households determine the number and type of dwelling units, including the lot size, but that the developer decides the site location for new construction. A schema of the model is shown in Figure 5.

Demand for housing in each period comes from newly created households, in-migrating households, and households relocating within the

Figure 5
Synthesized Flow Diagram for the
Southeastern Wisconsin Residential Model



region. The first two groups are given exogenously to the model from the regional economic model. The third is determined endogenously by applying a relocation rate, derived from historical data, to the households in each of the region's zones. Housing supply in each period consists of units vacated by intraregional movers and new construction.

Households are classified into sixteen groups, according to education, occupation, income, age, sex of head, and race. Each of these groups is assigned a relocation rate within the region and a distribution of housing type choices. Regional total demand for housing, by housing type, is obtained and used in the land developer's and builder's decisions about the number and type of lots and housing units to be constructed.

Given the number of lots of each type to be developed within the entire area, a linear programing procedure is used to assign the quantity of development by type to each zone. The model allows five different lot sizes. The cost of developing each lot size varies with type of soil and physical characteristics of the site. Raw land costs are not included in development costs. Development in each period takes place in those zones having the minimum cost of development. The solution given by the linear programing problem minimizes land development costs subject to the constraints that a predetermined number of lots of each size are developed and no more land is developed in each zone than is available, including the land needed by the service sector to support the residential use.

The builder simply constructs houses on the developed land. The quantity of each type of housing to be constructed, in each zone and in each time period, is determined by recursive programing on the basis of actual houses constructed in the past and a given vacancy rate. Finally, the location of the sixteen household groups is determined by matching the available housing types with the choices of each group. In addition to having appropriate housing types, the zone must satisfy an accessibility constraint peculiar to each group. Access is measured in terms of the transportation time to employment, shopping, and population.[2]

[2] We have not been able to determine from any of the published material of the Southeastern Wisconsin Regional Planning Commission, or from our correspondence with K. J. Schlager, Chief Systems Engineer of the SEWRPC, the nature of this accessibility constraint or its operational function within the model. An article by Schlager ("A Recursive Programming Theory of the Residential Land Development Process," *Highway Research Record,* 207, 1967) suggests that the accessibility constraint is in fact a "capacity" constraint imposed on the distribution of household types in each zone. The "capacity" in this constraint is the amount and distribution of accessible activities that affect the household location decision. The demand for the capacity of each activity in each zone is the summation of the demand of households to which this activity is accessible, accessibility being a simple binary variable (i.e., capacity is accessible to a household or it is not). However, we have not been able to determine whether this capacity constraint is the accessibility constraint mentioned in published descriptions of the SEWRPC or not.

Industrial Land Use

Two methods are suggested for determining industrial land use in the Southeastern Wisconsin study. It is not clear which method or combination of methods was incorporated in the final model. One method is simply to assign industrial locations consistent with the overall land-use design plan. All output of this model is conditional on an exogenously specified distribution of industrial employment. In practice, this land must be made available to industry by being cleared and provided with requisite services.

The alternative method is to use a linear programing algorithm to determine industrial location. This procedure is similar to that described for allocating residential site land development. Again, the solution is obtained from a linear programing problem to minimize development costs, subject to the constraint that the demand for land must be satisfied. In addition, industries are permitted to locate only in zones having certain characteristics, that is, those that satisfy a number of specific industry constraints.

Service Sector

The quantity of land used by the service sector in each zone is determined by applying a historical ratio of service to residential and industrial land use. The quantity of service land use in each zone, in turn, changes the accessibilities used in the residential location simulation model, and thus affects the location of land development, new construction, and households in the next time period.

Special and Agricultural Sectors

As explained above, the special sector consists mostly of highways, parks, and government offices. The quantity of land in each zone devoted to this sector is determined exogenously. Agricultural land use is simply the residual in each zone after the quantity of land used by the other four sectors is determined.

OVERVIEW

The technique for testing the feasibility of the land-use design by means of land-use simulation models in the Southeastern Wisconsin Regional Land-Use and Transportation Study is unique. This model is distinguished by its attempt to incorporate behavioral aspects into its design. Still, important questions about the comprehensiveness of the model must be raised.

In the "taxonomic analysis" used to classify households in order to match them with housing unit types, one is struck not so much by the variables used as by the absence of variables usually thought to be of major importance in determining households' choices among housing types. These include the size of families, number of automobiles, and number of workers. In addition, in this analysis racial detail seems clearly deficient. Only nonwhite households with female heads were separately analyzed. The model suffers, as do most of this type, from its exclusion of the effect of depreciation or demolition of existing housing structures on decisions to develop previously undeveloped land. Neglect of the importance of the housing stock is particularly striking in a model that is otherwise quite detailed as to housing supply.

While the model has included the behavior of households relocating in order to change their housing bundle, the modeling of movers does not appear to be adequate. For example, each of the household types is assigned a relocation rate and this rate is applied to all zones. One suspects that moving behavior, even by household type, is very dependent on location. Further, it is likely that grouping new households, movers, and in-migrants into the same categories with respect to their demand for new housing may mix some very different behavioral groups.

One of the methods used for determining industrial site locations could be a potential source of trouble. In it, industries have simply been placed where the planners would like them to locate, with the hope that they will somehow be induced to locate on these sites. Given the pivotal importance of industry location in the SEWRPC model, it is very strange that none of the published reports suggest an industry location routine, judgmental or otherwise. The primary function of the model is to simulate the consequence of an industry locational pattern on nonindustrial land use, so that adjustments can be made in controlling parameters (transportation facilities, zoning laws, etc.) to obtain a general land-use configuration that satisfies certain design objectives. It seems highly improbable that the configuration of controls satisfying nonindustrial land-use objectives also suffices to induce industry to locate on planned sites. Clearly, insufficient attention has been given by SEWRPC to the specification of variables and parameters affecting industry location.