SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

NEWSLETTER
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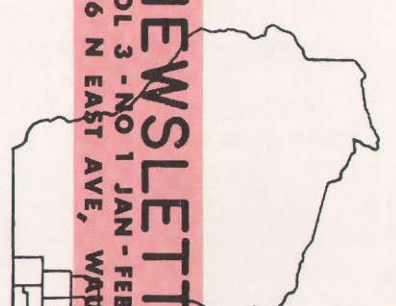

THE ROLE OF SYSTEMS ENGINEERING IN REGIONAL PLANNING

In December of 1962, the Southeastern Wisconsin Regional Planning Commission completed the first phase of a program designed to develop a series of mathematical models which will assist in the development of regional land use-transportation and water resource plans. This initial phase of the program was performed under contract by the College of Engineering of Marquette University, but the remainder of the program will be completed with staff personnel in connection with the transportation study and watershed planning programs.

THE USE OF MATHEMATICAL MODELS . . .

What is a mathematical model and why do we need models in regional planning? A model is a replica or representation of some other object or thing. All of us are familiar with toy models of airplanes, automobiles and ships. A model airplane is a miniature representation of a life-sized airplane. Such models "look like" the object they represent. Architects and engineers often use such models to aid them in the design of buildings, bridges, and airplanes.

All of the above models, however, are static; they do not change over a period of time. A second kind of a model known as a simulation model or simulator is dynamic in that it "acts like" the system it represents over a period of time. The Air Force has made extensive use of simulators (also called Link Trainers) to train pilots prior to actual flight operations. Small scale water flow simulators have been constructed to simulate the flow of water in a river basin.

PHYSICAL SIMULATORS ARE NOT PRACTICAL . . .

Physical simulators can be quite complex and expensive, and they become quite impractical for large scale systems. Such large systems can, however, be represented by mathematical simulators using an electronic digital computer. The flow of water in a river channel may be represented by a simple mathematical equation. Large numbers of such equations may represent the complex relationships of an entire river basin. Although each of the equations is quite simple, the large number of such equations needed to represent a large system make it desirable to perform the computations on an electronic digital computer. Small systems, however, can be simulated using manual calculations.

HOW A MATHEMATICAL MODEL IS BUILT . . .

The nature of a mathematical simulator may be clarified by the illustration in Figure 1. To "build" a mathematical simulator we must provide a set of mathematical relationships (equations) and some typical real data as inputs. The simulator will then "act like" the real life system as it operates over time. This real life system may be automobile traffic in a highway network, water flow in a river basin or even the changes in the land use pattern of a city, county or region.

MATHEMATICAL SIMULATOR

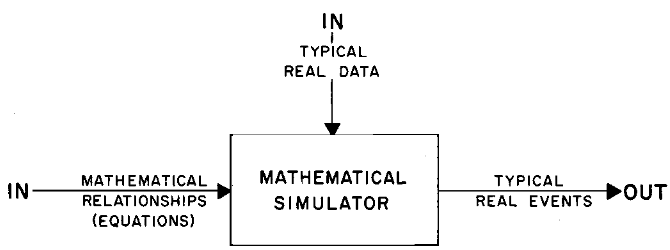

FIGURE 1

Regional planning is a complex operation, involving the planning of interrelated transportation, land use and water resource systems. Each of these systems is composed of a large number of interacting elements. How can plans be developed for these complex systems that take account of these interactions? One approach, of course, is to try a plan and see how it works out. But such a trial and error approach can be quite expensive and aggravating if the initial approach was ill-conceived, and the plan fails.

SOLUTIONS CAN BE TESTED . . .

Use of a mathematical simulator enables us to test a plan for a complex system <u>before</u> we select this plan as a final choice. In other words, it is possible to "experiment" with different plans on the computer in the same way that a chemist experiments in the laboratory with a new chemical product. No responsible scientist or engineer would ever approve the use of a new device without experimental verification in the laboratory. Using the mathematical simulator, it is no longer necessary for the planner to "fly blind" in his selection of systems plans.

THE MODEL WILL NOT FORMULATE THE ALTERNATE PLANS . . .

It is quite important to emphasize that the model does not develop plans. The planner must still formulate the plans before he tests these plans with the model just as the electronics engineer must design and build his new television set before he tests it in the laboratory. The model helps the planner in three ways:

1. It forces him to be precise in his descriptive understanding of the system. To develop a model, it is necessary to describe the system in detail. Vague notions and "fuzzy" thinking are minimized.

2. The model provides a logical framework for data collection, processing and analysis. Data requirements will be evident from the basic information or constants needed to implement the use of the systems simulation model.

3. Finally, and most important, the model enables the planner to quantitatively test the feasibility and benefit-cost ratios of alternative plans.

FOUR MODELS ARE BEING DEVELOPED . . .

Four kinds of models are now being developed for use in regional planning in Southeastern Wisconsin:

1. Regional Activity Model
2. Spatial Activity Model
3. Transportation Model
4. Water System Model

These four models are closely related in their application as shown in Figure 2.

RELATIONSHIP OF REGIONAL MODELS

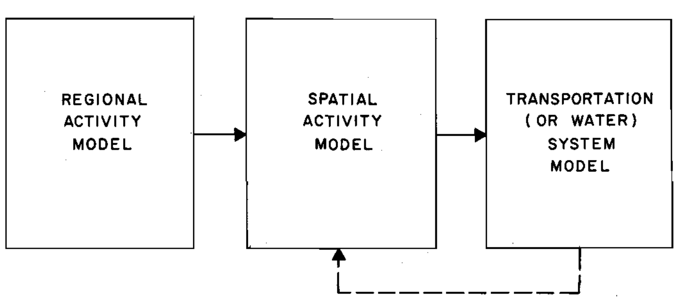

FIGURE 2

REGIONAL ACTIVITY MODEL . . .

The regional activity model is an economic model that simulates economic activity and population growth in the region. This model is basic since no sound plans can be formulated in the region that ignore the dynamic nature of the region's economy. The nature and extent of economic and population growth determine both the kind of community pattern transportation network and resource planning the region will need and also the facilities it can financially support.

SPATIAL ACTIVITY MODEL . . .

Future land use patterns in the region are simulated in the spatial activity model. The inputs to this model are the economic activity and population growth generated in the regional activity model site accessibility and suitability, and existing or proposed local land use plans and policies. The spatial model distributes population and employment over the land in the region. Alternative land use patterns as they are affected by the transportation network,water and sewer availability and plant locations may be tested with the model.

TRANSPORTATION AND WATER MODELS . . .

The land use pattern determines the demands for public transportation sewerage, drainage, water supply, school and park facilities. These demands are the input to the transportation and water models which are used to test alternative system designs. The transportation model is really a series of models which:

1. Generate trips from land use characteristics.
2. Distribute these trips to zonal areas in the region (trip distribution).
3. Assign these trips to highway or transit networks (traffic assignment).

Using these trip distribution and traffic assignment models it is possible to test a number of alternative highway-transit network plans and to eventually select the plan with the greatest benefits for the least cost to the public.

All of the above models, except the water system model, will be applied in the regional land use-transportation study. The regional activity and spatial activity models were originally developed for application in this region. The transportation models will be modifications of models previously developed by earlier transportation studies in Detroit, Chicago and Pittsburgh. Such transportation models have reached a high degree of refinement. The other models are newer in nature, and are capable of providing a real contribution to regional planning.

CRITICAL PATH MODELS . . .

Models have a number of other applications related to city, county and regional planning. Another class of models, known as critical path models, are useful in planning and scheduling projects. These critical path models are now being used extensively in the construction industry for scheduling large scale construction projects. A critical path network has been prepared for the regional land use-transportation study. This network will provide a detailed knowledge of the time each of the study activities must begin and end in order to complete the study on schedule.

NOT CONFINED TO LARGE SCALE PLANNING . . .

Use of models need not be confined to large scale regional planning. Simulation models may also be effectively applied to smaller scale problems such as local traffic operations, local land use planning or local facilities planning. An urban traffic control simulator has been developed by the International Business Machine Corporation to simulate the flow of individual vehicles in a small street network. Such a model would be extremely useful in evaluating alternative plans for improving traffic flow in a central business district, shopping center or industrial area. Such models are useful in local community planning. Technical services to assist local communities in the application of such models may be an important part of the Commission's community assistance program in years to come.

The simulation model is rapidly becoming an extremely useful tool in the development and testing of land use,transportation and resource plans at city, county and regional level.

TRAVEL SURVEYS FOR THE REGIONAL LAND USE-TRANSPORTATION STUDY . . .

The starting point for a study of future transportation needs is a comprehensive survey of the travel that occurs today. How many trips are made? Where do they begin and end? How are they made? Who makes them? Why?

To find the answers to such questions the Southeastern Wisconsin Regional Land Use-Transportation Study will mount three major trip surveys: the home interview, the truck-taxi, and the roadside interview.

continued . . . . .

HOME INTERVIEW SURVEY . . .

The home interview survey will be the most inclusive. To canvass all of the approximately 500,000 dwelling places in the 2,700 square mile region would be prohibitively expensive; instead, advanced techniques of sampling must be employed. It is statistically sound to interview a random sample ranging from 1 in 10 to 1 in 25 households. The results of such a cross-section can then be expanded to represent all households.

The home interview survey is much like a regular census, but with particular emphasis upon trip-making. Questions cover the type of dwelling place, the number of residents and visitors, the sex, race, age, and occupation of each household member, the number of autos and the number of licensed drivers, and for each reported trip the origin and destination, the mode of travel, the trip purpose, the land use at origin and destination, the time of arrival and departure, and many other related items. A typical interview with a responsible member of the households lasts thirty minutes and affords ample time for thorough questioning and response.

THE TRUCK-TAXI SURVEY . . .

The truck-taxi survey, which will be scheduled concurrently with the home interview survey, records trips by trucks and taxis registered at addresses within the region. These are sampled from official registration lists in Madison. The interview is made with the driver of each vehicle or with his dispatcher. The data recorded will include the type of vehicle, the garaging address, the business of the owner, and trip information similar to that obtained in the home interview survey.

ROADSIDE INTERVIEW . . .

To account for travel in the region by non-residents and by externally garaged trucks, roadside interview stations will be established at the major entry points to the region. A large sample of the passing vehicles will be stopped and the drivers interviewed. Because of the limited time available, questions must concentrate upon origin, destination, land use, trip purpose, and other items pertaining directly to the particular trip intercepted.

The composite of the three surveys represents the total travel in the region as if all three were taken on the same day. Problems of management, however, require that the interviewing be extended over a period time, excluding Saturdays and Sundays, and scheduled to avoid a daily or weekly bias. This technique has the added advantage of providing the true picture of typical travel behavior, unaffected by special events on particular days.

TRAVEL SURVEYS . . . continued

It will probably be impossible to cover the entire region by the conventional home interview and truck-taxi survey techniques. In the more sparsely settled parts of the region, some adaptation of the mailed questionnaire technique may be necessary. This has been done successfully in similar areas elsewhere and the net result is the same: a complete picture of all travel in the region.

TARGET STARTING DATE . . .

The staff is presently making preparations for these surveys; the target date for starting actual field operations is May 1. Meanwhile, there are procedural manuals to be written, forms to be designed and printed, field offices to be located and equipped, and personnel to be hired and trained. This is difficult and time consuming, yet it is absolutely essential. An inventory of travel is necessary for objectivity and perspective. Having the facts pertaining to travel eliminates much that would otherwise be guesswork. Decisions calling for large public expenditures warrant more than quick superficial judgments. Decisions of this magnitude must be made only after all the facts have been carefully considered and reflectively projected into the future. An accurate travel inventory is the only possible foundation for future planning and for a sound investment of the transportation dollar.

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AWP TO HOLD ANNUAL CONFERENCE

All phases of transportation will be discussed at the 1963 Annual Planning Conference sponsored by the AWP, to be held this year at the Northland Hotel in Green Bay. The two day conference, scheduled for March 29 and 30, will cover the role of the highway, mass transit, the changing role of rail transportation as well as the changing role of truck transportation, waterways and air transportation. Registration will be from 12:00 - 1:30 Friday. For additional information, write to:

Association of Wisconsin Planners
155 East Kilbourn Avenue
Milwaukee 2, Wisconsin

NEXT QUARTERLY MEETING

The next regular Quarterly Meeting of the Commission has been scheduled for Thursday evening, March 7, at the Kenosha County Courthouse at 7:30 P.M. An agenda will be supplied upon request.

QUOTABLE QUOTE ...

"And one thing characterizes all genuine systems, whether they be mechanical like the control of a missile, biological like a tree, or social like the business enterprise: it is interdependence. The whole of a system is not necessarily improved if one particular function or part is improved or made more efficient. In fact, the system may well be damaged thereby, or even destroyed. In some cases the best way to strengthen the system may be to weaken a part --- to make it less precise or less efficient. For what matters in any system is the performance of the whole; this is the result of growth and of dynamic balance, adjustment, and integration rather than of mere technical efficiency."

From: THINKING AHEAD

Potentials of Management Science by Peter F. Drucker

As published in Harvard Business Review, January - February 1959.

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