3. Design analysis procedures and identify data requirements for determining appropriate problem solutions that are consistent with goals,
4. Collect data,
5. Analyze problems in terms of alternative solutions, and
6. Synthesize solutions and develop plans.

If this approach is used, we may well find that certain problems overlap considerably in method of analysis, data, and solution. We may also find that there are overlapping needs for travel simulations in many applications. These possibilities, however, should develop as results of analysis rather than as starting points.

Throughout, if we use such an approach, we should be able to plan statewide transportation systems through increasing our knowledge of and ability to deal with the phenomenon of statewide transportation rather than through knowing about a complex transportation planning technology. If we work on the basic needs identified in Drake's paper in directly addressing problems rather than in developing a monolithic procedure, we will be well on our way not only to developing good statewide transportation plans but also to solving our statewide transportation problems.

Discussion of Resource Paper

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The methodology for planning statewide multimodal goods movement systems should begin with a definition of goals and objectives and follow with a systems approach through evaluation of alternatives and final selection of a statewide goods movement system. However, there are several ways to develop such a framework for this planning methodology; the level of detail of each step can vary from state to state; the responsibility for conducting each step may be assigned to either statewide, regional, or local governmental units; and, in general, a framework to satisfy all transportation planners is difficult to envision.

The goods movement system can be viewed in terms of inputs and outputs, with constraints and impacts as shown in Figure 4. Figure 4 also shows the same input-output representation with some elaboration of the constraints, controls, and outputs. The goods movement system is composed of physical, human, activity, and concomitant subsystems, as shown in Figure 5. These subsystems are described as follows:

1. The physical subsystem includes all goods-movement vehicles and facilities and the goods that are expected to be moved in the region;
2. The human subsystem includes the operators of those vehicles and facilities, the shippers and consumers or final receivers, and the community that is affected by the goods movement system;
3. The activity subsystem involves the entire spectrum of activities that occur with the movement of goods and includes total goods flows, flow patterns, costs, operating schedules, terminal location and operation, and land use development; and
4. The concomitant subsystem encompasses the results of the accomplishment of the movements of goods and may be further divided into environmental, social, and economic consequences of goods movements.

Regardless of how one chooses to represent the statewide goods movement system, it remains a very complex system with many viewpoints, involves several modes of transport, and has far-reaching social, economic, and environmental consequences. The consequences of goods movements on the transportation network, land use, land use patterns, and environment must be addressed in any truly comprehensive trans-

Figure 4. Input-output representation of a statewide goods movement system.

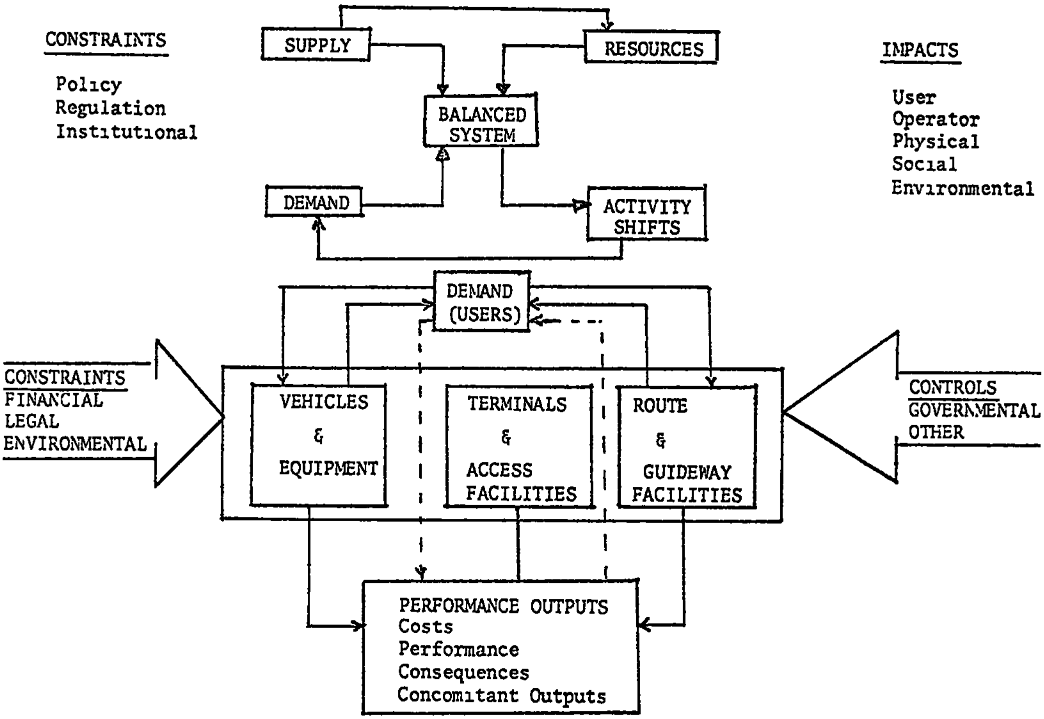
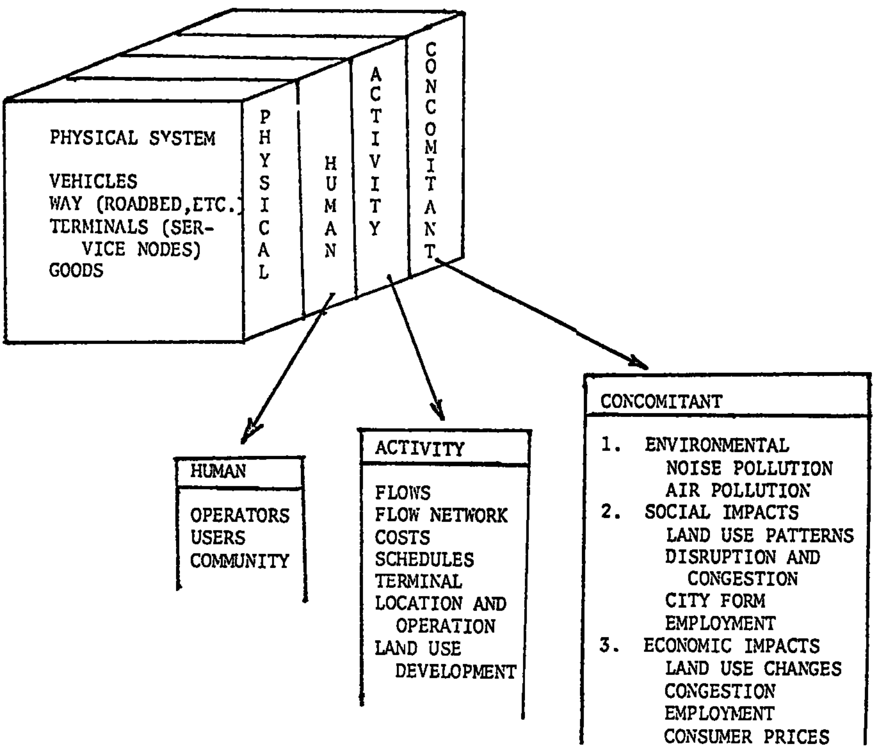


Figure 5. Subsystems and components of a goods movement system.



portation planning effort. A comprehensive study of the goods movement system, even as a subsystem of total transportation, requires a systems approach. Figure 6 shows a systems approach to the analysis of goods movement.

A network study of flows is necessary to enable the reduction of overlapping or unnecessary vehicle movements. The consideration of all modes is also absolutely essential. For example, if the energy situation either becomes worse or remains as a long-term problem, the following types of shifts are entirely possible and desirable:

1. Pipelines may be used to move many products, for they are more energy efficient than either rail or truck;
2. The piggyback type of intermodal coordination may become commonplace (with new terminal distribution systems extending into the city so that system gains in rural movements are not lost in urban congestion); and
3. A major research effort will be made to develop innovation alternative goods

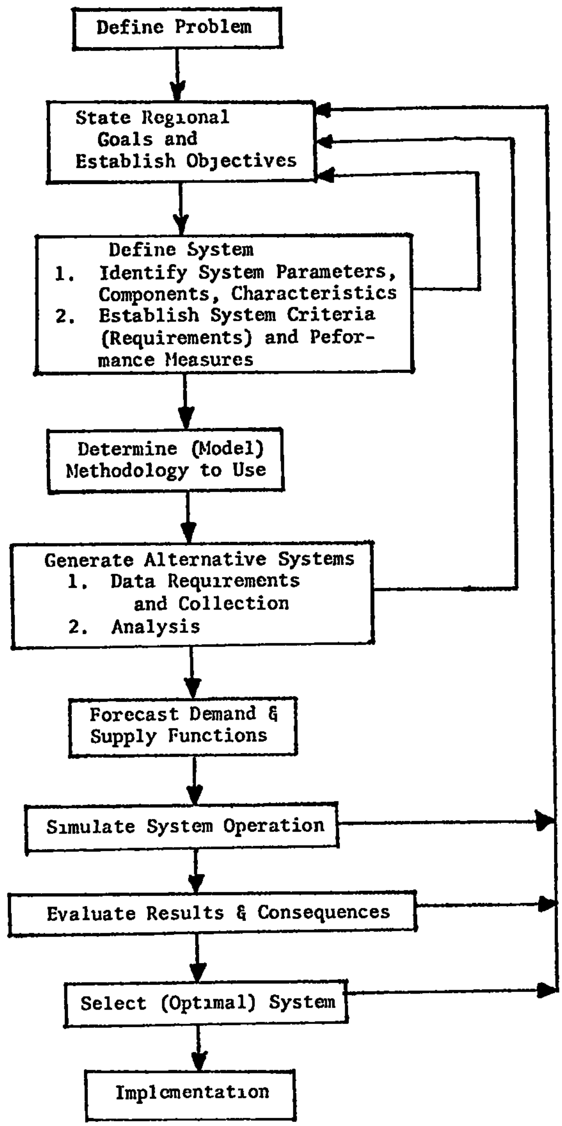


Figure 6. Systems approach to study of urban and interurban goods movement.

movement systems and techniques (currently about 45 percent of the total national expenditures for transportation is for freight).

Drake's discussion of the problems of obtaining behavioral information for freight analysis is appropriate. Careful attention should be given to goods movement data requirements prior to any major data collection effort. This implies that a basic methodology should have been established in order to determine data requirements, and this is precisely the way goods movement research should proceed. Recognizing the almost total lack of goods movement data, Drake recommends that collection of basic flow data begin immediately. However, this recommendation should receive very careful scrutiny; otherwise, unneeded data or data in an inappropriate form may be obtained at a rather high cost.