ABRIDGMENT

Grant, Albert A., and Harvey, Carroll B., Office of Planning and Programming, D. C. Department of Highway and Traffic. "Highway Programming in the Nation's Capital - A Progress Report." Presented at the 45th Annual Meeting of the Highway Research Board, Washington, D. C., January 17-21, 1966.

INTRODUCTION

Many large urban areas are finding it more and more difficult to obtain the final planning decisions necessary to complete their portions of the Interstate System on schedule. In the District of Columbia, the problem is further complicated by the considerable interest and influence of the President, the Congress and a host of Federal agencies in the decision-making process.

In anticipation of a fast approaching, critical programming period, the District of Columbia Department of Highways and Traffic, in March of 1964, undertook a research project to improve scheduling procedures.

BACKGROUND

The District of Columbia Department of Highways and Traffic is subject to an unusual number of review and approval procedures and controls by numerous layers of local and Federal authorities involved in the planning and implementation of highway projects. Congress has appropriated funds for elements of the Interstate System each year since 1956 and carefully reviews each project contained in the annual budget requests of the Department. The Executive Branch of the Government also carefully reviews the plans and programs of the Department.

The Department also works closely with the National Capital Planning Commission and the National Capital Transportation Agency in coordinating current highway and transit planning with urban development planning for the District of Columbia. In addition, the Department submits all major highway plans to the Fine Arts Commission for advice and coordinates fully with such agencies as the National Park Service, General Services Administration, Corps of Engineers, Bureau of Public Roads, National Capital Housing Authority and many others in the development of final, acceptable, detailed plans.

The District of Columbia is the core of the National Capital Region, the fastest growing urban area in the Nation, which includes portions of the State of Maryland and Commonwealth of Virginia. Because of the differing organizational, political and geographic characteristics of the District

of Columbia and its neighboring States and local communities, highway programming procedures must incorporate a high level of comprehensive regional coordination, not only to insure continuity of major highway facilities, but to insure that regional highway facilities are properly coordinated with other forms of transportation and urban development plans.

ORGANIZATION AND CONDUCT OF RESEARCH PROJECT

The objective of the project was to develop critical path method (CPM) networks, schedules and resource requirements for the completion of the Interstate Highway System in the District of Columbia, and for the highway projects in the Six Year Public Works program; to develop a manual of procedures for monitoring and updating the CPM networks, schedules and resource requirements; and to demonstrate the reasonableness of the networks and the method of application.

Recognizing that there were personnel in nearly every operating unit of the Department who had been previously trained in CPM techniques and procedures, a high level Departmental CPM Policy Committee was established to monitor and evaluate the progress of the study, assign experienced personnel to an operating task force, and insure cooperation within each unit.

MAJOR RESTRAINT FACTORS

The research team agreed that a pre-requisite to further development of the major informational activities was a determination of the relative impact and control of major restraint factors. After considerable discussion of the various factors that might affect scheduling procedures, the research team isolated four (4) major restraint factors which appeared to exhibit the most significant degree of control over priorities and program schedules. Before the project was completed new legislation concerning the relocation of displaced families was passed by the Congress. This increased the number of major restaint factors to five (5).

- Fund availability (both D. C. and Federal).
- Planning decisions on major route locations.
- Need to maintain normal city functions during construction (i.e. traffic, communications, commercial activities, non-conflicting construction contracts, etc.)
- Deadline for completion of the Interstate System.
- Availability of relocation housing for displacees.

The research team recognized that of the five major restraint factors isolated, both the decision-making process (factor No. 2 above) and the deadline for completion of the Interstate System were fixed controls not susceptible to significant manipulation by the Department. On the other hand, the maintenance of normal city functions during construction was a restraining factor in which the Department could exercise considerable influence in that many alternatives were available to insure the continuity of vital city functions.

It then became apparent to the research team that the major restraints to completing the Interstate program were fund availability and the availability of relocation housing. Emphasis was placed upon the funding factor as a prime control in the development and design of the programming system. At the same time relocation needs were viewed as another major control.

SYSTEM DESIGN

After considerable discussion of the basic information needs essential to a successful scheduling procedure, the research team defined three major areas of informational requirements as follows:

- Multi-project schedules and resource requirements for long-range scheduling of total program.
- Individual project schedules and resource requirements for detailed project control.
- Monitoring, reporting and updating procedures.

The research team further agreed that the most effective system for providing an improved, practical and realistic program schedule would be one which utilized factual historical data as a basis for estimating future time and resource requirements. As a result of this agreement, the concept of a "data bank" was introduced as a fourth major informational requirement. The data bank procedure would allow for the storing of actual performance data for the various activities associated with completed projects, thus providing a potentially valuable informational tool for the implementation of the individual and multi-project scheduling activities and the updating procedures.

MULTI-PROJECT SCHEDULING AND RESOURCE REQUIREMENTS

A generalized set of schedules were developed first to define the entire program rather than individual projects. These schedules were shown in bar graph form with five different types of activities. They included:

1. Planning Studies
2. Design
3. Right-of-Way Acquisition
4. Contract Letting
5. Construction

The construction activity was further subdivided into four sub-activities. They were:

a. Grading, Drainage and Walls

b. Structures

c. Paving

d. Miscellaneous (Signing, Landscaping, Lighting)

These generalized schedules were called macro-schedules and were used as the basis for the multi-project scheduling. All projects to be scheduled were assigned priorities and classified as to type of facility (i.e. expressway, major arterial, local street, etc.). A cost estimate was provided for each of these macro-activities along with estimates of the appropriate manpower requirements by work type (i. e. Bridge Design Engineer, Landscape Architect, etc.).

The assigned priority and the anticipated available funds were used to determine when the projects would be scheduled. The aggregate of these macro-schedules for each individual project resulted in an overall multi-project schedule.

The multi-scheduling process provides a complete long-range program with high priority projects schedules at as early a date as funding or other restraints will permit. The input requirements for this process include anticipated budget funds by fiscal years, other restraint factors, project descriptions and time and cost data for activities as defined in the macroscopic network (See Figure 1). The output from the process is in the form of multi-project bar graphs. The output is the basis for development of the Department of Highways and Traffic's Six Year Public Works Plan.

The Six Year Public Works Plan is revised each year and the timing is such that the first year of the Six Year Plan is the basis for development of the detailed budget request for that year.

INDIVIDUAL PROJECT SCHEDULING AND RESOURCE REQUIREMENTS

When a project within the program approaches its actual start date, a detailed activity schedule is developed by utilizing a detailed model macroscopic network. The model macroscopic network is a consolidation of a series of smaller detailed networks which show the sequential arrangement of activities within each of the individual operating units. These smaller nets were developed by the experienced task force members within each unit and by the Planning Research Section. Figure 2 is an example of one operating unit's detailed macroscopic network.

When each unit had developed an acceptable network of its internal operations, the nets were combined into a model microscopic network. The actual model microscopic network has more than 400 specific operations.

Before the detailed schedules can be completed, the model microscopic network, which was developed for the most complete type of project, must be "hand tailored." "Hand tailoring" involves eliminating those activities in the model network which are not required for a given project. Since the most complex project was used as the basis for the development of the model, tailoring is the rule rather than the exception.

The input of this process for individual project scheduling includes project type (i.e. freeway, major arterial, frontage road, etc.) and project extent (1,000 feet of roadway, etc.).

The output from the detailed scheduling process includes time, cost and manpower data for each activity in a project, along with the critical path for that project. A calendar dating procedure is later used once the actual starting date is established.

MONITORING, REPORTING AND UPDATING PROCEDURES

Constant surveillance of any program is essential since schedules will change due to fund availability, delayed decisions, potential contract conflicts, and disruption of traffic or other vital city functions.

In order to achieve an adequate level of surveillance, project progress is reported by the Project Engineer in each operating unit each month. These individual progress reports are summarized by a Project Control Unit within the Programming Section of the Office of Planning and Programming and submitted to the Director, the Deputy Director and to each operating unit supervisor.

When a project is delayed, a "Delay and Impact Report" is submitted for that project. This report notes that a project is behind schedule and will be delayed unless some action is taken to overcome the delay. The impact of the delay on other projects, on funding, and on the overall program is also noted, along with the name of the operating unit which is responsible for initiating a schedule adjustment, resource adjustment or for correcting a delay.

The reporting procedures reflect a major objective of the research project; namely, to simplify the number, preparation and distribution of necessary reports.

DATA BANK PROCESS

The data bank is probably the most important new feature which was developed as part of the research project. It provides an automated library of historical time, cost and resource information by project type on computer data cards. The data bank process has as a part of its operation an automatic retrieval technique which utilized ADP procedures. The principal input to the data bank is comprehensive factual data developed from completed projects. The information is stored in the data bank for each activity in both micro and macro networks and related to a common basis for measurement. While time, cost and resource information is stored for the micro-activities, only time and resource information based on estimated costs are available for the macro-activities. For the macro-activities, therefore, project cost becomes a measure of extent or size and is used as an input item.

The principle upon which the data process hinges is the method of least squares which is used to fit a polynomial to the observed historical data.

SYSTEM APPLICATION TO DATE

Thus far the District has developed preliminary multi-project schedules for all of the Interstate projects to be constructed in the city as well as all of the ABC projects within the Six Year program. Refinement of reporting techniques and format is continuing. The District has started to change its progress reporting procedures. In the past, each unit reported progress separately. This information is now being combined to show overall project progress. Those active projects which are on schedule are all listed with their proposed completion date. Those projects which are behind schedule are shown on a "Delay and Impact" report. This report names the project, the amount of delay encountered, and the unit responsible. This information provides the basis for policy decisions to either adjust the schedule or to take steps to overcome the delay.

SUMMARY AND CONCLUSIONS

The purpose of this paper has been to report on the results and progress to date of a coordinated research effort undertaken by the District of Columbia Department of Highways and Traffic in anticipation of a rapidly approaching need for an improved objective and practical method of priority program scheduling and procedures. Based on the unusual working environment and complex organizational relationships unique to the District of Columbia, the major restraint factors for effective program scheduling were defined and evaluated in terms of their relative impact upon the scheduling procedure.

Three major areas of informational requirements were developed as follows:

- Multi-project schedules and resource requirements for long-range scheduling of total program.
- Individual project schedules and resource requirements for detailed project control.
- Monitoring, reporting and updating procedures.

Each area was developed in detail to provide practical information in a form readily usable for purposes of decision making and implementation of major projects.

Against the background of control and approval procedures required in the District of Columbia, the restraint factor of funding availability was found to be the most important single control element. Most of the other factors considered were either fixed to a point beyond the control of the Department or sufficiently subject to manipulation by the Department so that impact upon the program could be minimized.

As a result of the need to improve the basis for projecting future time and resource requirements, a data bank procedure was adopted to store factual historic data on completed projects and to provide a more objective basis for future estimates.

The data bank procedure is a relatively new innovation which can provide a valuable tool for improved decision making activities. While each new project exhibits differing characteristics from previous projects because of changes in the relationship of the highway to its environment, it is believed that by developing common standards of measurement for specific data gathered from actual experience on past projects, the data bank procedure will make a significant contribution to improved forecasting of future schedule requirements.