Advance Programming Methods For State Highway Systems

JAMES O. GRANUM, Deputy Chief Engineer, Highways Division, Automotive Safety Foundation, and CLINTON H. BURNES, Chief, Highway Needs Branch, U.S. Bureau of Public Roads

An examination of the decision-making processes involved in selecting highway improvement projects in certain states and a Canadian province is reported in this paper. It is concluded that eight major factors that must be present for most effective programming of work are: (a) legislative support, (b) executive action, (c) factual survey, (d) budget decision, (e) systematic priority analysis, (f) systematic coordination, (g) scheduling and control, and (h) administrative organization. These are briefly described and illustrated by example.

Adequate advance programming requires firm and stable policies, well understood by staff, and full implementation of the entire "package" of those eight factors. It is suggested that if any state should incorporate all the best features found in the composite group studied, major improvements in work-flow, economy and benefits to the public would ensue.

● IT IS WELL understood that, within limits, the more lead-time that can be provided in advance of construction, the more probable it is that the best engineering can be accomplished, resulting in greater satisfaction to the public and minimum cost. Thus, the prime object of advance programming is to establish firmly, with little chance of last-minute revisions, the work program for several years ahead of actual date of beginning construction. A second objective is to select the projects comprising the programs on the basis of demonstrated relative need.

These appear to be such desirable goals that failure to achieve them satisfactorily and universally is proof of the very great problems involved — even to the point where literature on the subject is virtually nonexistent. The problems revealed in this study will also be described under the appropriate headings.

LEGISLATIVE SUPPORT

Legislative demand and constructive action for adequate programs based on need and set up in advance, are desirable, if not essential, elements in the decision-making process.

An outstanding example of such effective leadership is that of the Administration and Congress of the United States in establishing a program, based on need, for the National System of Interstate and Defense Highways. The values to and the accomplishments of the states pursuant to that program are too well-known to require further description.

Within the states, there is a wide variety of legislative action, or lack of it. In the broadest sense, however, all states through such action have guided programs by dictating the distribution of state-collected funds to road and street systems. More than half the states have dedicated all highway-user tax revenues to highway, road and street purposes (1). These actions, coupled with similar actions by the Federal Government, establish the general scope and nature of the respective highway programs. They represent the first and perhaps the most significant consideration in "advance programming," which requires long-range financing having stability and dependability.

Unfortunately, many state legislatures have not had adequate factual surveys as a basis on which to consider proper distribution of funds to the various systems. Moreover, some which have had access to such surveys have not made sufficient use of them, or, in many states, facts have not been kept up to date.

Within the framework of broad legislative intent and action on fund distribution, several state legislatures have acted more specifically to give guidance to programs of the state highway departments. One of the most detailed is found in California where the law requires specified percentages, based on 20-yr estimated needs, of total funds to be spent on the state highway system in each county (2). For many years, Michigan and Mississippi were required to spend funds in specified percentages in three area divisions of the states.

Ohio passed a special bond issue, proceeds of which were to be spent for construction on a limited part of the state highway system. Selection of that "Major Thoroughfare System" and priority of improvements were under guidance of a special "Construction Council" (3). Many other instances of special fund financing for specific purposes, often limited to particular locations, routes or systems, have occurred throughout highway history. Operation of the Federal-aid funds is perhaps the most general application.

All these suggest the broad nature of legislative intent to guide decision-making. Where too detailed, the ability of administrators to adapt to changing conditions is handicapped; on the other hand, their own responsibilities for making program decisions are somewhat simplified by the action of higher authority.

That most legislatures have not seen fit to spell out detailed program guidance is recognition that such policies are difficult to set factually in a sufficiently flexible manner, and that annual programs should remain largely under administrative control. This may be a compliment to successful administration, which thereby assumes the obligation to accomplish the most effective possible work in the public interest. At the same time, administrators become subject to heavy regional and personal pressures from all kinds of special interest groups whose desires do not always dovetail into the best statewide programs.

In addition to broad, or sometimes more detailed, allocation of finances, some legislatures, such as in Ohio (4) and Indiana (5), have required advance annual work programs to be established by the administrators and published. One of the more recent is in Iowa, which requires a 5-yr published state highway program showing sufficiency ratings for each project which, presumably, are to be selected on the basis of relative need (6). Note that the legislatures cited have required publication of advance programs. In those states, as well as others (7), publication appears to be considered necessary as part of the accountability of the highway department to the public, and for stabilizing the general nature of the programs.

Such various indications of legislative interest and support of advance programming are helpful to administrators in establishing an objective and systematic approach to the problem. Where such clear support is lacking, tradition may often permit, if not encourage, excessive political manipulation of project selection through activities of legislators, the public and the administration itself. Frequently, projects so selected are definitely needed, but choice of location, design and timing may be based less on statewide relative need than on political expediency. If so, development of firm advance programs that are defensible by economic and engineering analysis remains an illusion.

EXECUTIVE ACTION

It is, of course, possible to develop objective advance programs without a clearly expressed legislative mandate. All that may be required is the desire of the legislators and administration to do so, plus effective evidence by the administration that such is the case. Most, if not all, engineering management prefers to operate with facts, rather than pressures alone, and responds to conditions where the objective approach is possible. Numerous administrative agencies have taken the initiative in proposing and publishing advance programs, hoping thereby to gain legislative and public support for soundly conceived operations and simultaneously to create public confidence which will enable continuation of a systematic approach.

Advance programming is a normal, everday activity of all highway departments, like those of any person in deciding what he is going to do tomorrow, next week, next month, or next year. But with widespread highway needs of many varieties, not all of which can be taken care of at the same time, and recognizing the importance of highways to various segments of the economy and traffic safety, and the cost and permanence of the facilities, the choices of what to do next, and when, become increasingly numerous and complex.

Executive action to improve advance planning and programming processes meeting the objectives stated earlier have been numerous, and successful in varying degrees. They reflect the degree of need and desire to achieve a systematic approach that will clearly define what should be done and when, as far ahead as is reasonable and possible. Top support is mandatory, for that is where final decisions are made. Success appears to be in direct proportion to the firmness and continuity of policies on which the programs are based.

Some advance programs have been prepared for the specific purpose of bond issues. Among these was a 12-yr program, set up project by project, grouped by 4-yr periods in Maryland (8); a program for an unspecified time period in Maine, listing projects by priority in each county; and a 1- to 4-yr program in Kentucky.

In other cases, advance programming has been undertaken routinely by direct administrative action. Notable among these is California which always has a 5-yr advance program, plus another 5-yr tentative list. More recently, Tennessee, Colorado, Michigan, Ontario, and perhaps others, have developed a working program of more than the next year's activity. All states have developed working schedules for several years in advance on the Interstate System, which indicates the feasibility of such action when decisions are made firmly.

The balance of this paper discusses the details of administrative advance programming methods.

FACTUAL SURVEY

It is manifestly impossible to select a program without some kinds of facts on which to base the selection. The words "factual survey" imply, however, the systematic organization of all the necessary engineering and economic facts by which decisions can be reached with a minimum of contradiction.

That is contrasted with the situation in which the judgment of one or more individuals, ranging from the governor to the district engineer, may be used exclusively without the recorded marshalling of data on which to base the judgment. That is not to say that such judgments are not good or valid ones, but other individuals may have, or claim to have, equally good judgments which lead them to arrive at different conclusions. Moreover, in such situations it is not known whether there might be other locations which deserve equal, if not earlier treatment, since the review of suggested programs derived on such a basis is generally limited to the relative merits of only the projects listed in the proposed program.

Opposed to strictly judgment bases, the factual survey is one which systematically analyzes all the possibilities, or at least narrows the field of undisciplined judgments to limited observations within a preconceived framework. Ordinarily, such factual surveys cover the entire road system for which the administrator is responsible. For maximum use in legislative action, however, they should cover all road and street systems in the state.

A common term is the "needs study" which makes a complete examination and analysis (within reasonable limits) of the present and future construction and maintenance requirements on the entire network, subdivided by systems, areas and jurisdictions (9). Excellent examples of such needs studies are found in many states and, more recently, in a somewhat less detailed manner, in all states in connection with the so-called "Section 210" studies now being undertaken by the Bureau of Public Roads.

The more detailed studies ordinarily compile all of the geometric and physical facts about every mile of the road system, the present and forecasted use of the highways by various classes of traffic, the construction history including the design of the base and

surface, the physical condition of the roadway, the maintenance cost, the accident problems, similar data with regard to all structures, and the general relationships of the various highway sections to the service requirements of the economy and to the geography of the area. When all these facts are appropriately related to the required standards for the anticipated demands of traffic, the kind and cost of the improvements required emerge as a carefully developed integrated total analysis of the improvement needs, related one to another, for a period of considerable time – usually twenty years ahead. Thus, nothing of a significant nature currently foreseeable is overlooked, and maximum use is made of staff whose specialties should be marshalled for proper decision-making.

Such a study process also provides a reasonable estimate of the necessary timing of each phase of the work. Each project is thus related to the ultimate route and area plans that are established. On many sections, it is possible to show that physical condition, maintenance cost, safety and highway capacity are such that the road is providing satisfactory service and may be expected to do so for an approximate number of years into the future. On the other hand, many sections are found which do not now give satisfactory service and, therefore, are special candidates for early improvement.

This type of study has been carried out in detail in a number of states and in the Province of Ontario. States include California, Colorado, Michigan, Illinois, Tennessee, Kentucky, Minnesota, Washington, Louisiana, and a number of others (10). The studies provide the basis for budget decisions described later, as well as for a finance plan, including the general allocation of funds to systems, which is the responsibility of the legislature or of the administrators as described previously. But, above all, the needs studies leave no stone unturned in the search for all the data which are required to assist in establishing a logical advance program and the development of a schedule of operations which will, in fact, meet the needs of the motorist and serve the public interest.

However, the extent to which these studies are used may fall short of their actual potential. When they are not kept up to date, they soon lose their value. New developments, not previously foreseen, frequently occur and may not be incorporated into the total picture. The physical and condition inventory may not be kept up properly, with the result that incorrect data are on file. New techniques in analysis of traffic and its relation to highway design should find their way into the factual survey – otherwise it becomes increasingly out of date. But all these defects can be remedied if there is full understanding and acceptance of the values to the administrator in the advance programming process.

Even when the studies are fresh and complete, they may be disregarded, and the work to be done each year selected instead on the basis of judgment alone. For example, one state with a very good factual survey makes very little use of it; the major approach to selection of work for the annual programs is through the advice of the district engineers, and there is little or no effort made to acquaint them with the value of the factual survey, although it is available for their use. On the other hand, perhaps one of the outstanding uses of such studies is found in the State of Tennessee (11).

The general techniques of making these studies have been reported in numerous papers (12) and in the highway needs reports of a number of states. They are two well known to require further elaboration here.

BUDGET DECISION

Within the framework of a finance plan and of general legislative allocation of funds to systems, governmental jurisdictions and sometimes areas, there is generally wide latitude in the use of both Federal and state money. Administrators must determine, for example, what percentage of available funds should be used for maintenance, for research, for administration and for other continuing costs. Of remaining money for construction, how much should be used for roadside parks, for new shops, for contingencies and emergencies; how much in urban areas as compared with rural areas; how much for bridges vs roads; for System A as compared with System B; for specified areas of the state?

Some questions may be decided by the law, some by knowledge of the needs and some by policy judgments – but they should be decided in the most rational manner possible, with a marshalling of the facts about each element. This suggests the need for complete cooperation of the bduget officers and the engineering forces – an apparently obvious requirement which frequently is not recognized. With better understanding by both business and engineering forces of each other's problems, advance programming can be improved.

More uniform accounting practices, permitting the state to review problems on a common base, would be desirable. This is possible through implementation of the Uniform Accounting Manual, developed by AASHO and now approved by 47 states (13).

Budget Preparation

The annual or biennial budget reflects the broad decisions that are made in advance. The budget shows financial limitations and intent within those limits in widely varying degrees, depending on the form and nature of the budget.

From a review of state highway expenditure budget forms in 18 states, it is apparent that no standardization exists in budget preparation (14). Each state has its own legal requirements and its individual format. Many states do not have published budgets that give much, if any, guidance to advance programming of construction work. Instead, they are "object" budgets, such as that of Virginia (Appendix 1-A), that show costs, sometimes in great detail, for personnel, equipment supplies and "contracts." These costs generally are summarized in three categories: (a) administration, (b) maintenance and (c) construction.

Only a few states have a "functional" budget, such as in California, in which construction or maintenance funds, or both, are allocated by purpose of expenditure; that is, by classes of work, by systems, and possibly by areas (Appendix 1-B, C, D).

It appears that the nature of state highway budgets depends not only on legal requirements and governmental policies covering all functions of state government, but also on the extent and nature of pre-planning on the one hand, and control of execution on the other.

Where legislators or administrators prefer to control tightly the number and cost of personnel, the number, type and cost of equipment, etc., then the "object" budget is adopted. Accounting is then concentrated on such matters and budget control exercised accordingly.

Where it is preferred to plan and control amounts to be spent for various functional purposes, the "functional" budget is used. Infrequently, both types are prepared. Even though legally not required, it is evident that in actual operation there must be at least an informal estimate of the functional type, in order to enable any kind of intelligent advance decisions to be made with regard to the work to be performed.

The detail in which voluntary (not legally required) functional budgets may be prepared depends on the administrator's desire to spell out, via the budget, the nature of the program he desires to carry out, and the amount of control he may wish to have for each element of the program.

Bases for Functional Budgets

Study of functional budgets indicates two broad bases for their development: (a) by restricted funds, and (b) by advance policy decision. In nearly all cases, some of both are necessary.

An example of emphasis on the former is the highway budget of Pennsylvania (Appendix 1-E). After budgeting certain funds as required by law, remaining funds are budgeted first in accordance with Federal-aid allocations and required state matching amounts, by Federal-aid systems. Consideration is given to amounts necessary for administration, engineering, maintenance and for non-Federal-aid mileage, but these may be reduced if necessary to match Federal-aid, or the latter may be deferred if the former group of costs is deemed more essential. No further subdivision is required, although for internal accounting control and reporting purposes there are numerous internal breakdowns. These, however, are not related to advance planning and programming purposes.

An example of emphasis on the second basis for budgeting — advance policy decision — is the budget of the Ontario Department of Highways. Having no "restricted funds" in the sense of federal systems established within the scope of the responsibilities of the Department (except for the Trans-Canada Highway), it is free to set its budget by advance policy decisions (Appendix 1-F). The capital expenditures are currently based on estimates of the needs of the several systems for which the Department is responsible, the rate of development desired for each, and the requirements of each district of the Province.

Similarly, the California budget, while adjusted to the Federal-aid allocations, is also based by law on needs of the state highway system in each county, including both rural and urban areas.

Budget Operation

One aspect of budget operation is of special significance to advance programming. That problem is the relation of the cash position of the highway fund to its encumbered status. This has considerable effect upon the advance program as it may appear at any given point in time.

Some states (for example, Michigan and New Jersey) require encumbrance against current funds of the full amount of all contracts, even though cash paid out (earnings) thereon may extend over two or more budget periods in the case of large contracts or contracts awarded late in the year. Obviously, such a requirement reduces the number of jobs that can be started early in a period of expanding income and programs, and tends to leave large cash balances unspent in early years.

On the other hand, Pennsylvania permits large contracts to be awarded and only partly encumbered for the amounts of cash to be paid against the current budget. The balances, with approval of the Governor, are deferred to the next budget biennium. Such balances are known as "contingent commitments," and become the first obligation, along with bonded debt service, against succeeding years' budgets. Ontario has a similar system, where the annual "carry-over" costs, or unearned contract estimates, are the first items charged against appropriations for the succeeding year. California law also permits "split projects" (contract award costs split between two budget years), and also awards six months ahead of the beginning of the budget year to which they are charged.

Where these latter methods of handling large contracts are permitted, greater flexibility in current programming is possible. More work can be started sooner, provided care is taken to anticipate the future cash needs, including amounts required to finance the federal share pending reimbursement, as related to income. In the long run, of course, no more work can be accomplished, but the benefits of earlier starts and completions, with less money idle in the bank, suggest the desirability of review of such possibilities. Where they exist, however, advance programming of the funds becomes essential.

Advance acquisition of right-of-way through revolving funds has effected great savings, and is another example of effective budget operation and need for advance programming.

Decision-Making for Functional Budgets

For fully effective advance programming, the functional budget is essential. It should be developed in sufficient detail to guide the general scope of the program for several years ahead. Yet, detail should not be so great that flexibility of engineering administration is denied. The balance between these two problems needs the best factual analysis possible, combined with good judgment. Perhaps fear of being irrevocably committed to a fixed detailed program has discouraged greater use of functional budgets and advance programming. This need not be, if careful study is given to the basis for arriving at decisions, the mechanics of budgeting and the degree of control desired.

In some way, the advance program must define the fiscal limits of each class of work. As an extreme example (but not unusual in a smaller agency such as a small

county), if it were determined that all available funds were required for routine maintenance, then no advance construction program would be possible at all.

Although most state highway programs are built heavily around available federal funds, there remain many areas of decision that should be reflected in formal or informal budgets for guidance of detailed project selection for annual construction programs.

For example, available interstate funds, though confined to that system, may be spent in any one year without federal restriction as to either city or rural location. The same is true of all Federal-aid primary funds. Moreover, there is no federal requirement for any method of selection of specific projects within each system or for division among various areas of the state. These matters are wisely left to the states to determine, subject to federal approval.

Similarly, subject only to state law as discussed earlier, state funds may be used with wide latitude. First obligations are generally debt service, if any, administration and engineering, and maintenance. With what is left, construction programs can be devised. To provide for intelligent distribution of available funds, administrators therefore need to have the best possible long range and generalized estimates of needs in all those areas.

Since administration and engineering costs depend on total expenditures, first attention (after debt service) should be given to maintenance needs. What are proper standards of maintenance; what do these cost in each district, considering the work load in each? Where are efficiencies possible? Can some items be reduced or eliminated, and with what savings? Should others be stepped up? How will construction reduce or increase costs? When those and similar questions are evaluated and estimated, a maintenance program will have been established, subject to later modification as the construction needs are evaluated.

For construction, as well as for maintenance, the factual survey or "needs study" provides the best source material. But at this stage, it is folly to attempt to select specific projects. That can be done better when the over-all costs are known. Then the initial general limits may be adjusted to fit requirements for certain projects, with full knowledge of how such revisions affect other parts of the budget and over-all program.

The budget should attempt, within limits of available funds, to provide for a stated rate of progress (to be decided by the administrator) towards meeting the needs. The "priority" of fund use (that is, the proportionate allocation) should be based on cost-estimate answers to statewide policy questions as follows:

1. How fast should the backlog of work be overcome?
2. Should that rate be different on different systems for which the state may be responsible?
3. Should the rates be different in different areas of the state, or in cities vs rural areas?
4. What are the relative needs of systems, areas, cities and county?
5. Should some entire routes be developed first, or meet needs wherever they occur?
6. How much should be allocated to bridges vs roads or streets?
7. What general classes of work are most important? For example, freeways, bypasses, reconstruction, stop-gaps.
8. What special obligations or prior commitments must be included in current programs?
9. What benefits are provided by various combinations of answers to the preceding?

The needs studies, if up-to-date, can provide many of the answers, or basis for answering those questions. But the decisions must be made at the highest level, subject to later review as to their effects on specific annual programs.

SYSTEMATIC PRIORITY ANALYSIS

The mere development of project priority ratings is sometimes erroneously considered to be the beginning and end of the advance programming process. Actually,

priority analysis is only one step in this process — a process that begins with legislative action, continues through identification of needed improvement projects, and ends with an actual program for scheduling their construction, periodically adjusted to reality. The advance planning of a construction program involves finding answers to three basic questions:

1. What will the physical and dollar needs be during the program period?
2. What amount of revenue will be available?
3. In what sequence should the needed projects be scheduled for construction?

The first two questions have already been discussed. Before discussing answers to the third question, however, a major subsidiary question must be resolved: "What short-range program period should be established?" While long-range programs provide the framework for visualizing over-all needs, the short-range program in contrast should, ideally, be long enough to provide time lags between planning and construction, to provide for fiscal planning, and to provide coordinated annual programs.

The establishment of an initial 5-yr short-range program, for example, was considered as a first step by Tennessee in its recent program development studies. Wisconsin bases annual work on a rolling 6-yr program. Each district engineer in Wisconsin ranks each project as to priority in his district and submits his recommended annual program by February 1 for the calendar year two years hence. This is to provide for needed lead time.

Having determined a desirable period for the short-range program, the next problem is to determine priorities for candidate projects. In Tennessee this entailed the development of a rating method "to establish a continuing construction program to meet future deficiencies as they accrue" (11). Among any group of deficient projects will be found a wide variance in the individual degrees of urgency. To rank such projects in order of relative urgency, some states maintain and use sufficiency ratings or other rating systems. A poll conducted by the Bureau of Public Roads in 1958 indicated a total of 39 states having a numerical rating system for determining road adequacy. Of these states, about 60 percent specifically reported using such numerical ratings in the formulation of improvement programs. The remainder either reported limited use or did not state what use was made of the rating system. A detailed discussion of sufficiency rating methods and their use in the states has been reported previously (15).

While some states rate all sections of highway from greatest to least sufficiency, Tennessee rated only critically deficient or "backlog" sections, as defined by tolerability criteria based on physical deviations from standards. By district, backlog needs were sorted into five groups from greatest to less deficiency so that each group made up one-fifth of the total critical deficiency dollar value. This method has the advantage of postponing consideration of less than critically deficient longer range needs which are indefinite as to urgency, timing and cost.

It is not necessary to discuss in detail the mechanics of putting a rating system together. Generally speaking, existing rating systems consider as factors to be measured such items as structural and drainage conditions, geometrics and capacity, and safety. In addition, greater attention is being given to classification of projects on the basis of economic justification, such as cost benefit analysis. Rate of return has recently been proposed as another guide for making decisions on project selection. Rate of return on investment is that rate of interest which will make future annual savings equivalent to the annual cost of the facility (16). Certainly, research should continue to develop measurements that are soundly based and more useful in the advance programming process.

Nevertheless, ratings are useful guides in project selection if certain limitations are recognized. One such limitation is the distortion caused by combining several individual deficiencies into one total sufficiency number. A total rating number of 70, say, may indicate a moderate degree of urgency. It is possible, however, that the rating for either capacity or structural condition, by itself, may indicate a much higher urgency and furnish a warrant for immediate construction.

The rating experience in several states suggests that a priority plan, whatever its numerical rating base or system, must consider each factor or element separately on

a pre-planned, systematic, uniform and practical basis. For example, since severe structural deficiencies are usually immediate problems, regardless of other considerations, remedial projects might be grouped first on this basis and sorted by rating. Generally, too, some projects in this deficiency category also show capacity deficiencies. Project selection in this case would be directed first to projects having combined structural-capacity deficiencies and, secondly, towards those with the more urgent structural deficiencies. In like manner, subsequent choices would pick up projects deficient in capacity and in other categories, depending on the rating system. Arraying all backlog needs projects in this fashion will provide a basis for the step-by-step evaluation and appraisal of candidate projects essential to systematic program development.

It should be recognized that each year additional projects become part of the current "backlog." Therefore, in planning for several years ahead, the program must account for such future work, as well as the previous critically deficient projects as yet uncompleted. This means that needs must be reviewed each year, on a continuing basis.

The prime objective of project rating, as indicated by practice in some states, including Colorado, Arizona and Tennessee, is to group projects by category of deficiency and by similar urgency of improvement. This narrows the range of judgment and provides the basis of, say, a flexible 5-yr program of critically urgent projects. In the formulation of annual programs, state experience again suggests that such flexibility is necessary if the contingent factors discussed in the next section, singly or in combination, are to be considered. Suffice it to say here that within deficiency groupings it is not so very important if a project in the third year program is moved ahead to the first year, or vice versa. The important objective of program planning is to assure that the group gets built during the 5-yr period.

SYSTEMATIC COORDINATION

Coordination, as used herein, is the integration of priority analysis with the many other considerations which enter into program development. These may be labeled "administrative", as they fall generally within the area of administrative decision. Included in this category of administrative considerations (not necessarily in order of importance) are such things as: (a) adequacy of department-wide staff; (b) program balance, by class of highway, by type of work, and by allocation of construction funds to districts or areas; (c) continuity of route improvement; (d) lead time needed for design, right-of-way acquisition, negotiations with other agencies and for state construction; and (e) commitments and local planning.

Systematic review of each of those factors is an essential part of the advance programming process. Realistic program schedules, requiring a minimum of revision, depend heavily on the adequacy of analysis of all such problems. Most of them are good candidates for continuing research and analysis to provide better facts on which to base decisions.

1. Adequacy of staff in terms of department-wide needs, and provision for it, can be guided by the findings of program planning, which in turn may be influenced by availability of department manpower or consultants. A good example of tying program planning to personnel needs is the experience of a midwestern state a few years ago. Forecasts of revenue related to advance program planning showed that the construction program would be increased in the neighborhood of sixty percent during the next four to five years. Immediately, a question was raised as to staff adequacy and the personnel office was asked to study the question. A subsequent analysis indicated that while existing design and construction personnel was adequate to handle an increased work load of up to twenty percent, its number was not sufficient to take care of a sixty percent increase. To provide manpower needed for the larger program, the personnel office accelerated recruiting and training activities. This action not only substantially solved the problem, but sharpened up training and promotional programs.

Another example of how the advance program may affect manpower needs is shown in Figure 1, depicting an analysis of Road Design staff needs in the Toronto Region of the Department of Highways of Ontario. With 35 lettings planned in the 1960-61 fiscal year, an appropriate (for average years' work) staff would fall behind the desired pro-

duction schedule. Even with an allowable overload, by the 24th letting the schedule could not be met thereafter. If the staff were not increased, nor the schedule revised, the shaded portion would have to be met by employment of outside consultants.

2. Program balance by type of work and by class of highway is closely related to "budget decision", previously discussed, and involves such factors as: (a) construction industry capabilities; (b) fiscal capabilities; and (c) area distribution of work. In the Tennessee study it was pointed out that "...a practical construction program must provide an adequate amount of work on the state highway system throughout the state and on the several subdivisions of the system, with due consideration for the various types of Federal-aid and state funds applicable to their improvement."

Since a program must be considered on a statewide basis, the manner in which construction funds are distributed by area or construction districts must first be resolved. In Tennessee, construction fund allocation is by district and is made in the ratio of district needs to total needs. The Province of Ontario also allocates construction funds in this manner but an adjustment is applied to assure a volume of work consistent with that required for a minimum district staff.

Wisconsin, on the other hand, has developed a formula which is based on area, population and mileage factors. The study points out that the formula was developed after investigation and the application of varying weights to each of several factors. It develops percentages which, when applied to the available funds (regardless of amount), indicates the sum to be allotted to each district annually. The factors comprising the formula and the weights assigned to each are:

FACTORS	WEIGHT
Population	10 points
Area	5 points
Urban State Trunk Mileage (including connecting streets)	25 points
[1] Adjusted Rural State Trunk Mileages	60 points
Total	100 points

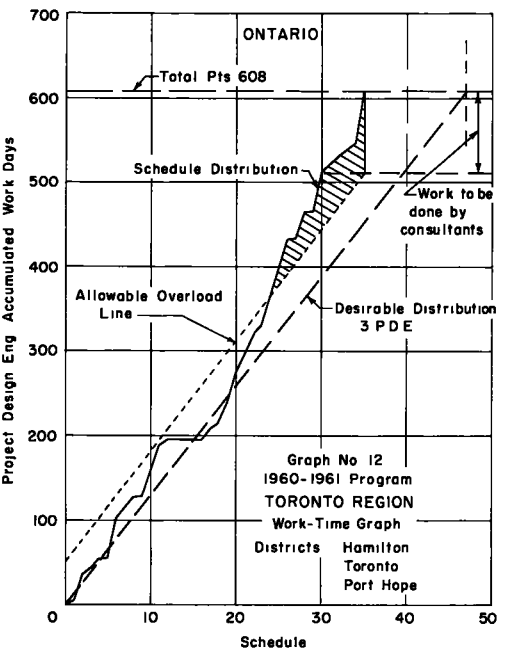


Figure 1.

[1] The total rural state trunk mileages for purposes of assigning point values were adjusted by applying the following:

$$\frac{\text{Actual rural miles x vehicle miles of travel per mile of rural state trunk highway}}{\text{Average sufficiency rating of all rural state trunk highways x 1,000,000}}$$

The above adjustment is based on the theory that sufficiency ratings are an indication of need (the higher the rating the less the need), and that vehicle miles of travel per mile of road is likewise an indication of need (the greater the use the more the need).

The allocation of construction funds to districts, whatever the method used, sets the rate of progress in system improvement programs. Since a balanced program provides work on all systems throughout the state, and since there is a legal and/or an administrative state, as well as federal, system classification, both classifications are considered in setting up and allocating the construction fund. (See California budget data by districts, (Appendix 1-D.)

Apparently it is common state practice to allocate, by district, funds available for expenditure on the primary, secondary, urban and other state systems; the Interstate

program, of course, is handled separately. The method of allocation, however, varies from state to state. In Tennessee, for example, programs are developed for each highway system so that, on the basis of need, a uniform rate of improvement from system to system is maintained.

Within allocated funds, programs are also balanced by type of work. Stage construction, for example, may be considered a major factor in developing programs. Minnesota currently programs about thirty percent of its construction fund for grading. Wisconsin, which also programs by stage construction, likewise maintains balance among grading, surfacing and bridge work. California, on the other hand, emphasizes freeway development as a whole, but does not neglect moderate improvements on more lightly traveled roads. Iowa's recently announced program includes special consideration of "bypasses."

3. Continuity of route improvement is another important consideration in program planning and development. In some states this is provided for by (a) establishing a program section of thirty, forty or fifty miles; and (b) determining the time period during which improvement of the entire length will be completed. Michigan's current 5-yr program, for example, stresses continuity of route development to modern standards. Elsewhere, completion of long sections of toll roads undoubtedly contributed greatly to their usefulness. Careful study should be made concerning the benefits of long stretches of route improvement vs piecemeal projects.

4. Lead time necessary to complete surveys, preliminary design studies, road design, negotiation and rights-of-way acquisition is becoming more fully recognized as a critical factor in program development. Lead time controls the letting date and therefore affects project scheduling. This is particularly true in urban work, where negotiations with utility and railroad companies, and with other governmental agencies might be quite prolonged.

To provide for lead time and stage construction, each annual program in Wisconsin "contains four types of projects: (a) surfacing for grading previously done; (b) grading and structures for construction that starts the year of the program; (c) right-of-way purchase for construction work to begin one year later; and, (d) engineering to prepare the plans for purchasing the right-of-way in two years following. Or, in other words, an extensive and comprehensive road improvement can show up in four successive annual programs in this order: (a) engineering; (b) right-of-way; (c) roadbed; and (d) bridge construction, paving."

Minnesota recently gave some consideration to programming by stages: Stage 1 — preliminary design; Stage 2 — design; Stage 3 — right-of-way acquisition; and Stage 4 — construction. In essence, this provides for four programs each of which can be controlled for timing. This provides assurance that there will be coordination in the processing of all major operations. However, it is accomplished, the project lead time requirement is basic to program scheduling which, in turn, affects the activities of all departmental organizational units. A sound over-all program planning procedure is necessary, therefore, to maintain a uniform and orderly flow of work throughout a department, division by division.

5. Commitments and relations between highway and city planning pertaining to work and construction sequences is another administrative consideration to reckon with in project scheduling. This is particularly important where agreements extend into a future period and include routes to be constructed by both state and city departments. It is obviously essential that over-all planning design and construction in such cases be carried out carefully so that scheduling during the agreement period is based on coordinated work sequences. Unquestionably, this is a universal situation which is present to a greater or less degree in all states. It is mentioned, however, because of its importance as a controlling consideration in setting up project schedules.

Since a systematic analysis and consideration of all essential factors appears to be a vital part of an effective advance programming process, it is suggested that a formalized check list of the preceding factors be used to account for each one on each project. This would provide evidence that nothing has been overlooked which might later affect project schedules.

SCHEDULING, CONTROL AND ADJUSTMENT

Once general decisions have been made concerning projects to be included in the advance program, it is necessary to devise a system that will organize the program within budget limits, control it and permit adjustment as time proceeds. The system is a vital part of the entire advance programming process.

Typical scheduling forms for allocation of project costs to time periods are shown in Figures 2-4, from California, Kentucky and Ontario. These contain:

1. Identification and limits.
2. Total costs.
3. Costs by elements.
4. Spread of costs by time periods.
5. Summaries by periods.
6. Remarks concerning reasons for inclusion, stage of plan completion and right-of-way procurement, and other general information.

Control systems are essential for intelligent organization of work schedules, for assuring that target expenditures will be made according to legislative and administrative policies, for coordinating construction progress, and for readjusting programs as revisions become necessary or possible. The extent to which those objectives are reached depends on the detail that is included and the relation of accounting and control procedures to the advance programming system.

Differences in concept and operation are indicated in the following discussion of the three examples.

Time Periods Covered

California's current program is based on 3 years, but this is the last part of a 5-yr program. Kentucky originally provided for 4½ years, and Ontario plans to develop its program for 7 years. All agree that the schedules for latter years are less firm than for earlier years of the period.

In addition, California includes a column for work to be programmed sometime beyond the limits of the current 3-yr schedule. Actually, each district in that state always has a tentative 5-yr program available, dropping one year and adding one annually.

It will be noted that all schedules are for more than one year, and that this is necessary to obtain sufficient lead time to provide for planning and for right-of-way purchase. If the law permits (as in California and Ontario), the schedule shows estimated expenditures, rather than contract encumbrances, spread in some instances over more than one year for the same contract. As discussed earlier in this paper, this allows more "starts" in earlier years than would be permitted by encumbering the current year's budget with the full amount of the contract.

Required fiscal or schedule controls may dictate further subdivision of each year. This is not required in California, but Kentucky elected to control by quarters, and Ontario by months. These closer subdivisions require more careful original analysis and more frequent adjustment. They have the advantage, however, of providing a basis for closer control of progress and faster reconsideration, within the year, of projects to be added or deleted.

Type of Work Included

The basic objective in the three systems under study is to establish a schedule of capital expenditures. Accordingly, estimated costs for construction projects are shown in the appropriate time periods. However, all construction work is not necessarily included.

In Ontario, for example, capital improvements to be undertaken by regular maintenance forces are not scheduled in the advance program. Kentucky has not included its large "RS" or Rural Secondary road program. California excludes minor projects for improved traffic operations, such as small jobs for channelizing, "thin blanket" resurfacing, and special grade crossing elimination.

Other items are included in the schedule, depending on the purposes to be served. These include right-of-way expenditures, breakdowns of total construction cost and details of the pre-construction engineering operations.

Right-of-Way. California and Kentucky include estimated expenditures by years or quarters, both as a budget control and as a guide to timing of purchase operations. The latter is of less importance in California, where a revolving fund permits advance purchase of right-of-way, with repayment to the fund as the project nears the award stage.

Property purchase in Ontario is not tied to specific project estimates, being limited only by a province-wide total for the year. Hence, the item "property" is included primarily as a schedule control to show the time when property should be purchased; no funds are indicated.

Breakdowns of Construction Cost. Depending on the size of the project, California may divide the work to be scheduled into its major elements, such as structures, grading and surfacing. This appears to be necessary if the expenditures for those items are to be made in separate years. California also may list a single large project but divide it into two or more units of length. Each of these units may be scheduled separately for separate program years. Sometimes portions of units are separately scheduled as described in the previous sentence. Kentucky generally provided for quarterly scheduling of grading and drainage, surfacing and structures. This permitted a more realistic estimate of the desired timing of the beginning and ending points of the work items. Moreover, it permitted an estimate of the carry-over into succeeding budget years.

Ontario indicates only the total estimated cost and timing of the beginning and end points of construction for the complete project. In the past, most of Ontario's structure contracts were completely separate from road contracts and therefore to this extent the costs were scattered by individual projects. Recently, however, many of the smaller structures are being included with the road contracts and therefore are hidden in the total schedule estimate.

Pre-Construction Engineering Operations. Any systematic scheduling of construction projects provides a basis for timing of pre-construction engineering operations. Thus, the three systems described indicate generally the deadline dates prior to which all engineering and property purchase should be complete if the expenditures are to be made in the time periods indicated. However, it is apparent that some systems are designed to provide closer control of the engineering operations.

The California procedure seems to lack the advance engineering control. However, all engineering and right-of-way purchase is done on the basis of work orders authorized by headquarters. Such authorizations are not given except pursuant to the advance planning program which, however, includes a rather complete list of projects, some of

PLANNING PROGRAM
July 1, 1960 to June 30, 1963
DISTRICT
Costs in Thousand of Dollars

County Humboldt
Sheet 1 of 3
Jan 1959

Co Rte Sec	Description	1958 Status Miles: From Mile	Sect	To Mile	Sect	Net Miles (to tenths)	Federal-Aid System	Unit Cost	Unbudgeted Construction Cost	Unbudgeted R/W Cost	1960-61 FY Constr	R/W	1961-62 Constr	R/W	1962-63 Constr	R/W	To Be Programmed after 1962-63 FY Constr	R/W	Remarks
1-Hum-1-B-C	1 0 Mi S Sylvandale to Myers Flat	7 1	1B	5 0	C	11 1	FAP 1		14,130	585									2/3 R/W in 1959-60
	Myers Bridge							1,800			1,800	300							Unit No 3 of Redwood Bypass
																			Project report approved
	Clear and Grub to County Bridge							400											1-25-55 4-lane full freeway
	Eagle Point Viaduct							1,800											Route adopted 3-21-56
	Myers Undercrossing							130											Mendocino County Line to
	Grade, Viaduct to Myers							220					2,550	285					Jordan Creek, Plans 10%
	Grading and minor structures			(4)				2,500							2,500				complete
	County Bridge to Myers																7,230		
	1 0 Mi S Sylvandale to County Bridge																		
	Grading & structures-surface entire project ADT-2, 500 Pk hr 400, Accident Rates 1955 4 2 (49) 1956 3 6 (42) 1957 2 8 (33) Av 3 5																		
1-Hum-1-C	Myers Flat to 1 0 miles S Dyerville	5 0	C	12 8	C	7 2	FAP 1		1,810		1,810								
	ADT-3, 000 Pk hr 480 Accident Rates 1955 4 2 (38) 1956 3 7 (32) 1957 5 3 (45) Av 4 4			(5)															Unit No 2 of Redwood Bypass
																			Balance of "split financed" project raised from 1,265 by
																			stabilization Plans 33%
																			complete

KENTUCKY DEPARTMENT OF HIGHWAYS
DIVISION OF PLANNING
SCHEDULE SUMMARY

FA System Primary Sec 2 3
State Classification Pool Projects Date 9/26/57
Other Designation

ESTIMATED COST IN THOUSANDS

ITEM NO	COUNTY PROJECT NO	ROUTE NO	LENGTH	ROAD NAME TERMINI	COST ITEMS	ITEM COST TOTALS	PROJECT COST TOTALS	1956 57 QUARTERS 3	4	1957 58 QUARTERS 1	2	3	4	1958 59 QUARTERS 1	2	3	4	1959 60 QUARTERS 1	2	3	4	1960 61 QUARTERS 1	2	3	4	REMARKS
	Todd 110-266-D	US 68	8.311	Elkton-Hopkinsville Road. From WCL Elkton to Christian County line	Engineering	45						10	10	10	15											
					ROW	100										25	25	25	25							
					Bridges	75															35	40				
					G & D	500														50	100	100	100	50	100	
					Paving	650	(1370)																		300	350
	Christian 24-65-0	US 68	8.486	Elkton-Hopkinsville Road. From Todd County line to Hopkinsville urban limits	Engineering	45						10	10	10	15											
					ROW	100										25	25	25	25							
					Bridges	50															20	30				
					G & D	500														50	100	100	100	50	100	
					Paving	700	(1395)																		300	400
	Barren-Edmonson-Warren	US 31W	22.0	Cave City - Bowling Green Road. From Cave City to junction US 68 east of Bowling Green.	Engineering	200					50	50	50	50												
					ROW	500								160	160	180										
					Bridges	60															30	30				
					G & D	3000											500	500	500	500	500	500				
					Paving	3500	(7260)														1500	1500	500			
	Ballard-Carlisle	US 51	12.0	Cairo-Fulton Road. From KY 440 to Hickman County line	Engineering	80					20	20	20	20												
					ROW	180									40	40	50	50			100	100	50		100	
					Bridges	350													100	100	150	150	100	100	100	100
					G & D	900															200	200	100		200	300
					Paving	1000	(2510)																			
	Hickman-Fulton	US 51	19.0	Cairo-Fulton Road. From Hickman County line to Tennessee State Line P S & E only	Engineering	100								25	25	25	25									
					ROW	300												75	75	75	75					
					Bridges	)																				
					G & D	) Schedule later																				
					Paving	)	(400)																			
	Morgan	US 460	3.0	West Liberty - Frenchburg Road. From Licking River Br. at Frenchburg to near KY 191 at Index	Engineering	20							10	10												
					ROW	15									5	10										
					Bridges																					
					G & D	525											50	150	100	100	125					
					Paving	240	(800)															80	60		100	
434	Hardin - Meade F 79 (22)	US 31W	15.2	US 31W - Elizabethtown-Louisville Road. From near junction old and new 31-W north of Elizabethtown to Tip Top	Engineering	205					50	50	50	55												
					ROW	1280								80	300	300	300	300								
					Bridges	1500													200	200	200	200	200	200	200	100
					G & D	2170													300	300	300	300	300	300	300	70
					Paving	1500	(6655)														300	300	150		300	450
				TOTAL																						

Figure 3.

PAGE

FIG. 4

WORK

DISTRICT 20 KENORA

HWY. No. 11 (611)

W.P. No. _____ YR. OF AWARD _____ LOCATION _____

LENGTH _____
TYPE OF WORK
CONTRACT No.

SECTIONS	FISCAL YEAR 19 -19												FISCAL YEAR 19 -19												FISCAL YEAR 19 -19											
	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH
TRAFFIC																																				
ADV. PLANNING																																				
DESIGN CRITERIA																																				
LOCATIONS																																				
SOILS																																				
BRIDGE																																				
R.D.O.																																				
PROPERTY																																				
PRIOR CONT. FOR _____																																				
PRIOR CONT FOR _____																																				
EXPENDITURE ESTIMATED																																				
EXPENDITURE PRE-ENG																																				
EXPENDITURE CONTRACT																																				
% COMPLETION																																				

W.P. No. _____ YR. OF AWARD _____ LOCATION _____

LENGTH
TYPE OF WORK
CONTRACT No.

SECTIONS	FISCAL YEAR 19 -19												FISCAL YEAR 19 -19												FISCAL YEAR 19 -19											
	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH
TRAFFIC																																				
ADV. PLANNING																																				
DESIGN CRITERIA																																				
LOCATIONS																																				
SOILS																																				
BRIDGE																																				
R.D.O.																																				
PROPERTY																																				
PRIOR CONT FOR _____																																				
PRIOR CONT FOR _____																																				
EXPENDITURE ESTIMATED																																				
EXPENDITURE PRE-ENG																																				
EXPENDITURE CONTRACT																																				
% COMPLETION																																				

W.P. No. _____ YR. OF AWARD _____ LOCATION _____

LENGTH
TYPE OF WORK
CONTRACT No.

SECTIONS	FISCAL YEAR 19 -19												FISCAL YEAR 19 -19												FISCAL YEAR 19 -19											
	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH
TRAFFIC																																				
ADV PLANNING																																				
DESIGN CRITERIA																																				
LOCATIONS																																				
SOILS																																				
BRIDGE																																				
R D O																																				
PROPERTY																																				
PRIOR CONT. FOR _____																																				
PRIOR CONT. FOR _____																																				
EXPENDITURE ESTIMATED																																				
EXPENDITURE PRE-ENG																																				
EXPENDITURE CONTRACT																																				
% COMPLETION																																				

which will not be prosecuted for several years beyond the budgeting period. Decisions on authorizing pre-construction engineering depend, therefore, not only on the advance program listed within the 3- or 5-yr period, but upon availability of engineering staff, urgency of necessary engineering studies in the face of rapid land development, and complexity of the project which may require five or more years from conception to plan completion.

Kentucky has proposed a somewhat more detailed indication of advance engineering requirements. "Engineering" is included as a programmed item, including the estimated cost thereof. It was intended that this cost would be part of the total budget and at the same time the schedule would indicate the beginning and ending dates of the pre-contract engineering operations. Recognizing the need for generalized advance studies of an area or route location (prior to beginning detailed plans, specifications and estimates) the Kentucky program included, as budgeted and scheduled items, certain of these studies for which no construction estimates were made, budgeted or scheduled. The intent was to define specifically the places where such studies should be made and to provide a time schedule for their completion. Decision on what studies should be prosecuted was planned to be based on the probability that the work would actually be carried out in the near future, following the completion of the studies. The intent was to avoid the preparation of studies so far in advance of probable actual construction that the studies would be of little value when the work might actually be carried out.

Ontario's emphasis has been on scheduling all of the pre-construction engineering and right-of-way operations in a manner which dovetailed each function into the other functions, so that final plans and estimates, as well as property, would be available prior to the desired advertising date. Recently, the Department of Highways has expanded its scheduling procedure, as indicated in Figure 4, to include the contract amounts by time periods as previously discussed. This provides opportunity for estimating the actual expenditures in each fiscal year. These depend considerably on the time of year of the award and on the nature of the work. Ontario has not attempted to estimate the advance engineering costs. The schedule is primarily for control of the beginning and ending points of each phase of the engineering function. It has been very successful in coordinating these activities and in obtaining plans on time to meet the proposed advertising dates.

Adjustment of the Advance Program

While the advance planning schedule sets forth the goal to be reached, in terms of money available in each period and the time required to prepare plans and purchase right-of-way, it is obvious that many things can happen to affect the planned schedule. Engineering may not proceed as rapidly as anticipated; public hearings and agreements with local officials may be difficult to resolve; right-of-way procurement may be delayed and construction itself may move at a faster or a slower pace than originally contemplated.

In order that a schedule of operations remains realistic, it is necessary to devise a systematic means first of checking and controlling all the elements of the schedule and, second, to adjust it to the realities of current operations. This involves not only timing, but cost problems. The latter may come about through contract award and final costs being in excess of the original estimates (or vice versa), or through revision of estimates, or because of decisions to delete or add projects, or because income is more or less than expected. The program must remain flexible (although not capricious) and therefore the programming system should be adapted to the requirements of the highway department.

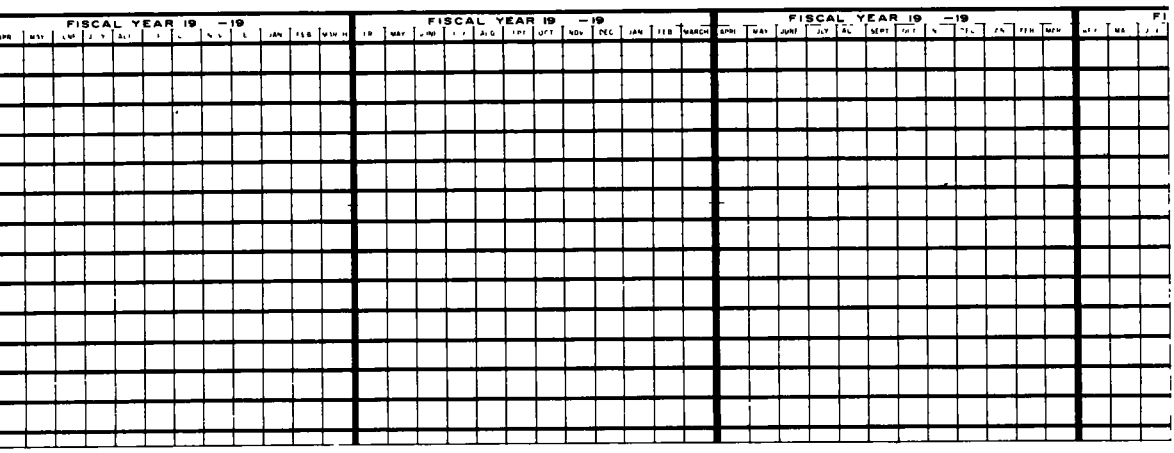
The objective is to provide a continuous or periodic "feed-back" of actual data which may cause the estimated initial program to be revised. In turn, the revised program will produce new project, cost and manpower allocations in subsequent time periods, and later data will be fed back for further adjustment and balance.

At the least, it appears that annual revisions of all the programs are generally accomplished. Since it is desirable to have the programs available somewhat before the beginning of the fiscal year, up-to-date information on which to base revised and new

PROJECT FLOW CHART

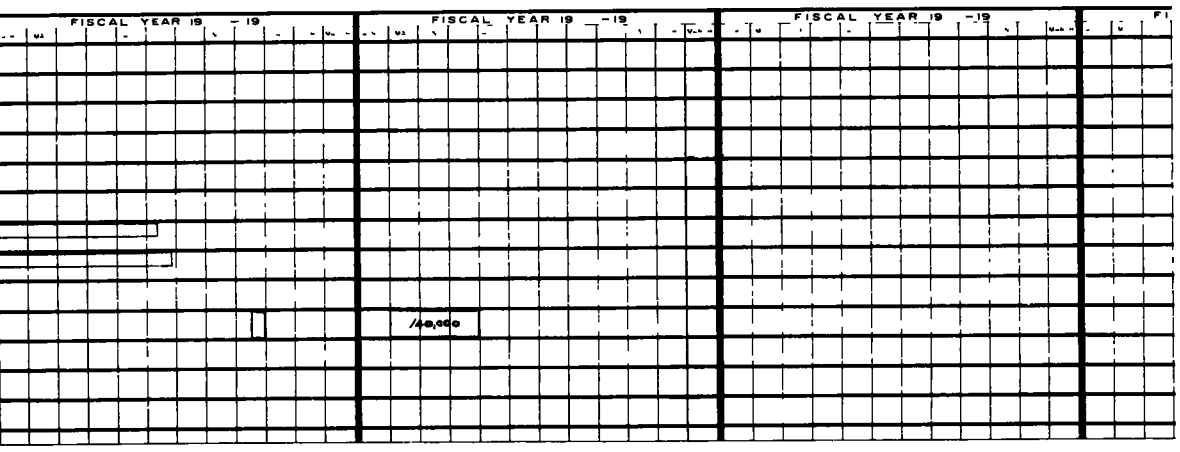
SCHEDULED DATES | ACTUAL DATES

CONTRACTOR



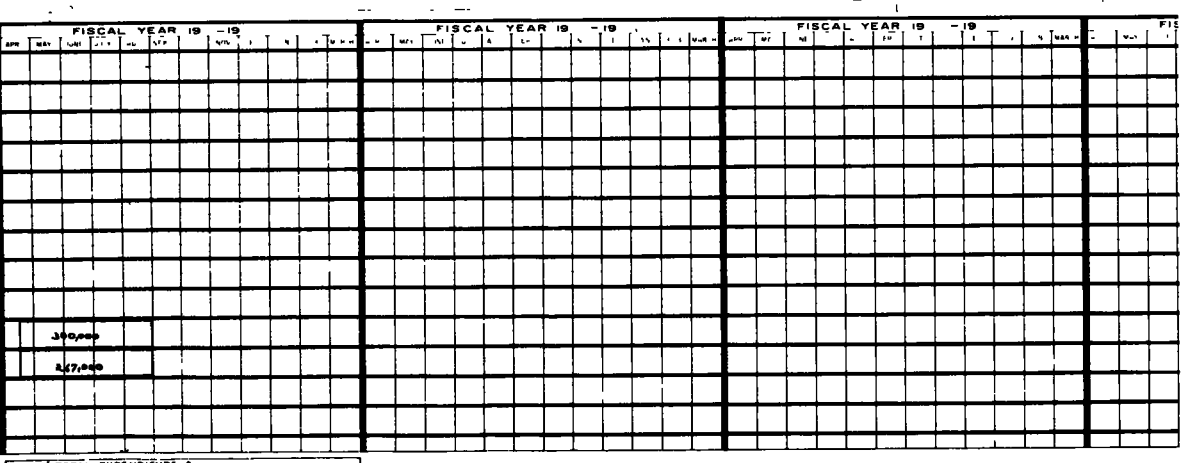
SCHEDULED DATES | ACTUAL DATES

CONTRACTOR



SCHEDULED DATES | ACTUAL DATES

CONTRACTOR



YEAR	TOTAL EXPENDITURE $			
	ESTIMATED	PRE-ENG	CONTRACT	ACTUAL
19	300			
19				
19				
19				
19				
TOTAL				

KENTUCKY DEPARTMENT OF HIGHWAYS
BUDGET & SCHEDULE PROJECT
RECORD

ITEM NO.	COUNTY - PROJECT NO.	ROAD NAME TERMINI	RELEASED FROM DESIGN _____	AREA _____
LENGTH			OFFICIAL ORDER SIGNING _____	CLASSIFICATION _____
ROUTE NUMBER			CONSTRUCTION CONTRACT LET _____	_____
			CONSTRUCTION COMPLETED _____	_____

	COST ITEMS	ITEM TOTALS	19 QUARTERS 1	2	3	4	19 QUARTERS 1	2	3	4	19 QUARTERS 1	2	3	4	19 - QUARTERS 1	2	3	4	19 - QUARTERS 1	2	3	4	REMARKS
PLANNING ESTIMATE	Preliminary Engineering																						
	ROW																						
	Bridge																						
	G & D																						
	Surfacing																						
	Supervisory Engineering																						
	TOTAL																						
REVISED ESTIMATE	Preliminary Engineering																						
	ROW																						
	Bridge																						
	G & D																						
	Surfacing																						
	Supervisory Engineering																						
	TOTAL																						
ACTUAL TO DATE	Preliminary Engineering																						
	ROW																						
	Bridge																						
	G & D																						
	Surfacing																						
	Supervisory Engineering																						
	TOTAL																						

B & S1

Figure 5.

programs is desirable. In this paper, however, it is presumed that a greater degree of flexibility is desired; the discussion therefore will deal with the control and adjustment problems occurring within the scope of both the long-range and annual work programs.

California. Because of the state's accounting and policy procedures, its advance planning program is ordinarily revised only annually. However, there is a systematic procedure to take account of the differences between the actual progress and the planned program — particularly as it affects the budgeted amounts.

First, the California budget establishes a specific unallocated amount for "contingencies." This provides a pool of funds from which to draw for unexpected expenditures, either for new projects or for extra expenditures above the original estimates on the planned program. At the same time, savings from lower-than-anticipated costs or deferred work are added to the contingency fund. It is watched carefully and appropriate decisions made, depending on the current status of the fund.

That procedure seems to present a simple and easy way of providing flexibility in the program. However, it would appear that if adjustments were numerous, it would be relatively easy for the program to get out of balance with original policy intent and it would fail to provide desirable guidance for close phasing of operations. Under California's decentralized plan of operation, however, each district office has only a limited program which it can keep well in mind and if such imbalances seem to be developing, they soon become apparent and can be dealt with immediately or called to the attention of head office for such action as may be desirable.

Ontario. The Province's plan in the past has been geared predominantly to a 1-yr schedule of precontract engineering operations only. Deadline dates were established for each phase of those operations, and for property purchase. The techniques of control were directed to elimination of bottlenecks in each major engineering and right-of-way function, with "expediters" working in each of those offices. The expediters developed internal schedules and kept track of the stage of physical progress in relation to the planned schedule and sub-schedules. This appeared to be an effective aid to all phases of pre-contract engineering; through frequent conferences of all affected parties, up-to-date information was made available to all on the current status of work in each office. However, it has not provided for centralized reporting and readjustment of schedules to a point where it is quickly visible. It is the intent of the Ontario Department to provide for some additional means of establishing this mechanics.

In addition to engineering schedules, the department is now embanking on the scheduled program control of expenditures for contract items. The new "work project" flow chart (Fig. 4) provides three lines at the bottom of each project schedule for that purpose. It will be noted that the original estimate of total cost and time period is first indicated, if that is all that is available when the work program is developed. Subsequently, as final plans and engineering estimates become available, the original estimate is revised and indicated on the second line under the heading, "expenditure." When this is done, the timing of the project may or may not be revised. Finally, on the third line, the actual contract award cost is indicated, again with or without any revision in timing. These costs are then summarized for each sheet (showing three separate projects) at the bottom of the page. Therefore, as the work progresses, by using the latest figures for each of the indicated years, up-to-date totals of the probable costs can be obtained; by adding a series of these sheets, the total program data are derived.

An additional item of information is contained in the Ontario sheets, showing the physical percentage complete, derived from field reports. Comparison of this with the anticipated scheduled progress gives some advance suggestion as to whether further revision of the original program, project by project, may be needed.

The mechanics of maintaining these data would seem to involve much hand work, particularly in revising the pre-contract engineering schedules. It will be noted that each line indicating one major operation has space for the scheduled timing, and below it another line for the actual progress. This would show at a glance the differences, but when the differences become so great as to require complete revision of the schedule, it would appear that a new sheet would have to be prepared manually.

Kentucky. In order to partly overcome the problem just mentioned, Kentucky planned a separate card, entitled "Budget and Schedule Project Record", (Fig. 5). One of these cards would be prepared for each project, showing first the original "Planning Estimate" taken from the original complete advance program which included all proposed projects in the planning period. Next, the actual expenditures to date would be posted in the lower part of the form. These data would presumably give some indication of the stage of progress in relation to the original planning estimate. From time-to-time, a "revised estimate", both of costs and timing, would be posted in the center portion of the card record. Such revisions would be based not only on the "actual to date", but on any later revisions of estimates or contract awards. By accumulating the data from the last revisions, an amended total program could be compiled.

Emphasis in the Kentucky procedure appears to be on cost rather than on engineering control and progress. However, it is clear that if only a small percentage of the planned engineering expenditures have been made at any given time, an indication is provided that progress is not as planned, and steps could be taken to speed the work up or revise the program accordingly.

From the preceding review, it appears that the objectives of a control system range from the broad designation of projects to be prosecuted within a given year, as in California, to highly detailed control of the separate pre-contract engineering functions and monthly expenditure rates for capital construction, as in Ontario.

Combinations of the desirable features of each of the systems described can be adapted to the objectives desired by administrators and engineers in other states. Since the primary object of any highway program is to construct improvement projects at a certain time and within budget limits, it is concluded that money-based time schedules listing each class of work by appropriate systems is the basic objective. A secondary objective is to utilize the same schedule as a means of control of pre-contract engineering and right-of-way functions, which may or may not be indicated through the medium of planned and actual expenditures. Instead, particularly for engineering functions, supplementary advance scheduling based on physical measures and time required may be developed. These, however, must be keyed to the construction schedule.

The adjustment processes studied so far apparently leave much to be desired. They involve either much manual effort and accumulation of data from several sources, or fail to reflect current status in sufficient time to permit readjustment of programs with full recognition of the over-all effect in relation to established policies.

It is hoped that this discussion of some of the better and more advanced techniques will invite additional contributions from states or other agencies which may have even better procedures, so that these may be studied and made available to others interested in this problem. Moreover, it is clear that there is much room for further research on the problems of coordination, control and adjustment -- especially through mechanical or electronic record keeping. It is visualized that once programs are established on a planned schedule basis, accounting records and physical progress reports could be keyed through tabulators or computers to the original schedule, adjustments indicated by machine, and a revised estimated program produced for further study with a minimum of manual labor.

Finally, it is observed that the schedules should be widely distributed throughout the department, for they become the chief means for communication of decisions by top management, and for coordination of activities of the entire department.

ADMINISTRATIVE ORGANIZATION

Advance programming and its control is clearly one of the principal responsibilities of highway management. Decision-making, in these days of greatly expanded programs and increased complexities and responsibilities, requires the maximum use of factual data. No doubt even the most competent administrator or chief engineer would agree that his judgment alone is not infallible. Study of possible alternatives, and correct choice among them, is the key to economic and efficient highway development. Since the decisions, however, must remain the responsibility of top management, it is important that the organization which is formed to assist in reaching the correct decisions

be closely related to the top management function. At the same time, it seems clear from this study that, for effective programming, the decisions should be a product of all the engineering and business functions of the whole department—for they each have a part to play. It is within this context that the reader should view the balance of this discussion.

An informal poll was conducted by the Bureau of Public Roads in 1958, in regard to the positioning of responsibility for (a) advance planning, and (b) programming. Results are given in Tables 1 and 2.

In viewing those results, one should be aware that "advance planning" and "programming" are not synonomous, and that definitions may be open to wide interpretation. The usual interpretation would define advance planning as the group of more general and preliminary studies that precedes the detailed design stage. The exact cut-off point to segregate the general from the detailed is difficult to establish; this suggests the importance of close coordination of the total process. "Advance programming," on the other hand, as defined in this paper is primarily the decision-making process concerned specifically with where and when work should be done, and only generally with what should be done. Advance programming relies in part on the latest and best engineering information, date and estimates available — whether from advance planning or detailed design stages.

In addition to the problem of definition, the actual development of planning and of programming may be widely different from the stated points of responsibility given in Tables 1 and 2. Although there appears to be a predominance of responsibilities centered in functions variously referred to as "Planning", "Traffic and Planning", "Programming and Planning", "Highway Planning Surveys", etc., there is indicated a considerable variety of other offices having responsibility. It can only be concluded that there is no one best place to carry on these activities — if present practice is any guide and the confusion of definition and objective persists.

There is some evidence to indicate that ideas and concepts concerning both the functions of advance planning and of advance programming, as well as requisite organization in terms of positioning and responsibility, are in a state of flux. This evidence is found in published and unpublished state highway department reorganization studies made within the past two or three years.

TABLE 1

SUMMARY SHOWING WHERE ADVANCE PLANNING IS PERFORMED

	No. of States
1. Committee, (coordinated through Chief Engineer)	1
2. Commissioner of Highways, (Chief Engineer and Staff Members, State Highway Engineer and Preconstruction Engineer)	2
3. Chief Engineer, (Staff Members, Deputy Commissioner, Engineering Division and Planning and Traffic Engineer)	2
4. Assistant Chief Engineer, Deputy Chief Engineer, Assistant State Highway Engineer, Deputy Territorial Engineer	5
5. Office Engineer — Construction Engineer	2
6. Planning, Research and Planning, Traffic and Planning, Program and Planning, Planning and Economics, Highway Planning Surveys, Highway Programming, Statistics	26
7. All Divisions, Staff	2
8. Program Coordinator, Coordinating Engineer	2
9. Design Engineer, Plans and Survey	3
10. No Assignment	6
	51[1]

[1] Includes Puerto Rico

Some highway departments cast advance programming largely in an engineering frame of reference, for example, California, Ontario. In these instances, the organizational unit responsible for program scheduling is a coordinating group, positioned close to the top echelon. Gathering project and financial information from the engineering, planning and finance divisions, this unit prepares an advisory program which is reviewed for priorities, lead time, availability of surveys, design schedules, right-of-way acquisition, negotiation requirements and the like, with the divisions involved. Adjustments are made to balance out engineering and administrative considerations with fiscal capabilities, and the final program with letting schedules is sent to top management for approval.

In contrast, some other states consider programming to be part of the highway planning process, segregated from engineering line functions and responsible only to top mangement. In line with this concept, the advance programming activity is generally assigned to a major organizational unit in a "planning and programming" division. Where organized in this manner, and where responsibility is assigned to a senior member of the staff as in Ohio (17), and recently Iowa (18), programming (which may be conducted in the same series of steps aforementioned, but as part of the generalized planning operation) is set in a mangement frame of reference. This is particularly the case in Wisconsin, where the "Job Guide" shows the director of planning and research functions "as a staff member of management.... charged with advising the commission and furnishing functional guidance to the Staff Divisions and Districts on highway planning, programs, highway systems and classification, economic, financial, legislative research, and related matters."

Evidence and observation, therefore, suggest that current thinking about the advance programming function and its organization framework fall into two major categories or concepts: that the advance programming activity (a) is basically an engineering function, the organization for which should be positioned near the top in the engineering hierarchy; or (b) is inseparably a major part of strategic and tactical planning and should, therefore, be positioned in the administrative or management hierarchy.

However, regardless of individual opinion as to concept and positioning, the authors' observations suggest that two generalizations can be made concerning the organization for advance programming. First, regardless of the specific organization or its positioning, the function itself must have full sanction and continued support of the chief executive, personally. His concepts and attitudes are extremely important, because he must ultimately approve all enabling and operational policy decisions.

The second generalization, again independent of a specific organization, is that the chief executive must clearly set forth the department's objectives and broad planning

TABLE 2

SUMMARY SHOWING WHERE PROGRAMMING IS PERFORMED

	No. of States
1. Committee, (Deputy Commissioner, Chief Engineer, Comptroller, and Director of each operating division)	1
2. Chief Engineer, or Assistant and State Highway Engineer	5
3. Plans and Office Engineer	8
4. Plans and Surveys; Location, Design and Urban; Design; and Plans and Estimates	6
5. Planning, Traffic and Planning, Programs and Planning, Programs, Planning and Economics, Planning and Research, Highway Planning Surveys, and Highway Programming	16
6. Advance Planning	2
7. Administrative Assistant and Administration Engineer	3
8. Program Coordinator, Communication and Control, Project Control, and Work Control Division	4
9. Division of Construction	2
10. Federal-aid Engineer with HPS	2
	49

policy. This policy provides planning factors and guide lines which delineate the scope of endeavour, as well as the working relationships of the advance programming organization with top level management, and with other staff and line divisions.

Experience with advance planning and with programming efforts has shown that, if the responsibilities of each organizational unit in the programming process are made clear, a much more realistic schedule of work, and easier adjustment of it, will result. Moreover, it is suggested that the keystone of sound program planning may be adequate communications for passing down the latest administrative thinking to the person or persons accountable for the activity. If this be true, then it is of utmost importance that such persons, particularly, be informed of all proposed policy changes or administrative thinking which directly affects their actual job responsibilities.

Programming and advance planning are so closely related to finance, traffic, design, right-of-way and nearly all other operating units, that positioning them in a separate division, independent of the engineering functions especially, may create problems of communication and effective coordination.

This study indicates the need for more research concerning the role of planning and of programming in highway management, with better consideration of the experiences of industry and business and their application to highway affairs.

However, department experience suggests one principle which must be applied to avoid delay in preparation of the necessary advance work schedules. The principle might be stated as: "Don't try to settle detailed design problems prior to organizing an advance plan and schedule of operations." Study has shown that much of the difficulty in establishing the advance program has resulted from getting bogged down in detailed planning, requiring innumerable minor decisions (and some major ones), before project urgency and general cost estimates are established. If details must be decided before work is scheduled, it will be found exceedingly difficult to set the right kind of goals.

It is the job of the advance programming group to spell out the need for doing some kind of work between points A and B, but not the details of exactly what it should be. The programming (or coordinating) group, of course, should have a general knowledge of the design requirements and at least a rough estimate of the cost. It must take into account the lead time necessary to get jobs under way, which is determined by consultation with other staff members, as well as the availability of funds and the numerous other factors previously described. Mixing these problems in with specific location and design problems is liable to be detrimental to both.

The work must rely, in the final analysis, upon informed judgment of those close to the problems, when it is clear that they have all the necessary facts upon which to base their judgments. Field forces, such as district engineers, should have a prominent part in this procedure.

One of the most effective advance programming operations viewed is found in California, where the district engineers initially propose their respective advance programs and schedules, which are designed to meet the targets previously established by headquarters. The programs are developed through combined staff consideration of the targets and the facts available concerning all needed work. The district engineer and the engineers of planning, design, maintenance, traffic, right-of-way, etc., confer frequently on the proper programming and scheduling of work — the actual compilation of which is the final responsibility of the planning engineer. Very frequently, basic information about every proposed job is available in compiled form, in a document known as a "Project Report", which summarizes the latest data, prior actions and current recommendations. This basic document is the foundation for planning decisions and, to the extent available, accompanies the district's final recommendations for each project when it is sent to headquarters.

At the California headquarters level, programs are reviewed by a board consisting of the program and budget, design, traffic, operations, bridge and advance planning engineers. The right-of-way office receives copies for comment and in case of question, the district engineer is invited to provide further information.

Thus, top management in California has the assurance that its entire staff has given full consideration to the projects which should be included in the advance program, as well as to the factors which influence their timing.

Other studies have attempted to define the "flow procedure" in the step-by-step development of advance programs. Further information of this type would be desirable, since there must be an appropriate procedure by which the facts are accumulated and summarized for action.

In the final analysis, however, it is concluded that all eight of the major factors outlined at the beginning of this paper are essential parts of sound and effective advance programming methods. Cooperation and teamwork are the lubricants that will make the methods work most smoothly. The objective is to make the right decisions, as far in advance as reasonable, and then adhere to them with as little change as possible.

REFERENCES

1. Automobile Manufacturers Association, "Automobile Facts and Figures." p. 50 (1958).
2. Deering's California Code, Streets and Highways Code, Sec. 188.4.
3. Baldwin's Ohio Revised Code, 1958, Sec. 5512.03 (Session Laws, 1954, Amended Senate Bill No. 362 Repealed).
4. Baldwin's Ohio Revised Code, 1958, Sec. 5528.07.
5. Burns Indiana Statutes, Sec. 36-2943.
6. HF 463, Iowa 59th General Assembly, 1959.
7. "Panel Discussion on Highway Programming." Highway Research Abstracts, 25:8, pp. 32-48 (Sept. 1955).
8. State Roads Commission of Maryland, "Proposed Twelve-Year Program for Road Construction and Reconstruction, 1954-1965," 1952; "Detail Sheets and Maps Showing Locations of Road Construction and Reconstruction in the Proposed Twelve-Year Program," 1952; and "Report as of December 31, 1958, Relating to the Twelve-Year Road Construction Program." 1959.
9. Fritts, C.E., and Buckley, J.P., "Objectives and Findings of Highway Needs Studies." HRB Proc., Vol. 28, pp. 1-13 (1948).
10. "Selected Publications of State Highway Needs Studies," Highway Research Correlation Service, Circular 287, (Aug. 1955); Automotive Safety Foundation, "Highway Transportation in Tennessee," (1955); Automotive Safety Foundation, "A Highway Program for Kentucky," (1955); Automotive Safety Foundation, "Modern Highways for Michigan," (1955); Automotive Safety Foundation, "Moving Ahead on Montana's Highways," (1956); Tennessee Department of Highways and Public Works, "A Planned Construction Program for the Tennessee State Highway System," (1957); Department of Highways of Ontario, "Ontario's Roads and Streets." (1958).
11. Donnell, Philip M., "Priorities Determination and Programming in Tennessee." HRB Bull. 158, p. 63 (1957).
12. Supra, Ref. 9; "Highway Needs Studies, A Symposum." HRB Bull. 158 (1957); "Highway Needs Studies." HRB Bull. 194 (1958).
13. American Association of State Highway Officials, "Manual of Uniform Highway Accounting Procedures." (1958).
14. Hankerd, Marian, "The Expenditure Budget Structure of State Highway Departments." unpublished, Automotive Safety Foundation (1959).
15. "Highway Sufficiency Ratings." HRB Bull. 53 (1952).
16. Oglesby, C.H., and Grant, E.L., "Economic Analysis — The Fundamental Approach to Decisions in Highway Planning Design." HRB Proc., Vol. 37, pp. 45-57 (1958).
17. Ohio Department of Highways, Organization Chart (Aug. 1959).
18. "Organization Study." Iowa State Highway Commission (July 1959).

CLASSIFICATION	1956-1957 (Year ended June 30, 1957) Appropriated	1956-1957 (Year ended June 30, 1957) Expended	Appropriation 1957-1958 (Year ending June 30, 1958)	Request 1958-1959 (Year ending June 30, 1959)	Request 1959-1960 (Year ending June 30, 1960)	Increase or Decrease (Increases shown in Black Face Type) 1958-1959 compared with 1957-1958	Increase or Decrease (Increases shown in Black Face Type) 1959-1960 compared with 1957-1958	Governor's Recommendations 1958-1959 (Year ending June 30, 1959)	Governor's Recommendations 1959-1960 (Year ending June 30, 1960)
Administration and Engineering—Expenses of Operation—Continued									
14 MATERIALS	$ 7,500	$ 7,679	$ 8,000	$ 8,000	$ 8,500		$ 500	$ 8,000	$ 8,000
15 EQUIPMENT	12,000	27,587	12,000	29,000	30,000	$ 17,000	18,000	29,000	29,000
17 CURRENT CHARGES & OBLIGATIONS	90,000	63,854	95,000	95,000	95,000			95,000	95,000
Total expenses of operation	$ 3,862,500	$ 3,924,311	$ 3,922,000	$ 4,740,406	$ 4,822,008	$ 818,406	$ 900,008	$ 4,637,000	$ 4,722,000
Capital Outlays									
25 EQUIPMENT	$ 70,000	$ 133,344	$ 70,000	$ 150,000	$ 160,000	$ 80,000	$ 90,000	$ 150,000	$ 160,000
Total for administration and engineering	$ 3,932,500	$ 4,057,655	$ 3,992,000	$ 4,890,406	$ 4,982,008	$ 898,406	$ 990,008	$ 4,787,000	$ 4,882,000
CONSTRUCTION AND MAINTENANCE OF ROADS									
Expenses of Operation									
11 PERSONAL SERVICE									
1110 Salaries		$14,398,130		$14,800,000	$15,300,000				
Continuation of present salaries				420,000	440,000				
Merit increases				230,000	300,000				
Reallocations and regradings				200,000	230,000				
Filling vacant established positions				100,000	125,000				
New positions				8,642,000	8,800,000				
1120 Wages		8,218,415		475,000	475,000				
1130 Special payments		418,116		2,800,000	2,800,000				
1140 Convict labor		2,793,159							
Total	$24,365,000	$25,827,820	$24,400,000	$27,667,000	$28,470,000	$ 3,267,000	$ 4,070,000	$24,743,000	$25,340,000
12 CONTRACTUAL SERVICES	$22,780,000	$37,281,363	$25,100,000	$43,143,394	$48,379,792	$18,043,394	$23,279,792	$42,171,500	$48,182,500
13 SUPPLIES /	3,200,000	3,145,072	3,300,000	3,300,000	3,421,000		121,000	3,300,000	3,400,000
14 MATERIALS	13,544,725	12,315,164	13,756,375	15,000,000	20,000,000	1,243,625	6,243,625	14,300,000	20,000,000
15 EQUIPMENT	40,000	34,093	45,000	50,000	55,000	5,000	10,000	50,000	55,000
17 CURRENT CHARGES & OBLIGATIONS	8,000,000	7,661,081	8,500,000	10,500,000	11,500,000	2,000,000	3,000,000	10,000.000	11,000,000
18 PENSIONS & RET. ALLOWANCES	855,000	910,000	875,000	925,000	975,000	50,000	100,000	925,000	975,000
Total expenses of operation	$72,784,725	$87,174,593	$75,976,375	$100,585,394	$112,800,792	$24,609,019	$38,824,417	$95,489,500	$108,952,500
Capital Outlays									
25 EQUIPMENT	$ 2,500,000	$ 2,115,895	$ 2,500,000	$ 3,000,000	$ 3,500,000	$ 500,000	$ 1,000,000	$ 3,000,000	$ 3,500,000
26 LAND AND STRUCTURES	7,500,000	7,569,578	7,500,000	21,300,000	22,000,000	13,800,000	14,500,000	21,000,000	22,000,000
Total capital outlays	$10,000,000	$ 9,685,473	$10,000,000	$24,300,000	$25,500,000	$14,300,000	$15,500,000	$24,000,000	$25,500,000
Total for construction and maintenance of roads	$82,784,725	$96,860,066	$85,976,375	$124,885,394	$138,300,792	$38,909,019	$52,324,417	$119,489,500	$134,452,500

Source: Virginia, "Budget, 1958-1960. Part II. Detailed Tables and Estimates"

APPENDIX 1 - B

CALIFORNIA DEPARTMENT OF PUBLIC WORKS, DIVISION OF HIGHWAYS STATE HIGHWAY FUND

Statement of Proposed Expenditures and Obligations to Be Incurred for Fiscal Year July 1, 1960 to June 30, 1961

(1)	Administration	$ 10,300,000
(2)	Maintenance	37,200,000
(3)	Signs and Stripe	1,500,000
(4)	Major Construction and Improvement	286,019,000
(5)	Minor Improvement and Betterment	800,000
(6)	Thin Blanket Program and Deferred Seal Coats	5,000,000
(7)	Contingencies	6,178,203
(8)	Rights-of-Way	121,787,304
(9)	Preliminary Engineering	31,500,000
(10)	Highway Planning	3,000,000
(11)	Buildings and Plants	8,000,000
(12)	Honor Camps (Sec. 188.7)	1,750,000
	Total Available for State Highways	$513,034,507

Administration of Outdoor Advertising Act	$ 110,000	
Maintenance of Bay Bridges	2,800,000	
Federal Aid Secondary	8,388,160	
Grade Crossings	5,000,000	
Federal Aid Secondary, Matching (Chapter 1871, Statutes 1953)	4,254,200	
Engineering for Cities	1,400,000	
Major City Streets (Sec. 194, S.H.C.)	34,257,000	
Sub-Total	$56,209,360	
Total Proposed Expenditures and Obligations to Be Incurred		$569,243,867

APPENDIX 1 - C

CALIFORNIA DEPARTMENT OF PUBLIC WORKS, DIVISION OF HIGHWAYS STATE HIGHWAY FUND

Summary of Proposed Expenditures and Obligations to Be Incurred for Construction of State Highways for Fiscal Year July 1, 1960 to June 30, 1961

	Northern County Group	Southern County Group	Total
Preliminary Engineering	$ 16,500,000	$15,000,000	$ 31,500,000
Construction Engineering	15,500,000	13,000,000	28,500,000
Rights-of-Way	49,315,000	72,472,304	121,787,304
Signs and Stripe	675,000	825,000	1,500,000
Minor Improvement and Bettterment	450,000	350,000	800,000
Grade Crossings	2,250,000	2,750,000	5,000,000
Thin Blanket Program and Deferred Seal Coats	3,500,000	1,500,000	5,000,000
Contingencies	3,178,203	3,000,000	6,178,203
Major Construdtion Projects	113,550,000	143,969,000	257,519,000
Federal-Aid Secondary Matching (Chapter 1871, Statutes 1953)	2,999,215	1,254,985	4,254,200
Totals	$207,917,418 45%	$254,121,289 55%	$462,038,707 100%

APPENDIX 1 - D

CALIFORNIA 1960-61 FISCAL YEAR BUDGET CONSTRUCTION AND RIGHT-OF-WAY BY FEDERAL-AID SYSTEM

October 28, 1959

District		Interstate	Primary	Urban	Secondary	Not F.A.	Total
I	Constr.	$ -	$ 7,548,000	$ -	$ 625,000	$ 297,000	$ 8,470,000
	R/W	-	1,405,000	-	85,000	35,000	1,525,000
	Total	-	8,953,000	-	710,000	332,000	9,995,000
II	Constr.	-	6,110,000	-	-	295,000	6,405,000
	R/W	1,380,000	145,000	-	-	150,000	1,675,000
	Total	1,380,000	6,255,000	-	-	445,000	8,080,000
III	Constr	769,000	5,140,000	9,070,000	2,190,000	-	17,169,000
	R/W	5,750,000	1,950,000	10,000	165,000	50,000	7,925,000
	Total	6,519,000	7,090,000	9,080,000	2,355,000	50,000	25,094,000
IV	Constr.	13,855,000	8,368,000	27,545,000	600,000	-	50,368,000
	R/W	19,855,000	1,854,000	7,325,000	137,000	829,000	30,000,000
	Total	33,710,000	10,222,000	34,870,000	737,000	829,000	80,368,000
V North	Constr.	-	1,955,000	160,000	610,000	935,000	3,660,000
	R/W	-	1,350,000	1,000,000	100,000	-	2,450,000
	Total	-	3,305,000	1,160,000	710,000	935,000	6,110,000
V South	Constr.	-	5,712,000	1,785,000	440,000	2,385,000	10,322,000
	R/W	-	960,000	1,095,000	505,000	435,000	2,995,000
	Total	-	6,672,000	2,880,000	945,000	2,820,000	13,317,000
VI North	Constr.	-	7,724,000	-	169,000	-	7,893,000
	R/W	569,000	1,510,000	2,805,000	1,000	-	4,885,000
	Total	569,000	9,234,000	2,805,000	170,000	-	12,778,000
VI South	Constr.	-	12,685,000	-	-	-	12,685,000
	R/W	1,600,000	2,753,000	839,000	-	-	5,192,000
	Total	1,600,000	15,438,000	839,000	-	-	17,877,000
VII	Constr.	48,500,000	23,300,000	10,113,000	170,000	2,803,000	84,886,000
	R/W	41,127,000	3,290,000	13,478,000	920,000	2,750,000	61,565,000
	Total	89,627,000	26,590,000	23,591,000	1,090,000	5,553,000	146,451,000
VIII	Constr	16,820,000	-	800,000	-	-	17,620,000
	R/W	3,490,000	658,000	550,000	260,000	110,000	5,068,000
	Total	20,310,000	658,000	1,350,000	260,000	110,000	22,688,000
IX	Constr.	-	2,400,000	95,000	-	-	2,495,000
	R/W	-	250,000	-	-	-	250,000
	Total	-	2,650,000	95,000	-	-	2,745,000
X	Constr.	8,150,000	1,935,000	7,820,000	1,680,000	-	19,585,000
	R/W	2,215,000	1,710,000	410,000	20,000	-	4,355,000
	Total	10,365,000	3,645,000	8,230,000	1,700,000	-	23,940,000
XI	Constr	11,806,000	4,060,000	95,000	-	-	15,961,000
	R/W	9,400,000	410,000	-	200,000	-	10,010,000
	Total	21,206,000	4,470,000	95,000	200,000	-	25,971,000
Total North	Constr.	$22,774,000	$38,780,000	$44,595,000	$5,874,000	$1,527,000	$113,550,000
	R/W	29,769,000	9,924,000	11,550,000	508,000	1,064,000	52,815,000
	Total	$52,543,000	$48,704,000	$56,145,000	$6,382,000	$2,591,000	$166,365,000
Total South	Constr.	$77,126,000	$48,157,000	$12,888,000	$ 610,000	$5,188,000	$143,969,000
	R/W	55,617,000	8,321,000	15,962,000	1,885,000	3,295,000	85,080,000
	Total	$132,743,000	$56,478,000	$28,850,000	$2,495,000	$8,483,000	$229,049,000
Total	Constr.	$ 99,900,000	$ 86,937,000	$57,483,000	$6,484,000	$ 6,715,000	$257,519,000
	R/W	85,386,000	18,245,000	27,512,000	2,393,000	4,359,000	137,895,000
	Total	$185,286,000	$105,182,000	$84,995,000	$8,877,000	$11,074,000	$395,414,000

APPENDIX 1 - E

STATEMENT OF FUNCTIONS
Pennsylvania Department of Highways

The Department of Highways builds, rebuilds, relocates, repairs, maintains and marks State and State-Federal highways. It exercises exclusive authority and jurisdiction over all State highways. (Admin. Code of 1929, Art. XX)

Program	1955-57 Actual Expenditures	1957-59 Estimated Expenditures	1959-61 Recommended
Administration	$12,006,557	$17,000,000	$21,566,131
Engineering	35,138,513	55,000,000	60,600,000
Construction financed with state funds	57,468,707	94,000,000	124,280,736
Construction financed with state and Federal-aid primary road funds	42,236,130	63,000,000	59,459,428
Construction financed with state and Federal-aid secondary road funds	22,905,193	33,000,000	36,141,611
Construction financed with state and Federal-aid urban road funds	38,819,406	56,000,000	68,208,771
Construction financed with state and Federal-aid interstate road funds	13,804,488	114,000,000	207,952,561
State highway and bridge authority rentals	14,216,810	15,900,000	17,500,000
Acquisition of right-of-way	26,299,652	55,000,000	89,000,000

Source: Pennsylvania "Motor License Fund."

APPENDIX 1 - F

DEPARTMENT OF HIGHWAYS OF ONTARIO
Capital Program 1959-1960

Financial Summary	Estimated Total Value	Proposed Expenditure
1. Road Construction		
A. Carry-Over Work		
(a) Construction division capital contracts	$61,000,000	$55,000,000
(b) Maintenance division capital projects	500,000	500,000
Sub-Total	$61,500,000	$55,500,000
B. Proposed New Work		
(a) Construction division capital projects	$105,400,000	$50,400,000
(b) Maintenance division capital projects	5,600,000	5,000,000
Sub-Total	$111,000,000	$55,400,000
2. Miscellaneous Construction		
A. Carry-Over Work		
Construction agreements (normal)	$1,030,000	$1,030,000
Construction agreements (special)	3,900,000	3,400,000
Contract post-award revisions	2,000,000	2,000,000
Preliminary project work	1,000,000	1,000,000
Sub-Total	$7,930,000	$7,430,000
B. Proposed New Work		
Construction agreements (normal)	$3,500,000	$1,700,000
Contract post-award revisions	1,000,000	1,000,000
Construction overhead	1,000,000	1,000,000
Railway grade-crossing protection	50,000	50,000
Municipal and award drains	70,000	70,000
Sub-Total	$5,620,000	$3,820,000
3. Engineering (head office) Planning and design, audit, checking, Materials and research section (all proposed new work)	$9,347,000	$9,347,000
4. Services		
Land surveys, property purchase, buildings, bridge and steel stockpile (all proposed new work)	$ 20,675,000	$ 20,675,000
Total	$216,072,000	$152,172,000
Review		
Carry-over work	$ 69,430,000	$ 62,930,000
Proposed new work	146,642,000	89,242,000
Total	$216,072,000	$152,172,000

(Authors' Note: Balance of 108-page "Capital Program" shows detail of projects proposed in above summary.)

Source: Department of Highways of Ontario, "Capital Program, Fiscal Year 1959-1960."